The Underlying Causes of Inequality in Dental Caries in Young Children Aged 2-6 Years Old in Surabaya, Indonesia: Oral Health Behaviour Perspective

by

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Thesis
Submitted to Flinders University
for the degree of

Doctor of Philosophy (PhD)
College of Medicine and Public Health
July 2019

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SUMMARY

Introduction: Dental caries are one of the most common childhood chronic diseases. The prevalence and severity of dental caries are high among preschool children with primary dentition. Oral health behaviours play a significant role in the development of dental caries among preschool children. Parents' personal and socio-environmental factors are known to have an influence on children's oral health behaviours and dental health outcomes; however, the process through which each factor influences oral health behaviours and how this affects young children's dental caries remains unclear. The purpose of this study is to develop an explanatory model of factors underlying inequality in dental caries in young children aged 2–6 years in Surabaya, Indonesia, in relation to oral health behaviours.

Methods: This study used a mixed-methods approach with a sequential explanatory mixed-methods design. During the first phase, a randomly selected sample of 1,606 preschool children aged 2–6 years in 62 preschools in Surabaya, participated, with their parents, in a cross-sectional study. The decayed, missing, or filled teeth (dmft) index was used to assess the prevalence (dmft>0) and severity of dental caries (dmft mean score) among children. A questionnaire was completed by the parents to assess the impact of dental caries on the quality of life of the children and their families, and to assess the association between oral health behaviours and dental caries. During the second phase, 16 parents from the caries group and 15 parents from the caries-free group were interviewed to explore and explain the parents' personal and socio-environmental factors that influence children's oral health behaviours and dental caries outcomes.

Results: The prevalence of dental caries in children aged 2–6 years in Surabaya was high (79.8%), and negatively impacted on the quality of life of children and their families. Dental caries was significantly associated with sugar snacking, bedtime bottle habits, and dental visits. There appeared to be a difference in parents' personal and socio-environmental factors, which influenced oral health behaviours between children in the caries and caries-free group. The results also indicated a dynamic interaction between parents' personal and socio-cultural factors as a pathway through which these factors influenced oral health behaviours and dental health outcomes in children.

Discussion: Oral health-related parenting practices played an important role in the establishment of oral health behaviours in preschool children and have a likely implication on children's dental health outcomes. In addition to oral health knowledge and skills, parenting skills are needed, particularly to overcome any personal and socio-cultural-related barriers that may emerge whilst adopting appropriate oral health behaviours for children.

Conclusion: Factors influencing children's oral health behaviours and dental health outcomes are complex and require multilevel interventions, involving individuals (parents), family, social and structural levels.

DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signed.....

Date....25 January 2019.....

Endorsed by Principal Supervisor

Signed.....

Date....25 January 2019.....

ACKNOWLEDGEMENTS

I would like to gratefully acknowledge my supervisors, Professor Sharon Lawn, Professor Paul Ward, and Associate Professor Loc Giang Do, and also my former supervisor, Dr. Mariastella Pulvirenti, for their guidance, support, and supervision throughout my study. Their steadfast commitment to supervision was invaluable as they generously provided their time to review drafts of the thesis and give constructive feedback. It would have been very difficult for me to finish this study without their encouragement.

I also wish to extend my thanks to a Flinders University Research Librarian, Ms. Leila Mohammadi, for her guidance and assistance to develop a search strategy for a scoping review of the literature.

I would like to acknowledge a professional editor who provided editing and proofreading without altering the substantive content of the thesis

I also express my gratitude to my scholarship body, Directorate General of Higher Degree (DGHE) – Ministry of Research, Technology, and Higher Education of the Republic of Indonesia for giving me an opportunity to undertake my study in Flinders University, Australia.

I express my sincere appreciation to all preschool children and their parents/caregivers who participated in the study. This study would never have been possible without their willingness to take part in the study. I also would like to thank all principals and teachers in preschools for their support during data collection, and also four dentists who helped me to carry out the dental examination in preschool children.

To all my family, my friends and my colleagues in Faculty of Dental Medicine, Airlangga University, particularly those in Dental Public Health Department, in Indonesia, I can only say thank you for your support during my PhD journey. To my parents and parents in law, there are not enough words to describe how thankful I am to you for your endless love and for all your support. A special thanks to Muhammad Iswahyudi, my very patient and understanding husband, who constantly kept me sane through the hectic time in my life and helped me get through all difficulties in completing my degree. To my lovely daughters, Aurea Isamira Natarina, Zilvana Isamira Monera, and Myesha Isamira Alesha, I would like to thank them for being my powerful source of motivation all the time.

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GLOSSARY OF TERMS

Dental caries: the medical term for tooth decay or cavities, which refer to the destruction of tooth as a result of tooth demineralization.

Early childhood caries (ECC): tooth decay (non-cavitated and cavitated lesions), missing teeth (due to caries), or filled tooth surfaces in primary dentition in children 72 months of age or younger.

Caries increment: the change of individual dmft/dmfs scores over a certain period of time.

Carious tooth with pulp involvement: the penetration of dental caries into the deeper parts of the tooth known as the dental pulp exposure.

Case control study: a study design, which retrospectively compares the exposure to a risk factor between the cases (a group of individuals who have a particular disease, e.g. dental caries) and the controls (a group of individuals who are disease-free). This study design aims to determine the association between the exposure to the risk factor and the disease.

Cavitated caries lesions: breakdown in surface tooth structure; It is characterized by visible cavities in the teeth; it usually denotes the loss of tooth enamel with/without the exposure of the underlying dentin.

Community based participation (participatory qualitative study): the involvement of people in a community in a project aiming to develop strategies to solve their own problem; It emphasises the active collaboration of participants during the research process, from the research design to the dissemination of findings.

Demineralisation: a chemical process, by which acid produced by bacteria dissolved minerals (calcium and phosphate) away from the hard tissues of the teeth and lead to the formation of tooth cavities.

Dental visits: visiting a dentist to get preventive and/or restorative dental care.

Dentine: the second layer of the tooth underneath the enamel. It is one of three hard tissues that make up the tooth.

dmfs index: an index to calculate the number of tooth surfaces in primary dentition affected by dental caries; The use of lower-case letters in dmfs refers to primary teeth.

dmft index: a method for calculating the number of teeth in primary dentition affected by dental caries; it is a common method for assessing the prevalence of dental caries and dental treatment

needs among child populations; The use of lower-case letters in dmft refers to primary teeth.

dmfs score: the number of decayed (d), missing (m), and filled (f) tooth surfaces (s) because of dental caries in primary dentition. The individual score ranges from zero to 88 for each child; The use of lower-case letters in dmfs refers to primary teeth.

dmft score: the number of decayed (d), missing (m), and filled (f) teeth (t) because of dental caries in primary dentition. The individual score ranges from zero to 20 for each child; The use of lower-case letters in dmft refers to primary teeth.

Enamel: The first layer of the tooth. It is one of three hard tissues that make up the tooth.

Health-related quality of life: the impact of health conditions on a person's physical, psychological, and social wellbeing.

Incidence: the proportion of new cases of a particular disease (e.g. dental caries) in a population at-risk who are initially disease-free over a certain period of time.

International Caries Diagnostic and Assessment System (ICDAS): a clinical scoring system for measuring dental caries based on the stage of the caries process (non-cavitated and cavitated caries lesions) and caries activity.

Fluorosis: an abnormal dental condition shown by mottling of the teeth because of excessive ingestion of fluoride.

Kappa statistics: a measure of inter-rater agreement or reliability by comparing the ability of different examiner to classify subjects into particular groups.

Labial surfaces: the tooth surfaces that face the inside area of the lip.

Lingual surfaces: the tooth surfaces that face the tongue.

Mandibular incisors: the front teeth in the lower jaw

Maxillary incisors: the front teeth in the upper jaw bone.

Non cavitated caries lesion: the initial clinical manifestation of dental caries, before a tooth cavity occurs; it is characterized by a change in colour and structure of the tooth surface.

Nursing caries: the rapid and progressive type of rampant caries in primary dentition; it is commonly associated with nursing practices as the causal factors (e.g. inappropriate bottle-feeding practices).

Prevalence: the proportion of persons in a population at-risk who suffer a particular disease (e.g. dental caries) at a specific point in time.

Permanent dentition: the adult teeth that show up after the baby teeth start to fall out by age 6 years on average.

Primary dentition: The baby teeth that start to show up at age of 6 months on average.

Prolonged bottle drinking: children who continue to drink from bottles at age 18 months old or older.

pufa index: an index to assess clinical consequences of untreated dental caries, consisting of pulp involvement, ulceration, fistula, and abscess; The use of lower-case letters in pufa refers to primary teeth.

Pulp: soft tissues in the centre of a tooth underneath the dentine; It consists of a large mass of blood vessels, nerves and connective tissue.

Rampant caries: a severe form of dental caries; It usually affects multiple surfaces of many teeth.

CHAPTER 1
INTRODUCTION

1.1 Background

Dental caries is widely recognised as a major global oral health burden (Bourgeois and Llodra, 2014; Kassebaum, et al., 2017; Moreira, 2012). The emerging public health issues due to dental caries are related to inequality in the distribution and treatment of dental caries across the globe (Kassebaum, et al., 2015). The increased prevalence of dental caries appears to occur in people with low socio-economic status (Wordley, Lee, Lomazzi, and Bedi, 2017). In such communities, children are often at high risk of dental caries (Alazmah, 2017). The severity of dental caries in children has been found to be significantly linked to the level of socio-economic deprivation. The greatest burden of dental caries is considered to be among socio-economically disadvantaged children (Fleming, 2015).

Dental caries has been identified as the most common childhood chronic disease (American Academy of Pediatrics [AAP], 2014; American Academy of Pediatric Dentistry [AAPD], 2018a). It is five times more prevalent than asthma and seven times more than hay fever and allergic rhinitis (Benjamin, 2010). Furthermore, dental care is one of the most common unmet needs in healthcare among children (Kassebaum, et al., 2015; Corrêa-Faria, Paixão-Gonçalves, Paiva, and Pordeus, 2016b; Kassebaum, et al., 2017). Dental caries in children is often left untreated (Kassebaum, et al., 2015; Corrêa-Faria, et al., 2016b; Kassebaum, et al., 2017). There has been no significant change in the prevalence and incidence of untreated dental caries in children since 1990 (Kassebaum, et al., 2015; Kassebaum, et al., 2017). Therefore, untreated dental caries in children is still a major public health issue in many countries around the world (Kassebaum, et al., 2015).

1.1.1 The significance of early childhood caries as a public health issue

Early childhood caries is considered a serious public health problem because of its high prevalence, the high cost of dental treatment, and its significant impact on the quality of life of the children and their family (Phantumvanit, et al., 2018). Despite the decline in the general prevalence of dental caries in children worldwide, dental caries remains a prevalent disease in preschool children (Splieth, Christiansen, and Foster, 2016; Alazmah, 2017; Eklund, 2017; Rozier, White, and Slade, 2017). Furthermore, while the burden of dental caries has decreased rapidly in most developed countries, the problem of dental caries still persists in many developing countries (Bourgeois and Llodra, 2014; Lagerweij and van Loveren, 2015).

Recent studies have indicated that children from developing countries have a higher prevalence of dental caries than their counterparts in developed countries even

though some specific population groups in developed countries also still experience high levels of dental caries. For example, in the United States, the prevalence of dental caries among children aged two to five years old between 2015 and 2016 was found to be 17.7% (Fleming and Afful, 2018). A study in Switzerland also showed that 24.8% of children aged 36 to 71 months old suffered dental caries (Baggio, Abarca, Bodenmann, Gehri, and Madrid, 2015). In Rotterdam, The Netherlands, 31.7% of six-year-old children were found to have been suffering from dental caries (van der Tas, et al., 2017). In contrast, for example, in Northern Thailand, 68.5% of young children aged three years old were found to have been experiencing dental caries (Peltzer and Mongkolchati, 2015). An analysis undertaken by the third National Oral Health Survey of China also showed a high prevalence of dental caries among five-year-old children in 31 provinces in China (except for Tibet): 66.9% (Sun, Bernabé, Liu, Gallagher, and Zheng, 2017b). The prevalence of dental caries was also found to be high among children aged four, five, and six years old in Tabriz, Iran, accounting for 73.1%, 78.0 %, and 87.7%, respectively (Khani-Varzegani, et al., 2017). Therefore, compared to developed countries, dental caries has remained a major public health challenge in many developing countries.

In addition, the treatment of dental caries in young children is costly, particularly when general anaesthesia is needed (Twetman and Dhar, 2015; Thomson, 2016). The high cost of dental treatment is associated with the rapid progress of dental caries (Gulabivala and Ng, 2014; Phantumvanit, et al., 2018). Children who received dental treatment often required further dental treatment, because the development of new dental caries was observed in the follow-up visit (Twetman and Dhar, 2015; Corrêa-Faria, et al., 2016b; Kakanur, et al., 2017), which indicates a high relapse rate (the range from 22 to 79%) (Twetman and Dhar, 2015). Furthermore, dental caries in primary dentition is a significant predictor of the future development of dental caries in permanent dentition (Fleming, 2015). In addition, given the fact of high rate of dental caries among children in socially disadvantaged populations (Otero, Pechlaner, Liberman, and Gürcan, 2015; Thomson, 2016), socio-economic disparities appear to account for the unequal distribution of untreated dental caries and dental care in children (Bourgeois and Llodra, 2014). Dental caries in children is therefore expected to be a growing public health burden (Thomson, 2016).

Many studies have shown the adverse effects of dental caries on the quality of life of the children and their families (Abanto, Panico, Bönecker, and Frazão, 2018; Freire, Corrêa-Faria, and Costa, 2018; Piva, Pereira, Luz, Hugo, and de Araújo, F. B, 2018). Oral health-related quality of life refers to the impact of oral health conditions on a person's physical, psychological, and social wellbeing (Abanto, et al., 2011). The

impact of early childhood caries on the quality of life of the children is commonly related to pain (Corrêa-Faria, et al., 2018; Vollu, da Costa, Maia, and Fonseca-Gonçalves, 2018), difficulty in eating some foods (Jankauskiené, Virtanen, and Narbutaité, 2017; Wong, et al., 2017), difficulty in drinking either hot or cold beverages (Collado, et al., 2017; Corrêa-Faria, et al., 2018), trouble sleeping (Collado, et al., 2017; Vollu, et al., 2018), feeling irritated (Jankauskiene, et al., 2017; Wong, et al., 2017), time off from school (Corrêa-Faria, et al., 2018; Vollu, et al., 2018), and avoiding smiling (Collado, et al., 2017; Jankauskiene, et al., 2017). The negative impacts of dental caries on the children's families have frequently been linked to the parents' feelings of upset and guilt (Wong, et al., 2017; Vollu, et al., 2018), time off from work (Jankauskiene, et al., 2017; Corrêa-Faria, et al., 2018), financial problems (Wong, et al., 2017; Vollu, et al., 2018), and sleep problems (Collado, et al., 2017; Vollu, et al., 2018).

1.1.2 The role of behaviour in the development of dental caries

A large number of studies demonstrate the significant role of behaviour in the development of dental caries in children (Mejàre, et al., 2014; Riggs, et al., 2015; Phantumvanit, et al., 2018). They emphasised sugar consumption and poor oral hygiene as key behaviours explaining the presence of dental caries in children (Bourgeois and Llodra, 2014; Phantumvanit, et al., 2018). The consumption of sugar-containing foods and beverages has been known to have a major role in the development of dental caries in children (Phantumvanit, et al., 2018). Many epidemiological studies have also demonstrated the association between sugar consumption and dental caries (Levin, Sokal-Gutierrez, Hargrave, Funsch, and Hoeft, 2017; Wagner and Heinrich-Weltzien, 2017). Foods and beverages containing sugar and natural sugar present in honey, syrup, unsweetened fruit juice, and fruit juice concentrates can cause dental caries (Fidler, et al., 2017). High-frequency sugar consumption exposes children to a greater risk of dental caries (Elamin, Garemo, and Gardner, 2018; Feldens, Rodrigues, de Anastácio, Vítolo, and Chaffee, 2018). Prolonged contact between sugar and tooth surfaces give an opportunity for tooth-adherent bacteria to use sugar to produce acid. The acid gradually erodes the minerals in the tooth surfaces, then causing tooth decay (Tinanoff, 2015). In addition to the frequency of sugar consumption, the risk of dental caries has been found to increase among children who consume a high total daily amount of sugar (Winter, Glaser, Heinzel-Gutenbrunner, and Pieper, 2015; Zaki, Dowidar, and Abdelaziz, 2015), who consume sugar-containing foods and beverages between meals (Kanemoto, et al., 2016), and who sleep with a bottle containing fluids other than water (Gopal, Chandrappa, Kadidal, Rayala, and Vegesna, 2016; Dabawala, Suprabha, Shenoy, Rao, and Shah, 2017). Sugar consumption among children aged 2 to 18 years old should be restricted to only less than 5% of the total daily

energy intake and should be consumed as part of their meals (Fidler, et al., 2017).

In relation to oral hygiene practice, twice daily tooth brushing using an age-appropriate size toothbrush (Phantumvanit, et al., 2018) with fluoride toothpaste is a key pillar in the prevention of dental caries (Wordley, et al., 2017). Parental assistance in tooth brushing is important for children younger than six years old, because they are still not capable of performing proper tooth brushing themselves (AAP, 2014; AAPD, 2018a). Furthermore, tooth brushing supervision is needed to prevent children from ingesting excessive amount of toothpaste containing fluoride (Fleming, 2015). The ingestion of excessive amounts of fluoride toothpaste in the long term during the period of tooth formation, particularly in young children aged two to four years old, can lead to the risk of a tooth enamel disorder known as enamel fluorosis in permanent dentition (Koch, Poulsen, and Twetman, 2001; Milgrom, Weinstein, Huebner, Graves, and Tut, 2011; AAPD, 2018a, 2018b). To reduce the risk of enamel fluorosis, the appropriate amount of toothpaste should be given to children according to their age. Children under three years of age should use fluoride toothpaste in a smear or rice-sized amount (approximately 0.1 mg fluoride). The amount of toothpaste is increased to a pea-sized amount of fluoridated toothpaste (approximately 0.25 mg fluoride) for children aged three to six years (Wright, et al., 2014; AAP, 2014; AAPD, 2018a, 2018b).

In addition to sugar consumption and oral hygiene practices, early preventive dental visits within the first year of life are crucial for children's dental health (Askelson, et al., 2015). The aim of these visits is to conduct dental screening and a caries risk assessment and to provide parental education and counselling about dental caries prevention (AAPD, 2018a). Early detection of caries lesions may also allow a preventive procedure, such as through topical fluoride varnish application, to arrest the progression of caries lesions and preserve the structure of the tooth (Phantumvanit, et al., 2018).

Oral health behaviours formed during early childhood are commonly acquired at home (Nanjappa, Hector, and Marcenes, 2015; Phantumvanit, et al., 2018) and may be retained in adulthood (Nanjappa, et al., 2015). Parents and family members play a major role in instilling the behaviours (Nanjappa, et al., 2015; Phantumvanit, et al., 2018). Children's oral health behaviours are influenced by multiple factors, which lie not only at the family level, but also at the social and structural level (Nanjappa, et al., 2015; Phantumvanit, et al., 2018). Given the prominent role attached to oral health behaviours for the development of dental caries in children, prevention should be started in early childhood, and it should be aimed at addressing risk factors of poor oral health behaviours that have likely implication on children's dental health outcomes (Bourgeois and Llodra, 2014).

1.1.3 Psychosocial determinants of dental caries

Some studies have focused on the personal characteristics of the parents of children experiencing dental caries, including the importance of parental cognitive issues on the establishment of children's oral health behaviours and dental health outcomes. Parents' low oral health literacy (Firmino, et al., 2017), low level of oral health knowledge (Heaton, et al., 2017), negative attitudes towards children's oral health (Gray-Burrows, et al., 2016; Choy and Isong, 2018), low internal locus of control (Wolfe, 2017), and low self-efficacy (Gray-Burrows, et al., 2016) were found to be significantly associated with poor oral health behaviours in children, and, therefore, increase the risk of dental caries (Firmino, et al., 2017; Su, Yang, Deng, Qian, and Yu, 2018). Furthermore, children's poor oral health behaviours, such as permissive sugar snacking (Moore, Goodwin, Brocklehurst, Armitage, and Glenny, 2017), poor oral hygiene practices (Masterson and Sabbah, 2015), and delay in children's first dental visits (Yang, Gromoske, Olson, and Chaffin, 2016), were found to be linked to parental stress, which also exposed the children to the risk of dental caries (Masterson and Sabbah, 2015).

A number of studies have also discussed the influence of social environments on the development of children's oral health behaviours and oral health outcomes. For example, exposure to unsupportive social environments, such as the pressure to give sugary snacks to children from people surrounding the parents (Moore, et al., 2017) and easy access to sugary snacks (Riggs, et al., 2015; Levin, et al., 2017) commonly increased the likelihood of children to consume sugary snacks and made the children susceptible to dental caries. Parents' subjective norms on oral hygiene practices and dental visits also influenced the establishment of oral hygiene practices and dental visits patterns in children (Trubey, Moore, and Chestnutt, 2015b; Wolfe, 2017), which then impact children's dental health outcomes (Amin and ElSalhy, 2017; Levin, et al., 2017). Furthermore, the availability of social support for parents (for example, through community oral health education and counselling programs) may also facilitate the establishment of appropriate oral health behaviours in children (Soussou, Aleksejūnienė, and Harrison, 2017; Choy and Isong, 2018) and reduce the prevalence of dental caries (Smith, Blinkhorn, Blinkhorn, and Hawke, 2018).

Parents' socioeconomic status has been found to be negatively associated with children's oral health behaviours (Nanjappa, et al., 2015; Priesnitz, et al., 2016) and dental caries outcomes (Ha, et al., 2016; Pinto, et al., 2017). Parents' educational level (Kato, et al., 2017), family income (Gomes, et al., 2018a, 2018b), and employment status (van der Tas, et al., 2017) have been considered significant predictors of dental caries in children. Poor oral health behaviours in children have also been linked to the low educational level of the children's parents (Sun, et al., 2017b), low family income

(Collins, Villa-Torres, Sams, Zeldin, and Divaris, 2016), and unemployment among mothers (Nicol, Al-Hanbali, King, Slack-Smith, and Cherian, 2014).

1.2 Statement of the problem

Research on children's dental health has traditionally focused on morbidity data on clinical indicators of dental caries by measuring the number of decayed, missing, and filled teeth/surface (dmft/dmfs score). This indicator represents the accumulated number of past dental caries and treatment and present untreated dental caries (Bourgeois and Llodra, 2014). A large number of epidemiological studies also have been carried out on the behavioural risk factors of dental caries and have confirmed the significant role of behaviours in the development of dental caries in children (Amin and ElSalhy, 2017; Levin, et al., 2017; Morikava, Fraiz, Gil, de Abreu, and Ferreira, 2018). Currently, the relevant literature has also given considerable attention to psychosocial determinants of dental caries in children (Firmino, et al., 2017; Su, et al., 2018). However, these studies are mostly carried out using quantitative methodological approaches, which aim to determine the association between parents' personal and socio-environmental factors and dental caries in preschool children. Relatively little attention has been given to get a better understanding aboutthe complex relationships between parents' personal and socio-environmental factors and dental caries of their children, which remains unclear and poorly understood. As such, if poor oral health behaviours can account for dental caries inequality in young children, there is a need to explore pathways through which parents' personal and socio-environmental factors influence parents' decision to adopt a particular oral health behaviour for their child. This would provide insights into why some children suffer dental caries, but others are caries-free.

The present study was conducted in the city of Surabaya, East Java Province, Indonesia. The reasons why Surabaya has been selected as the study location include that in the World Health Organization (WHO) region of South East Asia (SEARO), Indonesia is in the risk category for the highest severity of dental caries (Moreira, 2012). East Java Province has a higher severity of dental caries than the national average (Health Research and Development Board, 2013). In East Java Province, the majority of dentists are located in the capital, Surabaya. Surabaya has the highest dentist-to-population ratio in Indonesia: 47.9 dentists to 100,000 patients (The Ministry of Health Republic of Indonesia, n.d.). This ratio has much exceeded the target for the Healthy Indonesia goal set by the Indonesian government at the province level (The Ministry of Health Republic of Indonesia, n.d.). Despite that this ratio is adequate and despite the presence of a dental health curriculum in most preschools in Surabaya, to the best of my knowledge as a dentist and a dental public health practitioner in Surabaya, dental caries remains prevalent among preschool children in Surabaya. A recent study on two preschools in Surabaya found a high prevalence of dental caries among young

children aged four and five years old, 88.24% and 83.4%, respectively (Hadi, 2014). However, dental caries studies for this age group in Surabaya are still meagre. There have been few epidemiological studies conducted in Surabaya regarding oral health behaviours and dental caries among preschool children, and no studies have been undertaken on the factors influencing oral health behaviours and dental caries among preschool children in Surabaya. Therefore, it is necessary to conduct a study to understand the issue of dental caries among preschool children in Surabaya, Indonesia.

1.3 Significance of the study

The findings of this study could provide a comprehensive and thorough understanding about the problems of dental caries among children in Surabaya from the perspective of oral health behaviours. Specifically, the findings could enhance the understanding of the process by which parents' personal and socio-environmental factors influence the establishment of oral health behaviours in children and affect the development of dental caries. The findings would also help us identify important intervention targets that could provide a basis for designing more appropriate oral health promotion and intervention programs aiming to reduce the incidence of dental caries in children in Surabaya.

1.4 Research questions

This study addresses problems related to dental caries in preschool children in Surabaya by answering the following research questions:

1. Is there an association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia?
2. Is there an association between the dental caries experience and quality of life of young children aged two to six years old in Surabaya, Indonesia and their families?
3. What are the factors influencing oral health behaviours among young children aged two to six years old in Surabaya, Indonesia who suffer from dental caries and those who are-caries free?

1.5 Purpose of the study

This study was designed to develop an explanatory model of factors underlying inequality in dental caries in young children aged two to six years old in Surabaya, Indonesia in relation to oral health behaviours, with four subsidiary aims and objectives. First, the study's aim is to assess the prevalence and the severity of dental caries in young children aged two to six years old in Surabaya, Indonesia by conducting oral examinations and calculating the prevalence and the severity of dental caries in young children aged two to six years old in Surabaya, Indonesia based on quantitative data. The second aim of this study is to examine

the association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia by conducting an oral health survey and aggregating data from oral examinations and the survey to analyse the association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia. The third aim is to examine the association between the dental caries experience and quality of life of young children aged two to six years old and their families in Surabaya, Indonesia by conducting a questionnaire oral health survey and aggregating data from oral examinations and the survey to analyse the association between the dental caries experience and quality of life of young children aged two to six years old and their families in Surabaya, Indonesia. The final aim is to explore and explain parents' personal and socio-environmental factors influencing oral health behaviours and dental health outcomes in young children aged two to six years old in Surabaya, Indonesia by conducting in-depth interviews with parents of children in both the caries and caries-free groups and analysing the qualitative data from the interviews to identify parents' personal and socio-environmental factors influencing oral health behaviours and dental health outcomes in young children aged two to six years old in Surabaya, Indonesia.

1.6 Research procedures

In this study, to address the research aims and objectives, a mixed-method approach with a sequential explanatory mixed-methods design is used. A quantitative approach precedes the qualitative approach to guide the purposeful sampling method for the in-depth qualitative comparison interviews of parents of children in the caries and caries-free groups. The results of the quantitative approach are also used to inform the appropriate questions for the in-depth interviews in the second phase of this study. Specifically, the quantitative approach examines the association between the oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, while the qualitative approach explains and illuminates the association between the oral health behaviours and dental caries experience found in the quantitative results. In the qualitative approach, parents' personal and socio-environmental factors influencing children's oral health behaviours are explored and explained, and these factors were compared between parents of children in the caries and caries-free groups. In total, 1,606 children aged two to six years old in 62 preschools in Surabaya and their parents/caregivers were included in the quantitative study, while in the qualitative study, 31 parents were included. Sixteen participants were assigned to the caries group and 15 to the caries-free group. The research methodology and procedures are discussed in more detail in Chapter 3.

1.7 Thesis outline

This thesis is divided into eight chapters, comprising an introduction; a literature review; an explanation of the research methodology; the study's quantitative, qualitative, and synthesis results; discussion; and conclusion. Chapter 1, this introduction, has given a background of the study and introduced the study presented in the body of the thesis. This chapter began by presenting the significance of early childhood caries as a public health issue, the role of behaviours in the development of dental caries, and psychosocial determinants of dental caries. Subsequently, this chapter presented a statement of the research problem, significance of the study, research questions, purpose of the study, and thesis outline.

Chapter 2 presents the results of a scoping literature review, a summary of the previous academic knowledge on the prevalence and severity of dental caries in preschool children; the impact of dental caries on the quality of life of the children and their families; children's oral health behaviours; and the psychosocial determinants of dental caries. At the end of the chapter, a conclusion regarding a knowledge gap in academic literature is made and the need for a further study to fill this gap is justified.

Chapter 3 explains the research methodology used in the study, a mixed-method approach to the answering of the research questions in this study. This chapter gives the rationale for the use of the mixed-method approach. Specifically, this chapter outlines the methodological approach, methods, participants, ethical considerations, procedures, and data analysis approach used in the study.

Chapter 4 presents the quantitative results of the statistical data analysis, consisting of the dental caries experience, sociodemographic characteristics, oral health-related quality of life, and oral health behaviours of the children under study. It starts with the descriptive statistics and continues with the analytical (inferential) statistics.

Chapter 5 presents the qualitative results of thematic data analysis of the interviews. The chapter outlines four broad themes related to the key findings of the quantitative study, comprising sugar snacking, bottle-feeding, oral hygiene practices, and dental visits. In each theme, the parents' personal and socio-environmental factors are compared between the parents of children in the caries group and those in the caries-free group.

Chapter 6 aims to synthesise the quantitative and qualitative results of the study. This chapter illuminates the quantitative results of why children who have dental caries were found to be more likely to engage in poor oral health behaviours than children in the caries-free group. By using the qualitative results, this chapter explains the pathways through which the differences in the parents' personal and socio-environmental factors influence the differences in oral health behaviours between children who have dental caries and those who are caries-free.

Chapter 7 discusses the main findings of the study. This chapter starts by explaining

the limitations of the study as well as its strengths, and it is followed by a discussion of oral health-related parenting practice, covering parenting styles, the effects of parenting styles on children's oral health behaviours, the effects of parents' oral health-related attitudes on parenting practices, the effects of parental stress on oral health-related parenting practices, and the effects of parents' locus of control on parenting practices. Socio-environmental factors influencing oral health-related parenting practices are discussed afterward. At the end of this chapter, recommendations for future research are proposed.

The final chapter concluding this study is Chapter 8, which provides a summary of the main findings of the study. Subsequently, this chapter demonstrates the significant contribution of the study to the knowledge on this topic and the implication of the study on dental caries interventions.

CHAPTER 2
LITERATURE REVIEW

In this study, a scoping review of the literature that is currently available on the topic of dental caries in preschool children is necessary. A scoping review differs from a systematic review. A systematic review aims to address a specific question using a relatively narrow range of quality-assessed studies with regard to a specific study design (Arksey and O'Malley, 2005). In contrast, a scoping review does not assess the quality of the studies included therein. Rather, it covers a broad range of literature to explore a wide range of topics about dental caries in preschool children, regardless of any particular study design. The scoping review in this study aims to examine the range, extent, and nature of the existing literature that is relevant to the topic of dental caries in preschool children by mapping the key concepts underpinning the studies included therein or summarising the existing knowledge on this topic (Arksey and O'Malley, 2005). At the end of a scoping review, a conclusion is drawn regarding the gaps or specific fields of study that have not yet been addressed in the literature. In this study, to obtain in-depth, broad findings from the scoping review, the methodological framework proposed by Arksey and O'Malley (2005) is used.

2.1 Review objectives

The objectives of this review are to review the literature that is currently available across a range of different population groups, specifically:

1. the prevalence and the distribution of dental caries in preschool children
2. the impacts of dental caries on quality of life of preschool children and their families
3. oral health behavioural risk factors of dental caries in preschool children
4. psychosocial determinants of dental caries in preschool children

2.2 Review methods

2.2.1 Eligibility Criteria

2.2.1.1 ***Type of studies***

To address all review questions, the review is not limited to a specific study design. All study designs that could address the review questions are considered. This scoping review aims to address the broad topic of dental caries in preschool children, to which many different study designs might be applicable.

2.2.1.2 ***Type of participants***

The scoping review considered studies involving young children aged two to six years old and/or their parents as participants. Studies involving

young children with physical and psychological health issues were excluded because they may have different patterns of dental caries as a result of their physical or psychological health problems, and this may then increase the risk of bias.

2.2.1.3 ***Study interest***

Based on the review questions and objectives, four inclusion criteria were applied. First, studies were required to have measured the prevalence and distribution of dental caries in preschool children. Second, the studies were required to have evaluated the impacts of dental caries on quality of life of preschool children and their families. Third, the studies were required to have examined oral health behavioural risk factors of dental caries in preschool children. Fourth, the studies were required to have examined the psychosocial determinants of dental caries in preschool children in relation to oral health behaviours.

2.2.1.4 ***Types of outcome***

The review considered studies that have dental caries in preschool children as a primary outcome. This review was limited to studies that assessed dental caries using a visual assessment. Studies involving oral radiographic tests, microbiological tests, or other laboratory tests were excluded. Only studies published within the past eight years (from 2010 to 2018) were included due to the rapidly evolving advanced research in the field of dental caries in preschool children. Studies in languages other than English were also excluded due to the cost and time involved in translating the material.

2.2.2 Information sources

To achieve a comprehensive coverage of the studies, research evidence was sought via different sources. Studies were first identified by searching relevant electronic databases, i.e. Medline, PubMed, CINAHL, Scopus, and PsychInfo. Those databases were recommended by a research librarian, being considered the primary sources for studies published in the field of dentistry, appropriate for the focus of the review; and providing sufficient topic coverage. In addition, reference lists of studies found by means of the database searches were searched, and all relevant citations are included in the review. A hand search for articles that had been missed in the databases and reference list searches was undertaken. Online sources of grey or unpublished literature were also considered. Those sources included conference proceedings, reports, and policy documents from websites of relevant national and local

organisations in the field of dentistry. The last search was run on 22 November 2018.

2.2.3 Search strategy

A research librarian was consulted in the construction of the search strategy. The search strategy for the electronic databases was developed from each research question and the definitions of the key concepts. A four-step search strategy was utilised in the review. First, the initial keywords for each review question were identified based on the researcher's knowledge of the scope of the review question and objectives for the purpose of performing initial searches in Medline and CINAHL. These are listed in Table 1. After that, the text in the titles, the abstracts obtained from the initial search, and the index terms used in the bibliographic database were analysed. The initial keywords were refined, and a logic grid of the keywords for each review question was created. Any synonyms or related terms were also considered. This process was iterative to ensure the comprehensive coverage of relevant and available studies. Second, a comprehensive and database-specific search strategy was undertaken using those keywords for each database included in the study. Each electronic database is likely to use a different system for indexing keywords within their search engines. Hence, the search strategy was tailored to each particular database. All the search strategies were documented in detail to improve the rigor and the reliability of findings. Third, the bibliographies of all studies retrieved from the database searches were checked in order to search for additional studies that could be included in this review. Fourth, a hand search of unpublished literature and other relevant studies that may have been missed in the database and reference list searches was also carried out.

Table 1. The Initial keywords used in each review objective

Review questions	Initial keywords
What is the prevalence and the distribution of dental caries in preschool children?	Young children, preschool children, dental caries, early childhood caries, dental cavity, dental decay, tooth cavity, tooth decay, cross-sectional studies, prevalence and distribution.
What are the impacts of dental caries on quality of life of preschool children?	Young children, preschool children, dental caries, early childhood caries, dental cavity, dental decay, tooth cavity, tooth decay and quality of life
What are the oral health-related behavioural risk factors of dental caries in preschool children?	Young children, preschool children, dental caries, early childhood caries, dental cavity, dental decay, tooth cavity, tooth decay, behavioural risk factors, sugar snacking, feeding practice, oral hygiene practice, tooth brushing, and dental attendance.
What are the psychosocial determinants of dental caries in preschool children?	Young children, preschool children, dental caries, early childhood caries, dental cavity, dental decay, tooth

	cavity, tooth decay, psychosocial factors, psychology, self-efficacy, social environment, and social support.

2.2.4 Study selection

A total of 443 studies were identified for inclusion in the review. A search of the Medline, PubMed, CINAHL, Scopus, and PsychInfo databases provided a total of 6,136 citations. Endnote Library, a bibliographic software package, was used to manage the references. After the duplicate citations were removed, 2,207 citations remained. The researcher hereof and another PhD student who is familiar with the scope of review questions and objectives independently screened the titles and the abstracts of 2,207 of the identified citations. They were initially blinded to each other's screening. Once the screening was complete, the screening results were compared. Cases in which there was a lack of consensus of whether a reference should be included or excluded were discussed. Any disagreements that arose between the two reviewers were resolved through discussion with the supervisory team. Of these studies, 1,301 papers were discarded because after reviewing the abstracts, it appeared that these papers clearly did not meet the eligibility criteria as described and they were not consistent with the review objectives. The full texts of the remaining 906 citations were screened in order to verify their relevance for inclusion in the final study selection. After screening the full texts of 906 references, the remaining 434 studies were eventually selected for this review. Nine additional citations are included in the review. These studies were derived from references that were cited in studies included in this review, relevant articles from other sources, and grey literature. The flowchart of the study selection is presented in figure 1.

2.2.5 Data extraction

After selecting the studies for inclusion in the review, the data from all the studies was extracted to identify and record the relevant details thereof. The data was extracted from papers by sorting and charting the key points and themes obtained from all the reviewed studies. The data recorded includes specific details about the authors, year of publication, aims of the study, study location, study participants, study methods, outcome measures, instruments, and results that are significant to the review questions and objectives. The data retrieved was presented in a tabular summary. The data was then collated, summarised, and reported in a narrative form to provide an overview of all the studies that are reviewed.

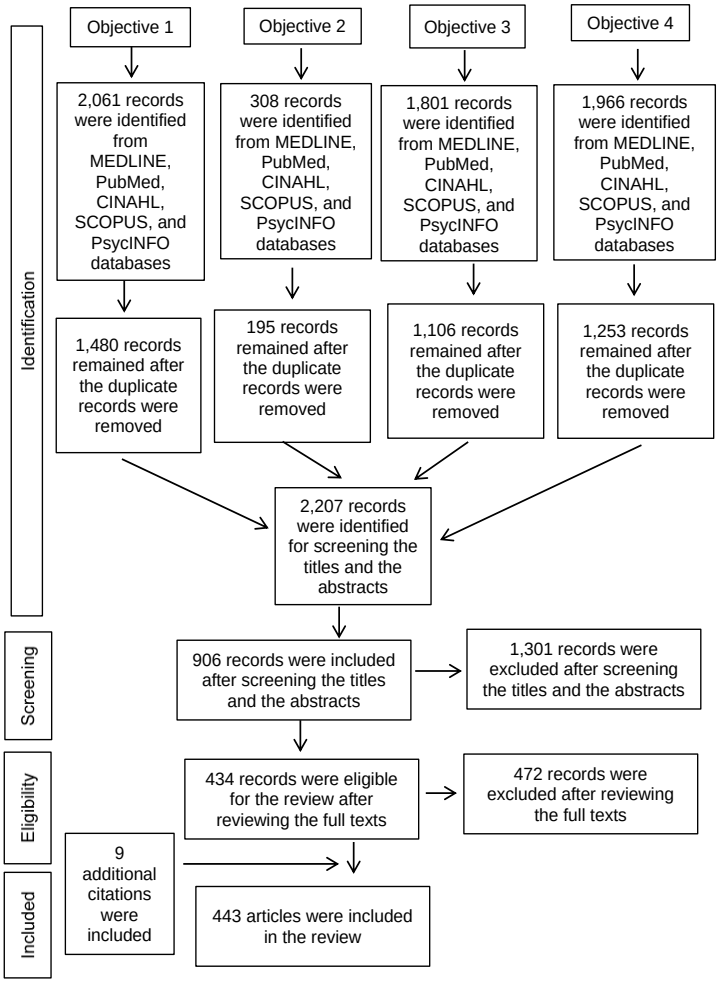

Figure 1. The flowchart of the study selection

2.3 Review results

2.3.1 The prevalence and distribution of dental caries in preschool children

Studies about the prevalence and distribution of dental caries in preschool children were derived from both developing and developed countries across the globe. The participant's ages ranged from zero to six years old. The most common methods used in the literature for assessing dental caries experience among preschool children were dmft (decay, missing, and filled teeth) and dmfs (decay, missing, and filled surfaces) index. The majority of studies on dental caries in preschool children followed the diagnostic criteria as described in the World Health Organization (WHO) basic oral health survey protocol (World Health Organization [WHO], 2013). The dmft/dmfs score is the sum of the decayed, missing, and filled teeth or tooth surfaces. This score described the number of tooth or tooth surfaces, which is affected by dental caries, both treated and untreated, in the past and present. The mean dmft/dmfs score reflects the severity of dental caries, measured by calculating the mean number of decayed, missing, and filled teeth or tooth surfaces among the population examined. The higher

the mean dmft/dmfs score, the more severe the dental caries in the population (WHO, 2013). Some studies also used the pufa (pulp involvement, ulcer, fistula, and abscess) index to assess the clinical consequences of untreated dental decay; the International Caries Diagnostic and Assessment System (ICDAS) to classify stages and caries process; or the Significant Caries (SiC) index. Only one study used self-reported early childhood caries (Al-Jewair and Leake, 2010).

The decay component commonly made a major contribution to the dmf score (Bönecker, Ardenghi, Oliveira, Sheiham, and Marcenes, 2010; Cadavid, Lince, and Jaramillo, 2010; Piovesan, Mendes, Ferreira, Guedes, and Ardenghi, 2010; Borges, Garbin, Saliba, Saliba, and Moimaz, 2012; Chu, Ho, and Lo, 2012b; Lourenço, Saintrain, and Vieira, 2013; Sujlana and Pannu, 2015; Elidrissi and Naidoo, 2016; Azrak, et al., 2017; Cortes, Ekstrand, Gamboa, González, and Martignon, 2017; Sun, et al., 2017b; Chandan, Saraf, Sangavi, and Khatri, 2018). The studies differ in their method of recording the decay component in the primary teeth. Some studies included both non-cavitated and cavitated lesions in the decay component of primary teeth, whereas others only included cavitated lesions. Furthermore, for the decay component, some studies differentiated cavitated lesion into cavitated enamel and cavitated dentine, whereas others did not differentiate the level of dental decay.

The prevalence and distribution of dental caries in preschool children vary in different parts of the world and even within the same country or region. Some studies showed a high prevalence of dental caries among preschool children, whereas others found few preschool children who experienced dental caries. In general, the prevalence of dental caries among preschool children in most developing countries is much higher than in developed countries (Bourgeois and Llodra, 2014; Lagerweij and van Loveren, 2015). This review presents the prevalence and distribution of dental caries among preschool children in developing and developed countries in diverse parts of the world according to the International Statistical Institute (2018).

2.3.1.1 Developing countries

Asian countries

A literature review showed that in Southeast Asia (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor Leste, and Vietnam), the prevalence of dental caries among five- to six-year-old children ranged from 25% to 95%, and the mean dmft ranged from 0.9 to 9.0 (Duangthip, Gao, Lo, and Chu, 2017). In Thai Nguyen, Vietnam, the prevalence of dental caries among children aged four years old was 91.9%, with a mean dmft score of 6.7 and a mean dmfs score of 11.6 (Huong, et al., 2017). In Thua Thien Hue province, Vietnam, the prevalence

of dental caries among children aged two to five years old was 89.1%, with a mean dmft score of 9.32. The prevalence and severity of dental caries increased with age (Nguyen, Ueno, Zaitsu, Nguyen, and Kawaguchi, 2018).

In the three provinces of Cambodia (Kampong Speu, Preveng, and Phnom Penh), the prevalence of dental caries among preschool children was higher among girls (67.2%) than boys (66.1%). The mean dmft score was higher among boys (5.4) than girls (5.3). The difference in dental caries experiences between boys and girls was not statistically significant (Turton, Durward, and Manton, 2015).

A cross-sectional 2009 study in four villages in the hilly rural area near Kyaing Tong, 456 km from the Shan State capital of Taunggyi in north-eastern Myanmar, showed that the prevalence of dental caries among children aged five years old was 25.2%, with a mean dmft score of 0.9. There was a higher prevalence of dental caries and a higher mean dmft score among boys than girls (Chu, Chau, Wong, Hui, and Lo, 2012a).

In India, a cross-sectional study of children aged three to six years old was conducted in Mysore. The results showed that the prevalence of dental caries was 56.6%. No significant association between gender and dental caries experience was found (Agarwal, Sunitha, Reddy, and Machale, 2012). Another cross-sectional study was carried out in the schools of Bengaluru city, Karnataka. The prevalence of dental caries among children aged 46-71 months was 34%. The prevalence of dental caries among females was found to be higher than among males: 36.5% for females compared to 31.45% for males (Anandakrishna, et al., 2014). A descriptive cross-sectional study in Belgaum city, among children aged three to five years old showed that the prevalence of dental caries was 63.17%, with a mean dmft score of 3.04. The prevalence of dental caries increased with age. There was no significant association between dental caries and gender (Sankeshwari, Ankola, Tangade, and Hebbal, 2013).

In addition, in Chandigarh city, India, the prevalence of children aged 36-72 months was 48.3%. The prevalence of dental caries and the mean dmft score increased with age. There was no significant difference in the prevalence of dental caries or the mean dmft score between males and females (Raj, Goel, Sharma, and Goel, 2013). In Bangalore city, Karnataka state, a cross-sectional survey showed that the prevalence of dental caries among children aged 8-48 months was 27.5%, with a mean dmft score of 0.854. The prevalence of dental caries increased with age (Prakash,

Subramaniam, Durgesh, and Konde, 2012). A study in the Santal (Tribal) community of West Bengal showed that the prevalence of dental caries was 46.42%, with a mean dmft score of 1.32. There was no significant difference in the prevalence of dental caries or the mean dmft score between males and females (Mandal, et al., 2015).

In Nagpur, India, the prevalence of dental caries among children younger than five years old was found to be 63.58%. The prevalence of dental caries increased with age, but no significant association was found between gender and dental caries (Bhayade, Mittal, Chandak, and Bhondey, 2016). In Bangalore, the prevalence of dental caries among children aged three to six years old was 82.2%, with a mean dmfs score of 9.10. A higher mean dmfs score was found among boys (9.88) than girls (7.11). No significant association was found between age and the mean dmfs scores (Chandan, et al., 2018). In Bhimavaram town, West Godavari district, Andhra Pradesh, the prevalence of dental caries increased with age, accounting for 15.4%, 37.7%, 22.9%, and 29.3% among children aged three, four, five, and six years old respectively. The prevalence of dental caries was also higher among girls (31.6%) than boys (22%) (Gopal, et al., 2016). In Tamil Nadu, the prevalence of dental caries was 40.6% (Henry, Muthu, Saikia, and Balamurugan, 2016). In Guwahati city, the prevalence of dental caries among children aged three to five years old was 56.09%, 37.12%, and 20.04% in the urban, semi-urban, and rural areas respectively (Kalita, Choudhary, Saikia, and Sarma, 2016).

In Chandigarh city, India the prevalence of dental caries among children younger than five years old was 40.7%, with a mean dmft score of 1.56 (Prabakar, John, and Srisakthi, 2016). In Ballabhgarh, Faridabad district, Haryana, the prevalence of dental caries among children aged five to seven years old was 33.2%, with a mean dmft score of 0.84. The prevalence and severity of dental caries was higher among girls than boys (Shah, et al., 2017). Another study in India showed that the prevalence of dental caries among three- to six-year-old Indian children was 50%. The risk of developing dental caries increased with age and was higher among boys than girls (Sridevi, Pranoti, Anand, Umesh, and Sachin, 2018). In the Ambala district of Haryana, the prevalence of dental caries was 50.7%, with a mean dmft score of 2.31 (Sudan, Sogi, and Veeresha, 2018). In the Pinjore Block (Panchkula), Haryana, the prevalence of dental caries among five-year-old children was 59%, with a mean dmft score of 2.79 (Sujlana and Pannu, 2015).

In Sri Lanka, specifically the Wattala Divisional Secretariat Area in the

Gampaha district, a study of children aged three to five years old showed that the prevalence of dental caries was 62.9%, with a mean dmft score of 2.65. There was no significant difference in the dental caries experience of different age groups or between males and females (Wellappuli and Amarasena, 2012). A descriptive cross-sectional study in the paediatric unit at the Teaching Hospital Ragama, University of Kelaniya, North Colombo showed that the prevalence of dental caries among children aged 36 to 60 months was 48%, with a mean dmft score of 1.81 (Perera, Fernando, Warnakulasooriya, and Ranathunga, 2014). A study on child welfare clinics within the Ragama Medical Officer of Health areas in Gampaha District showed that the prevalence of dental caries among children aged 24-59 months was 38%, with a mean dmft score of 1.41. The prevalence of dental caries increased with age, from 8.9% for children aged 24-29 months to 68.8% for children aged 54-59 months. There was a higher prevalence of dental caries among females than among males (Perera, Abeyweera, Fernando, Warnakulasuriya, and Ranathunga, 2012). In Kegelle district, a cross-sectional study showed that the prevalence of dental caries among children aged 48-72 months was 7.9%, with a mean dmft score of 6.4 (Nanayakkara, Renzaho, Oldenburg, and Ekanayake, 2013).

In Pakistan, in Saddar town, Karachi, a cross-sectional study of children aged three to six years old was conducted. The prevalence of dental caries was reported to be 50.9%. The prevalence of dental caries increased with age. However, there was no significant difference in the prevalence of dental caries according to gender (Dawani, Nisar, Khan, Syed, and Tanweer, 2012). A survey of children aged three to five years old in the district of Lahore showed that the prevalence of dental caries was 40.5%, with a mean dmft score of 1.85. The prevalence of dental caries and the mean dmft score increased with age. There was a higher prevalence of dental caries and a higher dmft score among boys than girls (Sufia, et al., 2011). In Rawalpindi and Islamabad, the prevalence of dental caries among children aged four to five years old was 3.9% (Kamran, Farooq, Faisal, and Jahangir, 2017).

In Lao PDR, a cross-sectional study of children aged 36-47 months in kindergartens in Vientiane showed that 82% of children experienced dental caries, with a mean dmft score of 5.5 (Senesombath, Nakornchai, Banditsing, and Lexomboon, 2010). In Thailand, in the Kohrean subdistrict of Phranakornsriayudhya province, a study of children aged two to five years old showed that the prevalence of dental caries was 95.4%, with a mean dmft

score of 9.14 (Sutthavong, et al., 2010). A cross-sectional survey of children aged five to six years old in Patumwan district, Bangkok showed that the prevalence of dental caries was 78.7%, with a mean dmft score of 6.15. There was a higher prevalence of dental caries and a higher mean dmft score among girls than among boys (Krisdapong, Somkotra, and Kueakulpipat, 2014). A study of five regions in Thailand also showed that the mean dmft score of children aged three to four years old was 4.4. The mean dmft score increased with age, from 4.1 for age three years old to 4.5 for age four years old. Regarding gender, the mean dmft score of males (4.5) was slightly higher than that of females (4.2) (Narksawat, Bonthum, and Tonmukayakul, 2011). In Northern Thailand, the prevalence of dental caries was 68.5% (Peltzer and Mongkolchati, 2015).

A study undertaken in Xishuangbanna and Lincang, Yunnan Province, in China showed that the prevalence of dental caries among Bulang children aged five years old was 85%, with a mean dmft score of 5.8. There was no significant difference in dental caries experience according to gender (Zhang, Liu, Lo, and Chu, 2014). In Xishuangbanna and Lincang, Yunnan Province, a study showed that the prevalence of dental caries in Dai children aged five years old was 89%. The mean dmft score was 7.0. There was no significant difference in the dental caries experience between boys and girls (Zhang, Liu, Lo, and Chu, 2013). A study of 3-6 years old children in four urban districts (Tongan, Helen, Siming and Huli) and two rural districts (Jimei and Xiang'an) in Xiamen city, China showed a significant difference in the prevalence of dental caries among age groups. The prevalence and the severity of dental caries increased with age, accounting for 56.8% with a mean dmft score of 3.06 in children aged 36-47 months old, 71.7% with a mean dmft score of 4.58 in children aged 48-59 months old, and 78.3% with a mean dmft score of 5.54 in children aged 60-70 months old. The mean dmfs score in those three age groups of children was 4.22, 6.86 and 9.49, respectively. The risk of developing dental caries and the severity of dental caries increased with age. No significant difference in the prevalence and severity of dental caries according to gender was found (Li, et al., 2011). Another study in China in 1995 showed that the prevalence of dental caries in children aged five years old was 76.55%, with a mean dmft score of 4.48. In 2005, the prevalence of dental caries among children aged five years old decreased to 66%, with a mean dmft score of 3.5 (Hu, Hong, and Li, 2011).

An analysis of the Global Burden of Disease Study 2015 showed that

the prevalence of dental caries among children in Sichuan province, Western China increased from 48.1% in 1990 to 55.9% in 2015. This prevalence was lower than the national prevalence (51.8% in 1990 and 56.7% in 2015) but was higher than the global prevalence (45.5% in both 1990 and 2015). The mean dmft score in Sichuan province was higher among boys than among girls (Wang, et al., 2017a). In the city of Wenzhou, China the prevalence of dental caries among children aged three to four years old in 2011 was 59.8%, with a mean dmft score of 2.9 and a mean dmfs score of 4.9. When the children grew to four to five years old in 2012, the prevalence of early childhood caries increased to 71.8%, with the mean dmft score also increasing to 4.2 and the mean dmfs score increasing to 9.4. The incidence of dental caries was 29.7%, with a caries increment of 1.1. In 2013, when the children grew to five to six years old, the prevalence of dental caries continued to increase to 76.4%, with a mean dmft score of 4.6 and a mean dmfs score of 11.5. The incidence of dental caries was 14.8%, with a caries increment of 0.7 (Wang, Wei, Li, and Mei, 2017b). In Weifang City, China the prevalence of dental caries was 53.3%, with a mean dmft score of 2.12. There was a significant difference in the mean dmft score according to gender and age (Jiang, 2017). In 31 provinces of Mainland China (except for Tibet), the prevalence of dental caries among five-year-old children was 66.9%, with a mean dmft score of 3.59. The mean dmft score was found to be higher among boys than girls. The risk of developing dental caries was also higher among boys (Sun, et al., 2017b).

Middle Eastern countries

In Jenin, Palestine a study was conducted among children aged four to five years old. The prevalence of dental caries was reported to be 76.2%. There was no significant difference in the dental caries experience between boys and girls (Azizi, 2014). A study of children aged two to four years old in the dental clinics of the Faculté De Médecine Dentaire, Université Saint-Joseph, Beirut, Lebanon showed that the prevalence of dental caries was 74.7%, with no filled teeth observed in all children. There was no significant difference in the prevalence of dental caries between boys and girls (Chedid, Bourgeois, Kaloustian, Baba, and Pilipili, 2011). In Istanbul, Turkey, a study also showed that none of the children aged 18 months to five years old had dental caries (Caglar, Görgülü, and Kuscu, 2016).

A national survey of children aged three and six years old in 2004 in Iran showed that the prevalence of dental caries among children aged three years old was 52%, with a mean dmft score of 1.9. Among the children aged six years old, the prevalence of dental caries was 89%, with a mean dmft score of five. In both age groups, there was a higher prevalence of dental caries and a higher mean dmft score among boys than among girls (Bayat-Movahed, et al., 2011). In TabrizIran, the prevalence of dental caries among children aged four, five, and six years old was 73.1%, 78.0 %, and 87,7%, respectively. However, dental caries was not significantly associated with age or gender (Khani-Varzegani, et al., 2017). The results of a data analysis of the Global Burden Disease Study in 2010 showed that the prevalence of dental caries among boys aged one to four years old increased frm 14.8% in 1990 to 15.1% in 1995, 15.4% in 2000, 15.7% in 2005, and then remained unchanged in 2010. A similar pattern was also found among girls aged one to four years old, accounting for 12.6%, 13%, 13.4%, 13.8% and 13.8%, respectively (Shoaee, et al., 2015).

A study in Jeddah, the Kingdom of Saudi Arabia showed that the prevalence of dental caries in children aged four to six years old was 91%. No significant difference in the prevalence of dental caries according to gender was found (Mannaa, Carlén, and Lingström, 2013). A systematic review aiming to assess the nationwide prevalence and severity of dental caries in children in Saudi Arabia found that the prevalence of dental caries among children aged three to five years old in in Riyadh was 74.8%, with a mean dmft score of 6.1. The prevalence of dental caries among children aged five years old in Al-Kharj province in Al-Riyadh in 2003 was 83.5%, with a mean dmft score of 7.12. The prevalence of nursing caries (caries affecting at least two maxillary incisors on either labial or lingual surfaces, without affecting the mandibular incisors) among children aged two to six years old in Al-Riyadh city was estimated to be 27.3%. An unpublished thesis studying children aged six years old in Jeddah showed that the prevalence of dental caries in the primary dentition was 85.5%, with a mean dmft score of 5.45. Another study of preschool children aged three to five years old in Jeddah showed that the prevalence of dental caries was 73%, and the prevalence of rampant caries (caries affecting at least two maxillary incisors on smooth surfaces) was 34%. The prevalence of dental caries increased with age. A study of children aged four to five years old showed that the prevalence of dental caries was 61% for children aged four years old, and 67% for children aged five years old. Another

study of children aged three to five years old in Al-Hassa, Eastern region showed that the prevalence of dental caries among them was 62.7%. The prevalence of dental caries in the primary dentition among Bedouin children with a mean age of 4.0 in Al-Qaseem region was 20.8%. In Al-Madinah, the prevalence of dental caries among children aged six years old was 87%, with a mean dmft score of 6.4 (Al Agili, 2013).

A systematic review and meta-analysis of studies in Gulf Cooperation Council States (Bahrain, Kuwait, King of Saudi Arabia, Oman, Qatar, and United of Arab Emirates) showed that the prevalence of dental caries in preschool children was 80.9%, with a mean dmft score of 5.14 (Al Ayyan, Al Halabi, Hussein, Khamis, and Kowash, 2018). A descriptive cross-sectional study in Qatar also showed that the prevalence of dental caries among kindergarten-aged children in Qatar was 89.2% (Alkhtib, et al., 2016). A secondary data analysis showed that the prevalence of dental caries among six-year-old children in Qatar was 71.4%, with a mean dmft score of 4.2. A higher prevalence of dental caries among girls than among boys was observed (Al-Thani, et al., 2018). \

African countries

A review based on a national children's oral health survey in South Africa in 1999/2002 showed that the prevalence of dental caries among children aged four to five years old there was 50.6%, and the prevalence of dental caries among children aged six years old was 60.3% (Steyn and Temple, 2012). In Johannesburg, the prevalence of dental caries among children aged four to six years old was 49.2%, with a mean dmft score of 2.3. The prevalence and the severity of dental caries increased with age (Mothupi, Nqcobo, and Yengopal, 2016).

In a study in Ife central local government area in Ile-Ife, Nigeria, the prevalence of dental caries among children aged four to six years old was 16.9%, with a mean dmft score of 0.58 (Oziegbe and Esan, 2013). In another study in Ile-Ife, the prevalence of dental caries was 6.6%, with a mean dmft score of 0.15. The prevalence of dental caries increased with age. The prevalence of dental caries was also higher among girls than boys (Folayan, et al., 2015).

A study undertaken in the Haydon Lutheran Hospital and its 20 mobile outreach community service sites in the Mbulu, Hanang, and Babati districts

of Manyara region, Tanzania showed that the prevalence of dental caries in children aged 6-36 months was 3.7%, with a mean dt score of 0.08. No significant difference in the prevalence and severity of dental caries according to age or gender was found (Masumo, Bardsen, Mashoto, and Åstrøm, 2012b). A cross-sectional reproductive and child health study in Kampala district, Uganda showed that the prevalence of dental caries in children aged 6-36 months was 17.6%, with a mean dt score 0.73. The prevalence of dental caries increased with age. No significant difference in the dental caries experience according to gender was found (Masumo, 2012b).

A descriptive cross-sectional study of children aged three to five years old in the Kiambaa division of Kiambu district in Central Province, Kenya showed that the prevalence of dental caries was 59.5%, with a mean dmft score of 2.46. The prevalence of dental caries and the mean dmft score increased with age. No significant difference in the prevalence of dental caries according to gender was found, but the mean dmft score was higher among boys than among girls (Njoroge, Kemoli, and Gatheche, 2010). In Khartoum State, Sudan, the prevalence of dental caries among children aged three to five years old was 52.4%, with a mean dmft score of 2.3. The mean dmft score increased with age. No significant association between gender and mean dmft scores was found (Elidrissi and Naidoo, 2016).

American countries

A cross-sectional study in the city of Diamantina, in the northern portion of the state of Minas Gerais, Brazil showed that the prevalence of dental caries among children aged three to five years old was 51.2% (Ramos-Jorge, Pordeus, Ramos-Jorge, Marques, and Paiva, 2014). During a screening program of children aged two to five years old in a dental school in São Paulo, the clinical examination results showed that the prevalence of dental caries in the primary dentition was 63.8% (Abanto, et al., 2011). In Santa Maria-RS city, a cross-sectional study showed that the prevalence of dental caries among children aged one to five years old was 23.4%, with a mean dmft score of 0.8. The prevalence of dental caries and the mean dmft score increased with age, but no significant difference in the prevalence of dental caries according to gender was found (Piovesan, et al., 2010). A cross-sectional study undertaken in Santa Maria, Rio Grande do Sul showed that when non-cavitated caries lesions were not considered in the analysis, the prevalence of dental caries among children aged 12-59 months was 37.9%,

with a mean dmft score of 1.36 and a mean dmfs score of 2.33. Those statistics increased to 69.5%, 4.02, and 6.56, respectively when non-cavitated caries lesions were included in the analysis. No significant difference in the prevalence of dental caries according to gender was found (Piovesan, et al., 2014).

In the city of Campina Grande, Brazil, a cross-sectional study of preschool children aged three to five years old showed that the prevalence of dental caries was 66.3% (Clementino, et al., 2015). A series of cross-sectional surveys of children aged one to four years old in Diadema, São Paulo showed a significant decrease in the prevalence of dental caries over the 11 years of the study, from 34.9% in 1997 to 23.5% in 2008. The trends tended to fluctuate from year to year. The mean dmfs score also decreased significantly over the 11 years of the study, from 2.1 in 1997 to 1.3 in 2008. The downward trend was also observed in each age group. In each period of the study, the prevalence of dental caries and the mean dmfs score consistently increased with age (Bönecker, et al., 2010).

A cross-sectional study of children aged four to six years old in Araçatuba, São Paulo in 2010 showed that the prevalence of dental caries was 41.19%. The prevalence of dental caries increased with age. Dental caries was slightly more prevalent among males than among females in all age groups. The prevalence of dental caries (including non-cavitated lesions) was 43.9%, and the prevalence of rampant caries was 0.16%. The overall mean dmft score was 1.53. The mean dmft score also increased with age (Borges, Garbin, Saliba, Saliba, and Moimaz, 2012). A cross-sectional of children aged five to six years old in Pelotas, southern Brazil showed that the prevalence of dental caries was 48.3%, with a mean dmft score of 1.9 and a mean dmfs score of 4.1 (Camargo, et al., 2012). In the city of Diamantina, in northern Minas Gerais, Brazil, a cross-sectional study of children aged three to five years old showed that the prevalence of dental caries was 53.6%. No significant difference in the distribution of dental caries according to gender was found. The prevalence of dental caries increased with age (Corrêa-Faria, Martins-Júnior, Vieira-Andrade, Marques, and Ramos-Jorge, 2013).

A cross-sectional study of Indigenous children aged five years old in the 12 Potiguara Indian rural villages of the reservation in three municipalities (Marcação, Baía da Traição, and Rio Tinto) in the northern Atlantic coastal area of Paraíba, Brazil showed that the prevalence of dental caries was 45.21%, with a mean dmft score of 2.53 for children aged 18-36 months old

and 87.32% with a mean dmft score of 5.87 for children aged five years old (Sampaio, Freitas, Cabral, and Machado, 2010). In the city of Santa Maria, Brazil, a cross-sectional study of children aged zero to five years old showed that the prevalence of dental caries was 16.42% (Ortiz, et al., 2014). A study of children aged two to five years old who sought dental care during the screening program in the School of Dentistry, University of São Paulo showed that the prevalence of dental caries was 63.8%, with a mean dmft score of 7.3. The severity of dental caries was found to increase with age (Carvalho, Abanto, Mendes, Raggio, and Bönecker, 2012). An epidemiological survey of dental caries in Monte Negro, a small town in the Amazonian state of Rondônia, reported a 65.58% prevalence of dental caries among a sample of five-year-old children (Bastos, et al., 2010). A quantitative study of five-year-old children in Pacoti city, Ceará, Brazil showed that the prevalence of dental caries was 67.8%, with a mean dmft score of 2.75 (Lourenço, et al., 2013). A cross-sectional study showed that the prevalence of dental caries among children aged two to six years old in the Southeast Region of Brazil was 33.7%. Dental caries increased with age, but no significant difference in the prevalence of dental caries according to gender was found (Antunes, Ornellas, Fraga, and Antunes, 2018).

Another study in Brazil also showed the prevalence of dental caries among children aged zero to six years old who attended the Cariology Clinic of Federal University of Paraiba (UFPB) in João Pessoa was 66.9%, with a mean dmft score of 3.47 (de Sousa, et al., 2017). In Porto Alegre, Rio Grande do Sul, Brazil the prevalence of dental caries among children aged zero to five years old was 19.1%, with a mean dmfs score of 1.12. The prevalence of dental caries and the mean dmfs score increased with age (Faustino-Silva, et al., 2018). In Canoa, Brazil, the prevalence of dental caries (including initial lesions) among children aged zero, one, two, three, four, and five years old in 2000 was 0%, 17.5%, 31%, 42.9%, 47.6%, 53.9%, respectively, with mean dmft scores of 0, 0.42, 1.08, 1.64, 1.87, and 2.34, respectively. The prevalence of dental caries reduced in 2010, accounting for 0%, 5.4%, 11.9%, 28.6%, 36.2%, and 39.8%, respectively, with mean dmft scores of 0, 0.28, 0.46, 1.07, 1.61, and 2, respectively. The prevalence of dental caries among boys was higher than girls, with higher mean dmft scores observed among boys than girls (Kramer, et al., 2015).

The results of an analysis of the 2010 National Brazilian Oral Health Survey showed that the prevalence of dental caries among children aged five

years old was 83.33%, with a mean dmft score of 2.42 (Miranda, Souza, and Leal, 2018). In Porto Alegre, Brazil, the prevalence of dental caries among children aged three to four years old increased from 90.9% in 2011-2012 to 91.6% in 2014 (Piva, et al., 2017). In the city of Barras, Piaui, Brazil, the prevalence of dental caries among children aged three to six years old was 67.62% (excluding non-cavitated carious lesions) and 68.79 (including non cavitated caries lesions). The prevalence of dental caries (including non-cavitated carious lesions) was higher among boys than girls. The risk of developing dental caries (including non-cavitated carious lesions) increased with age (Viana, et al., 2015). In another study, the prevalence of dental caries among five-year-old Brazilian children was 49.05%, with a mean dmft score of 2.93. A higher dmft score was observed among boys than girls (Brizon, Rojas, Ambrosano, Guerra, and Pereira, 2016).

In Porto Alegre, Brazil, the presence of severe early childhood caries at 38 months old among the children studied was found to be 34.3%, with a mean dmft score of 1.5 (Chaffee, Feldens, Rodrigues, and Vítolo, 2015). In the city of Diamantina, the prevalence of dental caries among children aged two to five years old was 43.2%. The prevalence of dental caries was found to be higher among boys than among girls, and it also increased with age (Corrêa-Faria, et al., 2015). In another study, the prevalence of dental caries among three- to four-year-old Brazilian children with a low socioeconomic status background was 68.9%, whereas none of children with a high socioeconomic background suffered dental caries (Lima, et al., 2016). In Florianópolis, Santa Catarina, Brazil, the prevalence of dental caries among children aged two to five years old was found to be 31%, with a mean dmft score of 1.14 (Massignan, et al., 2016). In Araçatuba, Brazil, the statistics showing the prevalence of dental caries among children aged 0-11, 12-23, 24-35, and 36-47 months old were 0%, 4%, 14%, and 29% respectively. The mean dmft scores were 0, 0.05, 0.29, and 0.81 respectively (Moimaz, Borges, Saliba, Garbin, and Saliba, 2016).

In Ecuador, the prevalence of dental caries among children aged zero to six years old was found to be 65.4%. The prevalence of dental caries reduced from 73.9% in 2011 to 63% in 2012 and 59.3% in 2013. The mean dmft score increased with age, from 0.1 among children aged zero- to one-year-old to 11.8 among children aged six years old (So, et al., 2017). In Bogota, Colombia, the statistics showing the prevalence of dental caries among children aged two, four, and six years old were 32%, 59%, and 66.5%,

respectively. The prevalence of dental caries increased when the initial caries lesions were included in the analysis, accounting for 73.5%, 88.5%, and 89.5%, respectively. The mean dmfs scores were 2.2, 5.5, and 5.5 among children aged two, four, and six years old, respectively. The mean dmfs scores increased to 4.8, 9.1, and 9.7, respectively when the initial carious lesions were included (Cortes, et al., 2017). In the urban area of Medellin, Colombia, a cross-sectional study showed that the prevalence of dental caries among children aged two and a half to four years old there was 34.2%, with a mean dmft score of 1.9. When non-cavitated lesions were included in the analysis, the prevalence of dental caries increased to 74.9%, with a mean dmft score of 7.7. Dental caries increased with age, but no significant difference in the prevalence of dental caries according to gender was found (Cadavid, et al., 2010).

European countries

A cross-sectional study of children aged two to six years old in various kindergartens in Prishtina and Prizren, Kosovo showed that the prevalence of dental caries among preschool children was 90.2%, with a mean dmft score of 5.86. The prevalence of dental caries and the mean dmft score increased with age. The mean dmft score was higher among boys than among girls (Begzati, Mega, Siegenthaler, Berisha, and Mautsch 2011). In another study in Kosovo, the prevalence of dental caries in primary dentition among children aged six years old was 26.3%. The mean dmft score was higher among boys than girls (Ferizi, Dragidella, Staka, Bimbashi, and Mrasori, 2017). In Bosnia and Herzegovina, the prevalence of dental caries among children aged 3-5 years old living in Sarajevo Canton was 83%, with a mean dmft score of 6.8. The prevalence of dental caries and the mean dmft scores increased with age (Šačić, Marković, Arslanagić, Zukanović, and Kobašlija, 2016). In Albania, the prevalence of dental caries among five-year-old Albanian children was 84.1%, with a mean dmft score of 4.41 (Hysi, Caglar, Droboniku, Toti, and Kuscu, 2017). A summary of the prevalence of dental caries in developing countries is presented in Table 2.

Table 2. A summary of the prevalence of dental caries in developing countries

Developing countries	Child's age	The prevalence of dental caries	The mean of dmft score	The mean of dmfs score
Asian countries				
Southeast Asia (Brunei	5 - 6 years old	25% - 95%	0.9 - 9.0	-

Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor Leste, and Vietnam)				
India	8 months - 7 years old	15.4% - 95%	0.854 - 9.32	7.11 - 11.6
Sri Lanka	2 - 6 years old	7.9% - 68.8%	1.41 - 6.4	-
Pakistan	3 - 6 years old	3.9% - 50.9%	1.85	-
Lao PDR	36 - 47 months old	82%	5.5	-
Thailand	2 - 6 years old	68.5% - 95.4%	4.1 - 9.14	-
China	3 - 6 years old	45.5% - 89%	2.12 - 7	4.22 - 11.5
Middle Eastern countries				
Palestine	4 - 5 years old	76.2%	-	-
Lebanon	2 - 4 years old	74.7%	-	-
Iran	1 - 6 years old	12.6% - 89%	1.9 - 5	-
Turkey	18 months - 5 years old	0%	-	-
The Kingdom of Saudi Arabia	2 - 6 years old	20.8% - 91%	5.45 - 7.12	-
African countries				
South Africa	4 - 6 years old	49.2% - 60.3%	2.3	-
Nigeria	4 - 6 years old	6.6% - 16.9%	0.15 - 0.58	-
Tanzania	6 - 36 months old	3.7%	0.08	-
Uganda	6 - 36 months old	17.6%	0.73	-
Kenya	3 - 5 years old	59.5%	2.46	-
Sudan	3 - 5 years old	52.4%	2.3	-
American countries				
Brazil	0 - 6 year old	0% - 91.6%	0 - 7.3	1.12 - 4.1
Ecuador	0 - 6 years old	59.3% - 73.9%	0.1 - 11.8	-
Colombia	2 - 6 years old	32% - 89.5%	1.9 - 7.7	2.2 - 9.7
European countries				
Kosovo	2 - 6 years old	26.3% - 90.2%	5.86	-
Bosnia and Herzegovina	3 - 5 years old	83%	6.8	-
Albania	5 years old	84.1%	4.41	-

2.3.1.2 Developed countries

American countries

A study in the northeast quadrant of the city of Rochester, New York, in the United States (U.S.) showed that the prevalence of dental caries among children aged 12 to 60 months old was 28%, with the mean dfs score of 1.56. Older children had a higher mean dfs score than younger children. However, no significant difference in the mean dfs score was found between boys and girls (Kopycka-Kedzierawski and Billings, 2011). A secondary analysis of data from the 1999-2004 National Health and Nutrition Examination Survey (NHANES) in the U.S. showed that the prevalence of dental caries in the primary teeth of children aged two to five years old was 23% (Bernabé, Delgado-Angulo, Murasko, and Marcenes, 2012). Another secondary analysis from the 1999-2004 NHANES for children aged two to five years old in the U.S. showed that the prevalence of dental caries was 28.5%. The prevalence of dental caries increased with age, but no significant difference in the prevalence of dental caries according to gender was found (Vargas, et al.,

2014). A study of kindergarten-aged children using secondary data from the North Carolina Medicaid files and the North Carolina Surveillance of Dental Caries (NCSoDC) showed that the prevalence of dental caries among Medicaid-enrolled children in NCSoDC was 47.66%, with a mean dmft score of 2.18 (Beil, Rozier, Preisser, Stearns, and Lee, 2014). A study of children aged six months to five years old at the paediatric clinics at Boston Medical Center, Boston University and the Floating Hospital, Tufts Medical Center, Boston showed that the prevalence of dental caries and the mean dmft score increased with age. The statistics showing the prevalence of dental caries were 6.2%, 17.6%, and 22.7% among children aged one to two years old, two to three years old, and three to four years old, respectively, while the mean dmft scores were 0.16, 0.58, and 0.93 among children aged one to two years old, two to three years old, and three to four years old, respectively. The prevalence of dental caries was higher among boys than girls. However, the mean dmft score did not differ significantly between boys and girls (Johansson, Holgerson, Kressin, Nunn, and Tanner, 2010).

A study in a private family medical practice in a frontier county in rural eastern Oregon, in the U.S. showed that 71.19% of patients aged one to four years old received oral health clinical screening. Among those who received oral health clinical screening, only 14.29% of patients had oral health problems, and 50% of them experienced dental caries (Davis, et al., 2010). A survey conducted at New Hampshire Head Start sites showed that 40.2% of children aged three to five years old had experienced dental caries. The prevalence of dental caries increased with age, but no significant difference in the proportion of dental caries between boys and girls was found (Anderson, Martin, Burdick, Flynn, and Blaney, 2010). A study of children aged three to five years old in 42 Head Start classrooms in Navajo Nation [a native American Territory], in the U.S. showed that the prevalence of dental caries was 89.3%, with a mean dmft score of 7.35 and a mean dmfs score of 21.30. The mean dmfs score significantly increased with age, and boys had a higher mean dmfs score than girls. After comparing the findings of this study with the findings of the previous dental surveys (the 1999 and 2010 Navajo Nation Indian Health Survey (IHS) and the National Health and Nutrition Examination Survey (NHANES) 1999-2004), this study concluded that there was no a considerable change in the prevalence of dental caries in the Navajo Nation within the previous 10-15 years, but a substantial improvement was noticed in the frequency of untreated dental caries. The severity of dental

caries in the Navajo Nation was found to be higher than the U.S. national rate (Batliner, et al., 2014).

A study undertaken in the IHS tribal sites, responsible for providing federal health services to American Indians and Alaska Natives (AI/ANs) in the U.S. showed that 54.1% of children aged 12-71 months old had dental caries, with a mean dmft score of 3.5. The prevalence of dental caries and the mean dmft score increased with age (Phipps, Ricks, Manz, and Blahut, 2012). A study of Alaska Native children aged four to five years old in five villages in the remote region of Alaska showed that the prevalence of dental caries was 87%, with a mean dft score of 5.0, compared to 35% of U.S. children, with a mean dft score of 1.6 (Centers for Disease, Control, and Prevention, 2011). A study of underprivileged children aged two to five years old who visited the Women, Infants, and Children Centers (WICs) or who were enrolled in Head Start programs in Los Angeles County, California showed that 44% of children had untreated cavitated dental caries, 29.1% had untreated non-cavitated dental caries, 73.2% had either cavitated or non-cavitated dental caries, and 83.1% had both cavitated and non-cavitated dental caries experience (Mulligan, Seirawan, Faust, and Barzaga, 2011).

A study undertaken in New Mexico, in the U.S. showed that the prevalence of untreated dental caries (dt) among children aged three to four years old there was 46%, with a mean dmft score of 5.7. A higher prevalence of dental caries was observed among girls than boys, but the severity of dental caries was higher among boys than girls (Batliner, et al., 2016). In Perry County, Alabama, the prevalence of dental caries among children aged one-year-old was 1.1%, with a mean dmft score of 0.02 and a mean dmfs score of 0.02. The prevalence of dental caries and the mean dmft and dmfs scores increased with age (Ghazal, et al., 2015a). One study of the 2011-2014 NHANES showed that the prevalence of untreated dental caries among children aged zero to five years old in the U.S. was 9.14% (Gupta, Vujicic, Yarbrough, and Harrison, 2018). In North Carolina, the prevalence of dental caries among kindergarten-aged children was 36.02%, with a mean dmft score of 1.48. The prevalence of dental caries was also higher among boys than girls. The association between gender and dental caries was also significant (Matsuo, Rozier, and Kranz, 2015).

The results of a U.S. NHANES showed that the prevalence of dental caries among children aged two to five years old increased from 24% in 1988-1994 to 28% in 1999-2004. It then decreased to 23% in 2011-2012. The mean

dfs increased from 2.15 in 1988-1994 to 2.58 in in 1999-2004 and remained unchanged in 2011-2012 (Rozier, White, and Slade, 2017). Another study showed that the prevalence of dental caries among children aged two to five years old was 39.7% in Los Angeles Count, California and 27.9% in the U.S. (Dye, Vargas, Fryar, Ramos-Gomez, and Isman, 2017). In another study in the U.S., between 2015-2016, the prevalence of dental caries among children aged two to five years old was found to be 17.7% (Fleming and Afful, 2018).

In the Nashville area, concerning HIS Tribes, in the U.S. the prevalence of untreated dental caries among children aged five years old and younger was 30.3% in 2010 and reduced to 27.49% in 2014 (Middlebrooks, 2015). The prevalence of dental caries among AI/AN children increased with age, accounting for 21.2%, 43.7%, 60.8%, 69.5%, and 75.1 % for children aged one, two, three, four, and five years old, respectively in 2010, and 18.1%, 39.4%, 59.9%, 69.4%, and 75.6%, respectively in 2014. The prevalence of dental caries from 2010 to 2014 reduced, except among children aged five years old. The mean dmft scores also increased with age, accounting for 0.94, 2.33, 3.91, 4.58, and 5.70 for children aged one, two, three, four, and five years old, respectively in 2010, and 0.80, 2.16, 4.08, 5.34, and 6.10, respectively in 2014. The mean dmft scores from 2010 to 2014 decreased among one- to two-year-old children, but increased among three- to five-year-old children (Ricks, Phipps, and Bruerd, 2015).

A study of children who came from African immigrant families living in Edmonton, Canada showed that the prevalence of dental caries among children aged six years old or younger was 63.7% (Amin, Perez, and Nyachhyon, 2015). In a study of Hutterite children aged 6-71 months old in Manitoba province, the prevalence of dental caries was reported to be 53%, with a mean dmft score of 2.8. Age was the strongest predictor of early childhood caries. However, the prevalence of dental caries and the mean dmft score did not differ significantly between boys and girls (Schroth, Dahl, Haque, and Kliewer, 2010). In Toronto, a secondary analysis of a study of children aged zero to five years old who received early dental care showed that 24% of children had one or more cases of dental decay. Dental caries increased with age. However, no significant difference in the prevalence of dental caries according to gender was found (Darmawikarta, et al., 2014). Another secondary analysis of cross-sectional data from the Toronto Perinatal and Child Health Survey (TPCHS) 2003 in Canada showed that the prevalence of self-reported dental caries in children younger than six years old was 4.7%.

The prevalence of dental caries among children aged younger than three years old was significantly higher than children aged three years old and older. No significant difference in the prevalence of dental caries according to gender was found (Al-Jewair and Leake, 2010). In British Columbia, Canada, the prevalence of dental caries experience among children aged four to six years old decreased from 38.9% in 2006-2007 to 36.7% in 2009/2010 (Poon, Holley, Louie, and Springinotic, 2015). In Winnipeg, Canada, the prevalence of dental caries among refugee and immigrant children aged 12-71 months old was 45.5%. The mean dmft score was 2.2, and the mean dmfs score was 4.8. No significant difference in the prevalence of dental caries according to gender was found. Gender was, however, significantly associated with the mean dmfs score. The risk of developing dental caries significantly increased with age (Azrak, et al., 2017). The prevalence of dental caries among preschool-aged children in different provinces/territories in Canada ranged between 50% and 100%, with the mean dmft scores ranging between 1.8 and 13.7 (Baghdadi, 2016).

In the La Araucanía, Los Ríos, and Los Lagos Regions of Chile, the prevalence of dental caries in children aged two to three years old was 52.79%, with a mean dmft score of 2.53. The prevalence of dental caries and the mean dmft scores increased with age. No significant difference was found between gender and dental caries (Espinoza-Espinoza, Muñoz-Millán, Vergara-González, Atala-Acevedo, and Zaror, 2016). In the city of Valdivia, Chile, the prevalence of dental caries was found to be higher among two-year-old children (12.6%) than four-year-old children (41%). The mean dmft score was also higher among two-year-old children (0.18) than four-year-old children (1.59) (Soto, Wilson, and Herreros, 2018). A cross-sectional oral health survey in the Caroni region of Central Trinidad showed that the prevalence of dental caries among children aged three to five years old there was 29.1%, with a mean dmft score of 1.4. The prevalence of dental caries was slightly higher among boys than girls (Naidu, Nunn, and Kelly, 2013).

European countries

According to a children's dental health survey in the United Kingdom (U.K.), the prevalence of dental caries among five-year-old children in the U.K. reduced over 40 years. In 1973, the prevalence of dental caries among five-year-old children was 72%, with a mean dft score of 4. The prevalence and severity of dental caries among five-year-old children reduced from 52% and

a mean dft score of 1.8 in 1983 to 43% and a mean dft score of 1.6 in 2003. In 2013, a lower prevalence and severity of dental caries among five-year-old children was observed in England, Wales, and Northern Ireland, accounting for 26%, with a mean dft score of 0.7 (Murray, Vernazza, & Holmes, 2015). In another study in England, Wales, and Northern Ireland, the prevalence of dental caries among children aged five years old was found to be 40% (excluding non-cavitated carious lesions) and 56% (including non-cavitated carious lesions). The prevalence of untreated decay was 28%. The mean of dmft scores was 2.0 (including non-cavitated caries lesions) and 1.2 (excluding non-cavitated caries lesions). The prevalence of severe dental caries among children aged five years old was higher among boys than girls (Vernazza, Rolland, Chadwick, and Pitts, 2016). A survey in England in 2007/2008 showed that the overall prevalence of dental caries in children aged five years old was 30.9%, ranging from 23.5% in the south-east coast to 39.8% in the north-east region. The overall mean dmft score was 1.11, ranging from 0.7 in the south-east coast to 1.52 in the north-east region. East Hertfordshire, in the east of England, was found to have the lowest estimate of dental caries, whereas Luton had the highest prevalence of dental caries, accounting for 8.8% and a mean dmft score of 0.27 and 43.9% and a mean dmft score of 1.94, respectively. The highest prevalence of dental caries estimated in the Primary Care Trust geography was in Brent, in the London region, while Bromley had the lowest estimated dental caries prevalence, accounting for 44.7% and a mean dmft score of 2.50 and 18.8% and a mean dmft score of 0.57, respectively (Davies, et al., 2011).

A cross-sectional survey of three inner north-east London areas (Hackney, Tower Hamlets, and Newham) showed that the prevalence of dental caries in children aged three to four years old was 23.54%, with a mean dmft score of 0.92 (Marcenes, et al., 2013). The prevalence of dental caries among five-year-old Charedi Orthodox Jewish children in London was found to be 58%, with a mean dmft score of 2.38 (Klass, Mondkar, and Wright, 2017). In Scotland, a National Health Service (NHS) study of children aged three years old in Greater Glasgow showed a decrease in the prevalence of dental caries over the four years of the study, from 26% in 2006/2007 to 17% in 2009/2010. The mean dmft also decreased from 1.1 in 2006/2007 to 0.4 in 2009/2010 (McMahon, Blair, McCall, and Macpherson, 2011). A secondary data analysis of the National Dental Inspection Programme (NDIP) survey of children aged five years old in Scotland in 2007/2008 showed that the

prevalence of dental caries was 42.5%, with a mean dmft score of 1.87. The mean dmft score significantly rose with age. However, no significant difference in the mean dmft score according to gender was found (Levin, Davies, Douglas, and Pitts, 2010).

Another survey in Scotland in 2008 showed a decrease in the prevalence of dental caries among children aged five years old. The prevalence of dental caries in 2008 was 42.3%, with a mean dmft score of 1.86, compared to 45.9% in 2006 and a mean dmft score of 2.16. A steady decline in dental caries experience was observed from 2003 to 2008. The prevalence of dental caries ranged from 29.2% in Borders to 47.8% in Lanarkshire, and the mean dmft score ranged from 1.24 in Orkney to 2.14 in Lanarkshire (Davies, et al., 2011). In the Isle of Islay, Scotland, the prevalence of dental caries among children aged five years old reduced from 61% during 1999-2003 to 15% during 2012-2014. The mean dmft score also reduced from 3.04 to 0.30 (Formby, 2015). In Wales, a survey of all 22 Unitary Authorities in Wales showed a decrease in the prevalence of dental caries and the mean dmft score, from 47.2% and a mean dmft score of 2.38 in 2005/2006 to 52.4% and a mean dmft score of 1.98 in 2007/2008 (Davies, et al., 2011). In the Falkland Islands, in the U.K. the prevalence of dental caries among five-year-old children was 34.6%, with a mean dmft score of 1.2 (Jones and Walters, 2015).

A study in the Netherlands showed that the prevalence of dental caries among children aged 24-71 months old who attended one government-based clinic and two university-based paediatric dentistry departments between the years 2010 and 2013 was 91.9%, with a mean dmft score of 8. The severity of dental caries increased with age. No significant difference in the prevalence of dental caries was observed according to age or gender (Ozen, et al., 2016). In Rotterdam, Netherlands the prevalence of dental caries among six-year-old children was 31.7% (van der Tas, et al., 2017).

A cross-sectional study in Attica, Greece showed that the prevalence of dental caries among children aged five years old was 16.5%, with a mean dmfs score of 0.85. Girls were found to be more likely to develop dental caries than boys (Mantonanaki, Koletsi-Kounari, Mamai-Homata, and Papaioannou, 2013). In the Athens metropolitan area, a cross-sectional study of two- to six-year-old children showed that the prevalence of dental caries among them was 30%. The prevalence of dental caries increased with age (Kavvadia, Agouropoulos, Gizani, Papagiannouli, and Twetman, 2012). A national survey

of Greek children in two cities (Athens and Thessaloniki), six counties (Achaia, Chania, Evros, Ionnina, Kastoria, and Larissa), and three islands (Lesbos, Naxos, and Kefallinia) showed that the prevalence of dental caries was 43%, with a mean dmft score of 1.77. No significant difference in the mean dmfs score according to gender was found (Oulis, et al., 2012). The prevalence of dental caries among children aged four to six years old in the Athens metropolitan area was 20.8%, with a mean dmft score of 0.67. A lower prevalence of dental caries was observed among boys than girls (Mantonanaki, Hatzichristos, Koletsi-Kounari, and Papaioannou, 2017).

A retrospective study in the city of Brescia, Italy showed that the prevalence of dental caries among children aged 24-30 months old was 80.84%. (Majorana, et al., 2014). In Sassari, northern Sardinia, a cross-sectional study on Italian preschool children aged 18-60 months old showed that the prevalence of dental caries was 15.9%, with a mean dmfs score of 0.94. The prevalence of dental caries and the mean dmfs score were both higher among older children aged 48-60 months old than among younger children aged 18-47 months old (Congiu, et al., 2014). In north-east Italy, the statistics showing the prevalence of dental caries among children aged three, four, and five years old were 17%, 24%, and 35% respectively. The mean dmft scores were 0.5, 0.8, and 1.3, respectively. The prevalence and mean dmft scores increased with age. No significant difference in the prevalence of dental caries according to gender was found. The prevalence and severity of dental caries decreased from 1984 to 2004 and remained unchanged from 2004 to 2011 (Ferro, Besostri, and Olivieri, 2017). Another study in Italy showed the prevalence of dental caries among Italian three- and five-year-old children was 14.4%. The likelihood of developing dental caries increased with age, but no significant difference in the prevalence of dental caries according to gender was found (Ugolini, Salamone, Agostino, Sardi, and Silvestrini-Biavati, 2018).

Five cross-sectional surveys of five-year-old children conducted by the Institute of Health Information and Statistics (IHIS) in the Czech Republic in 1994, 1997, 2000, 2003, and 2006 showed that the prevalence of dental caries decreased significantly, from 76.1% in 1994 to 57.8% in 2006. The mean dmft score also significantly decreased, from 3.5 in 1994 to 2.7 in 2006. The results of national cross-sectional surveys of 5-year-old children conducted by the Institute Dental Research (IDR) in the Czech Republic in 1998, 2001, 2005, and 2010 also showed a significant decrease in the

prevalence of dental caries, from 73.3% in 1998 to 55.1% in 2010. A significant decrease was also found in the mean dmft score, from 3.7 in 1998 to 2.9 in 2010 (Lenčová, Pikhart, and Broukal, 2012).

A study in Vorarlberg, Austria showed that the prevalence of dental caries among children aged five years old was 43.1%, with a mean dmfs score of 5.4 and a mean dmft score of 2.3 (Wagner, Greiner, and Heinrich-Weltzien, 2014). In Germany, in northern Hesse, in the district of Waldeck-Frankenberg, the prevalence of dental caries among children aged five to seven years old was 45% and the mean dmft score was 1.88 (Pieper, et al., 2012). A study of children aged three to five years old in Heidelberg and the Rhein-Neckar District, Germany showed that the prevalence of dental caries was 20.9%, with a mean dmft score of 0.75 and a mean dmfs score of 1.57. The prevalence of dental caries increased with age (Bissar, Schiller, Wolff, Niekusch, and Schulte, 2014). In the Kyffhäuser district of the German federal state Thuringia, there was an increase in the prevalence of dental caries among two- and three-year old children, from 16.6% in 2008 to 20.6% in 2009 and 27.8% in 2010. When non-cavitated carious lesions were included, these proportions increased from 52.5% in 2008 to 62.6% in 2009 and 64.1% in 2010. The mean dmfs score also increased from 2.5 in 2008 to 3.3 in 2009 and 4.4 in 2010 (Pitchika, et al., 2016).

The Polish National Oral Health Survey conducted in the Podlaskie region showed that in 2011, the prevalence of dental caries among children aged five years old was 85.9%. Although the mean dmft score among boys was higher than girls, there was no significant difference in the mean dmft score between boys and girls (Baginska, Rodakowska, Wilczyńska-Borawska, and Jamiołkowski, 2013). A study in Switzerland showed that the prevalence of dental caries among children aged 36 to 71 months old there was 24.8%. No significant difference in the prevalence of dental caries according to gender was found (Baggio, Abarca, Bodenmann, Gehri, and Madrid, 2015). The prevalence of dental caries among children aged five years old in seven municipalities in Denmark was 25%, with a mean dmfs score of 1.2 in public dental clinics and 72%, with a mean dmfs score of 1.2 in private dental clinics. No significant difference in the prevalence of dental caries according to gender was found (Christensen, Petersen, and Hede 2010). In another study, the prevalence of dental caries among three-year-old Danish children was 4.6%, with a mean dmfs score of 0.22 (Nørrisgaard, Qvist, and Ekstrand 2016).

A study in the south-west region of Halland in Sweden showed a decrease in the prevalence of dental caries among children aged three to six years old, from 16% in 2006 to 11.4% in 2010 (Stromberg, Magnusson, Holmén, and Twetman, 2011; Strömberg, Holmén, Magnusson, and Twetman, 2012). The prevalence of dental caries in the Halland region remained stable from 10.6% in 2010 to 10.5% in 2016 (Holmén, Strömberg, Håkansson, and Twetman, 2018). In Jönköping, the statistics showing the prevalence of dental caries among three-year-old children over a 30-year period were 65%, 38%, 30%, 28%, and 31%, with mean dfs scores of 3.9, 2.0, 2.3, 1.2, and 1.8 in 1973, 1978, 1983, 1993, and 2003, respectively. In the same periods, the statistics showing the prevalence of dental caries among five-year old children were 91%, 75%, 71%, 52%, and 54%, with mean dfs scores of 11.2, 6.3, 5.9, 3.7, and 3.5, respectively (Koch, Helkimo, and Ullbro, 2017). Over 40 years, in Jönköping, the prevalence of dental caries among children aged three and five years old increased from 65% and 91% respectively in 1973 to 21% and 31% respectively in 2013. The mean dft score among children aged three and five years old also decreased from 2.7 and 6.5 respectively in 1973 to 1 and 1.5 respectively in 2013 (Norderyd, et al., 2015). In the county of Skaraborg, 20.6% of children developed new cavitated carious lesions from three to six years of age. This proportion was higher (39.9%) when non-cavitated carious lesions were included (Östberg, Skeie, Skaare, and Espelid, 2017).

The prevalence of dental caries among children aged five years old in Norway in 2007 was found to be 34%, with a mean dmft score of 1.3. No significant difference in the dental caries experience of boys and girls was found (Wigen and Wang, 2010). Another study also showed that the prevalence of dental caries among children aged five years old in Norway was 11%, with a mean dmft score of 0.3. No significant difference in the prevalence of dental caries according to gender was found (Wigen, Espelid, Skaare, and Wang, 2011). A study in 21 schools in Clermont-Ferrand, France showed that 27.6% of children aged five years old there had dental caries, with a mean dmft score of 1.18 and a mean dmfs score of 3.24 (Tubert-Jeannin, Leger, and Manevy, 2012).

A repeated cross-sectional study in Kaunas, Lithuania showed that the prevalence of dental caries among children aged four to six years old increased from 85.4% in 2000 to 88.4% in 2010, but the difference was not significant. Comparing the mean dmft score according to gender and age over

the ten-year period of study, the difference was statistically significant, from 7.42 in 2000 to 12.03 in 2010. The likelihood of developing dental caries increased with age. However, no significant difference in the prevalence of dental caries according to gender was found (Razmienė, Vanagas, Bendoraitienė, Andriuškevičienė, and Slabšinskienė, 2012). Another study in towns of Plungė and Jonava, Lithuania found that the prevalence of dental caries among children aged four to six years old there was 91% in Plungė and 90% in Jonava. Comparing the prevalence of dental caries among age groups, the statistics showing the prevalence of dental caries among children aged four, five, and six years old were 78.7%, 97.3%, and 95.3%, respectively. The severity of dental caries was higher among older children than younger children (Razmienė, Vanagas, Bendoraitienė, and Vyšniauskaitė, 2011). In ten counties in Lithuania (Vilnius, Kaunas, Klaipėda, Šiauliai, Panevėžys, Marijampolė, Telšiai, Alytus, Utena, and Tauragė), the prevalence of dental caries among children aged three years old was 50.6%, with a mean dmft score of 2.1 and a mean dmfs score of 3.4 (Slabsinskiene, et al., 2010).

Australia and New Zealand

In Western Australia, the mean dmft scores among children aged five and six years old were 1.37 and 1.28, respectively, whereas the mean dt scores for the same age group were 1.16 and 0.86, respectively (Arrow, 2016). A study in New South Wales also showed the proportion of children aged five to six years old who were caries-free: 55.6% and 54.8%, respectively. The mean dmft scores were 1.74 and 1.82, respectively. Age and gender were not significantly associated with dental caries (Blinkhorn, et al., 2015). In Victoria, Australia, the prevalence of dental caries among children aged 18 months old was 7.8% and increased to 22.8% when these children became 36 months old (Gussy, et al., 2016). The prevalence of preschool refugee children in western Australia was 62%, with mean dmft scores of 5.2 (Nicol, et al., 2015).

In Melbourne, in 2012, the statistics showing the prevalence of dental caries among children aged one, two, three, and four years old were 1%, 9%, 17%, and 31%, respectively, and these proportions increased to 6%, 18%, 46%, and 59%, respectively when non-cavitated carious lesions were included in the analysis. The mean dmfs scores were 0.08, 0.43, 0.77, and 2.29 for children aged one, two, three, and four years old, respectively, and

the scores increased to 0.31, 0.83, 2.11, and 4.12, respectively when non-cavitated carious lesions were included in the analysis (Gibbs, et al., 2016). In Queensland, the prevalence of dental caries among children aged four to six years old with a low socioeconomic background from 1998 to 2008 (pre-fluoridation) was 84%, with a mean dmft score of 5.12 and a mean dmfs score of 8.01. The prevalence of dental caries decreased to 76% from 2011 to 2012 (post-fluoridation) with a mean dmft score of 3.99 and a mean dmfs score of 5.52 (Koh, et al., 2015). In New Zealand, a secondary analysis of the national aggregated data collected from dental examinations in New Zealand's Child Oral Health Services between 2004 and 2013 showed that the prevalence of dental caries among five-year-old children decreased from 48.9% in 2004 to 43.3% in 2013. The mean dmft scores also decreased from 2.18 in 2004 to 1.93 in 2013 (Schluter and Lee, 2016).

Asian countries

In Japan, The Fukuoka Child Health Study (FCHS) of children aged three years old in Fukuoka city, a metropolitan area on Kyushu Island, showed that 20.7% of the children experienced dental caries, with a mean dmft score of 0.70 (Tanaka, Miyake, and Sasaki 2010). Another study of children aged three-years-old who attended a dental check-up at one of ten community health centres administered by the municipal government in Nagasaki showed that the prevalence of dental caries was 36.4%, with a mean dmft score of 1.6. No significant difference in the prevalence of dental caries according to gender was found (Kawashita, et al., 2011). A study in six health medical clinics (Bedok, Hougang, Jurong, Tampines, Woodlands, and Yishun) in Singapore showed that the prevalence of dental caries among children aged 18-48 months old there was 48%, with a mean dt score of 2.3 and a mean ds score of 3.0. None of children had missing or filled teeth. The severity of dental caries was significantly associated with age (Hong, et al., 2014).

A study of Chinese preschool children aged three to five years old in Hong Kong showed that the prevalence of dental caries was 35.1%, with a mean dmft score of 1.5 (Wong, Mc Grath, King, and Lo, 2011). Another study in Hong Kong also showed that the prevalence of dental caries among children aged five years old was 75.44%, with a mean dmft score of 4.2. A significant association between gender and dental caries experience was found, but boys had a higher mean dmft score than girls (Bridges, et al., 2014). Another cross-sectional study in Hong Kong showed that the prevalence of

dental caries among five-year-old children there was 55.4%, with a mean dmft score of 2.7. No significant difference in the prevalence of dental caries according to gender was found (Chen, et al., 2017). A summary of the prevalence of dental caries in developed countries is presented in Table 3.

In a dental health survey conducted in Dong-gu, Ulsan, South Korea, the prevalence of dental caries among children aged six years old and younger was found to be 45.7%. The prevalence of dental caries increased with age. However, there was no significant difference in the distribution of dental caries between boys and girls (Han, et al., 2014). According to the National Korean Oral Health Survey, the prevalence of dental caries among children aged two to six years old decreased in 2000, 2006, and 2012. For boys, the prevalence of dental caries was 82.54% in 2000, 70.3% in 2006, and 63.52% in 2012, whereas for girls, the prevalence of dental caries was 84.14%, 64.5%, and 60.86% in the same respective years. The mean dmft score for boys was 5.08, 3.12, and 2.98 in 2000, 2006, and 2012, respectively, whereas the mean dmft score for girls was 5.93,2.53, and 2.59 in the same respective years (Kim, Shim, Kim, and An, 2017).

The prevalence of dental caries aged four to six years old in the Kaohsiung area, Taiwan was higher among immigrant children than among native children, accounting for 79.4% with a mean dmft score of 3.88 among immigrant children, and 88.7% with a mean dmft score of 6.05 among native children (Lin, et al., 2014a). In San-Ming District of Kaohsiung City, the prevalence of dental caries among children aged four to six years old was 76.6%. The prevalence of dental caries increased with age and was found to be higher among boys than among girls (Lin, et al., 2017).

Middle Eastern Countries

A systematic review aiming to summarise the available studies on the epidemiology of dental caries in the United Arab Emirates (UAE) showed that the prevalence of dental caries among children aged four to six years old there ranged from 78.85% to 95%, and the mean dmft score ranged from 5.1-8.4 in Abu Dhabi. In Ajman, the prevalence of dental caries ranged from 72.9% to 76.1%, and the mean dmft score ranged from 4.4 to 4.5. In Abu Dhabi, the prevalence of dental caries among children aged five years old ranged from 80% to 95%, with a mean dmft score of 5.1. Another study in Abu Dhabi in 1996 found that the prevalence of dental caries of children born in the United Arab Emirates ranged from 36% to 47% for children aged two years old, 71%

to 86% for children aged four years old, and 82% to 94% for children aged five years old, with a mean dmft score of 8.4. In Al Ain, the prevalence of dental caries was 94%, with a mean dmft score of 8.6. Another study in Al Ain showed that the prevalence of dental caries among children aged four to five years old was 78.83%, with a mean dmft score of 5.82. The prevalence of dental caries increased with age, but no significant association in prevalence of dental caries was found according to gender (Al-Bluwi, 2014).

The same systematic review also found that in the first comprehensive oral health survey of school children in the United Arab Emirates in all seven emirates (Abu Dhabi, Dubai, Sharjah, Umm Al-Qaiwain, Fujairah, Ajman, and Ra's Al-Khaimah) in 2001-2002, the prevalence of dental caries among children aged five years old was 83%, with a mean dmft score of 5.1. In a cross-sectional study of children aged five to six years old in Ajman in 2002-2003, the mean dmft score was 4.5. Another study of children in Ajman in 2010 showed that the prevalence of dental caries ranged from 72.9% to 80%, and the mean dmft score ranged from 4 to 4.5 for children aged five to six years old. The mean dmft score was higher among boys than girls. In the Emirate of Ajman, a study of children aged five to six years old found that the prevalence of severe early childhood caries was approximately 31.1% (Al-Bluwi, 2014).

In Al-Ain city, in the UAE the prevalence of dental caries among children younger than five years old was 99.4%, with a mean dmft score of 10.9 and the mean dmfs score of 32.1 (Kowash, 2015). In the Emirate of Ras of Al Khaimah, the prevalence of dental caries among children aged four to six years old was 74.1%, with a mean dmft score of 3.07 (Kowash, Alkhabuli, Dafaalla, Shah, and Khamis, 2017). In Abu Dhabi, United Arab Emirates, the prevalence of dental caries was 57%, with a mean dmft score of 1.68, but the mean dmft score was not significantly associated with gender and age (Elamin, et al., 2018).

Table 3. A summary of the prevalence of dental caries in developed countries

Developing countries	Child's age	The prevalence of dental caries	The mean of dmft score	The mean dmfs score
American countries				
The United States	6 - 71 months old	1.1% - 89.3%	0.02 - 7.35	0.02 - 21.30
Canada	0 - 71 months old	4.7% - 100%	1.8 - 13.7	4.8
Chile	2 - 3 years old	12.6% - 52.79%	0.18 - 2.53	-
Trinidad	3 - 5 years old	29.1%	1.4	-
European countries				
The United Kingdom	3 - 5 years old	8.8% - 72%	0.27 - 4	-
Netherlands	24 - 71 months old	31.7% - 91.9%	8	-
Greece	4 - 6 years old	16.5% - 43%	0.67 - 1.77	0.85

Italy	18 - 60 months old	14.4% - 80.84%	0.5 - 1.3	-
The Czech Republic	5 years old	55.1% - 76.1%	2.9 - 5.7	-
Austria	5 years old	43.1%	2.3	5.4
Germany	2 - 7 years old	16.6% - 64.1%	0.75 - 1.88	1.57 - 4.4
Poland	5 years old	85.9%	-	-
Switzerland	36 - 71 months old	24.8%	-	-
Denmark	3 - 5 years old	4.6% - 72%	-	0.22 - 1.2
Sweden	3 - 6 years old	10.5% - 91%	-	1 - 11.2
Norway	5 years old	11% - 34%	0.3 - 1.3	-
France	5 years old	27.6%	1.18	3.24
Lithuania	3 - 6 years old	50.6% - 97.3%	2.1 - 12.03	3.4
Australia	18 months - 6 years old	1% - 84%	1.28 - 5.2	0.08 - 8.01
New Zealand	5 years old	43.3% - 48.9%	1.93 - 2.18	-
Asian Countries				
Japan	3 years old	20.7% - 36.4%	0.70 - 1.6	-
Singapore	18 - 48 months old	48%	2.3	3
Hong Kong	3 - 5 years old	35.1% - 75.44%	1.5 - 4.2	-
South Korea	6 years old and younger	45.7% - 84.14%	2.59 - 5.93	-
Taiwan	4 - 6 years old	76.6% - 88.7%	3.88 - 6.05	-
Middle Eastern countries				
The United Arab Emirates (UAE) - Abu Dhabi, Dubai, Sharjah, Umm Al-Qaiwain, Fujairah, Ajman, and Ra's Al-Khaimah)	2 - 6 years old	36% - 99.4%	1.68 - 10.9	32.1

2.3.2 The impact of dental caries on the quality of life of preschool children

Oral health-related quality of life of children with dental caries and their families has been assessed in the literature by means of various instruments. The majority of studies adopted the Early Childhood Oral Health Impact Scale (ECOHIS) in a different version, adjusted to the study location. Some studies utilised the Parental-Caregivers Perceptions Questionnaire (P-CPQ), the Family Impact Scale (FIS), or the Pediatric Oral Health-Related Quality of Life (POHQoL) scale (Albino, et al., 2014; Braun, et al., 2014). Many studies found a significant association between dental caries and the quality of life of the affected children and their families (Cunnion, et al., 2010; Wong, et al., 2011; Kramer, et al., 2013; Scarpelli, et al., 2013; Queiroz, de Alencar, Requejo, Gonçalves, and Maia, 2015). The mean score of oral health-related quality of life was higher among children who had dental caries than children who were caries-free (Albino, et al., 2014; Clementino, et al., 2015; Abanto, et al., 2018). Furthermore, an increase in the severity of dental caries among preschool children was found to be associated with an increase in the negative impacts of dental caries on the quality of life of the children and their families (Abanto, et al., 2011; Kramer, et al., 2013; Baghdadi, 2014; Ramos-Jorge, et al., 2014; Clementino, et al., 2015; Ramos-Jorge, 2015; Arrow and Klobas, 2016; Birungi, Fadnes, Nankabirwa, Tumwine, and Åstrøm, 2016; Corrêa-Faria, et al., 2016a; Firmino, et al., 2016; Guedes, Ardenghi, Piovesan, Emmanuelli, and Mendes 2016; Naidu, Nunn, and Donnelly-Swift, 2016; Chaffee,

Rodrigues, Kramer, Vítolo, and Feldens, 2017; Fernandes, et al., 2017; Corrêa-Faria, et al., 2018; Freire, et al., 2018; Piva, et al., 2018; Vollu, et al., 2018). Some studies also found an improvement in the quality of life of both the children and their families after dental treatment (de Paula, et al., 2015; Ridell, et al., 2015; Arrow and Klobas, 2015; Yawary, Anthonappa, Ekambaram, McGrath, and King, 2016; Collado, et al., 2017; de Souza, Harrison, and Marshman, 2017; Jankauskiené, et al., 2017; Wong, et al., 2017). Only one study reported no significant association between the oral health status and quality of life of the affected children and their families (Braun, et al., 2014).

The majority of the reviewed studies reported a more profound impact of dental caries on the children than on their families (Abanto, et al., 2011; Kramer, et al., 2013; Nanayakkara, et al., 2013; Scarpelli, et al., 2013; Ramos-Jorge, et al., 2014; Corrêa-Faria, et al., 2016a; Vollu, et al., 2018). Oral symptoms and functional limitations were the most frequently reported impacts of dental caries on the affected children, whereas parental emotions and family activities were the most frequently reported impacts of dental caries on the affected children's families (Li, Zhi, Zhou, Qiu, and Lin, 2015; de Souza, et al., 2017; Vollu, et al., 2018). Pain; difficulty in eating and drinking; irritability; sleeping problems; and difficulty in smiling were frequently reported as children's impacts, while feelings of guilt and distress were frequently reported as family impacts (Ramos-Jorge, et al., 2014). Only one study reported more impacts on the affected children's families than on the children themselves (Jankauskiené, Virtanen, Kubilius, and Narbutaité, 2014). A summary of the impacts of dental caries on the quality of life of the children and their families is presented in Table 4.

Table 4. A summary of the impacts of dental caries on quality of life of the children and their families

Oral health-related quality of life							
Child Impacts				Family impacts			
Oral symptoms	**Functional limitations**	**Emotional/psychological wellbeing**	**Social wellbeing**	**Parental emotions**	**Family activities**	**Family conflict**	**Financial**
Pain	- Difficulty in eating some foods - Difficulty in drinking hot or cold beverages - Trouble sleping/ sleepless nights - Difficulty in biting or chewing firm foods - Requiring a longer time than others to eat a meal - Breathing through the mouth - Difficulty in pronouncing some words - A delay in speech development	- Being irritated, frustrated, angry or bad tempered - Feeling upset, woried and unhappy - Feeling anxious and fearful - Feeling shy and embarrassed - Self-immage - Crying	- Being absent from school or day care - Social interaction - Social activities - Family activities - Being reluctant to talk to other children - Difficulty in concentration - Poor school performance - Avoiding smiling or laughing - Avoiding talking - Avoiding playing or doing usual activities with others	- Feeling of guilt and distress - Parents' worries about the consequences of dental caries experienced by their children and children's life opportunities.	- Children who experienced dental caries required more attention from their families. - Absence from work - Sleeping disruption - Less time for oneself or other family members - Interference with family activities	- Children blaming or arguing with their parents or other relatives - Feeling uncomfortable in public places - Being jealous of parents or others in the family	Family financial problems

2.3.2.1 Child impacts

Oral symptoms

Oral symptoms were the most frequently reported impact of dental caries on children (Jankauskiené, et al., 2014). Some studies found a significant association between dental caries and oral symptoms (Wong, et al., 2011; Ramos-Jorge, et al., 2015; Corrêa-Faria, et al., 2018; Vollu, et al., 2018). If left untreated, dental caries had a significantly worse impact on oral symptoms than if it had been treated (Guedes, Ardenghi, Piovesan, Emmanuelli, and Mendes, 2016; Piva, et al., 2018). Several studies also found a significant improvement in oral symptoms after dental treatment (de Paula, et al., 2015; Ridell, et al., 2015; Abanto, et al., 2016; Yawary, et al., 2016; de Souza, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017).

Parents/caregivers frequently reported pain as the major impact of dental caries on preschool children in the oral symptoms domain (Cunnion, et al., 2010; Abanto, et al., 2011; Wong, et al., 2011; Isong, Luff, Perrin, Winickoff, and Ng, 2012; Masumo, Bardsen, Mashoto, and Åstrøm, 2012a; Naidu, Nunn, and Forde, 2012; Kramer, et al., 2013; Scarpelli, et al., 2013; Bach and Manton, 2014; Baghdadi, 2014; Braun, et al., 2014; Jankauskiene, et al., 2014; Krisdapong, et al., 2014; Nicol, et al., 2014; Ramos-Jorge, et al., 2014; Arrow and Klobas, 2015; Li, et al., 2015; Riggs, et al., 2015; Corrêa-Faria, et al., 2016a; Firmino, et al., 2016; Yawary, et al., 2016; Collado, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018). Dental pain occurred as a result of delays in dental care (Smith and Freeman, 2010). Some studies also reported a significant association between dental caries and dental pain (Moura-Leite, et al., 2011; Ortiz, et al., 2014; Queiroz, et al., 2015; Ramos-Jorge, et al., 2015). Children who had dental caries were found to be more likely to experience dental pain than those who did not (Ortiz, et al., 2014). The more severe the dental caries, the more frequent the affected children suffered pain (Moura-Leite, et al., 2011; Boeira, et al., 2012). A significant decrease in the prevalence of pain was also observed after dental treatment (Cunnion, et al., 2010; Jankauskiene, et al., 2014; Collado, et al., 2017). Only two studies reported pain as the least profound impact of dental caries on the affected children (Masumo, et al., 2012a; Naidu, et al., 2016). In addition to pain, other studies also reported food caught in or between the teeth or stuck in the roof of the mouth (Baghdadi, 2014) and bad breath (Baghdadi, 2014; Nicol, et al., 2014) as the impacts of dental caries on children in the oral symptoms domain.

Functional limitations

Functional limitations have also been reported as significantly associated with dental caries in children (Wong, et al., 2011; Ramos-Jorge, et al., 2015; Guedes, et al., 2016; Corrêa-Faria, et al., 2018; Piva, et al., 2018; Vollu, et al., 2018). The three most frequently reported impacts of dental caries on children in the functional limitations domain were 1. difficulty in eating some foods (Cunnion, et al., 2010; Abanto, et al., 2011; Wong, et al., 2011; Isong, et al., 2012; Masumo, et al., 2012a; Naidu, et al., 2012; Kramer, et al., 2013; Scarpelli, et al., 2013; Braun, et al., 2014; Jankauskiene, et al., 2014; Krisdapong, et al., 2014; Nicol, et al., 2014; Ramos-Jorge, et al., 2014; Arrow and Klobas, 2015; Li, et al., 2015; Queiroz, et al., 2015; Ramos-Jorge, et al., 2015; Riggs, et al., 2015; Corrêa-Faria, et al., 2016a; Firmino, et al., 2016; Naidu, et al., 2016; Yawary, et al., 2016; Collado, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018), 2. difficulty in drinking hot or cold beverages (Abanto, et al., 2011; Wong, et al., 2011; Kramer, et al., 2013; Scarpelli, et al., 2013; Jankauskiene, et al., 2014; Ramos-Jorge, et al., 2014; Arrow and Klobas, 2015; Li, et al., 2015; Corrêa-Faria, et al., 2016a; Firmino, et al., 2016; Naidu, et al., 2016; Yawary, et al., 2016; Collado, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018; Queiroz, et al., 2015; Ramos-Jorge, et al., 2015), and 3. trouble sleeping/sleepless nights (Cunnion, et al., 2010; Abanto, et al., 2011; Wong, et al., 2011; Masumo, et al., 2012a; Kramer, et al., 2013; Scarpelli, et al., 2013; Bach and Manton, 2014; Baghdadi, 2014; Jankauskiene, et al., 2014; Krisdapong, et al., 2014; Nicol, et al., 2014; Ramos-Jorge, et al., 2014; Arrow and Klobas, 2015; Li, et al., 2015; Corrêa-Faria, et al., 2016a; Firmino, et al., 2016; Yawary, et al., 2016; Collado, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018; Queiroz, et al., 2015; Ramos-Jorge, et al., 2015). Children with a toothache were significantly more likely to experience difficulty in eating or drinking than children without a toothache (Clementino, et al., 2015). A study also reported that children's eating difficulties also had an influence on their nutritional intake (Riggs, et al., 2015). Sleepless nights were also caused by a toothache as a result of delays in dental care (Smith and Freeman, 2010). Eating and drinking difficulties and trouble sleeping significantly improved following dental treatment (Collado, et al., 2017).

Other functional limitations affected by dental caries included having difficulty in biting or chewing firm foods (Cunnion, et al., 2010; Naidu, et al., 2012; Baghdadi, 2014), requiring a longer time than others to eat a meal (Baghdadi, 2014), breathing through the mouth (Baghdadi, 2014), having difficulty in pronouncing some words (Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018), and experiencing a delay in speech development (Riggs, et al., 2015). Only one study reported no significant difference between children who had dental caries and those who were caries-free in having difficulties in pronouncing a particular word (Cunnion, et al., 2010). Some studies also reported a significant improvement in the functional limitation domain after dental treatment (de Paula, et al., 2015; Ridell, et al., 2015; Abanto, et al., 2016; Yawary, et al., 2016; de Souza, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017).

Emotional/psychological wellbeing

Dental caries has also been significantly associated with psychological problems in children (Wong, et al., 2011; Ramos-Jorge, et al., 2015; Guedes, et al., 2016; Corrêa-Faria, et al., 2018; Piva, et al., 2018; Vollu, et al., 2018). The impact of dental caries on children's emotional wellbeing included being irritated, frustrated, angry, or bad tempered (Cunnion, et al., 2010; Abanto, et al., 2011; Wong, et al., 2011; Masumo, et al., 2012a; Kramer, et al., 2013; Scarpelli, et al., 2013; Braun, et al., 2014; Jankauskiene, et al., 2014; Nicol, et al., 2014; Ramos-Jorge, et al., 2014; Arrow and Klobas, 2015; Li, et al., 2015; Corrêa-Faria, et al., 2016a; Firmino, et al., 2016; Naidu, et al., 2016; Yawary, et al., 2016; Collado, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018); feeling upset, worried, or unhappy (Cunnion, et al., 2010; Baghdadi, 2014; Braun, et al., 2014; Nicol, et al., 2014); feeling anxious or fearful (Baghdadi, 2014); and feeling shy or embarrassed (Isong, et al., 2012; Baghdadi, 2014; Krisdapong, et al., 2014). Some studies also reported crying as one impact of dental caries on affected children (Masumo, et al., 2012a; Braun, et al., 2014; Krisdapong, et al., 2014).

The impact of dental caries on children's psychosocial wellbeing has also been related to the appearance of the children's teeth due to dental caries or its treatment (Isong, et al., 2012), because this condition influences the children's self-image (Wong, et al., 2011; Jankauskiene, et al., 2014). A qualitative study in Boston in the U.S. also revealed that dental caries had a negative impact on children's self-esteem because their friends and families

often teased them regarding their dental appearance, such as tooth discoloration or missing teeth due to dental caries (Isong, et al., 2012). However, another study reported no significant difference between children who had dental caries and children who were caries-free in terms of their being mocked by other children (Cunnion, et al., 2010). Several studies found a significant improvement in children's self-image (de Paula, et al., 2015; Ridell, et al., 2015; Abanto, et al., 2016; Yawary, et al., 2016; de Souza, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017) and the children's overall psychological wellbeing following dental treatment (de Paula, et al., 2015; Ridell, et al., 2015; Abanto, et al., 2016; Arrow and Klobas, 2016; Yawary, et al., 2016; de Souza, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017). Two studies reported that the lowest mean score of oral health-related quality of life was in the children's self-image domain (Jankauskiene, et al., 2014; Ortiz, et al., 2014).

Social wellbeing

Dental caries has also been significantly associated with children's social wellbeing (Lourenço, et al., 2013; Ramos-Jorge, et al., 2015; Guedes, et al., 2016; Corrêa-Faria, et al., 2018; Piva, et al., 2018; Vollu, et al., 2018). Being absent from school was the most commonly reported impact of dental caries on children's social wellbeing (Cunnion, et al., 2010; Abanto, et al., 2011; Wong, et al., 2011; Kramer, et al., 2013; Scarpelli, et al., 2013; Bach and Manton, 2014; Baghdadi, 2014; Braun, et al., 2014; Jankauskiene, et al., 2014; Ramos-Jorge, et al., 2014; Arrow and Klobas, 2015; Li, et al., 2015; Corrêa-Faria, et al., 2016a; Firmino, et al., 2016; Naidu, et al., 2016; Yawary, et al., 2016; Collado, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018). Only one study found that absence from school or day care was the least frequently reported impact of oral health problems on children's overall quality of life (Braun, et al., 2014).

The impact of dental caries on children's social wellbeing has also been related to social interaction (Jankauskiene, et al., 2014), social activities (Cunnion, et al., 2010), and family activities (Cunnion, et al., 2010). Specifically, the impacts of dental caries on children's social wellbeing included being reluctant to talk to other children (Baghdadi, 2014), difficulty in concentration (Baghdadi, 2014), poor school performance (Krisdapong, et al., 2014), avoiding smiling or laughing when around other children (Abanto, et al., 2011; Wong, et al., 2011; Kramer, et al., 2013; Scarpelli, et al., 2013; Baghdadi, 2014; Jankauskiene, et al., 2014; Ramos-Jorge, et al., 2014; Arrow

and Klobas, 2015; Gomes, Perazzo, Martins, Paiva, and Granville-Garcia, 2015b; Li, et al., 2015; Corrêa-Faria, et al., 2016a; Firmino, et al., 2016; Naidu, et al., 2016; Yawary, et al., 2016; Collado, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018), avoiding talking (Abanto, et al., 2011; Wong, et al., 2011; Kramer, et al., 2013; Scarpelli, et al., 2013; Jankauskiene, et al., 2014; Ramos-Jorge, et al., 2014; Arrow and Klobas, 2015; Li, et al., 2015; Corrêa-Faria, et al., 2016a; Firmino, et al., 2016; Naidu, et al., 2016; Yawary, et al., 2016; Collado, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018), and avoiding playing or doing usual activities with others (Cunnion, et al., 2010; Masumo, et al., 2012a; Kramer, et al., 2013; Krisdapong, et al., 2014). Only one study reported no impact of dental caries on children's social wellbeing at both school and home (Lourenço, et al., 2013). Two studies also reported that the lowest mean score of oral health-related quality of life was in the context of the children's social wellbeing or social interaction (Jankauskiene, et al., 2014; Ortiz, et al., 2014).

2.3.2.2 Family impacts

Parental emotions

Dental caries in children has been significantly associated with parental emotions (Ramos-Jorge, et al., 2015; Guedes, et al., 2016; Corrêa-Faria, et al., 2018; Piva, et al., 2018; Vollu, et al., 2018). Feelings of guilt and distress were the most frequently reported impacts of dental caries in terms of parental emotions (Abanto, et al., 2011; Thomson and Malden, 2011; Wong, et al., 2011; Arora, et al., 2012; Carvalho, et al., 2012; Masumo, et al., 2012a; Kramer, et al., 2013; Scarpelli, et al., 2013; Baghdadi, 2014; Jankauskiene, et al., 2014; Ramos-Jorge, et al., 2014; Arrow and Klobas, 2015; Li, et al., 2015; Queiroz, et al., 2015; Corrêa-Faria, et al., 2016a; Naidu, et al., 2016; Yawary, et al., 2016; Collado, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018). A qualitative study reported that most parents felt guilty and upset because their children suffered dental pain as a result of delays in dental care (Smith and Freeman, 2010; Isong, et al., 2012), having poor aesthetic dental appearance due to dental caries, or requiring general anaesthesia for dental management of dental caries (Isong, et al., 2012). Parents' feelings of guilt and distress significantly improved after dental treatment (Collado, et al., 2017).

In addition, some parents felt they were to blame because healthcare providers or clinicians often related dental caries in children to parenting

failure (Isong, et al., 2012). Several studies have considered the impact of dental caries on parental distress (Wong, et al., 2011; Arora, et al., 2012; Jankauskiene, et al., 2014; Ortiz, et al., 2014; Riggs, et al., 2015), which also significantly improved following dental treatment (Abanto, et al., 2016; Yawary, et al., 2016; de Souza, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017). A semi-structured interview with 19 Community and Family Health Nurses (CFHNs) in South Western Sydney, Australia showed that as a result of a lack of knowledge about the causes of dental caries in children, most mothers felt despair, anger, surprise, and shock after they were informed that their children had poor dental health due to inappropriate feeding practices (Arora, et al., 2012). Dental caries in children also impacted parents' worries about the consequences of dental caries experienced by their children (Riggs, et al., 2015) and about children's life opportunities (Thomson and Malden, 2011).

Family activities

Some studies found a significant association between dental caries experience and family activities (Wong, et al., 2011; Ramos-Jorge, et al., 2015; Guedes, et al., 2016; Corrêa-Faria, et al., 2018; Piva, et al., 2018; Vollu, et al., 2018), because children who suffered dental caries required more attention from their families (Baghdadi, 2014; Thomson and Malden, 2011). Absence from work was the most frequently reported impact of dental caries on the family activities domain (Abanto, et al., 2011; Thomson and Malden, 2011; Wong, et al., 2011; Masumo, et al., 2012a; Kramer, et al., 2013; Scarpelli, et al., 2013; Baghdadi, 2014; Jankauskiene, et al., 2014; Ramos-Jorge, et al., 2014; Arrow and Klobas, 2015; Li, et al., 2015; Ramos-Jorge, et al., 2015; Corrêa-Faria, et al., 2016a; Naidu, et al., 2016; Yawary, et al., 2016; Collado, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018). One study found that family activities significantly improved after dental treatment (Collado, et al., 2017), but three other studies found a different result (Abanto, et al., 2016; de Souza, et al., 2017; Jankauskiene, et al., 2017). Other impacts of dental caries on family activities included sleep disruption (Thomson and Malden, 2011; Baghdadi, 2014), less time for oneself or other family members (Thomson and Malden, 2011; Baghdadi, 2014), and interference with family activities (Thomson and Malden, 2011).

Family conflict

Dental caries in children also caused disagreement and conflict in the

family. The impact of dental caries on conflicts in the affected children's families has been related to the children blaming or arguing with their parents or other relatives (Thomson and Malden, 2011; Baghdadi, 2014), feeling uncomfortable in public places, and being jealous of parents or others in the family (Thomson and Malden, 2011). Family conflict as an impact of dental caries in children significantly improved following dental treatment (Abanto, et al., 2016; de Souza, et al., 2017).

Financial

Several studies reported family financial problems as an impact of dental caries in children (Abanto, et al., 2011; Wong, et al., 2011; Masumo, et al., 2012a; Kramer, et al., 2013; Scarpelli, et al., 2013; Jankauskiene, et al., 2014; Ramos-Jorge, et al., 2014; Arrow and Klobas, 2015; Li, et al., 2015; Corrêa-Faria, et al., 2016a; Naidu, et al., 2016; Yawary, et al., 2016; Collado, et al., 2017; Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018; Vollu, et al., 2018). The financial impact of dental caries in children has frequently been associated with the high cost of dental treatment, which may be burdensome for some families (Isong, et al., 2012).

2.3.3 Oral health behavioural risk factors of dental caries in preschool children

Behaviours are significant predictors of dental caries in preschool children (Mejàre, et al., 2014). Proper oral health behaviours and habits reduced children's vulnerability to dental caries (Mattheus, 2010). Dental caries in children has also been significantly associated with parents' adherence to recommended oral health behaviours (Albino, et al., 2014). This section reviews the existent literature on dietary practices, oral hygiene practices, and dental visits. A summary of oral health behavioural risk factors of dental caries in preschool children is presented in Table 5.

Table 5. A summary of oral health behavioural risk factors of dental caries in preschool children

Oral health behavioural risk factors of dental caries in preschool children		
Dietary practices	**Oral hygiene practices**	**Dental visits**
- Dietary intake of sugar and snacking on sweets between meals. - Bedtime eating - The initial age at which the children began to consume sweets. - The frequency of sugar consumption, including snacking on sweets - High total intake of sugar - The type of sugar consumed and the retentiveness of the food. - The consumption of sweet beverages	- Twice-daily tooth brushing - Regular tooth brushing - The initial age at which children begin tooth brushing - The use of fluoride toothpaste - The amount of toothpaste used - Tooth-brushing supervision/parental	- Dental visit history - Frequency of dental visits - Regular dental visits - The last dental visit - The reason for the previous dental visit - The age of the first dental visit

- High-frequency sweet beverage consumption - Sweet beverage in a bottle - Sweet beverages at night - The type of sweet beverages - The amount sweet beverages consumed - Sleeping with a bottle containing fluids other than water - High-frequency bottle feeding - Night bottle feeding - The initial age of bottle weaning	assistance in tooth brushing - The time at which the teeth were brushed and the time spent on brushing teeth	

2.3.3.1 Dietary practices

Dietary practices, including dietary intake of sugar and snacking on sweets between meals, are widely known as key behavioural risk factors that may cause dental caries in children (Mattheus, 2010; Meurman, and Pienihäkkinen, 2010; Senesombath, et al., 2010; Kawashita, et al., 2011; AAP, 2014; AAPD, 2018a; Majorana, et al., 2014; Mejàre, et al., 2014; AbdelAziz, Dowidar, and El Tantawi, 2015; Riggs, et al., 2015; Baghdadi, 2016; Gopal, et al., 2016; Saido, Asakura, Masayasu, and Sasaki, 2016; Caleza-Jimenez, Yañez-Vico, Mendoza-Mendoza, Palma, and Iglesias-Linares, 2017; Dabawala, et al., 2017; Levin, et al., 2017; Wagner and Heinrich-Weltzien, 2017). The risk of developing dental caries increased with increasing per capita sugar expenditure (Steyn and Temple, 2012). The introduction of sweets to children before 12 months of age (Chaffee, et al., 2015) or before 18 months of age (Castilho, Mialhe, Barbosa, and Puppin-Rontani, 2013) also increased the risk of developing dental caries. Only a few studies reported that dietary practices, including sweets consumption (Cadavid, et al., 2010; Lin, et al., 2014a), and the initial age at which the children began to consume sweets (Paglia, et al., 2016) were not significantly associated with dental caries.

The frequency of sugar consumption, including snacking on sweets (Mattheus, 2010; Meurman and Pienihäkkinen, 2010; Chankanka, et al., 2012; Kavvadia, et al., 2012; Bach and Manton, 2014; Zhang, et al., 2013; Anandakrishna, et al., 2014; Zhang, et al., 2014; Li, et al., 2015; Elidrissi and Naidoo, 2016; Elamin, et al., 2018), total intake of sugar (Johansson, et al., 2010; Masumo, et al., 2012b; Sankeshwari, et al., 2013; Bach and Manton, 2014; Winter, et al., 2015; Zaki, et al., 2015; Peres, et al., 2016), and the timing of sugar consumption (Bach and Manton, 2014) were found to be significantly associated with dental caries. Many studies have shown that the high prevalence and severity of dental caries has been associated with high-

frequency sugar consumption, including snacking on sweets (Begzati, Berisha, and Meqa, 2010; Johansson, et al., 2010; Mattheus, 2010; Jacobsson, Koch, Magnusson, and Hugoson, 2011; Kawashita, et al., 2011; Narksawat, et al., 2011; Chu, et al., 2012b; Mahesh, Muthu, and Rodrigues, 2013; Mannaa, et al., 2013; Naidu, et al., 2013; Al-Bluwi, 2014; Han, et al., 2014; Hong, et al., 2014; Krisdapong, et al., 2014; Majorana, et al., 2014; Ferrazzano, Sangianantoni, Cantile, and Ingenito, 2015; Li, et al., 2015; Sujlana and Pannu, 2015; Kalita, et al., 2016; Kanemoto, et al., 2016; Ozen, et al., 2016; Bonotto, Montes, Ferreira, Assunção, and Fraiz, 2017; Chen, et al., 2017; Kowash, et al., 2017; Ribeiro, et al., 2017; Sun, Zhang, W. and Zhou, 2017a; Sun, et al., 2017b; Feldens, et al., 2018; Morikava, et al., 2018; Nguyen, et al., 2018), particularly between meals (Chedid, et al., 2011; Singh, Purohit, Sequeira, and Acharya, 2011; Prakash, et al., 2012; Sankeshwari, et al., 2013; AAP, 2014; AAPD, 2018a; Bissar, et al., 2014; Kanemoto, et al., 2016). Some studies have also recommended the restriction of sugar consumption between meals to prevent the development of dental caries (Wigen and Wang, 2010; Baghdadi, 2011; AAP, 2014; AAPD, 2018a; Giannattasio, et al., 2015). However, a systematic review reported that the association between the frequency of sugary foods consumption and dental caries as well as the association between snacking between meals and dental caries are still debatable (Hooley, Skouteris, Boganin, Sandatur, Kilpatrick, 2012). Some studies also found no significant association between the frequency and amount of sugar intake and dental caries (Cadavid, et al., 2010; Meurman and Pienihäkkinen, 2010; Schroth, Dahl, Haque, and Kliewer, 2010; Naidu, et al., 2013; Pieper, et al., 2012; Wong, Lu, and Lo, 2012; Sankeshwari, et al., 2013; Darmawikarta, et al., 2014; Duijster, et al., 2015a; Ghazal, et al., 2015b; Lee, Kim, Jin, Paik, and Bae, 2015; Karjalainen, et al., 2015; Fan, Wang, Xu, and Zheng, 2016; Gibbs, et al., 2016; Onyejaka and Amobi, 2016; Paglia, et al., 2016; Östberg, et al., 2017).

In addition, the high prevalence and severity of dental caries have also been associated with bedtime eating (Li, et al., 2011; Phillips, Masterson, and Sabbah, 2016; Hultquist and Bågesund, 2016; Li, Wulaerhan, Liu, Abudureyimu, and Zhao, 2017; Sun, et al., 2017a). However, a systematic review reported that the association between bedtime eating and dental caries is still unclear (Hooley, et al., 2012). Two studies did not find a significant association between bedtime eating of sweet snacks or beverages and dental caries (Un, et al., 2017; Morikava, et al., 2018).

The type of sugar consumed and the retentiveness of the food also determine the length of time for which the teeth are exposed to sugar (Luke, Gough, Beeley, and Geddes, 1999). The length of time for which the teeth are exposed to sugar has been found to influence the development of dental caries (Marrs, Trumbley, and Malik, 2011). High prevalence and severity of dental caries have significantly been associated with the consumption of crisps (Johansson, et al., 2010) and sweets (Johansson, et al., 2010; Senesombath, et al., 2010). Children who consumed presweetened cereals at meals at a high frequency have significantly been associated with developing non-cavitated caries (Chankanka, et al., 2012) However, some studies showed that the prevalence and severity of dental caries have not significantly been associated with consumption of sweets or other confectionaries (Wigen and Wang, 2010; Li, et al., 2011; Chankanka, et al., 2012; Dawani, et al., 2012).

A cohort study in Boston, U.S. found that snacking on foods other than crisps and sweets, such as ice-cream, popcorn, cookies, cereals with milk, dry cereals, dried fruit, yoghurt, fresh fruit, and crackers only had a minimal effect on the development of dental caries (Johansson, et al., 2010). In a systematic review, the association between non-fresh fruit and popcorn consumption and dental caries remained unclear (Hooley, et al., 2012). A study in Norway also showed that the consumption of cookies, cakes, chocolate, and wine gums was not significantly associated with the development of dental caries (Wigen and Wang, 2010). Furthermore, in Japan, consumption of cheese, bread, and butter were not significantly associated with the development of dental caries (Tanaka, et al., 2010). The frequency of consumption of unprocessed starches for snacks and sugar-based dessert consumption also did not differ significantly between children in the caries and caries-free groups (Chankanka, et al., 2012).

In addition to sugary foods, the consumption of sweet beverages is influential in the development of dental caries. In New Zealand, beverages were the most frequent source of sugar consumption in children (Bach and Manton, 2014). High-frequency sweet beverage consumption was significantly associated with the high prevalence and severity of dental caries (Senesombath, et al., 2010; Milgrom, et al., 2011; Pieper, et al., 2012; Chi, 2013; Krisdapong, et al., 2014; Majorana, et al., 2014; Wigen and Wang, 2015; Gibbs, et al., 2016; Hoffmeister, Moya, Vidal, and Benadof, 2016; Hultquist and Bågesund, 2016; Kalita, et al., 2016; Ozen, et al., 2016; Warren,

et al., 2016; Fidler, et al., 2017; Lin, et al., 2017), particularly when it was consumed at night (Phillips, et al., 2016; Wigen and Wang, 2015; Kraljevic, Filippi, and Filippi, 2017) and in a bottle (Baghdadi, 2016).

The type of sweet beverages consumed influenced the development of dental caries (Bach and Manton, 2014). The risk of developing dental caries increased among children who drank drinks other than water daily (Meurman and Pienihäkkinen, 2010); who had a low frequency of drinking 100% juice drinks (Chankanka, et al., 2011; Vargas, et al., 2014; AbdelAziz, et al., 2015) and sugar-free beverages (Warren, et al., 2016); who drank powdered beverages (Chankanka, et al., 2011; Bach and Manton, 2014), soft drinks (Centers for Disease, Control and Prevention, 2011; Chedid, et al., 2011; Milgrom, et al., 2011; Chankanka, et al., 2011; Chankanka, et al., 2012; Bach and Manton, 2014; Han, et al., 2014; Lim, Tellez, and Ismail, 2015; Baghdadi, 2016; Celik, Celik, and Tunac, 2016), sport drinks (Kawashita, et al., 2011), cordials (Bach and Manton, 2014), and commercial fruit juice (Mantonanaki, et al., 2013; Bach and Manton, 2014; Baghdadi, 2016; Hoffmeister, et al., 2016; Birungi, et al., 2017) very frequently. In contrast, several studies did not find an association between dental caries and consumption of sugary drinks (Lin, et al., 2014a), such as pure juice (Warren, et al., 2016), powdered sugar beverages (Chankanka, et al., 2012), regular soft drinks (Chankanka, et al., 2011), sugar-containing soft drinks (Wigen and Wang, 2010), sweet juice drinks (Chankanka, et al., 2011; Dawani, et al., 2012), syrup (Dawani, et al., 2012), milk (Tanaka, et al., 2010; Chankanka, et al., 2011; Darmawikarta, et al., 2014), and water (Chankanka, et al., 2011; Warren, et al., 2016).

In addition, although a systematic review of the effects of sugary or carbonated drinks consumption on the development of dental caries has remained unclear (Hooley, et al., 2012). The American Academy of Pediatrics and American Academy of Pediatric Dentistry encourages children to drink water and avoid carbonated, sugared beverages and juice drinks that are not 100% juice. The consumption of 100% fruit juice should be restricted to no more than four to six ounces per day to reduce the risk of developing dental caries (AAP, 2014; AAPD, 2018a). A study in Finland also showed that the initial age at which a child begins to consume juice, tea, and soft drinks was not significantly associated with the development dental caries, but the amount of such drinks was significantly associated with dental caries (Paglia, et al., 2016).

Milk consumption had a predictive effect on the prevalence and

severity of dental caries (Li, et al., 2011). The consumption of unsweetened milk reduced the risk of developing dental caries (Johansson, et al. 2010; Senesombath, et al. 2010; Chankanka et al., 2012; Dawani, et al. 2012; Krisdapong, et al., 2014; Zaki, et al., 2015). In Japan, a low prevalence of dental caries was also significantly associated with the consumption of yoghurt four times per week (Tanaka, et al., 2010). The consumption of milk itself did not increase the risk of developing dental caries unless sugar was added to enhance its flavour (Chedid, et al., 2011; Dawani, et al., 2012; Bach and Manton, 2014; Perera, et al., 2014) and it was consumed using a feeding bottle, as much as the children wanted (Bach and Manton, 2014). Only one study found no significant association between the consumption of milk and dental caries (Chankanka, et al., 2012; Warren, et al., 2016).

In addition, sleeping with a bottle containing fluids other than water is one of the risk factors that may cause dental caries in children (Begzati, et al., 2010; Johansson, et al., 2010; Mattheus, 2010; Slabsinskiene, et al., 2010; Chedid, et al., 2011; Narksawat, et al., 2011; Pieper, et al., 2012; Prakash, et al., 2012; Zhang, et al., 2013; AAP, 2014; Bissar, et al., 2014; Congiu, et al., 2014; Hong, et al., 2014; Axelsen, Owais, Qian, Perigo, and Weber-Gasparoni, 2016; Gandeeban, et al., 2016. Gopal, et al., 2016; Hoffmeister, et al., 2016; Dabawala, et al., 2017). High-frequency bottle feeding also significantly increased the risk of developing dental caries (Slabsinskiene, et al., 2010; Mahesh, et al., 2013). The more frequently the children were bottle fed, particularly at night, the more they were exposed to the risk of developing dental caries (Slabsinskiene, et al., 2010; Hoffmeister, et al., 2016). However, a systematic review reported that the effect of bottle feeding on the development of dental caries is still debatable (Hooley, et al., 2012). Some studies also found no significant association between bottle feeding and the development of dental caries (Cadavid, et al., 2010; Schroth, et al., 2010; Chu, et al., 2012b; Corrêa-Faria, et al., 2013; Lin, et al., 2014a; Zhang, et al., 2014; Elidrissi and Naidoo, 2016; Fan, et al., 2016; Chen, et al., 2017; Kraljevic, et al., 2017; Un, et al., 2017; Feldens, et al., 2018). However, to reduce the risk of developing dental caries, the American Academy of Pediatrics has recommended discouraging children from sleeping with a bottle and that children should be weaned from the bottle by the age of 12-month-old (AAP, 2014) or 18-month-old at the latest (AAPD, 2018a).

With regard to the initial age of bottle weaning, there were no inconsistent findings about the effects of the age of bottle weaning on the

development of dental caries (Hooley, et al., 2012). A study in Hong Kong reported that the age of bottle weaning has significantly been associated with the prevalence and severity of dental caries (Wong, et al., 2012). A delay in bottle weaning beyond 12 months of age (Hooley, et al., 2012; Dabawala, et al., 2017) or 18 months of age (Ozen, et al., 2016) has been found to be a significant predictor of dental caries. One study found that the longer the studied children were bottle fed, the higher the severity of dental caries they experienced (Begzati, et al., 2010; Narksawat, et al., 2011; Kanemoto, et al., 2016). Another study also showed that night bottle feeding was not significantly associated with dental caries if it was discontinued before 18 months of age (Ozen, et al., 2016). Therefore, to reduce the incidence of dental caries, children should be discouraged from drinking from a bottle containing sugar (Giannattasio, et al., 2015). In contrast, some studies found that the initial age of bottle weaning was not predictive of dental caries (Narksawat, et al., 2011; Corrêa-Faria, et al., 2013; Chen, et al., 2017). The severity of dental caries also did not differ significantly according to the age of bottle weaning (Senesombath, et al., 2010; Chu, et al., 2012b; Pieper, et al., 2012; Bissar, et al., 2014; Kraljevic, et al., 2017).

2.3.3.2 Oral hygiene practices

Some studies showed a significant association between oral hygiene practices and dental caries (Senesombath, et al., 2010; Singh, et al., 2011; Tubert-Jeannin, et al., 2012). Twice-daily tooth brushing has been considered as preventive of dental caries (Wagner and Heinrich-Weltzien, 2017). Low prevalence and severity of dental caries have significantly been associated with regular tooth brushing (Slabsinskiene, et al., 2010; Narksawat, et al., 2011; Razmiene, et al., 2011; Mannaa, et al., 2013; Ferrazzano, et al., 2016; Baghdadi, 2016; Levin, et al., 2017), while children who had no preventive dental care at home had an increased risk of developing dental caries (Kawashita, et al., 2011). Only a few studies found no significant association between daily tooth brushing and dental caries (Chedid, et al., 2011; Zhang, et al., 2014; Hultquist and Bågesund, 2016). Furthermore, inconsistent findings have been found in the association between the frequency of tooth brushing and dental caries. In many studies, the risk of developing dental caries increased among children who did not brush their teeth frequently (Al-Jewair and Leake, 2010; Senesombath, et al., 2010; Centers for Disease, control and Prevention, 2011; Chankanka, et al., 2011; Singh, et al., 2011;

Borges, et al., 2012; Chankanka, et al., 2012; Hooley, et al., 2012; Prakash, et al., 2012; Wong, et al., 2012; Lourenço, et al., 2013; Ghazal, et al., 2015b; Lee, et al., 2015; Sujlana and Pannu, 2015; Wigen and Wang, 2015; Winter, et al., 2015; Celik, et al., 2016; Gopal, et al., 2016; Hoffmeister, et al., 2016; Ozen, et al., 2016; Sujlana, Baweja, Kaur, and Kaur, 2016; Birungi, et al., 2017; Bonotto, et al., 2017; Kowash, et al., 2017; Sun, et al., 2017a; Un, et al., 2017; Elamin, et al., 2018; Morikava, et al., 2018). However, in other studies, no significant association was found between the frequency of tooth brushing and dental caries (Begzati, et al., 2010; Cadavid, et al., 2010; Schroth, et al., 2010; Li, et al., 2011; Chu, et al., 2012a., 2012b; Dawani, et al., 2012; Hooley, et al., 2012; Mahesh, et al., 2013; Han, et al., 2014; Krisdapong, et al., 2014; Wagner, et al., 2014; Duijster, et al., 2015a; Folayan, et al., 2015; Sohn, 2015; Elidrissi and Naidoo, 2016; Fan, et al., 2016; Gibbs, et al., 2016; Kanemoto, et al., 2016; Moimaz, et al., 2016; Onyejaka and Amobi, 2016; Peres, et al., 2016; Chen, et al., 2017; Dabawala, et al., 2017; Li, et al., 2017; Östberg, et al., 2017; Sun, et al., 2017b).

In relation to the initial age at which children begin tooth brushing, a lower prevalence of dental caries was observed among children who started tooth brushing in earlier than children who started tooth brushing in later (Senesombath, et al., 2010; Slabsinskiene, et al., 2010; Li, et al. 2011; Chu, et al., 2012b; Hooley, et al., 2012; Wong, et al., 2012; Bissar, et al., 2014; Wagner, et al., 2014; Winter, et al., 2015; Bhayade, et al., 2016; Özen, et al., 2016; Huong, et al., 2017; Kraljevic, et al., 2017; Östberg, et al., 2017; Sun, et al., 2017a, 2017b). The American Academy of Pediatrics and American Academy of Pediatric Dentistry recommended that tooth brushing with toothpaste should begin when the first primary tooth erupts (AAP, 2014; AAPD, 2018a). Furthermore, the New Zealand Ministry of Health recommended the initiation of tooth brushing by the age of 12 months old or younger to reduce the risk of developing dental caries (New Zealand Guidelines Group, 2009). The opposite result was found in a cross-sectional study in Xinjiang, China, which found a high prevalence of dental caries among children who started their oral hygiene practices at young age (Li, et al., 2017). Other studies also found no significant association between the initial age of tooth brushing and dental caries (Cadavid, et al., 2010; Wigen and Wang, 2010; Li, et al., 2011; Hooley, et al., 2012; Pieper, et al., 2012; Prakash, et al., 2012; Duijster, et al., 2015a; Elidrissi and Naidoo, 2016; Gopal, et al., 2016; Chen, et al., 2017; Dabawala, et al., 2017).

In addition, the use of fluoride toothpaste has been widely accepted as one of methods of delivering topical fluoride, which plays an important role in dental caries prevention. On the tooth surface, fluoride acts as a reservoir to repair tooth damage caused by bacterial acid production (Milgrom, et al., 2011). Fluoride can inhibit the process of demineralisation (the reduction of tooth minerals) and promote remineralisation (restoring tooth minerals) by adsorbing calcium and phosphate ions from saliva (Bach and Manton, 2014). A high concentration of fluoride can also disrupt the growth of caries-causing bacteria on the dental surfaces, so it can arrest the process of dental caries (Milgrom, et al., 2011; Bach and Manton, 2014).

Some studies showed a significant association between the use of fluoride toothpaste and a lower prevalence of dental caries (Al-Jewair and Leake, 2010; Mattheus, 2010; Slabsinskiene, et al., 2010; Chedid, et al., 2011; Dawani, et al., 2012; Prakash, et al., 2012; Krisdapong, et al., 2014; Mejàre, et al., 2014; Wagner, et al., 2014; Wright, et al., 2014; Garcia, et al., 2015; Winter, et al., 2015; Baghdadi, 2016; Gopal, et al., 2016; ; Birungi, et al., 2017; Dabawala, et al., 2017; Wagner and Heinrich-Weltzien, 2017). The American Academy of Pediatrics and American Academy of Pediatric Dentistry recommends the use of fluoride toothpaste to prevent dental caries, but the amount of toothpaste used should be limited to a smear or a grain of rice-sized amount of fluoridated toothpaste for children younger than three years old, and this should be increased to a pea-sized amount by the age of three years old (AAP, 2014; AAPD, 2018a). The amount of toothpaste used for tooth brushing has significantly been associated with dental caries (Cadavid, et al., 2010). Therefore, twice-daily supervised tooth brushing with an age-appropriate toothbrush and fluoride toothpaste size is effective in delivering fluoride to the teeth in order to prevent dental caries (Milgrom, et al., 2011).

In addition, the use of toothpaste containing fluoride between 1,000 and 1,500 ppm after the first tooth erupts is considered effective in preventing dental caries (Fleming, 2015). The New Zealand Ministry of Health recommends the use of toothpaste with a fluoride concentration of 1,000 ppm in a smear amount for children aged five years old or younger, and in a pea-sized amount for children aged six years old or older (New Zealand Guidelines Group, 2009). However, other studies have found that toothpaste containing 1,500 ppm of fluoride was more effective in preventing dental caries than toothpaste containing only 1,000 ppm of fluoride (Twetman, et al., 2003; Baghdadi, 2011). In populations that have a high risk of developing dental

caries, the use of fluoride toothpaste for tooth brushing was found to be effective if used with high concentrations of fluoride, high-frequency use, and with the supervision of adults (Twetman, et al., 2003; Baghdadi, 2011).

In contrast, other studies found no significant association between the use of fluoride toothpaste and dental caries (Cadavid, et al., 2010; Li, et al., 2011; Narksawat, et al., 2011; Wong, et al. 2012; Folayan, et al., 2015; Elidrissi and Naidoo, 2016; Kanemoto, et al., 2016; Li, et al., 2017; Sun, et al., 2017a). The effectiveness of fluoride toothpaste in preventing dental caries in children under six years old is still controversial. The controversy is related to the likelihood of young children not spitting or even swallowing the toothpaste, particularly if they are not supervised. Swallowing an excessive amount of fluoride can cause fluorosis (an abnormal dental condition shown by mottling of the teeth because of excessive ingestion of fluoride) in permanent dentition (Milgrom, et al., 2011).

Low prevalence and severity of dental caries were significantly associated with tooth-brushing supervision/parental assistance in tooth brushing (Senesombath, et al., 2010; Slabsinskiene, et al., 2010; Narksawat, et al., 2011; Hooley, et al., 2012; Pieper, et al., 2012; Prakash, et al., 2012; Tubert-Jeannin, et al., 2012; Mahesh, et al., 2013; Wagner, et al., 2014; Sujlana and Pannu, 2015; Collett, et al., 2016; Gopal, et al., 2016; Hoffmeister, et al., 2016; Kraljevic, et al., 2017; Sun, et al., 2017a). The American Academy of Pediatrics and American Academy of Pediatric Dentistry recommends that parents/caregivers help their children brush their teeth until their children are capable of brushing their teeth by themselves, usually at around eight years old (AAP, 2014; AAPD, 2018a), while the New Zealand Ministry of Health recommends that parents/caregivers should help their children brush their teeth until the age of six years old. The New Zealand Ministry of Health explained that children younger than six years old still have limited manual dexterity skills for tooth brushing. As a result, without tooth-brushing assistance from adults, they are not able to completely remove the plaque on their teeth, thus increasing the risk of developing dental caries (New Zealand Guidelines Group, 2009). Furthermore, tooth-brushing supervision is important for ensuring that none of the toothpaste is swallowed by the child (Fleming, 2015). However, several studies did not find that tooth-brushing supervision or parental assistance in tooth brushing was predictive of dental caries (Cadavid, et al., 2010; Schroth, et al., 2010; Narksawat, et al., 2011; Chu, et al., 2012b; Hooley, et al., 2012; Bissar, et al., 2014; Lin, et al., 2014a;

Duijster, et al., 2015a; Elidrissi and Naidoo, 2016; Gibbs, et al., 2016; Gopal, et al., 2016; Kanemoto, et al., 2016; Özen, et al., 2016; Chen, et al., 2017; Dabawala, et al., 2017; Li, et al., 2017).

In a systematic review, some studies also reported that dental caries were significantly associated with the time at which the teeth were brushed and the time spent on brushing teeth (Hooley, et al., 2012). The New Zealand Ministry of Health recommends tooth brushing twice daily, in the morning and before sleeping at night (New Zealand Guidelines Group, 2009). A study in Italy also found a significant association between tooth brushing after each meal and dental caries (Congiu, et al., 2014). However, another study found that dental caries was not significantly associated with the time at which the teeth were brushed (Hooley, et al., 2012; Mahesh, et al., 2013; Kanemoto, et al., 2016) and the time spent on brushing teeth (Hooley, et al., 2012; Kowash, et al., 2017; Sun, et al., 2017a). Furthermore, no significant association was found between tooth brushing with fluoride toothpaste more than once a day and dental caries (Gussy, et al., 2016); between tooth brushing at night and dental caries (Prakash, et al., 2012; Dabawala, et al., 2017; Morikava, et al., 2018); and between tooth brushing after eating sweets and dental caries (Lin, et al., 2014a).

2.3.3.3 Dental visit

Many studies showed a significant association between having a history of dental visits and dental caries experience. The prevalence of dental caries was found to be higher among children who had visited a dentist than children who had never visited a dentist (Cadavid, et al., 2010; Schroth, et al., 2010; Senesombath, et al., 2010; Singh, et al., 2011; Borges, et al., 2012; Chu, et al., 2012b; Mahesh, et al., 2013; Naidu, et al., 2013; Beil, et al., 2014; Fan, et al., 2016; Kanemoto, et al., 2016; Moimaz, et al., 2016; Amin and ElSalhy, 2017; Birungi, et al., 2017; Li, et al., 2017; Un, et al., 2017). Among the children who experienced dental caries, the prevalence of untreated dental caries was higher among children who had never visited a dentist than children who had visited a dentist (Beil, et al., 2014). However, a few studies have shown that dental caries was not significantly associated with dental visit history (Wong, et al., 2012; Mantonanaki, et al., 2013; Gopal, et al., 2016; Onyejaka and Amobi, 2016).

In addition, a high frequency of dental visits was significantly associated with a high severity of dental caries (Winter, et al., 2015), whereas

a low frequency of dental caries was significantly associated with a low prevalence of dental caries (Phillips, et al., 2016). Another study also found that children who had a high frequency of dental visits had lower dental caries increment than children who had a low frequency of dental visits (Winter, et al., 2015). However, a few studies showed that dental caries experience was not significantly associated with the frequency of dental visits (Wagner, et al., 2014; Dabawala, et al., 2017).

In some studies, children who had regular dental visits were significantly associated with having a low prevalence of dental caries experience (Senesombath, et al., 2010; Camargo, et al., 2012; Wong, et al., 2012; Al-Bluwi, 2014; Han, et al., 2014; Lin, et al., 2014a; Ghazal, et al., 2015b; Lee, et al., 2015; Sohn, 2015; Winter, et al., 2015; Özen, et al., 2016; Chen, et al., 2017; Lin, et al., 2017; Un, et al., 2017) and a low incidence of dental caries (Lee, et al., 2015; Huong, et al., 2017). On the other hand, some studies have shown that the risk of developing dental caries increased among children who had regular dental visits (Bissar, et al., 2014). One study also found an increase in the incidence of dental caries among children who had a history of previous regular dental visits at age three (Ghazal, et al., 2015b). A few studies did not find a significant association between regular dental visits and dental caries (Kopycka-Kedzierawski and Billings, 2011; Hooley, et al., 2012; Sohn, 2015).

In addition, dental caries was significantly associated with the last dental visit (Lin, et al., 2014a; Özen, et al., 2016; Sun, et al., 2017a). Children who had visited a dentist within the past six months were more likely to have a lower dental caries experience than children who did not visit a dentist within the last six months (Congiu, et al., 2014; Krisdapong, et al., 2014). However, dental caries was more prevalent among children who had visited a dentist within the last 12 months than children who had not visited a dentist within the last 12 months (Al-Jewair and Leake, 2010; Zhang, et al., 2013; Vargas, et al., 2014; Zhang, et al., 2014). Another study in the U.S. also reported a significant difference in the dental caries experience of children who had had dental visits within the last 12 months, within the last one to two years, and within the last two years or more and children who had never had a dental visit (Kopycka-Kedzierawski and Billings, 2011). Only one study showed that having a dental visits within the past 12 months was not significantly associated with dental caries experience (Kopycka-Kedzierawski and Billings, 2011).

Dental caries was significantly associated with the reason for the previous dental visit (Cadavid, et al., 2010). Some studies found a significant association between problem-driven dental visits and dental caries (Dabawala, et al., 2017; Kowash, et al., 2017). The problem-driven nature of dental visits was evidenced by the presence of dental caries at the children's first dental visit (Özen, et al., 2016). One study also found a significant association between a dental treatment history and a high prevalence of dental caries (Camargo, et al., 2012). However, the association between having a dental treatment history and dental caries is still unclear (Hooley, et al., 2012). Another study found no significant association between problem-driven dental visits and dental caries, compared to regular dental visits (Sohn, 2015).

Regarding the age of the first dental visit, there has not yet been an agreement on the effectiveness of early preventive dental visits in improving children's oral health outcomes (Bhaskar, McGraw, and Divaris, 2014). One study showed that the initial age of the first dental visits was significantly associated with dental caries (Celik, et al., 2016). Dental visits within six months after the first primary tooth eruption reduced the risk of developing dental caries (Narksawat, et al., 2011; Chankanka, et al., 2012). A systematic review also reported that early preventive dental visits were significantly associated with a decrease in the subsequent non-preventive dental visits and related expenditure, and they increased the likelihood of having future preventive dental visits (Bhaskar, et al., 2014). The American Academy of Pediatrics, and the American Academy of Pediatric Dentistry also recommended that the first dental visit for children should be when the first primary tooth erupts or no later than 12 months of age (AAP, 2014; AAPD 2018a). An early dental visit aims not only to provide an oral examination and preventive dental care for the child, but also to provide guidance to parents on the prevention of early childhood caries through favourable oral health practices (AAPD, 2018a).

In contrast, another study in the U.S. found higher a dental caries prevalence among children who had visited a dentist at an early age (younger than 24 months old) than children who had visited a dentist at a later age (24 months or older) (Beil, et al., 2014). Another study also found no significant association between a dental visit at age six and dental caries (Peres, et al., 2016). Some studies also found no significant association between the initial age at which a child has their first dental visit and dental caries (Wagner, et

al., 2014; Özen, et al., 2016; Bhaskar, et al., 2014; Beil, et al., 2014). The likelihood of having future restorative or emergency dental visits (non-preventive dental visits) also did not differ significantly between children who had their first preventive dental visit by the age of one year old and at a later age (Bhaskar, et al., 2014).

2.3.4 Psychosocial determinants of dental caries in preschool children

This section reviews the existent literature on psychosocial determinants of dental caries in preschool children. A summary of psychosocial determinants of dental caries in preschool children is presented in figure 2.

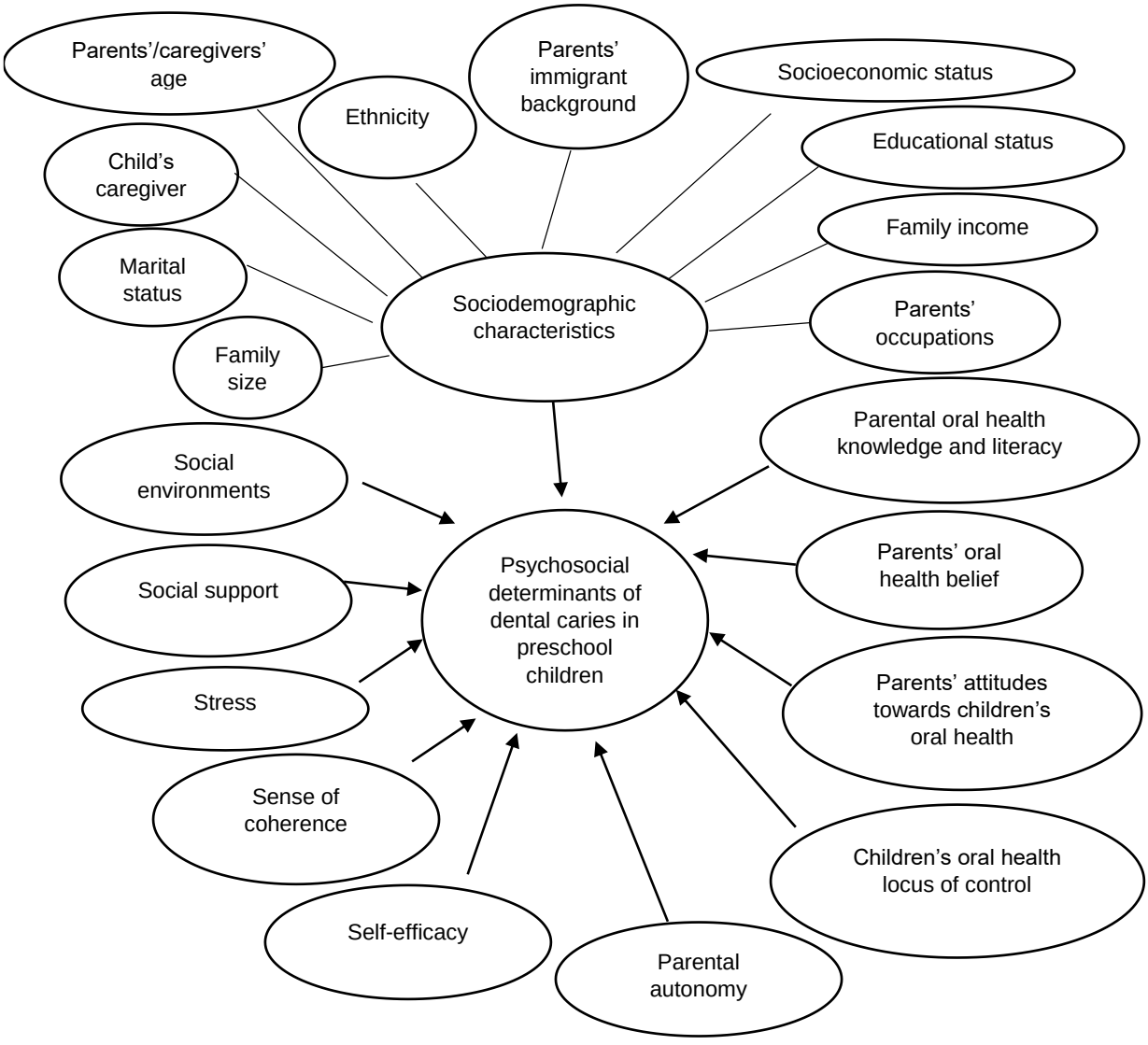

Figure 2. A summary of psychosocial determinants of dental caries in preschool children

2.3.4.1 Sociodemographic characteristics

Family size

A higher dental caries experience score was associated with a large number of family members living in one household (Schroth, et al., 2010; Tubert-Jeannin, et al., 2012; Lourenço, et al., 2013; Dantas, et al., 2015; Sujlana and Pannu, 2015; Hoffmeister, et al., 2016; Warren, et al., 2016; Gomes, et al., 2018b). Several studies also showed a significant association between the number of siblings and dental caries (Lourenco, et al., 2013; Sujlana and Pannu, 2015; Gomes, et al., 2018b). Having no siblings or having more than one sibling increased the risk of developing dental caries (Schroth, et al., 2010; Wellappuli and Amarasena, 2012; Corrêa-Faria, et al., 2013; Congiu, et al., 2014; Moimaz, et al., 2014; Hoffmeister, et al., 2016) and increased the likelihood of dental care-seeking behaviours (da Silveira, Costa, Azevado, Romano, and Cenci, 2015). In Kuwait, having more than five children in the household was significantly associated with poor oral health behaviours, such as not limiting sugar consumption, not ensuring their children's teeth were brushed two to three times a day, and not having a first dental visit for their children before the age of three years old (Ashkanani and Al-Sane, 2013).

Some studies found that high prevalence and severity of dental caries were significantly associated with later-born children compared to first-born children (Kawashita, et al., 2011; Hooley, et al., 2012; Dabawala, et al., 2017). Firstborn children were also more likely to have their teeth brushed at an earlier age than children who were born later (Sun, et al., 2017b). Only two studies found that being a firstborn child increased the likelihood of developing dental caries (Mahesh, et al., 2013; Sun, et al., 2017b). Older siblings can act as role models in tooth brushing for their younger brothers and sisters (Huebner and Riedy, 2010). A qualitative study in North Carolina, in the U.S. also found that modelling older siblings or parents' oral hygiene routine helped parents to deal with their children's negative responses to tooth brushing (Collins, et al., 2016). Regular dental visits of other siblings might also influence younger children's willingness to visit a dentist (Hoeft, Barker, and Masterson, 2011).

In addition, parents commonly learned from their own experiences with their older children to improve their younger children's oral health behaviours. One study showed that older children's experience of having decayed teeth extracted due to excessive sugar consumption encouraged mothers to have a strong desire to limit their children's sugar intake (Herman, Malhotra, Wright,

Fisher, and Whitaker, 2012) A qualitative study in the U.S. also revealed that some mothers limited their children's sweets consumption to prevent dental caries after they realised that children who had a taste for sweets had more dental caries than children who preferred vegetables and fruits. They also weaned their younger children from bottles at an earlier age after they realised that prolonged bottle-feeding caused dental caries in their older children. Some mothers also learned about children's dental needs and the appropriate age for their first dental visit when they took their older children to a dentist. They started to develop a positive attitude towards their children's dental care by taking their subsequent children to visit a dentist for a regular check-up (Hoeft, Barker, and Masterson, 2010). The older children's dental caries experience made parents realise that their children were susceptible to dental caries, and they became aware of the adverse impact of dental caries on their children's health and social activities. As a result, they treated dental caries prevention and management for their children as a priority, and they made an effort to engage in more favourable oral health behaviours for their subsequent children (Isong, et al., 2012).

In contrast, some studies reported that dental caries were not significantly associated with the number of family members living in the household (Albino, et al., 2014; Lim, et al., 2015; Peltzer and Mongkolchati, 2015; Sarracini, et al., 2015), the number of siblings in the family (Li, et al., 2011; Mannaa, et al., 2013; Menon, Nagarajappa, Ramesh, and Tak, 2013; Sankeshwari, et al., 2013; Folayan, et al., 2015; Sun, et al., 2017b; Faustino-Silva, et al., 2018) and birth order (Wigen, et al., 2011; Sankeshwari, et al., 2013). Some studies also found that the number of siblings was not significantly associated with tooth-brushing practices (Trubey, Moore, and Chestnutt, 2015a) and dental visits (Sujlana, et al., 2016). A qualitative study in the U.S. also found that birth order had little or no influence on the age at which the child had their first dental visit (Hoeft, et al., 2011). Furthermore, with regard to the number of children in the household, only very slight differences in the mean score of the oral health knowledge and literacy of parents or caregivers were observed (Vann, Lee, Baker, and Divaris, 2010).

Marital status

Having parents who were married or living together reduced the risk of children developing dental caries (Piva, et al., 2017), whereas single parenthood predisposed the children to a high risk of developing dental caries

(Chu, et al., 2012b; Hooley, et al., 2012; Seow, 2012;. Weatherwax, Bray, Williams, and Gadbury-Amyot, 2015; Pinto, et al., 2016; van der Tas, et al., 2017). This finding is associated with economic hardship and limited access to dental care services (Seow, 2012), lower household income, family stress, and less social support (Hooley, et al., 2012). Children who had a change in family status were found to be twice as likely to develop dental caries than those who had no change in family status (Wigen, et al., 2011).

On the contrary, one cross-sectional study found a lower prevalence of dental caries among children from single-parent families than children from nuclear families (Faustino-Silva, et al., 2018). In some studies, a significant association between marital status and dental caries was not found (Al-Jewair and Leake, 2010; Corrêa-Faria, et al., 2013; Krisdapong, et al., 2014; Moimaz, et al., 2014; Folayan, et al., 2015; Peltzer and Mongkolchati, 2015; Sarracini, et al., 2015; Weatherwax, et al., 2015; Ferrazzano, et al., 2016). Marital status was also not significantly associated with children's oral health behaviours (Heaton, et al., 2017), such as their consumption of sugary foods (Nanjappa, et al., 2015) and dental care-seeking behaviours (da Silveira, et al., 2015; Sujlana, et al., 2016). A longitudinal study also reported that status as a single parent was not significantly associated with parental indulgence or having a negative attitude towards healthy diet (Skeie, Klock, Haugejorden, Riordan, and Espelid, 2010).

Child's caregiver

The prevalence of dental caries was lower among children who were cared for by caregivers other than their parents, including day care and domestic helpers, than children who were cared for by their parents, and the prevalence of dental caries was even higher among children who were looked after by grandparents (Chu, et al., 2012b; Mahesh, et al., 2013; Zhang, et al., 2014; Chen, et al., 2017; Faustino-Silva, et al., 2018). The high rate of dental caries among children who were cared for by their grandparents was related to dietary choice and snacking behaviours (Congiu, et al., 2014). Furthermore, children who were cared for by caregivers other than their parents were found to be more likely to brush their teeth than children who were looked after by their parents (Ashkanani and Al-Sane, 2013). In contrast, a few studies found no significant association between the identity of a child's caregiver and their dental caries experience (Zhang, et al., 2013; Bridges, et al., 2014). One study also found that compared to other caregivers, mothers had better knowledge

of their children's oral health (Ashkanani and Al-Sane, 2013; Chia, Densie, and Morgan, 2015) and had more of a positive attitude towards regular dental visits for their children (Ashkanani and Al-Sane, 2013).

Parents'/caregivers' age

The effects of the parents'/caregivers' age on the development dental caries in their children has remained a debate (Hooley, et al., 2012). In some studies, dental caries in children has been significantly associated with the parents'/caregivers' age (Baghdadi, 2011; Masumo, et al., 2012b; Castilho, et al., 2013; Menon, et al., 2013; Batliner, et al., 2014; Bridges, et al., 2014; Lim, et al., 2015; Han, et al., 2014; Warren, et al., 2016). The prevalence of dental caries increased along with the parents'/caregivers' age (Masumo, et al., 2012b; Han, et al., 2014), while a high severity of dental caries was significantly associated with younger parents/caregivers (Wellappuli and Amarasena, 2012; Bridges, et al., 2014; Hoffmeister, et al., 2016).

Oral health knowledge and literacy increased along with the parents'/caregivers' age (Vann, et al., 2010; Sehrawat, et al., 2016). Older parents/caregivers were more likely to have better knowledge of the impact of dental caries on a child's growth and also were more likely to regularly brush their children's teeth than younger parents/caregivers, but younger parents/caregivers had better knowledge of the right time for the first dental visit for their children (Ashkanani and Al-Sane, 2013). Older parents/caregivers were also more likely than younger parents/caregivers to introduce tooth brushing to their children at an earlier age (Sun, et al., 2017b) and to take their child for a dental visit (Mantonanaki, et al., 2013). However, other studies reported that parents'/caregivers' age was not significantly associated with dental caries in their children (Al-Jewair and Leake, 2010; Wigen, et al., 2011; Corrêa-Faria, et al., 2013; Albino, et al., 2014; Peltzer and Mongkolchati, 2015; Phillips, et al., 2016; Piva, et al., 2017; Sun, et al., 2017b; Calvasina, O'Campo, Pontes, Oliveira, and Vieira-Meyer, 2018; Faustino-Silva, et al., 2018; Gomes, et al., 2018a, 2018b), parents'/caregivers' oral health knowledge (Chia, et al., 2015), parental indulgence, and having a negative attitude towards the importance of controlling sugar snacking (Skeie, et al., 2010), children's sugar consumption (Masumo, et al., 2012b), and dental service use in children (Camargo, et al., 2012; da Silveira, et al., 2015; Hoeft, et al., 2011).

Ethnicity

Many studies showed a significant difference in the dental caries experience among ethnic groups (Cunnion, et al., 2010; Johansson, et al., 2010; Piovesan, et al., 2010; Jacobsson, et al., 2011; Singh, et al., 2011; Marcenes, et al., 2013; Beil, et al., 2014; Darmawikarta, et al., 2014; Hong, et al., 2014; Vargas, et al., 2014; Wagner, et al., 2014; Bright, Alford, Hinojosa, Knapp, and Fernandez-Baca, 2015; Matsuo, et al., 2015; Weatherwax, et al., 2015; Kanemoto, et al., 2016; Schluter and Lee, 2016; Yang, et al., 2016; Cabral, Mota, Cangussu, Vianna, and Floriano, 2017; Klass, et al., 2017; Mantonanaki, et al., 2017; Elamin, et al., 2018; Shackleton, et al., 2018; Su, et al., 2018). Children from ethnic minority backgrounds had an increased risk of developing dental caries due to the social disadvantages related to their low socioeconomic status (Hooley, et al., 2012; Seow, 2012; Castilho, et al., 2013; Shackleton, et al., 2018). Furthermore, the traditional culture, values, customs, and norms of a family play an important role in shaping their oral health knowledge, literacy, beliefs, attitudes, and practices (Vann, et al., 2010; Baghdadi, 2011; Castilho, et al., 2013; Chia, et al., 2015; Ching-Feng, 2017), and therefore augmenting the risk of developing dental caries (Arora, et al., 2012; Seow, 2012).

Cultural beliefs and practices within certain ethnic groups were also significantly associated with dietary/feeding practices (Arora, et al., 2012; Hooley, et al., 2012; Hong, et al., 2014; Zhang, Lo, Liu, and Chu, 2015; Kanemoto, et al., 2016; Elamin, et al., 2018), including a child's consumption of sugary foods (Nanjappa, et al., 2015). For example, in Burma, parents gave soft-boiled eggs, bananas, kongi (rice), fine minced meat, potatoes, and carrots to an infant as their first solid foods, whereas Karen mothers gave rice (which was very soft cooked and squeezed through a cloth) followed by banana and papaya. Excessive consumption of juice and/or sweet bubble tea was observed in Karen communities (Nicol, et al., 2014). Compared to other marginalised children in India, aboriginal/tribal children were more likely to consume sugar between meals, three times a day (Singh, et al., 2011). In Saudi Arabia, the consumption of sweet foods has also become an accepted norm (Baghdadi, 2011). Parents' permissive attitudes towards sugar snacking were also found to be common in the Chinese culture (Ching-Feng, 2017).

Cultural beliefs and practices within ethnic groups also influenced the ways in which parents performed oral hygiene practices for their children (Castilho, et al., 2013; Klass, et al., 2017). For example, in Melbourne, Australia, Lebanese and Iraqi parents rarely performed oral hygiene practices

for their children, because most people in their ethnic communities never cleaned their teeth and ignored oral hygiene practices (Riggs, et al., 2015). In Saudi Arabia, most parents are relatively late in introducing oral hygiene practices. Most children do not brush their teeth regularly, and the use of fluoride toothpaste was found to be very rare (Baghdadi, 2011). Children's independent tooth brushing was also found to be common in Chinese culture (Ching-Feng, 2017). In Burma, parents rubbed the children's teeth using charcoal. In Ethiopia, they chewed betel nut and rocks. In Afghanistan, they used miswak (sticks), salt, and the green skin from walnut fruit or nuts. To relieve toothaches, in Burma, parents rubbed the children's gums with clove oil or with hot date pulp in Sudan (Nicol, et al., 2014).

In addition, ethnicity was found to influence dental care-seeking behaviours, including preventive practices (Amin and Perez, 2012). For example, in Saudi Arabia, most parents are relatively late in their dental care-seeking behaviours. Seeking relief from pain is the most common reason for a dental visit. They had less of a positive attitude towards routine dental check-ups and preventive dental care. Oral health knowledge and awareness, including the appropriate age for the child's first dental visit, are also very low. Furthermore, oral healthcare culture is underdeveloped, and regular dental visits have not become an accepted norm in Saudi Arabia (Baghdadi, 2011). In India, aboriginal/tribal children were found to be more likely than other marginalised children to never visit a dentist (Singh, et al., 2011).

In addition, the risk of developing dental caries increased among non-English-speaking parents (Al-Jewair and Leake, 2010). English-speaking parents also had better oral health knowledge, more favourable oral health behaviours, better knowledge of dental care, higher maternal self-efficacy, and greater internal locus of control than non-English-speaking parents (Tiwari, Mulvahill, Wilson, Rai, and Albino, 2018). Language barriers may influence children's oral health status in relation to access to oral healthcare (Castilho, et al., 2013). Furthermore, the results of a qualitative study revealed that mothers from non-English speaking backgrounds were reluctant to comply with the advice given by nurses about proper oral health behaviours that they did not consider as sensitive to their cultural norms. Nurses also perceived a difficulty in changing behavioural habits related to cultural norms, such as consumption of juice and milk with added sugar, prolonged bottle feeding, and sugar in the bottle (Arora, et al., 2012).

In contrast, several studies found no significant association between

ethnicity and dental caries (Al-Jewair and Leake, 2010; Meurman and Pienihäkkinen, 2010; Jacobsson, et al., 2011; Kopycka-Kedzierawski and Billings, 2011; Mulligan, et al., 2011; Singh, et al., 2011; Nanayakkara, et al., 2013; Krisdapong, et al., 2014; Gibbs, et al., 2016; Phillips, et al., 2016; Sun, et al., 2017b). Furthermore, some studies have found that ethnicity only had little or no influence on the initial age of tooth brushing (Sun, et al., 2017b), the age at which a child is taken for their first dental visit (Hoeft, et al., 2011), and the use of a dental care service (Camargo, et al., 2012; Christian, et al., 2015; Yang, et al., 2016).

Parents' immigrant background

Some studies showed a significant association between parents' immigrant background and dental caries (Tubert-Jeannin, et al., 2012; Bissar, et al., 2014; Lin, et al., 2014; Mejàre, et al., 2014; Quach, Laemmle-Ruff, Polizzi, and Paxton, 2015; Kraljevic, et al., 2017; Östberg, et al., 2017). Children with parents who had immigrant backgrounds had an increased risk of developing dental caries due to the social disadvantages related to their low socioeconomic status (Hooley, et al., 2012; Seow, 2012; Riggs, et al., 2015). With regard to oral health behaviours, a longitudinal study in Norway reported that permissive attitudes to diet and hygiene were more prevalent among immigrant parents than native parents (Skeie, et al., 2010). The results of focus group discussions with three migrant communities in Melbourne, Australia revealed that easier access to confectionary, such as sweets and chocolate in Melbourne than in their home countries has led to an increase in their sugar consumption, which impacted the development of dental caries among their children. The most commonly perceived barrier to purchasing fresh food in local markets was related to its high cost, limited public transport choice, lack of access to private transport, and language differences (Riggs, et al., 2015).

Living in poverty also commonly became a barrier to accessing proper dental care among children with parents who had immigrant backgrounds. A study of children of new and emerging refugee communities in western Australia revealed that parents choose to use salt for tooth cleaning because of the perceived high cost of toothbrushes and toothpaste sold in refugee camps. Furthermore, refugees commonly experienced a difficult resettlement period. Therefore, social issues, such as housing, food, transport, and mental health, became their priorities instead of dental health (Nicol, et al., 2014). A

language barrier was also a major reason for immigrant parents delaying dental care for their children (Lukes, 2010). Only one study found no significant association between immigrant status and early childhood caries (Al-Jewair and Leake, 2010).

Socioeconomic status

Inequalities in dental caries was observed among different socioeconomic groups (Davies, et al., 2011; Ha, et al., 2016). Low socioeconomic status is closely associated with socially disadvantaged communities, such as racial or ethnic minorities, low social class, low educational level, low income, and poverty, which are the social determinants of health inequality. The difference in socioeconomic conditions among individuals is closely linked to a difference in material circumstances and behaviours that impact health inequity and wellbeing (Seow, 2012; Ha, et al., 2016).

Low socioeconomic status has been found to be a significant predictor of the high prevalence and severity of dental caries in children (Mattheus, 2010; Arora, et al., 2012; Chankanka, et al., 2012; Hooley, et al., 2012; Prakash, et al., 2012; Tubert-Jeannin, et al., 2012; Castilho, et al., 2013; Mantonanaki, et al., 2013; Menon, et al., 2013; Majorana, et al., 2014; Wagner, et al., 2014; Baggio, et al., 2015; Paula, Ambrosano, and Mialhe, 2015; Poon, et al., 2015; Winter, et al., 2015; Gopal, et al., 2016; Ha, et al., 2016; Hoffmeister, et al., 2016; Lima, et al., 2016; Dabawala, et al., 2017; Khani-Varzegani, et al., 2017; Mantonanaki, et al., 2017; Pinto, et al., 2017). Two cross-sectional dental caries surveys conducted in the city of Canoas, Brazil 10 years apart (2000 and 2010) found no improvement in inequalities in the distribution of dental caries among children. Prevalence of dental caries was more likely to reduce among children from a high socioeconomic status than those with a low socioeconomic status (Kramer, et al., 2015). However, two studies found a higher prevalence and severity of dental caries among children in high socioeconomic groups than children in low socioeconomic groups (Al Agili, 2013; Onyejaka and Amobi, 2016). Some studies also reported no significant association between socioeconomic status and dental caries (Agarwal, Nagarajappa, Keshavappa, and Lingesha, 2011; Raj, et al., 2013; Sankeshwari, et al., 2013; Folayan, et al., 2015; Ribeiro, et al., 2017).

In addition, some studies showed a significant difference in the oral health behaviours of children of low socioeconomic status and children of high

socioeconomic status (Pieper, et al., 2012; Castilho, et al., 2013). Poor oral health behaviours are more prevalent among children in low socioeconomic groups than children in high socioeconomic groups, which predisposed children in low socioeconomic groups to a higher risk of developing dental caries (Seow, 2012; Pieper, et al., 2012; Castilho, et al., 2013; Ha, et al., 2016). Children in high socioeconomic groups were less likely than children in low socioeconomic groups to use a baby bottle or to be bottle fed until eight months of age (Pieper, et al., 2012). Tooth brushing at an early age and parental assistance in tooth brushing were also more common among children in high socioeconomic groups than children in low socioeconomic groups (Pieper, et al., 2012). Furthermore, children in low socioeconomic groups were more likely than children in high socioeconomic groups to use toothpaste with a higher fluoride concentration (Lima, et al., 2016) and to have an irregular frequency of tooth brushing in terms of morning and evening tooth-brushing routines (Trubey, et al., 2015a).

In contrast, one study found no significant association between a child's socioeconomic status and their consumption of sugary snacks (Nanjappa, et al., 2015). Another study also found that the frequency of consumption of sugary drinks per day, the total sugar intake between meals, the duration of night-time bottle drinking, prolonged bottle drinking, and the frequency of tooth brushing did not differ significantly between children in low socioeconomic groups and children in high socioeconomic groups (Pieper, et al., 2012).

In addition, socioeconomic status was found to be a powerful predictor of dental service use (Al-Tamimi and Petersen, 1998; Baghdadi, 2011). The likelihood of having dental visits and dental treatment was found to be higher among children in high socioeconomic groups than children in low socioeconomic groups (Pieper, et al., 2012; Mantonanaki, et al., 2013; Priesnitz, et al., 2016), while children of low socioeconomic status were more likely than children in high socioeconomic groups to delay using dental health services (Al-Tamimi and Petersen, 1998; Baghdadi, 2011). Limited access to dental health services among children in low socioeconomic groups can be explained by parents' low perceived needs for dental visits (Seow, 2012), parents' inability to pay for dental care due to financial constraints (Al-Tamimi and Petersen, 1998; Mattheus, 2010; Baghdadi, 2011; Hooley, et al., 2012), or a lack of availability of dental care services (Al-Tamimi and Petersen, 1998; Baghdadi, 2011; Seow, 2012).

Educational level

Parents' educational level was found to be a significant predictor of dental caries in preschool children (Castilho, et al., 2013; Mejàre, et al., 2014; Kato, et al., 2017). The high prevalence and severity of dental caries in children were significantly associated with parents' low educational attainments (Mattheus, 2010; Wigen and Wang, 2010; Chedid, et al., 2011; Borges, et al., 2012; Chu, et al., 2012b; Oulis, et al., 2012; Prakash, et al., 2012; Corrêa-Faria, et al., 2013; Al-Bluwi, 2014; Albino, et al., 2014; Batliner, et al., 2014; Bridges, et al., 2014; Piovesan, et al., 2014; Zhang, et al., 2014; Weatherwax, et al., 2015; Yang, et al., 2016; Cabral, et al., 2017; Sun, et al., 2017a; van der Tas, et al., 2017; Brito, et al., 2018; Elamin, et al., 2018); whereas parents who had a high educational level reduced the risk of having dental caries in children (Wong, et al., 2012; Tanaka, et al., 2013; Congiu, et al., 2014; Heima, Lee, Milgrom, and Nelson, 2015; Sohn, 2015; Li, et al., 2017; Su, et al., 2018). However, other studies found no significant association between parents' educational level and dental caries (Al-Jewair and Leake, 2010; Cadavid, et al., 2010; Johansson, et al., 2010; Piovesan, et al., 2010; Jacobsson, et al., 2011; Li, et al., 2011; Masumo, et al., 2012b; Menon, et al., 2013; Dantas, et al., 2015; Guan, et al., 2015; Lim, et al., 2015; Gibbs, et al., 2016; Moimaz, et al., 2016; Östberg, et al., 2017; Calvasina, et al., 2018; Gomes, et al., 2018a, 2018b).

Parents' high educational level positively influenced parents' eagerness for oral health information, knowledge, attitudes, and practices (Arora, et al., 2012; Sehrawat, et al., 2016). Oral health knowledge and literacy increased along with the educational level of parents/caregivers (Vann, et al., 2010; Chia, et al., 2015). Parents/caregivers who had a high educational level were also more likely than parents/caregivers who had a low educational level to treat baby teeth as important (Sohn, 2015). A study in the Netherlands also found higher self-efficacy among children of parents with higher educational level than lower educational level (Duijster, et al., 2015a).

In addition, parents'/caregivers' educational level may influence their children's dental caries through oral health behaviours (Sohn, 2015). Parents/caregivers with a low educational level were more likely than parents/caregivers with a high educational level to engage in poor oral health behaviours (Ashkanani and Al-Sane, 2013). Parents with a low educational level tended to have a negative/indulgent attitude towards diet (Skeie, et al.,

2010). As a result, children whose mothers had a low educational level were more likely than children whose mothers had a high educational level to have high-frequency sugary foods consumption (Nanjappa, et al., 2015). However, one study found no significant association between the children's parents' educational level and sugar consumption (Masumo, et al., 2012b). The high educational level of parents was commonly associated with positive attitudes toward children's oral self-care (Castilho, et al., 2013) and the importance of dental visits (Al-Tamimi and Petersen, 1998; Baghdadi, 2011; Granville-Garcia, et al., 2015). Parents/caregivers with a high educational level were more likely to start their children's tooth brushing at an early age (Sun, et al., 2017b), perform twice-daily tooth brushing (Heima, et al., 2015; Sohn, 2015), and have regular dental visits both for themselves and their children (Heima, et al., 2015; Sohn, 2015). One study found no significant association between parents' educational level and the children's dental visits (Christian, et al., 2015).

In some studies, dental caries were only significantly associated with either the father's educational level (Nanayakkara, et al., 2013; Zhang, et al., 2013; de Sousa, et al., 2017) or the mother's educational level (Wigen, et al., 2011; Kakanur, et al., 2017; Khani-Varzegani, et al., 2017; Li, et al., 2017). Many studies showed that the risk of dental caries increased among children who had mothers with a low level of education (Piovesan, et al., 2010; Schroth, et al., 2010; Wigen, et al., 2011; Seow, 2012; Perera, et al., 2012; Al-Bluwi, 2014; Moimaz, et al., 2014; Bright, et al., 2015; Ferrazzano, et al., 2016; Peltzer and Mongkolchati, 2015; Sujlana and Pannu, 2015; Ju, Jamieson, and Mejia, 2016; Phillips, et al., 2016; Warren, et al., 2016; Faustino-Silva, et al., 2018; Nguyen, et al., 2018; Pourhoseingholi, Baghban, Baghestani, and Ghasemi, 2018). A low maternal educational level is also associated with a low level of oral health knowledge, negative attitudes towards children's oral health, negative health beliefs, and poor oral health behaviours such as inappropriate feeding practices, excessive sugar consumption, inadequate oral hygiene practices, and limited access to dental care (Seow, 2012; Van den Branden, Van den Broucke, Leroy, Declerck, and Hoppenbrouwers, 2013; Sujlana, et al., 2016; Heaton, et al., 2017). Routine dental visits and better dental care practices were also more common among children whose mothers had a high educational level than among children whose mothers had a lower educational level. However, other studies found no significant associations between the mother's educational level and dental

caries (Schroth, et al., 2010; Agarwal, et al., 2011; Mahesh, et al., 2013; Mannaa, et al., 2013; Zhang, et al., 2013; Bissar, et al., 2014; Sarracini, et al., 2015; Corrêa-Faria, et al., 2016b; Piva, et al., 2017; Ribeiro, et al., 2017). One study also found no significant association between the mother's educational level and good oral hygiene (da Silveira, et al., 2015). A qualitative study also revealed that the mothers' educational level had little or no influence on the age at which their child had their first dental visit (Hoeft, et al., 2011).

Family income

Many studies found that the prevalence and severity of dental caries was significantly associated with family income (Johansson, et al., 2010; Piovesan, et al., 2010; Bernabe, et al., 2012; Hooley, et al., 2012; Mannaa, et al., 2013; Bridges, et al., 2014; Bernabé, Sabbah, Delgado-Angulo, Murasko, and Gansky, 2015; Yang, et al., 2016; Li, et al., 2017; van der Tas, et al., 2017). A higher prevalence and severity of dental caries were found among children who came from low-income families than among children who came from families with higher incomes (Al-Jewair and Leake, 2010; Johansson, et al., 2010; Mattheus, 2010; Borges, et al., 2012; Chu, et al., 2012b; Corrêa-Faria, et al., 2013; Hooley, et al., 2012; Pieper, et al., 2012; Wong, et al., 2012; Tanaka, Miyake, Sasaki, and Hirota, 2013; Batliner, et al., 2014; Bridges, et al., 2014; Darmawikarta, et al., 2014; Moimaz, et al., 2014; Piovesan, et al., 2014; Bright, et al., 2015; Capurro, Lafolla, Kingman, Chattopadhyay, and Garcia, 2015; Guan, et al., 2015; Ferrazzano, et al., 2016; Moimaz, et al., 2016; Sánchez-Pimienta, Batis, Lutter, and Rivera, 2016; Cabral, et al., 2017; Kato, et al., 2017; Li, et al., 2017; Brito, et al., 2018; Calvasina, et al., 2018; Gomes, et al., 2018a, 2018b). However, the pattern of association between family income and dental caries in children was different across studies (Heaton, et al., 2017).

In a systematic review, some studies reported that a high prevalence of dental caries was significantly associated with children from low-income families, whereas other studies reported that children from high-income families were more likely to suffer dental caries than children from low-income families (Al-Bluwi, 2014). A longitudinal study in the U.S. also showed that a high prevalence of dental caries was observed among children from low-income families at both the baseline and the six-month follow-up. However, at the 12-month recall, the prevalence of dental caries was higher among children in high-income families than among children in low-income families

(Cunnion, et al., 2010). In Pakistan, despite the high prevalence of dental caries among children in low-income families, dental caries were found to be more severe among children in high-income families than among children in low-income families (Sufia, et al., 2011). However, several studies found no significant difference in the prevalence and severity of dental caries between children in high-income families and low-income families (Piovesan, et al., 2010; Li, et al., 2011; Wigen, et al., 2011; Masumo, et al., 2012b; Perera, et al., 2012; Wong, et al., 2012; Nanayakkara, et al., 2013; Albino, et al., 2014; Batliner, et al., 2014; Lim, et al., 2015; Peltzer and Mongkolchati, 2015; Sarracini, et al., 2015; Weatherwax, et al., 2015; Corrêa-Faria, et al., 2016b; Phillips, et al., 2016; Warren, et al., 2016; de Sousa, et al., 2017; Piva, et al., 2017; Elamin, et al., 2018).

A qualitative systematic review found that parents on low incomes were more inclined to offer sugary snacks to their children because they saw sugary snacks as an alternative to other more costly pleasures that they could not provide for their children due to financial constraints (Moore, et al., 2017). A study also reported that children from low-income families were found to be more likely to have a high sugar intake than children from high-income families (Masumo, et al., 2012b). Financial constraints also appeared to prevent low-income families from purchasing healthier foods and beverages for their child, as they were perceived as being expensive (Collins, et al., 2016). Furthermore, a study in New Zealand found a significant association between parents' income and oral health knowledge (Chia, et al., 2015). Another study also found a significant association between children from high-income families and learning correct teeth brushing techniques at an early age (Sun, et al., 2017b).

In addition, household income was also significantly associated with the utilisation of dental services among preschool children (Granville-Garcia, et al., 2015; Yang, et al., 2016). Children from high-income families were found to be more likely to have routine dental visits and to get their teeth treated than children from low-income families (Camargo, et al., 2012). In low-income families, the high costs of dental care were frequently associated with a delay in dental visits (Naidu, et al., 2012) due to financial constraints (i.e. needing to pay for their children's dental care) (Mattheus, 2010; Hooley, et al., 2012).

Financial constraints and not having dental insurance coverage were the most common barriers to dental visits as perceived by parents on low

incomes (Webster, Ware, Ng, Post, and Risko, 2011; Collins, et al., 2016). This was demonstrated by the perceived high costs of dental treatment for dental cavities (Collins, et al., 2016). However, two studies found that insurance status was not a barrier to accessing dental care (Heaton, et al., 2017; Cianetti, et al., 2017). A qualitative study in Winnipeg, Canada also suggested that parents' delaying taking their children for their first dental visit were not merely influenced by financial constraints to accessing preventive dental care. Rather, the problem-oriented nature of the dental visit, the perceived lower importance of preventive dental care, and their child's temperament were the most commonly reported barriers to taking their children for early preventive dental check-ups (Schroth, et al., 2016). In other studies, dental caries were not found to be significantly associated with parents' access to dental care (Wigen and Wang, 2010), healthcare card status (Gibbs, et al., 2016), and dental insurance (Lim, et al., 2015). Family income also only had little or no influence on the age at which children were taken for their first dental visit (Hoeft, et al., 2011). A study in California, U.S. also found no significant association between income and positive oral health behaviours (Heaton, et al., 2017).

Parents' occupations

Dental caries were significantly associated with parents' employment status (Congiu, et al., 2014). A high prevalence and severity of dental caries in children were associated with a low number of adults who were employed in the household, low-paid occupations, unemployed parents (Hooley, et al., 2012), and parents who had no paid job (van der Tas, et al., 2017). Concerning parents' occupation level, in households where the breadwinner had an unskilled/low occupation status, children were more likely to have dental caries than those where one or both parents had a skilled/semi-skilled/high occupation status (Meurman and Pienihäkkinen, 2010; Castilho, et al., 2013; Krisdapong, et al., 2014; Cabral, et al., 2017; Kato, et al., 2017). A study from Greater Noida, India found a positive association between parents' employment status and their oral health knowledge, attitudes, and practices (Sehrawat, et al., 2016). However, one study reported that having unemployed parents was a factor in preventing dental caries (Congiu, et al., 2014). Some studies also found no significant association between employment status and dental caries (Al-Jewair and Leake, 2010; Piovesan, et al., 2010; Darmawikarta, et al., 2014; Han, et al., 2014; Piovesan, et al.,

2014; Lim, et al., 2015).

In particular, dental caries were significantly associated with the employment status (Congiu, et al., 2014) or the activities (Tubert-Jeannin, et al., 2012) of the child's mother. The risk of developing dental caries was significantly higher among children whose mothers were unemployed compared to children whose mothers were employed (Mahesh, et al., 2013; Kato, et al., 2017; Skafida and Chambers, 2018). A qualitative study revealed that the mother's employment status influenced their bottle-feeding practices (Nicol, et al., 2014). Furthermore, not having dental health coverage in the family's health insurance was also related to the unemployment status of mothers, and this was perceived as one of the main barriers to accessing professional dental care (Nicol, et al., 2014). However, a systematic review found that children whose mothers were unemployed had a lower risk of developing dental caries than children whose mothers were working (Castilho, et al., 2013). Some studies also found that the mother's employment status was not significantly associated with the prevalence of dental caries (Lourenço, et al., 2013; Tanaka, et al., 2013; Moimaz, et al., 2014; Heaton, et al., 2017; Piva, et al., 2017) or access to dental care (Lourenço, et al., 2013).

2.3.4.2 Parental oral health knowledge and literacy

Parents' oral health knowledge was significantly associated with children's oral health status (Castilho, et al., 2013). The high rate of dental caries was associated with a lack of knowledge about children's oral health (Mattheus, 2010; Slabšinskienė, et al., 2010; Chu, et al., 2012b; Hooley, et al., 2012; Isong, et al., 2012; Tubert-Jeannin, et al., 2012; Wong, et al., 2012; Albino, et al., 2014; Folayan, et al., 2015; Chen, et al., 2017; Azimi, et al., 2018; Su, et al., 2018) and low oral health literacy (Bridges, et al., 2014; Firmino, et al., 2017). Low levels of oral health knowledge were associated with low levels of oral health literacy (Vann, et al., 2010). Children whose parents had adequate oral health literacy were more likely than children whose parents had inadequate oral health literacy to have a higher level of oral health knowledge, perceive the seriousness of their oral health problems, have a stronger internal locus of control, have higher self-efficacy, engage in more favourable oral health behaviours, perceive the benefits of engaging in favourable oral health behaviours, perceive fewer barriers to engaging in favourable oral health behaviours, and perceive that their child was less susceptible to dental caries (Brega, et al., 2016). However, some studies

showed that dental caries among children was not significantly associated with parents' oral health knowledge (Li, et al., 2011; Hong, et al., 2014; Weatherwax, et al., 2015), parental awareness of dental caries (Mahesh, et al., 2013), parents' health literacy levels (Albino, et al., 2014), and parents' oral health literacy levels (Brega, et al., 2016).

In addition, a study in Greater Noida, India also found that dental caries was significantly associated with parents' oral health knowledge, attitudes, and practices (Sehrawat, et al., 2016). Parents' knowledge about children's oral health had a positive and significant association with children's oral health behaviours (Isong, et al., 2012; Ashkanani and Al-Sane, 2013; Castilho, et al., 2013; Heaton, et al., 2017). The acquisition of oral health knowledge through oral health education may also lead to motivation for behavioural change (Baghdadi, 2011), whereas having inadequate knowledge about the risk factors of dental caries was associated with poor oral health behaviours (Naidu, et al., 2012). For example, parents' knowledge about children's oral health has an influence on dietary choice (Hoeft, et al., 2010; Hooley, et al., 2012). Dietary choices from an earlier age will influence the development of long-term dietary behaviours and habits in relation to food tastes and preferences (e.g., sweet preferences). Children whose parents were more knowledgeable about oral health literacy were more likely to have a lower sugar consumption and have a low rate of dental caries than children whose parents had low levels of knowledge (Hoeft, et al., 2010; Vann, et al., 2010; Hooley, et al., 2012). A lack of knowledge about healthy foods, snacks and beverages also appeared to contribute to children's oral health problems (Collins, et al., 2016).

A qualitative study in North Carolina, U.S., also showed that insufficient knowledge about the fluoride content in tap water and its role was evident among low-income parents. This led them to avoid drinking tap water because of the perceived amount of fluoride in tap water (Collins, et al., 2016). A community-based participatory qualitative study also revealed that parents tended to substitute tap water with soft drinks due to its smell and taste. They were also not aware of the role of fluoridated water in promoting healthy teeth (Nicol, et al., 2014).

In addition, parents who had low levels of oral health knowledge were found to be more likely to put their children to bed with the bottle than parents who had high levels of oral health knowledge and oral health literacy (Vann, et al., 2010). Children's oral health problems were also related to lack of

knowledge about the appropriate age for bottle weaning (Collins, et al., 2016).

Parents who had high levels of oral health knowledge and oral health literacy were also more likely than parents or caregivers who had low levels of oral health knowledge to perform daily brushing/cleaning for their children (Vann, et al., 2010). A study in the U.K. showed that parents' inadequate knowledge of tooth brushing, such as only knowing about the importance of twice-daily tooth brushing with fluoride toothpaste but not about supervised brushing, was a barrier to successfully performing their child's proper tooth brushing routine (Gray-Burrows, et al., 2016). Another study found that poor oral health knowledge was also significantly associated with the irregular frequency of tooth brushing in the evening, although no significant association was found between poor oral health knowledge and the irregular frequency of tooth brushing in the morning (Trubey, et al., 2015a). Furthermore, a lack of knowledge about the use of fluoridated toothpaste also appeared to contribute to children's oral health problems (Collins, et al., 2016). In Trinidad, the majority of parents used herbal/low/non-fluoride children's toothpaste because they worried about the adverse effects of swallowing excessive amounts of fluoride from toothpaste (Naidu, et al., 2012).

With regard to dental visits, a lack of knowledge about the ideal age for a child's first dental visit and recommended dental care standards for children had an effect on a delay in the child's first dental visit and in the utilization of dental services for children (Lukes, 2010; Mattheus, 2010; Schroth, et al., 2010; Naidu, et al., 2012; Lourenço, et al., 2013; Mannaa, et al., 2013; Hong, et al., 2014). However, in a study conducted in Melbourne, Australia, parents' oral health knowledge was not found to be significantly associated with children's dental visits (Christian, et al., 2015).

A systematic review showed that although parents' oral health knowledge impacted on children's oral health behaviours and oral health status, parents' own oral health behaviours were more strongly associated with their children's oral health behaviours and oral health status (Castilho, et al., 2013). Some studies demonstrated that parents' knowledge and awareness about their children's oral health did not reflect on the translation of their knowledge into practice (Huebner and Riedy, 2010; Lukes, 2010; Naidu, et al., 2012; Castilho, et al., 2013; Marshman, et al., 2016) and could not predict their children's oral health status (Castilho, et al., 2013).

2.3.4.3 Parents' oral health belief

Parents' oral health beliefs were a significant predictor of dental caries in preschool children (Mejàre, et al., 2014). Belief is considered to be a perception of reality that may differ from true reality (Hooley, et al., 2012). Parents who had negative oral health beliefs increased their children's vulnerability to dental caries (Mattheus, 2010; Smith and Freeman, 2010). A perceived susceptibility to dental caries and perceived barriers to dental caries prevention were lower among parents of caries-free children than parents of children who had dental caries (Albino, et al., 2014). However, one study showed that fatalistic beliefs about oral health were not significantly associated with the development of new caries (Lim, et al., 2015). Another study also showed that dental caries were not significantly associated with parents' perceived seriousness about children's dental caries and parents' perceived benefits of encouraging favourable oral health behaviours (Albino, et al., 2014).

Oral health behaviours are commonly derived from maternal beliefs about children's oral health. Mothers who had negative oral health beliefs towards their children's oral health are more likely to engage in poor oral health behaviours that may predispose children to a high risk of early childhood caries (Seow, 2012; Heaton, et al., 2017). For example, in Iraqi, Lebanese and Pakistani communities, mothers gave sugar to their children because they believed that it was a source of nourishment and was essential for their children's growth and development as well as providing comfort for them (Riggs, et al., 2015). In Trinidad, although most parents were aware that bottle-feeding at night could cause dental caries, they still bottle-fed their children at night regardless. They reasoned that bottle-feeding could comfort their children during the night and would help get them to fall asleep. Their children also drank milk more if they use a bottle instead of a cup (Naidu, et al., 2012). In the U.S., Mexican-American mothers perceived that dental caries were caused by a detrimental effect of the bottle nipple materials rather than the liquids contained in the bottle. As a result, they made inadequate efforts to prevent dental caries, such as replacing the use of a bottle with a sippy cup to drink liquids containing sugar, or removing the bottle from their children's mouth after they finished drinking at night (Hoeft, et al., 2010).

In addition, the oral health beliefs of the mother influenced drinking choices for children. Mothers who had a strong desire to limit their children's sugar intake believed in the effects of sugar on the development of dental

caries (Herman, et al., 2012; Choy and Isong, 2018), and their children were also less likely to consume sweetened beverages as a result (Choy and Isong, 2018). Some mothers also perceived that behavioural changes, such as hyperactivity and restlessness, were the result of sweetened drinks (Hoare, et al., 2014). Furthermore, mothers who gave water to their children believed that water had health benefits for their children and could prevent decay, because unlike sweetened drinks there is no sugar in water (Hoare, et al., 2014). Mothers who preferred tap water perceived that the fluoride contained in tap water was important in preventing dental caries, whereas mothers who preferred bottled water reasoned that they disliked the taste of tap water and prevented the ingestion of fluoride contained in tap water because they considered that fluoride had adverse health effects (Hoare, et al., 2014). Some mothers who consumed tap water also changed their children's fluoride toothpaste to non-fluoride toothpaste in order to prevent the excessive consumption of fluoride (Hoare, et al., 2014).

Mothers who allowed their children to consume sweetened beverages, such as fruit juice or flavoured milk, also perceived health benefits in these sweetened beverages (Hoare, et al., 2014). They also perceived that drinking sweet beverages was acceptable for older children (Hoare, et al., 2014). Similarly, a study in Japan showed a belief in the benefits of sport drinks consumption to their children's health, and was often cited by mothers as the reason for giving sports drinks to their children (Kawashita, et al., 2011). A mixed-methods study in Boston, U.S. also found that parents were more likely to limit their child's consumption of sweetened beverages if they believed the adverse health consequences of excessive sugar in sweetened beverages, such as dental caries, obesity and hyperactivity (Choy and Isong, 2018). In contrast, the barriers to limiting children's consumption of sweetened beverages were related to parents' belief of the importance of fruit juice to their child's health and parents' concern about the quality of both tap water and bottled water (Choy and Isong, 2018). Only one study reported no significant association between the perceived importance of controlling children's consumption of sweets and the development of dental caries (Wigen and Wang, 2010).

With regard to oral hygiene practices, a qualitative study revealed that most parents commonly followed their traditional oral health practices to clean their teeth and maintain their oral health. For example, the use of miswak or the combination of miswak and tooth brushing came from parents' belief that

miswak has antibacterial properties that can prevent and treat dental caries or other oral health problems; whereas toothpaste was perceived to only give a fresh feeling in the mouth (Riggs, et al., 2015). Other traditional oral hygiene practices reported by parents were the use of derum (fruit from a walnut tree), sheb (skin from the outside of a walnut), neem and dentonic powder (a natural alternative to toothpaste), salt, bicarbonate of soda, sage, coal, carnation flowers and apple cider. Some parents also used matchsticks, cotton thread or string as an alternative to dental floss. They also believed in traditional medication to treat dental pain and infection by using garlic, cloves and aspirin. A Lebanese caregiver also said that an Arabic doctor prescribed a mixture of sage and ash to heal infections by applying it to the teeth or gums (Riggs, et al., 2015). A study in Miami-Dade, Florida also showed that parents who perceived the seriousness of tooth decay were more likely to encourage their children to use a fluoride toothpaste (Clarke, 2017).

In addition, parents' belief in the importance of tooth brushing for their children's dental health is one of the facilitators of good oral hygiene, whereas fatalistic oral health beliefs will become a barrier to tooth brushing. Parents who performed twice-daily brushing believed that good oral hygiene practices at home were important in preventing dental health problems in the future. They also perceived that tooth brushing skill is a skill that has to be learned by everyone (Huebner and Riedy, 2010). Furthermore, parents' belief in the consequence of irregular tooth brushing influenced parents' likelihood to successfully develop their child's tooth brushing routine (Gray-Burrows, et al., 2016). In contrast, parents who believed that frequent tooth brushing would remove the enamel did not perform twice-daily tooth brushing as a result (Huebner and Riedy, 2010). Also, parents who perceived that their children were not susceptible to dental caries tended to engage in inadequate oral hygiene practices (Isong, et al., 2012).

Similarly, a study in Wales, U.K. also showed that parents who perceived tooth brushing as part of the morning routine, which is associated with waking up, showering, eating breakfast and leaving for school tended to brush their children's teeth in the morning for purely cosmetic purposes, whereas parents who perceived tooth brushing as an evening routine, which is related to having dinner, shower and going to bed, brushed their children's teeth in the evening to maintain their children's dental health (Trubey, Moore, and Chestnutt, 2014). In contrast, parents who perceived no importance to brushing their children's teeth in the evening were less likely to brush their

children's teeth in the evening (Trubey, et al., 2014). In addition, parents who performed regular tooth brushing for their children also believed in the negative dental health consequences of irregular tooth brushing (Huebner and Riedy, 2010). The frequency of tooth brushing among children was influenced by what parents believed about the frequency of tooth brushing in other children (Trubey, et al., 2014). Only one study reported no significant association between the perceived importance of tooth brushing and the development of dental caries (Wigen and Wang, 2010).

A low rate of dental visits was often associated with fatalistic beliefs of dental caries in children. Parents who perceived that their children were not susceptible to dental caries tended to place a low importance on dental visits at an early age. They were unaware of the presence of dental caries in their children until a dentist told them (Isong, et al., 2012). The result of focus group discussions also revealed that low rates of dental attendance occurred because most mothers perceived the presence of dental problems as a call for action. The absence of dental problems indicated good oral health, and thus, no care was required. They also perceived that dental caries in children were always symptomatic and would be easily detected by looking at the indicators of dental caries, such as cavities, discoloration and pain. A dentist would, therefore, only play a role in repairing dental problems. They also perceived that dental problems were not serious issues and were only related to social and personal (aesthetic/appearance) consequences rather than health consequences (Amin and Perez, 2012). Another study also showed that clinical conditions with symptoms, particularly dental caries with toothache, influenced parental perceptions of their children's oral health (Gomes, et al., 2015a).

2.3.4.4 Parents' attitudes towards children's oral health

Dental caries were significantly associated with parents' perceived importance of baby teeth (Hong, et al., 2014). The risk of dental caries in children increased among parents who had negative attitudes towards children's oral health (Hooley, et al., 2012; Sarracini, et al., 2015; Pinto, et al., 2016; Azimi, et al., 2018; Su, et al., 2018) and children's oral health needs, and among parents who had indulgent and permissive attitude towards diets, including sugar snacking (Hooley, et al., 2012; Mejàre, et al., 2014; Östberg, et al., 2017) and children's oral hygiene practices (Hooley, et al., 2012; Östberg, et al., 2017). Only two studies found no significant association between parents' attitude and dental caries (Sujlana and Pannu, 2015;

Weatherwax, et al., 2015).

Parents' attitudes towards children's oral health had a positive association with children's oral health behaviours (Naidu, et al., 2012; Ashkanani and Al-Sane, 2013) and children's oral health outcomes (Castilho, et al., 2013). Compared to parents of children who had dental caries, parents of children who were caries-free placed a higher importance on their children's oral health behaviours (Albino, et al., 2014). Parents who showed positive attitudes towards children's oral health tended to establish favourable oral health behaviours, such as limited sugar intake and regular tooth brushing (Herman, et al., 2012; Castilho, et al., 2013). The establishment of favourable oral health behaviours at an early age had a positive impact on the prevention of dental caries and could reduce the number of dental caries in children (Castilho, et al., 2013).

A mixed methods study in Boston, U.S. found that parents who had a positive attitude towards limiting their child's sweetened beverages intake, such as perceiving the importance of limiting their child's consumption of sweetened beverages to prevent dental caries with all associated social and health consequences, were also more likely to have the intention to limit their child's sweetened beverage consumption, and their children would also be less likely to consume sweetened beverages (Choy and Isong, 2018). A qualitative systematic review also found that parents were inclined to offer sugary snacks to their child if they saw sugary snacks as a tool to manage their child's behaviour, to avoid conflict, as a reward for good behaviour, or giving additional nutritional value to their child because of fussy eating health-related concerns, or avoiding hunger (Moore, et al., 2017). Parents' perceived lack of time to prepare healthy diets for children had also led some parents to choose convenience foods instead. However, one study did not find a significant association between parents' positive attitudes towards healthy diet and child's positive oral health behaviours (Wolfe, 2017). A study in Miami-Dade, Florida, also showed that parents' positive attitude toward dental caries prevention was not significantly associated with the frequency of candy consumption among their child, but it only significantly reduced the likelihood of their child to consume soft drinks containing sugar (Clarke, 2017).

With regard to oral hygiene practices, parents who had negative attitudes towards children's oral hygiene practice tend to lack efforts to encourage their children to have regular tooth brushing (Hoeft, et al., 2010). Parents who perceived the importance of maintaining dental health since

primary dentition also tended to engage in good oral hygiene practices, whereas parents who perceived that primary teeth were not important were likely to perform poor oral hygiene practice (Huebner and Riedy, 2010; Amin and Perez, 2012; Naidu, et al., 2012). Time constraints also became a common reason for parents to not regularly brush their children's teeth (Hoeft, et al., 2010; Huebner and Riedy, 2010). However, one study did not find a significant association between parents' positive attitudes towards oral hygiene and child's positive oral health behaviours (Wolfe, 2017).

In addition, parents' attitudes towards dental visits were significantly associated with their child's dental visits (Wolfe, 2017). A delay in dental visits or a low level of dental care was also commonly associated with mothers' perception of the reduced value of dental health problems due to the temporary nature of primary teeth (Arora, et al., 2012; Nicol, et al., 2014) and mother's negative attitudes towards children's dental care (Mattheus, 2010; Hoeft, et al., 2011). A study in Melbourne, Australia, showed that delays in dental visits among children was mostly because parents perceived no reason for their child's dental visit, and those children were more likely to have dental caries (Christian, et al., 2015). Some parents also showed low awareness about their children's dental care, unless there was a visible dental health problem in their children, such as cavities and tooth staining, or their children complained about dental pain (Schroth, et al., 2010; Smith and Freeman, 2010; Hoeft, et al., 2011; Arora, et al., 2012; Dabawala, et al., 2017). A study in Brazil also found that the presence of dental caries in children increased the likelihood of dental care-seeking behaviours (da Silveira, et al., 2015).

A qualitative study in Canada revealed that the major barrier to dental caries prevention was mothers who did not perceive the importance of early detection. They commonly placed little value on illness-prevention or oral health promotion (proactive) approaches. Rather, they visited a dentist only to seek professional care when dental problems were present (Amin and Perez, 2012). A qualitative study in North Carolina, U.S., also found time constraints as the barrier to getting routine dental check-ups for children. Dentist opening times that did not suit their work schedule often became their reason for delaying their child's dental visit (Collins, et al., 2016). In contrast, mothers who perceived that dental caries in children were nasty due to lack of care were likely to have positive attitudes towards the importance of children's dental care and take their children to regularly visit a dentist to prevent dental caries (Hoeft, et al., 2011). However, two studies reported that dental service

use was not significantly associated with mothers' perceptions of children's oral health and children's need for treatment (Camargo, et al., 2012; Sujlana, et al., 2016).

In addition, parents who showed positive attitudes towards children's oral health did not always reflect that they translated their attitudes into proper oral health behaviours, which could prevent dental caries from occurring in their children (Arora, et al., 2012; Prabhu, et al., 2013). In a high risk population, parents who had a negative attitude towards children's oral health might also find it difficult to change their behaviour through oral health education (Castilho, et al., 2013). Besides which, parents' oral health behaviours were more strongly associated with children's oral health behaviours and children's oral health status rather than parents' attitudes towards their children's oral health. Parents' own childhood and current oral health behaviours might informed parents to adopt particular oral health behaviours for their children (Riggs, et al., 2015).

Maternal oral health behaviours, such as sugar consumption, poor oral hygiene and dental visits, could increase the risk of having children who suffer from dental caries (Phillips, et al., 2016). Mothers might have a tendency to adopt their sugary drinking habits during childhood for their children (Hoare, et al., 2014) or give sweets to their children because they did not want their children to have the similar emotional feelings of loss as they experienced during their own childhood due to limited access to sweets (Herman, et al., 2012; Moore, et al., 2017). However, mothers who suffered dental caries in their childhood might recognize the negative effects of sweet beverages on their children's dental health. As a result, they would prefer their children to drink water instead of sugary drinks to prevent dental caries (Clarke, 2017). In relation to oral hygiene practices, a study in Florida also found a positive association between mother's frequency of tooth brushing and their child's frequency of tooth brushing (Rahbari and Gold, 2015). However, some studies did not find a significant association between parents' tooth brushing frequency and their child's dental caries (Warren, et al., 2016; Östberg, et al., 2017; Hong, et al., 2014).

In addition, parents' dental visits are significantly associated with the child's dental visits (Sujlana, et al., 2016). Delays in children's dental care were also frequently related to parents' experiences in their childhood. Most parents reported to have bad experiences and unpleasant dental treatment in their childhood. These experiences made them feel fear, anxiety and trauma

regarding dental procedures. Some of them also disliked the smells, sights and sounds of the equipment in dental clinics (Smith and Freeman, 2010; Naidu, et al., 2012). Some parents also reported that their dentists blamed them for not looking after their children's oral hygiene. This reduced their confidence to take their children to get dental care (Naidu, et al., 2012). A study also found that a high prevalence of dental caries in children was associated with parents who experienced a fear of dentists (Hooley, et al., 2012). Furthermore, parental neglect was associated with limited dental care which could increase children's vulnerability to dental caries (Mattheus, 2010). However, a longitudinal study in the county of Skaraborg in Southern Sweden did not find a significant association between parents' patterns of dental visit and an incremental increase of caries among children (Östberg, et al., 2017).

2.3.4.5 Children's oral health locus of control

Children's oral health locus of control is closely associated to oral health behaviours and has a predictive effect on children's oral health status. Children's oral health locus of control is a parental attitude or belief of who has control over their children's oral health. The control can come from either an internal or an external source. A mother has an internal oral health locus of control if she believes that she has control over their children's oral health, whereas a mother has an external oral health locus of control if she believes that their children's oral health depends on external factors such as dental health professionals, other people, luck, fate and chance. Mothers who had an internal oral health locus of control were more likely than mothers who had an external oral health locus of control to adopt more oral health-promoting behaviours, have more positive attitudes towards children's dental care, and have better oral health outcomes for their children (Seow, 2012). In some ethnic groups, parents also tended to adopt illness reaction as their oral health approach because they believed that God takes care of people and determines future events (Amin and Perez, 2012). A study in the Netherlands also found a stronger internal oral health locus of control among parents with higher levels of education than parents with a lower educational level (Duijster, et al., 2015a).

Parents' perceived ability to control their child's behaviours was a significant predictor of their child's oral health behaviours (Wolfe, 2017). Children of mothers who had a strong internal oral health locus of control have lower dental caries experience than children of mothers who had an external oral health locus of control (Hooley, et al., 2012; Seow, 2012; Albino, et al.,

2014; Duijster, et al., 2015a; Sujlana and Pannu, 2015). Mothers who had a weak internal locus of control also increased the likelihood of having children who suffered severe dental caries (Smith and Freeman, 2010). However, a systematic review also showed that the association between mothers' oral health locus of control and dental caries was not clear. Some studies found the effects of having a weak internal locus of control on children's dental caries, whereas other studies found no association between mothers' locus of control and dental caries (Hooley, et al., 2012). A few studies also reported no significant association between parents' locus of control and dental caries in children (Weatherwax, et al., 2015; Östberg, et al., 2017; Gomes, et al., 2018b).

2.3.4.6 Parental autonomy

A low level of parental autonomy was frequently associated with poor oral health behaviour. Low parental autonomy was also often associated with dysfunctional parenting styles. Inconsistency, verbosity, using indirect commands and lack of enforcement in parenting style are associated non-compliant behaviours on preschool children (Seow, 2012). Parents who use these parenting styles would find it difficult to restrict their children's sugar consumption or to ask their children to brush their teeth, because their children would either tend to disobey their commands (Hoeft, et al., 2010; Nicol, et al., 2014) or the parents did not want to make their children upset (Hoeft, et al., 2010). Similarly, parents who were coercive, too permissive, lax or too harsh in parenting styles were more likely to have children with aggressive behaviours that would make it difficult for parents to encourage their children to brush their teeth or visit a dentist (Seow, 2012).

With regard to sugar consumption, mothers who had a strong desire to limit their children's sugar intake and adopt supportive parenting styles were successful in restricting their children's sweet beverages (Choy and Isong, 2018). This included setting clear rules of their child's sweetened beverage consumption, being consistent with the rule (Herman, et al., 2012; Choy and Isong, 2018), having the perceived ability to control their child's behaviours in response to the rule (Herman, et al., 2012; Choy and Isong, 2018), eliminating the availability of sweetened beverages at home (Hoare, et al., 2014; Choy and Isong, 2018), encouraging water drinking habits, and having control over their child's beverage choices (Choy and Isong, 2018). Furthermore, children of assertive mothers commonly obeyed their mother's command to not drink

sweet beverages (Hoare, et al., 2014).

The result of interviews with mothers in Australia also showed that despite high frequency of sugary drink consumption in their social environment, some mothers showed a great sense of autonomy by establishing good water drinking habits in early childhood. Role modelling of water drinking habits was used as the strategy of promoting water consumption to children (Hoare, et al., 2014). A mixed methods study in Boston, in the U.S. also highlighted the importance of parents being a positive role model in terms of healthy drinking habits for their child (Choy and Isong, 2018).

In contrast, parents who had less desire to limit their child's sugar consumption and to adopt more permissive parenting style (Choy and Isong, 2018), were less assertive and could not resist their children's urge to eat sweets or snacks (Herman, et al., 2012; Castilho, et al., 2013). The most common reason was a perceived inability to control their child's behaviours, and social pressure (Choy and Isong, 2018). Some parents perceived that despite their knowledge about the role of diet in their children's oral health problems, they had little control over their children's daily diet, particularly when their children became older and made their own choices (Riggs, et al., 2015). Other parents also revealed that they were not able to prevent their children from consuming sugary snacks due to the influence of their surrounding social environment, such as their family, friends and their neighbourhood (Naidu, et al., 2012), meaning that children had easy access to sugary foods and beverages (Hoeft, et al., 2010). In some studies, some mothers succumbed to their children's preference to drink sweet beverages because their children disliked the smell and taste of tap water. They often gave up easily by allowing soft drink consumption or adding cordial or juice into water when their children refused to drink water (Hoare, et al., 2014; Nicol, et al., 2014). As a result, parents who were not able to restrict their children's consumption of sugary foods and beverages increased the risk for suffering dental caries in their children (Isong, et al., 2012; Hong, et al., 2014).

In a study in the U.K., most parents highlighted the importance of parenting skills to successfully performing twice-daily tooth brushing in terms of the establishment of routine setting and behaviour management (Gray-Burrows, et al., 2016). Most parents cited that perceived difficulties in dealing with their child's non-compliant behaviours towards tooth brushing was a barrier to performing twice-daily tooth brushing with their child (Collins, et al.,

2016; Gray-Burrows, et al., 2016). One study in the U.S. also showed that parents who were able to manage their child's behaviours during tooth brushing tended to help their child to brush and spend longer time for their child's tooth brushing routines, and therefore decrease the risk for having dental caries in their children (Collett, et al., 2016). Several studies also found that parents who adopted authoritative parenting styles were more likely than parents who adopted authoritarian or permissive parenting style to have children who showed more positive behaviour during dental visits (Aminabadi, Deljavan, Jamali, Azar, and Oskouei, 2015; Howenstein, et al., 2015), less anxiety (Aminabadi, et al., 2015) and less dental caries (Howenstein, et al., 2015). A case study also stated that children who had severe dental caries was a result of child abuse and neglect because of insufficient parenting, including in dental care (Smitt, Mintjes, Hovens, Leeuw, and de Vries, 2018).

Regarding the role of parenting style in the development of dental caries, a study found an association between parenting style and dental caries (Seow, 2012), whereas in another two studies, this association was not found (Hooley, et al., 2012; Dabawala, et al., 2017). A study in the Netherlands found a significant difference in parenting practices between parents of children who had dental caries and parents of children who were caries-free, in terms of positive involvement, encouragement, and problem-solving. No significant differences in parenting practices were found with regard to routines, structures, discipline, coercion, and interpersonal atmosphere (Duijster, et al., 2015a). A systematic review also showed that the impact of child-rearing abilities on children's dental health status depended on parents' ability to encourage their children to pursue good oral health behaviours (Castilho, et al., 2013). This included the management of children's behavioural problems such as their resistance to tooth brushing (Hoeft, et al., 2010; Castilho, et al., 2013; Marshman, et al., 2016), and parental supervision of child's behaviours (Levin, et al., 2017), which became a common barrier to performing proper oral health behaviours.

In addition, the success of gaining a great sense of parental autonomy was determined by child temperament. Children who had difficult temperaments increased the likelihood of suffering severe dental caries than children with easy temperaments (Slabšinskienė, et al., 2010). Child temperament or emotional reactions of children, such as being upset or scared, also often prevented parents from pursuing proper oral health behaviours (Huebner and Riedy, 2010; Hoare, et al., 2014). A systematic

review reported that children with difficult temperaments were more likely than children with easy temperaments to sleep with a bottle containing milk, but were less likely to have twice-daily tooth brushing. As a result, children with difficult temperaments were more likely than children with easy temperaments to suffer dental caries at an earlier age (Hooley, et al., 2012).

Similarly, parents who experienced child behaviour management problems during previous dental visits were also associated with a high rate of dental caries in children, because parents commonly perceived a lack of power to manage their children's behaviours; and this might predict the likelihood of engaging in less favourable oral health behaviours (Hooley, et al., 2012). Only two studies showed that children's fear for going to the dentist was not significantly associated with dental service use (Camargo, et al., 2012; Christian, et al., 2015).

2.3.4.7 Self-efficacy

Self-efficacy was one of the facilitators of performing good oral health behaviours. Self-efficacy refers to the extent to which parents feel confident about their ability to successfully engage in a particular oral health behaviour to maintain their children's oral health (Albino, et al., 2014) – for example, the parents' perceived ability to limit their child's sugar consumption demonstrated to high levels of self-efficacy. They tended to believe that limiting sugar consumption was beneficial to their children's health (Herman, et al., 2012) and had a strong desire and intention to limit their children's sugar intake (Herman, et al., 2012; Choy and Isong, 2018). As a result, their child would be less likely to consume sweetened beverages (Choy and Isong, 2018). A study in Northern Ireland also found that parents of children who were caries-free were more likely than parents of children who had dental caries to have higher self-efficacy, to control sugar consumption, by setting the rules and structure and restricting the availability of sugary snacks and beverages in the home (O'Malley, et al., 2018).

Regarding oral hygiene practices, parents' perceived lack of skills and confidence to properly brush their child's teeth was a barrier to performing their child's tooth brushing routine (Gray-Burrows, et al., 2016). Parents who were able to perform their children's tooth brushing routines demonstrated higher levels of self-efficacy than parents who were not able to perform their children's tooth brushing routines (Huebner and Riedy, 2010). To increase children's cooperation for tooth brushing, they tried to make tooth brushing

activities as fun as possible through playing, singing, brushing while watching a video or brushing in different locations. Some parents also provide visual reminders to encourage their children to brush their teeth such as checklists, charts hung in plain sight or stickers as an incentive (Huebner and Riedy, 2010).

In contrast, parents who were not able to perform their children's tooth brushing routines perceived that they lacked the competence to encourage their children to brush their teeth and they were likely to have poor oral hygiene (Hoeft, et al., 2010). They also did not know what to do when their children did not want to open their mouth or refuse to brush their teeth. They tended to have less power to increase children's cooperation for tooth brushing (Huebner and Riedy, 2010).

Parents' perceived lack of confidence about proper tooth brushing techniques and skills was also the common barrier to performing regular tooth brushing (Huebner and Riedy, 2010; Castilho, et al., 2013). They were reluctant to brush their children's teeth because they feared hurting their children's mouth while brushing (Huebner and Riedy, 2010). Parents who were less insistent with tooth brushing were also significantly associated with irregular frequency of child's tooth brushing routine and dental caries in children (Trubey, et al., 2015a), particularly in the absence of parental assistance in tooth brushing (Sujlana and Pannu, 2015).

In addition, a low rate of dental care was associated with parents who perceived lack of self-efficacy to access and effectively use dental care. They lacked the confidence to interact with dental professionals and to navigate the oral healthcare system (Amin and Perez, 2012). Furthermore, early preventive dental visits were prevalent among children whose parents who had high self-efficacy (Askelson, et al., 2015). However, two studies in the U.S. and the Netherlands found no significant difference in self-efficacy between parents of children who had dental caries and those who were caries-free. In a systematic review, a sense of competence was also not associated with dental caries in children (Hooley, et al., 2012).

2.3.4.8 Sense of coherence

Sense of coherence is defined as the extent to which the world makes sense and is meaningful for parents (Albino, et al., 2014). A cross-sectional study in the city of Campina Grande, Brazil, showed that parents who have a low sense of coherence, increased the risk of dental caries in their children

(Gomes, et al., 2018b). A systematic review reported an association between a low sense of coherence and high rate of dental caries in children. Parents who have a low sense of coherence made less effort to change behaviours due to their perceived lack of power. This may predict the likelihood of engaging in less favourable oral health behaviours (Hooley, et al., 2012). Another study also found a significant difference in sense coherence between parents of children who had dental caries and children who were caries-free. A sense of coherence related to comprehensibility and meaningfulness was higher among parents of children who were caries-free than children who had dental caries (Albino, et al., 2014).

2.3.4.9 Stress

Parents' psychological stress may predispose children to a risk of dental caries. Some studies showed that compared to caries-free children, children who suffered dental caries had higher levels of parental distress (Albino, et al., 2014) and general stress (Seow, 2012; Masterson and Sabbah, 2015). In a review, a stressed mother tended to neglect their children's oral hygiene practices, and was too permissive in allowing sugary foods, snacks and beverages as a substitute for their attention to their children due to daily stressful conditions. These behaviours might predispose children to a high risk of dental caries (Seow, 2012; Masterson and Sabbah, 2015). A qualitative systematic review also found that caregivers were inclined to offer sugary snacks to their child when they experienced competing demands and needed peace and quiet, such as being busy, tired, rushed or struggling to deal with negative emotions or difficult life conditions (Moore, et al., 2017).

High parenting stress was found to be a significant predictor of children's dental caries, but no significant association was found between parent-child dysfunction interaction and dental caries (Menon, et al., 2013). Parenting stress was commonly linked to a late first dental visit and poor oral hygiene practices and dietary habits for their children that might increase the risk for early childhood caries (Seow, 2012).

In addition to parenting stress, maternal stress may come from diverse sources such as economic pressure, socially disadvantaged conditions, life events and family functions and interactions (Seow, 2012). Maternal psychological stress could be associated with dysfunctional parenting styles (Seow, 2012). A prior qualitative study in the U.K. found that stressful life events as the most common parents' perceived barriers to provide adequate

tooth brushing supervision to children (Marshman, et al., 2016). Maternal poor mental health was also a significant factor of a delay in children's dental visits, and was significantly associated with child's poor oral health outcomes (Yang, et al., 2016). In the U.S., stress related to location was also higher among parents of children who had dental caries than children who were caries-free. However, there was no significant difference between parents of children who had dental caries and parents of caries-free children in stress-related personal expectations, community family dysfunction, community risky behaviour and community economic distress (stress due to disruptive issues in the community) (Albino, et al., 2014).

In addition, depression and anxiety are signs of parenting stress. An association was found between depressed mothers and dysfunctional parenting styles. Depressed mothers commonly have a low sense of parenting competence and have inadequate coping strategies to cope with the normal demands of child rearing (Seow, 2012). Parents or caregivers with depression symptoms or with a low capacity in coping with stress were associated with high rate of dental caries in children (Al-Jewair and Leake, 2010; Hooley, et al., 2012; Dos, et al., 2017). Mothers with anxiety and limited coping skills commonly made less effort to change behaviour due to their perceived lack of power (Hooley, et al., 2012). They also tended to adopt poor oral health behaviours for their children, such as poor dietary habits, poor feeding practices and poor oral hygiene practices that exposed their children to a higher risk of early childhood caries (Hooley, et al., 2012; Seow, 2012). Furthermore, maternal depressive symptoms and anxiety were positively associated with children's dental fear (Costa, Correa, Goettems, Pinheiro, and Demarco, 2017). Only one study reported that common mental disorders of mothers/caregivers, including depression and anxiety, were not significantly associated with dental care access of children, the frequency of daily tooth brushing, night nursing, dental caries history and caries incidence (Almeida, Vianna, Cabral, Cangussu, and Florian, 2012).

2.3.4.10 Social support

The availability of social supports also plays an important model in encouraging and helping parents/caregivers to maintain their children's oral health (Collins, et al., 2016). Parental social support measured the availability of any help from others when parents needed it (Albino, et al., 2014). Supportive social environments, availability of fluoridated community water

(Mattheus, 2010; Dabiri, Fontana, Kapila, Eckert, and Sokal-Gutierrez, 2016; Schluter and Lee, 2016), healthy food choices, transport resources and culture supporting health promotion played a role in reducing children's vulnerability to dental caries (Mattheus, 2010). Parents' perceived social support in relation to informational support, appraisal support, emotional support and instrumental support increased the likelihood of parents having good oral health knowledge, and positive attitudes towards children's oral health, and therefore engaging in favourable oral health behaviours (Huebner and Riedy, 2010; Scheiwe, Hardy, and Watt, 2010; Vichayanrat, Steckler, Tanasugarn, and Lexomboon, 2012; Raj, et al., 2013; Mathu-Muju, McLeod, Donnelly, Harrison, and MacEntee, 2017).

Dental caries was also lower among children who had access to preventive oral health programs compared to children who had no access to preventive oral health programs (Lemos, Barata, Myaki, and Walter, 2012; Murphy, Burch, Dickenson, Wong, and Moore, 2018). A retrospective study in El Salvador also found a significant reduction in dental caries among children aged 3–6 years after the implementation of community-based preventive oral health intervention programs through the incorporation of a community oral health education and fluoride supplementation program (Dabiri, et al., 2016). A review also showed that community-based intervention programs involving lay people or community health workers in the implementation of the program, such as through oral health counselling and education, fluoride varnish applications to children, and dental screenings, were considered effective in preventing the incidence of dental caries (Albino and Tiwari, 2016). A systematic review also showed that oral health interventions through counselling/oral health education, topical fluoride application, and dental examination were effective in reducing the prevalence of dental caries in children aged 0–5 years (Smith, et al., 2018). A cross-sectional study in the city of Fortaleza, Brazil, also showed that children whose parents received conditional cash transfer programs aiming to reduce poverty and inequality had a lower risk of having dental caries than children whose parents did not receive the program (Calvasina, et al., 2018). In contrast, children's vulnerability to dental caries increased because of the absence of community based services, community dental programs, healthcare providers, low cost of dental treatment, family and social support, community efforts endorsed by nursing, and lack of community access to dental services where dental examination, parental education and dental treatment can occur to prevent

dental diseases (Mattheus, 2010). Furthermore, living areas influenced parents' eagerness for health information and oral health knowledge (Arora, et al., 2012).

Social networking and peer support can also help to link parents/caregivers with and benefit from resources aiming to promote children's oral health such as through community programs (Collins, et al., 2016). Focus group discussions with parents from different ethnicities in Canada also revealed that social support from community health workers and community programs helped mothers to find and interact with health service providers, because mothers in low-income family or new comers commonly lacked the confidence to interact with dental professionals and to navigate the oral healthcare system (Amin and Perez, 2012). Furthermore, social supports from dentists was influential in encouraging parents to look after their children's teeth by adopting healthy oral healthcare habits (Nicol, et al., 2014). A study in Lewis County, in the U.S. also showed that providing oral health educational information combined with direct instructions, tooth brushing practice and peer support problem solving significantly increased parents' knowledge of children's oral health, parents' attitudes towards the importance of tooth brushing, and parents' self-efficacy for tooth brushing; and, therefore, increased the number of parents who brushed their child's teeth twice a day (Huebner and Milgrom, 2015). In contrast, parents who had limited social support commonly had less adequate coping skills than their counterparts and chose to engage in unhealthy behaviours for themselves and their children (Mattheus, 2010). However, in some studies, dental caries experience was not significantly associated with parents' perceived social support (Scheiwe, et al., 2010; Vichayanrat, et al., 2012; Raj, et al., 2013; Duijster, et al., 2015a; Lim, et al., 2015).

Oral health education and counselling was important and effective for preventive strategies (Skeie and Klock, 2018; Choy and Isong, 2018), to improve oral health behaviours (Albino and Tiwari, 2016), and decrease the risk of having dental caries in children (Masumo, et al., 2012b; Schroth, et al., 2015; Albino and Tiwari, 2016; Memarpour, Dadaein, Fakhraei, and Vossoughi, 2016; Si, Guo, Yuan, Xu, and Zheng, 2016). Oral health education was significantly associated with an increase in parental knowledge about children's oral health (Memarpour, et al., 2016; Si, et al., 2016; Hoeft, Barker, Shiboski, Pantoja-Guzman, and Hiatt, 2016; Makvandi, Karimi-Shahanjarini, Faradmal, and Bashirian, 2015) and the improvement in parents' attitudes

towards oral health in early childhood (Schroth, et al., 2015; Makvandi, et al., 2015). Informational support received by parents through oral health education could increase perceived behavioural control (Makvandi, et al., 2015) and facilitate the establishment of good oral health behaviours such as reducing sugar consumption, oral hygiene practice and regular dental check-ups (Naidu, Nunn, and Irwin, 2015; Webster, et al., 2011; Isong, et al., 2012; Masumo, et al., 2012b; Van den Branden, et al., 2014; Ionta, et al., 2015; Makvandi, et al., 2015; Riggs, et al., 2015; Schroth et al., 2015; Memarpour, et al., 2016; Hoeft, et al., 2016, Soussou, et al., 2017; Choy and Isong, 2018), or at least influence parents' intentions to engage in good oral health behaviours both for themselves and their child (Arpalahti, Järvinen, Kommonen, Tolvanen, and Pienihäkkinen, 2016).

In addition, in order to be effective in giving informational support to parents regarding children's oral health through oral health education, education materials such as videos, leaflets (Gray-Burrows, et al., 2016), booklets (Makvandi, et al., 2015), and pamphlets (Choy and Isong, 2018), should use short, simple sentences in the parents' own language (Nicol, et al., 2014), use less medical terminology (for non-dental users) (Nicol, et al., 2014; Gray-Burrows, et al., 2016), use pictures as illustrations (Nicol, et al., 2014), use interactive visual demonstration (Gray-Burrows, et al., 2016), and use culturally appropriate models (Nicol, et al., 2014; Braun, et al., 2016). Parents tend to not follow oral health information that conflicted with their own beliefs (Riggs, et al., 2015). A quasi-experimental study in Southern Brazil also showed a lower prevalence of dental caries among children whose mothers received oral health education with brief verbal instructions than children whose mothers received oral health education from a pamphlet (Azevedo, Romano, Correa, Santos, and Cenci, 2015). However, a cross-sectional study in Xianjing, China found a higher prevalence of dental caries among children whose parents received oral healthcare instructions (Li, et al., 2017). A few studies also found that informational support was not significantly associated with dental caries (Senesombath, et al., 2010) and the utilisation of dental health services (Camargo, et al., 2012).

The risk for dental caries was also influenced by residential location and living conditions in relation to the access to health resources. The prevalence of dental caries was higher among children who lived in more isolated areas with lower socioeconomic levels (Phipps, et al., 2012). Geographical isolation may limit access to dental services that were one of

necessary supports required by parents (Hooley, et al., 2012). For example, in Sudan, there was no dental clinic in rural areas. If available, they did not have a dentist but only a technician who focused on deciduous teeth extraction rather than dental caries prevention. In Nigeria, although dental caries prevention services were available, the services were very expensive and could only be accessed by people who lived in cities. In Iran and Iraq, good and affordable oral healthcare was available. They also promoted children's oral health on television. However, war had often disrupted it. Meanwhile, in Kuwait, Bedouins had no access to oral health services served by the government because they were not acknowledged as citizens by the state (Nicol, et al., 2014). Furthermore, the result of interviews in the U.S. showed that perceived difficulty to access dental care for their children was commonly because most dentists refused to take care children under three years old (Hoeft, et al., 2011).

In Canada, ignorance of the existing publicly funded dental programs, preventive dental services and available resources, which provided assistance in dental health coverage to low-income families also became a barrier for mothers to utilize professional preventive dental care (Amin and Perez, 2012). A study in Melbourne, Australia, with a sample of children aged 1–4 years old and their families from migrant backgrounds, also showed that children's dental visits were significantly associated with parental awareness of where to see a dentist (Christian, et al., 2015). Deprivation also influenced the severity of dental caries because children who lived in poor areas were more likely to have difficulty accessing dental health services, particularly for preventive dental care, than children who lived in rich areas (Levin, et al., 2010; Davies, et al., 2011; McMahon, et al., 2011; Arora, et al., 2012; Tubert-Jeannin, et al., 2012; Vargas, et al., 2014; Dantas, et al., 2015). However, although a high incidence of dental caries was significantly associated with parents' perceived difficulty in accessing dental care for their children, parents who perceived no difficulty in accessing dental care for their children did not always predict a high rate of dental service use (Kopycka-Kedzierawski and Billings, 2011).

In addition to limited dental resources, including dentists, in the remote areas, dental caries were significantly associated with the lack of fluoridated water. Children who lived in villages with non-fluoridated water significantly increased the risk for having dental caries severity 3.5 times higher than children who lived in villages with fluoridated water (Centers for Disease,

Control and Prevention, 2011). A study in the Logan-Beaudesert district in the state of Queensland, Australia, also showed a significant decrease in the prevalence and the severity of dental caries among children after 36 months of water fluoridation (Koh, et al., 2015).

In addition, social supports derived from school education through parent/teacher network in schools, such as meetings, a workshop or school programs related to children's dental health education, was considered to be able to help parents to get information about how to maintain oral health in preschool children (Naidu, et al., 2012; Collins, et al., 2016). For example, school education through teachers, school services, peer groups and the provision of information to parents were influential in encouraging healthy eating habits for children and their families (Nicol, et al., 2014). Tooth brushing programs and activities in school were proven to effectively reduce the severity of dental caries (Macpherson, Anopa, Conway, and McMahon, 2013) and reduce caries incidence among preschool children (Petersen, et al., 2015). A systematic review showed that school teachers were an important support mechanism in children's oral health education by encouraging children to engage in good oral health habits and restricting sugary foods and drinks consumption during school time (Castilho, et al., 2013; Choy and Isong, 2018). In deprived areas, the absence of oral health promotion programs in schools increased the likelihood of having a high severity of dental caries in children (Tubert-Jeannin, et al., 2012).

Early oral health education and preventive measures were essential to preventing dental caries in children. Oral health education and promotion programs which provide adequate information on children's dental care, including favourable oral health habits and attitudes are helpful in increasing the level of knowledge and to change attitudes and belief (Castilho, et al., 2013). The acquisition of oral health knowledge through oral health education may lead to motivation and in turn behavioural change (Baghdadi, 2011). However, a study showed that although oral health education in schools was effective to increase mother's awareness of children's oral health, an increase in awareness did not necessarily reflect on behaviours. No changes in mothers' behaviours after oral health education was found in this study (Hoeft, et al., 2010). Furthermore, a review showed that school-based dental caries prevention programs mostly aimed at encouraging students to establish and maintain positive oral health practices. However, none of studies about school-based programs clearly demonstrated efficacy of school-based dental

caries prevention programs for preventing dental caries (Albino and Tiwari, 2016).

A systematic review of oral health intervention also proposed a multilevel approach to reducing paediatric oral health disparities, because oral health education alone was not able to reduce the prevalence of dental caries. Educating lay communities to counsel caregivers of preschool children as well as media campaigns promoting the prevention of dental caries can reduce the prevalence of dental caries in children, but more intensive support was required for children in high-risk communities. Funding and structural supports were required to implement ongoing prevention oral health programs aiming at reducing dental caries in children. School based promotion programs and services can also improve paediatric oral health outcomes through prevention-oriented health providers (Al-Sadhan, 2003).

In addition, oral health behavioural changes should include dietary modification, oral hygiene and dental visits. To achieve this, support should be given through educating parents about the benefits of reducing the frequency of sugar-sweetened beverages, encouraging the consumption of water or zero-calorie beverages, educating parents about the benefits of brushing with fluoridated toothpaste, teaching and enforcing proper tooth brushing technique followed by tracking tooth brushing behaviours and assessing the improvement in oral health, and encouraging parents to have regular dental visits to receive direct preventive care by educating them about the benefits of it. Support for families can be given by educating and encouraging mothers to prepare healthy meal and snacks, reducing sugar-sweetened beverage intake and enforcing regular tooth brushing with a fluoridated tooth paste. Providing free toothbrushes and toothpaste at regular intervals can also become another form of support to overcoming the barriers to regular tooth brushing (Al-Sadhan, 2003).

Support for community level can be derived from school board or community leaders to restrict access to sugar-sweetened beverage by prohibiting sugar-sweetened beverage companies to place their vending machines in school, enacting the tax of sugar-sweetened beverage, building healthy stores which sell only healthy food and beverages, promoting water consumption or developing fluoride milk programs in areas where there is fluoride contained in water (Al-Sadhan, 2003). In macro environment, support can be derived from a policy aiming at restricting access to sugar-sweetened beverage, such as reducing or eliminating transportation subsidies to rural or

remote areas (Al-Sadhan, 2003; Chi, 2013), restricting colourful packaging and small size bottle of sweetened beverages that was considered as a part of marketing to attract children's attention to purchase by some mothers (Hoare,et al., 2014), and restricting advertising and marketing as they influence parents' foods choice for their child (Moore, et al., 2017). Finally, at a national level, support for behavioural changes in relation to dietary habits could be provided by strengthening the regulation of food labelling, restricting unhealthy food advertisement, increasing taxation of unhealthy food, improving access to healthy food and banning on the sales of unhealthy and sugary foods and beverages around school (Al-Sadhan, 2003).

2.3.4.11 Social environments

Social environment was commonly associated with children's dental caries. Social environment had an influence on children's sugar consumption and often gave children access to sugary foods and beverages that became a barrier to most mothers to prevent their children consuming sugar (Hoeft, et al., 2010; Kawashita, et al., 2011; Amin and Perez, 2012; Herman, et al., 2012; Naidu, et al., 2012; Hoare,et al., 2014; Moore, et al., 2017). The accessibility of sugary foods and beverages impacted on an increase in sugar consumption and played an important role in the development of dental caries in children (Riggs, et al., 2015). A qualitative study found that children with a high risk of dental caries appeared to have easy access to sugary snacks, such as by living near highway or stores, and also tended to consume processed-food (Levin, et al., 2017). In contrast, children with low risk of dental caries appeared to live in remote or rural area, and tended to consume foods from family farms (Levin, et al., 2017).

Pressures from surrounding social environments, such as family, their children's friends at school and neighbourhood were other obstacles for mothers who attempted to restrict sugar consumption (Naidu, et al., 2012; Moore, et al., 2017). Family members and social settings, such as parties or other special occasions, were frequently reported allow their children to consume sweet beverages (Hoare,et al., 2014). A qualitative systematic review also found that caregivers were inclined to offering sugary snacks to their child in special occasions or celebrations (Moore, et al., 2017).

A cross-sectional study in North East London also found a significant association of family functioning and the frequency of sugary foods consumption among children (Nanjappa, et al., 2015). Most mothers perceived to lack support to limit their children's sugar intake, because when

they children got sweet from other family members, they could not argue or asked them to stop giving sweet to their children (Herman, et al., 2012). A mixed-methods study in Boston, in the U.S., also found that family attitudes towards limiting sweetened beverages among children were associated with parents' intention to limit their child's sweetened beverages (Choy and Isong, 2018). With regard to dental visits, motivation for the first dental visit may also come from social environments surrounding parents (external prompts), such as recommendation from paediatrician, school requirement, recommendation from a variety of social and welfare service providers (Women, Infants and Children Nutrition site, continuation school and community centre) and family members (Hoeft, et al., 2011).

In addition, social environments also influenced parents' oral health beliefs. Family background, experiences and culture and also friends play an important role have a great influence on parental belief about children's oral health and children's oral healthcare (Isong, et al., 2012; Gray-Burrows, et al., 2016). If families and friends surrounding parents believed that baby teeth are not important and there were no long-term consequences of dental caries because of the temporary nature of the primary teeth, parents would be likely to cling to the belief. Parents who had a fatalistic belief about baby teeth were less likely to engage in favourable oral health behaviours and place a low importance of dental visits. Consequently, their children were prone to dental caries (Isong, et al., 2012).

A mixed methods study in Boston, U.S.A. also found that family and social environments, in terms of sweetened beverages culture and practices were the greatest barriers to limiting the child's sweetened beverages intake. The most common reason was because of the availability of sweetened beverages in the home and in social environments (Choy and Isong, 2018). A qualitative systematic review also found that caregivers were inclined to offer sugary snacks to their child when sugar snacking was a part of family culture or other children consumed sugary snacks (Moore, et al., 2017). Furthermore, parents' perceived subjective norm was a significant predictor of sugar snacking behaviours and dental visit patterns in their children (Wolfe, 2017). Parents' perception of how frequently other parents in their social environment brushed their child's teeth was also significantly associated with their child's frequency of tooth brushing (Trubey, et al., 2015b).

In addition, living areas influenced the prevalence and the severity of dental caries (Levin, et al., 2010; Slabšinskienė, et al., 2010; Castilho, et

al., 2013; Hoffmeister, et al., 2016; Cabral, a et al., 2017; Li, et al., 2017; Sun, et al., 2017b; van der Tas, et al., 2017). Children who lived in rural areas had a higher prevalence and severity of dental caries than children who lived in urban areas (Narksawat, et al., 2011; Oulis, et al., 2012; Castilho, et al., 2013; Corrêa-Faria, et al., 2013; Zhang, et al., 2014; Zhang, et al., 2016). However, some studies reported a higher prevalence and severity of dental caries among children in urban areas than children in rural areas (Levin, et al., 2010; Bayat-Movahed, et al., 2011; Sufia, et al., 2011), Other studies also found no significant difference in the prevalence, the severity, and the incidence of dental caries between children who lived in rural areas and children who lived in urban areas (Anderson, et al., 2010; Bayat-Movahed, et al., 2011; Li, et al., 2011; Baginska, et al., 2013; Raj, et al., 2013; Zhang, et al., 2013; Corrêa-Faria, et al., 2016b).

Living areas influenced the exposure to sugary beverages. A high consumption of sugary beverages was found in living areas where access to sugary beverages was easy (Steyn and Temple, 2012; Castilho, et al., 2013; Nicol, et al., 2014). A study also found that children who lived in urban areas were more likely to started brushing early than those in rural areas (Sun, et al., 2017b). With regard to dental visits, a higher frequency of children who had a history of dental visits was found in metropolitan areas than in non-metropolitan areas (Beil, et al., 2014). Only one study did not find a significant association between area of residence and dental visits (Sujlana, et al., 2016).

2.4 Knowledge gap

From the literature review, dental caries remained the most prevalent chronic childhood diseases around the globe. Although a general decline in dental caries was evident in children in developed countries, dental caries were still a major problem for children in developing countries and in some indigenous and minority populations in both developed and developing countries. Dental caries in children did not only affect their physical wellbeing, but also their social and psychological wellbeing. It also had impacts on the wellbeing of the family. A large number of epidemiological studies demonstrated the significant role of behaviour in the development of dental caries among children. Poor dietary habits, poor oral hygiene practice and poor dental attendance were key behaviours explaining the presence of dental caries in children.

With regard to high prevalence, high costs of dental treatment, and its significant impact on the quality of life, studying levels and emerging patterns of behavioural determinants of

dental caries in children is fundamental to designing appropriate oral health promotion programs and preventive activities. From the literature review, many studies have highlighted psychosocial determinants of dental caries in children; however, to what extent each factor can influence the development of oral health behaviours and affect dental caries in children is still unclear and remains poorly understood. If poor oral health-related behaviours can account for dental caries inequality in young children, then developing an explanatory model of the underlying determinants of oral health behaviours and choices may provide a valuable perspective on why some young children suffer dental caries whereas others are caries-free.

In addition, social cognitive theory (SCT) is one of the psychosocial theories that have been widely applied to health-related behaviours (Bandura, 1998). From a SCT perspective, behaviour is influenced by multiple determinants, covering both individual and socio-environmental factors (Redding, Rossi, Rossi, Velicer, and Prochaska, 2000). SCT explains how personal and socio-environmental factors impact on a behaviour that contributes to human health (Bandura, 1998). SCT recognizes the dynamic interaction between individual, socio-environment and behaviours as the determinants of health outcomes. Behaviours are the result of observational or experiential learning from environments surrounding an individual, for example through observing someone's behaviour or personal experience (Bandura, 1998; Redding, et al., 2000). The results of such learning from the environment will strongly influence an individual's internal factors and vice versa. In SCT, personal and socio-environmental factors may act as determinants for each other to develop behaviours. The changes of internal (individual) and external (environmental) factors may then contribute to the development of behaviours (Redding, et al., 2000). Therefore, by putting the interaction between the internal and external properties that make-up individual behaviour into consideration, the process by which these internal and external properties work and are drawn upon by the individual, may be fully understood.

This study was conducted in Surabaya, Indonesia. In the WHO region of South East Asia (SEARO), Indonesia is in the category of risk for the highest severity of dental caries (Moreira, 2012). East Java Province is one of the provinces in Indonesia that has the severity of dental caries higher than the national average (Health Research and Development Board, 2013). In East Java Province, the majority of dentists are located in Surabaya, which is the capital of East Java Province. Surabaya has the highest ratio of dentist to population that reaches 47.9 dentists to 100.000 populations. This ratio has far exceeded the target for the *Healthy Indonesia* goal set by the Indonesian government in the province level (The Ministry of Health Republic of Indonesia, n.d.). Despite the adequacy of ratio for dentist to population and the presence of dental health curriculum in most preschools in Surabaya, dental caries remains prevalent among preschool children. Recent study in two preschools in Surabaya found a high prevalence of dental caries among young children aged 4–5 years old, namely is

88.24% and 83.4% (Hadi, 2014). However, to the best of my knowledge as a dentist and dental public health practitioner in Surabaya, dental caries studies for this age group in Surabaya are still limited. Furthermore, there are few epidemiological studies conducted in Surabaya regarding oral health behaviours and dental caries among preschool children in Surabaya. In particular, there is no study about the underlying determinants of oral health behaviours and dental caries among preschool children in Surabaya from the perspective of social cognitive theory. Therefore, there is a need to conduct research to understand the issue of dental caries among preschool children in Surabaya in more detail.

2.5 The purpose of study

The overall purpose of this study is to develop an explanatory model of factors underlying inequality in dental caries in young children aged two to six years old in Surabaya, Indonesia, in relation to oral health behaviours. Further subsidiary aims and objectives of this study are as follows:

Aim 1: To assess the prevalence and the severity of dental caries in young children aged two to six years old in Surabaya, Indonesia.
Objective 1: Conducting oral examinations and calculating the prevalence and the severity of dental caries in young children aged two to six years old in Surabaya, Indonesia based on quantitative data.

Aim 2: To examine the association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia.
Objective 2: Conducting an oral health survey and aggregating data from oral examinations and the survey to analyse the association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia.

Aim 3: To examine the association between the dental caries experience and quality of life of young children aged two to six years old and their families in Surabaya, Indonesia.
Objective 3: Conducting a questionnaire oral health survey and aggregating data from oral examinations and the survey to analyse the association between the dental caries experience and quality of life of young children aged two to six years old and their families in Surabaya, Indonesia.

Aim 4: To explore and explain parents' personal and socio-environmental factors influencing oral health behaviours and dental health outcomes in young children aged two to six years old in Surabaya, Indonesia.

Objective 4: Conducting in-depth interviews with parents of children in both the caries and caries-free groups and analysing the qualitative data from the interviews to identify parents' personal and socio-environmental factors influencing oral health behaviours and dental health outcomes in young children aged two to six years old in Surabaya, Indonesia.

From the review of oral health-related behaviours and early childhood caries literature, I developed following research questions:

1. Is there an association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia?
2. Is there an association between the dental caries experience and quality of life of young children aged two to six years old in Surabaya, Indonesia and their families?
3. What are the factors influencing oral health behaviours among young children aged two to six years old in Surabaya, Indonesia who suffer from dental caries and those who are caries free?

In order address these research questions, I undertake a mixed method study to get a better understanding about the difference of oral health related behaviours between young children who have caries and those who are caries free (quantitative study) and the underlying psychosocial determinants of those differences (qualitative study) in Surabaya. By using social cognitive theory as a theoretical framework, the result of this study may offer a holistic understanding of the psychosocial circumstances that lead parents to adopt either proper oral health behaviours or poor oral health behaviours for their children. Therefore, the findings may inform policy makers and dental public health professionals, particularly in Surabaya, in their efforts to reduce caries prevalence in young children through a specific behavioural intervention program in Surabaya. The methodological approach for this study will be discussed in detail in the next chapter (Chapter 3).

CHAPTER 3
RESEARCH METHODOLOGY

This chapter discusses the mixed-method approach taken in this study. It was considered the most appropriate approach for answering the research questions. Table 6 presents how this study addresses the research questions by considering its research questions, aims, methodological approach, methods, and results.

Table 6. Linking research questions, aims, methodological approach and results

Research questions	Aims	Methodological approach	Methods	Results
Is there an association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia?	1. To assess the prevalence and the severity of dental caries in young children aged two to six years old in Surabaya, Indonesia. 2. To examine the association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia.	Quantitative methodological approach	1. Oral examinations 2. Questionnaire and oral health survey	1. The prevalence and severity of dental caries. 2. The association between oral health behaviours and dental caries experience.
Is there an association between the dental caries experience and quality of life of young children aged two to six years old in Surabaya, Indonesia and their families?	To examine the association between the dental caries experience and quality of life of young children aged two to six years old and their families in Surabaya, Indonesia.	Quantitative methodological approach	Questionnaire and oral health survey	The association between dental caries experience and quality of life of young children aged two to six years old and their families in Surabaya.
What are the factors influencing oral health behaviours	To explore and explain parents' personal and socio-	Qualitative methodological approach	In-depth interviews with parents of children in both the caries and	1. Parents' personal and socio-environmental factors

among young children aged two to six years old in Surabaya, Indonesia who suffer from dental caries and those who are caries free?	environmental factors influencing oral health behaviours and dental health outcomes in young children aged two to six years old in Surabaya, Indonesia.		caries-free groups (from the quantitative phase of the study).	influencing children's oral health behaviours and dental health outcomes. 2. Pathways through which parents' personal and socio-environmental factors influenced parents' decisions to adopt a particular oral health behaviour for their child.

In this study, the results of the quantitative approach provide a snapshot of the association between oral health behaviours and dental caries, whereas the results of the qualitative approach reveal the difference in the parents' personal and socio-environmental factors that influence their children's oral health behaviours between children in the caries and caries-free groups. The qualitative results also reveal pathways through which parents' personal and socio-environmental factors influenced their decision to adopt a particular set of oral health behaviours for their children. Therefore, the integration of the results of both the quantitative and qualitative approaches provide a thorough understanding as to why some children suffer from dental caries, but others are caries-free. This chapter is divided into six sections: the methodological approach, methods, participants, ethical considerations, procedures, and data analysis. In each section, the quantitative and qualitative approaches are discussed in turn.

3.1 Methodological Approach

In order to answer the research questions, the researcher has used a mixed-method approach, as mentioned earlier. A mixed-method approach is a methodological approach of inquiry that purposefully collects, analyses, and integrates both quantitative and qualitative data into a single study (Creswell, 2014; Creswell and Clark, 2011). There is a continuing debate concerning the paradigmatic foundations for supporting mixed-method research. The concept of a paradigm as an epistemological stance is dominant in social science research methodology, and it has a major influence on discussions about the possibility of conducting mixed-method research. This version of a paradigm draws attention to the trilogy of the philosophy of knowledge, containing assumptions related to the nature of reality (ontology), the nature of knowledge (epistemology), and methodological assumptions to produce

knowledge in an appropriate way. The tenets of ontology, epistemology, and methodology set the boundaries of the paradigms (Morgan, 2007). Some researchers who have relied the paradigm as an epistemological stance believed that mixed-method research is impossible due to the incompatibility of the paradigms underlying the methods. They argued that each method has its own philosophical principles that are impossible to combine and should therefore be distinguished from each other (Teddlie and Tashakkori, 2003; Morgan, 2007). Furthermore, different research paradigms generate different types of knowledge (Morgan, 2007).

In contrast, other researchers rejected the tenets of paradigm incompatibility and believed that conducting mixed-method research is possible with some different assumptions. First, some argued that there is no link between paradigms and methods because paradigms and methods do not depend on one another. Second, mixed-method research is possible if the paradigms underpinning the methods are kept separate to acknowledge the strengths of each. Third, multiple paradigms should be used as the foundation for mixed-method research because all paradigms are invaluable. Fourth, conducting mixed-method research is possible, but the researchers must select the best paradigm for the study (Teddlie and Tashakkori, 2003).

With regards to mixed-method research, the view of the paradigm concept has currently shifted from the epistemological stance to the paradigm as a shared belief among researchers. It emphasizes which research questions are most valuable and which research methods are appropriate to address those research questions. Different to the concept of the paradigm as an epistemological stance, this concept of a paradigm emphasises practical approaches instead of theoretical approaches. It draws attention to substantive decisions about what the researchers choose to study and how they choose to conduct the study (Morgan, 2007). Some researchers also believe that only a single paradigm can serve as the foundation for conducting mixed-method research (Teddlie and Tashakkori, 2010).

In this study, the pragmatic approach is used to support the researcher's preference for conducting mixed-method research. The pragmatic approach clearly falls within the concept of a paradigm as a shared belief among researchers (Morgan, 2007). The pragmatic approach values the philosophy of knowledge underlying both the quantitative and qualitative approaches. It also rejects the force of selecting one paradigm over another (Creswell, 2014; Teddlie and Tashakkori, 2003; Creswell and Clark, 2011). The research questions are central to the pragmatic approach (Morgan, 2007). The pragmatic approach supports the use of both quantitative and qualitative approaches in a single study that best meet the research purposes. The concern of the pragmatic approach is how to generate the best knowledge about the problems being studied (Creswell, 2014; Teddlie and Tashakkori, 2003; Creswell and Clark, 2011).

In addition, the pragmatic approach relies on the abductive process, which is the

process of movement back and forth between qualitative and quantitative approaches in order to purposefully combine the two (Morgan, 2007). The integration of quantitative and qualitative approaches is a continuous and iterative process (Teddlie and Tashakkori, 2010). In this way, the inductive results derived from the qualitative approach become the basis for obtaining the deductive findings derived from a quantitative approach and vice versa (Morgan, 2007). This study started with deductive logic within the quantitative study to justify or predict children's oral health behaviours that impact the incidence of dental caries. Then, based on these results, this study moved to inductive logic within the qualitative study of the parents to find the emergent themes about the psychosocial factors of dental caries in relation to children's oral health behaviours.

The rationale for conducting mixed-method research using a pragmatic approach in this study is that the mixed method is the best approach for answering the research questions. The researcher combined the quantitative and qualitative methods to thoroughly answer the research questions. The results gathered from the integration of quantitative and qualitative methods may produce a more complete understanding of factors contributing to children's oral health behaviours than the use of either a quantitative or qualitative approach in isolation (Creswell, 2014; Creswell and Clark, 2011). Using either quantitative or qualitative data alone is inadequate for providing a complete understanding of the problems being studied. Each quantitative and qualitative methodological approach offers different ways of framing the problems and has limitations that can be addressed by the other (Creswell, 2014).

In this study, the quantitative studies provide a general picture of the association between oral health behaviours and dental caries experience of young children aged two to six years old in Surabaya. A purely quantitative study is limited in its capacity to explore the factors that may contribute to parents' choice of oral health behaviours. Factors underlying the influences on children's behaviours and the process by which parents make a decision to adopt a particular behaviour are still unclear. Therefore, there is a need to further explain the results of quantitative studies in order to completely understand the problem of dental caries in young children. Qualitative research is the preferred method in this regard (Creswell, 2003). The results of quantitative study can be used as guidance for interviews due to the complex construct and multiple dimensions of oral health behaviours. Both quantitative and qualitative data types inform one another and thoroughly address the research questions (Creswell, 2014). Furthermore, an integration of quantitative and qualitative approaches allows the researcher to evaluate the results better than a single approach used in isolation. The results may provide a comprehensive and thorough understanding about the association between oral health behaviours and dental caries experience among young children aged two to six years old and the factors underlying the influences on children's behaviours that, in turn, impact their dental caries experience (Creswell and Clark, 2011). By using a mixed-method approach, this

study aims to offer breadth and depth of understanding about young children's oral health behaviours (Creswell, 2014).

3.2 Methods

The research design within the mixed-method approach in this study differs from studies using either a single quantitative or qualitative approach. The researcher used a sequential explanatory mixed-method design consisting of two distinct phases (Quantitative-Qualitative/QUAN-QUAL). In this study, both the quantitative and qualitative methodological approaches are prioritised equally, because until this study, there have only been very few quantitative studies examining the associations between oral health behaviours and dental caries among young children aged two to six years old in Surabaya, and a qualitative study is therefore also necessary for revealing parents' personal and socio-environmental factors that have influenced their decision to adopt a particular oral health behaviour for their children (Andrew and Halcomb, 2009). In the sequencing process, quantitative and qualitative data is sequentially collected and analysed (Creswell and Clark, 2011).

There are two distinct interactive phases in this process. The researcher began with a quantitative approach as a preliminary to the qualitative approach in order to examine associations between oral health behaviours and dental caries among young children aged two to six years old in Surabaya. In the second phase, collection and analysis of qualitative data followed the collection and analysis of quantitative data. The researcher connected the quantitative and qualitative phases by using the results of the quantitative approach to inform how the qualitative approach would be undertaken in the second phase of this study. First, the results of the preliminary quantitative approach guided a purposeful sampling method for the in-depth qualitative comparison interviews of two groups of parents/guardians by identifying parents/guardians who had young children with caries, and young children who were caries-free. Potential participants were parents/guardians of such children who provided their contact details upon completion of the questionnaire in the quantitative study, and indicated their willingness to volunteer for an interview. The researcher then purposefully recruited participants who provided either typical or remarkable responses in the questionnaire. These responses became the focus of the interviews. These participants were considered leading exemplars/outliers who could explain in detail the psychosocial factors influencing their choice of particular oral health behaviours for their children that have impacted their children's dental caries status (Creswell and Clark, 2011). Second, the results of the quantitative approach helped to inform appropriate questions for the in-depth interviews in the second phase of the study; for example, to explain significant/insignificant or unexpected/surprising results among the quantitative results. Furthermore, the researcher connected results of the quantitative and qualitative approaches during the interpretation process by discussing how the qualitative

results can help illuminate the findings of the quantitative approach (Creswell and Clark, 2011).

3.2.1 Quantitative methods

In the first phase of the study, the researcher undertook a quantitative method. A quantitative method aims at statistical theory testing by examining the association between variables to either confirm, modify, or reject an existing theory (Creswell and Clark, 2011). As shown in Table 2, the aims of using a quantitative methodological approach in this study are (1) to assess the prevalence and the severity of dental caries in young children aged two to six years old in Surabaya, Indonesia; (2) to examine the association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia; and (3) to examine the association between the dental caries experience and quality of life of young children aged two to six years old and their families in Surabaya, Indonesia. The researcher began with a cross-sectional survey study using a questionnaire for data collection (Appendix 1). The use of a cross-sectional study design aims to measure the risk indicators (oral health-related behaviours) and the disease (dental caries) at the same time (Bonita et al., 2006). The questionnaire was self-administered to parents/guardians to gather demographic data and information about their children's oral health behaviours (dietary habits, oral hygiene practice, and dental visits). The questions in the questionnaires were modified from different and validated sources, such as the National Child Oral Health Survey, the Early Childhood Impact Scale (ECOHIS), and other previously published research (Kruger, Dyson, and Tennant, 2005; Du, Luo, Zeng, Alkhatib, and Bedi, 2007; Declerck, et al., 2008; Wong, et al., 2012; Corrêa-Faria, 2013; Armfield and Beckwith, 2014; Beckwith, Koster, and Ha, 2014; Mejia, Ellershaw, Ha, and Koster, 2014). All of the questions were relevant for the purpose of this study.

The variables measured in this study are socio-demographic factors; children's oral health behaviours; parental perception of the impacts of dental caries on the quality of life of the affected children and their families; and the children's dental caries status. The socio-demographic factors assessed in this study were each child's gender and age; the caregiver's age; the caregiver-child relationship; the caregiver's ethnicity; the caregiver's educational level; and the caregiver's monthly household income. The sociodemographic variables are presented in Table 7.

Table 7. Socio-demographic variables

Variables	Description	Response coding
Child's gender	Gender of the child.	1=Male 2=Female
The child's age	The age of the child (in years and months).	2=2 years old 3=3 years old 4=4 years old

		5=5 years old 6=6 years old
The caregiver's age	The age of the caregiver (in years).	1=19-29 years old (young adults) 2=30-37 years old (middle age adults) 3=37-65 years old (older adults)
The caregiver-child relationship	The relationship between the caregiver and the child.	1=Parents 2=Other than parents
The caregiver's ethnicity	The ethnicity of the caregiver.	1= Javanese 2=Madurese 3=Chinese 4=Others
The caregiver's educational level	The highest level of education the caregiver has completed.	1=Primary educational level (elementary school) 2=Secondary educational level (junior and senior high school) 3=Tertiary educational level (diploma, undergraduate, master and doctoral degree)
The caregiver's monthly household income	The average monthly total income in the household.	1=Low income (Rp. 1.499.999 or lower) 2=Low middle income (Rp. 1.500.000-Rp. 2.499.999) 3=Middle income (Rp. 2.500.000-Rp. 3.499.999) 4=High middle income (Rp. 3.500.000-Rp. 4.999.999) 5=High income (Rp. 5.000.000 or higher)

For assessing children's oral health behaviours, the questions consisted of three domains: dietary practices, oral hygiene practices, and dental visits. The questions about dietary behaviours examined bedtime bottle habit; age of bottle weaning; sugar snacking; the type of snacks; and the frequency of sweet snack and drink consumption. The variables of dietary behaviours are presented in Table 8.

Table 8. Variables of dietary behaviours

Variables	Description	Response categories
Bedtime bottle habit	A child's habit of sleeping with a bottle.	1=Yes 2=No
Age of bottle weaning	The age by the time the child were weaned from bottles.	1=18 months old or younger 2=Older than 18 months old 3=Still bottle-feeding 4=Never bottle-feeding
Sugar snacking	The consumption of sweet foods and beverages.	1=Yes 2=No
The type of snacks	The types of snacks (foods and beverages) that the child usually consumed.	1=Sweet snacks 2=Savoury snacks 3=Both sweet and savoury snacks 4=Never consuming snacks
Frequency of sweet snack and drink consumption	The frequency of child's daily consumption of sweet snacks and beverages.	1=Twice or less a day 2=Three times a day 3=More than three times a day

Oral hygiene practices were assessed by means of questions about the initial age of the children cleaning their teeth without toothpaste; the initial age of children cleaning their teeth with toothpaste; the frequency of tooth brushing; the amount of toothpaste on the toothbrush; licking toothpaste; and tooth-brushing supervision. The

variables of oral hygiene practices are presented in Table 9.

Table 9. Variables of oral hygiene practices.

Variables	Description	Response coding
The initial age of the children cleaning their teeth without toothpaste	The age by the time the child was introduced to oral cleaning without toothpaste.	1=0-6 months old 2=6-12 months old 3=12-24 months old 4=24-36 months old 5=36 months old or older 6=Never cleaning without toothpaste
The initial age of children cleaning their teeth with toothpaste	The age by the time the child was introduced to tooth cleaning with toothpaste.	1=0-12 months old 2=12-24 months old 3=24-36 months old 4=36 months old or older 5=Never cleaning with toothpaste
The frequency of tooth brushing	The frequency of child's daily tooth brushing.	1=Less than twice a day 2=Twice or more a day 3=Never tooth brushing
The amount of toothpaste on the toothbrush	The amount of toothpaste applied on the child's tooth brush.	1=Smear layer 2=Pea size 3=Half of the brush head 4=Never tooth brushing
Licking toothpaste	The child's habit of licking toothpaste.	1=Never licking toothpaste 2=Sometimes licking toothpaste 3=Often licking toothpaste
Tooth-brushing supervision	The role of parents/caregivers in their child's tooth brushing supervision.	1=Never give any supervision 2=Apply toothpaste and help brushing 3=Only put toothpaste on toothbrush 4=Only watch and give advice 5=Other kind of supervision 6=Never tooth brushing

For assessing the dental service use of the children, their parents were asked about the children's dental visit history; the date of the last dental visit; the reason for the last dental visit; perceived delays in dental care; the types of dental care delay; the reasons for dental care delays; and dental fear. The variables of dental visits are presented in Table 10.

Table 10. Variables of dental visits.

Variables	Description	Response coding
The children's dental visit history	Whether the child has visited a dentist or not.	1=Yes 2=No
The date of the last dental visit	The last time the child visited a dentist.	1=Less than 6 months ago 2=6 months to less than 12 months ago 0=Never visited a dentist
The reason for the last dental visit	The primary reason for their child's last dental visit.	1=Preventive dental visit 2=Non-preventive dental visit 0=Never visited a dentist
Perceived delays in dental care	Whether the parents/caregivers delayed their child's dental care or not.	1=Yes 2=No
The types of dental care delay	The types of the child's dental care that have been delayed by the parents/cargivers.	1=Preventive dental care 2=Non-preventive dental care 3=Both preventive and non-

		preventive dental care 0=No delays in dental care
Cost-related dental care delay	Whether the parents/caregivers delayed their child's dental care because of the cost or not.	1=Yes 2=No 0=No delays in dental care
Time-related dental care delay	Whether the parents/caregivers delayed their child's dental care because of time constraints or not.	1=Yes 2=No 0=No delays in dental care
Child-related dental care delay	Whether the parents/caregivers delayed their child's dental care because of child-related barriers or not.	1=Yes 2=No 0=No delays in dental care
Other reasons for dental care delay	Whether the parents/caregivers delayed their child's dental care because of other reasons or not.	1=Yes 2=No 0=No delays in dental care
Dental fear	Child's fear of the dentist.	1=Yes 2=No

Parental perception of the impacts of dental caries on the quality of life of the children and their families was assessed using the ECOHIS. This consists of 22 questions in the child impact section and nine in family impact section. In the child impact section, there are four descriptive domains, comprising oral symptoms, functional limitations, emotional wellbeing, and social wellbeing. In the family impact section, there are three descriptive domains, including family activities, parental emotions, and family conflict (appendix 1). The responses are coded using a six-point scale, with the response code 1 for 'never', 2 for 'once or twice', 3 for 'sometimes', 4 for 'often', 5 for 'very often', and 6 for 'I don't know'. The individual scores were calculated as a simple sum of the response codes. The number of 'I don't know' responses were counted but were ultimately excluded from the individual score totals. Questionnaires having two or more unanswered items in the child domain or one or more unanswered items in the family domain were excluded from the analysis. The theoretical model for the possible associations between: (1) oral health behaviours and dental caries, and (2) dental caries and oral health-related quality of life is presented in figure 3.

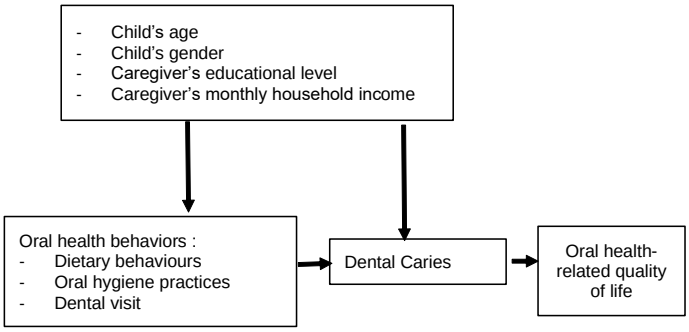

Figure 3. Theoretical model

The questionnaire was first developed in English before being translated into Indonesian by two local bilingual experts who were fluent in both languages. The researcher used the procedure of back translation to translate the questionnaire into Indonesian. After the questionnaire was translated, another translator, who had had no contact with the original questionnaire, translated the questionnaires back into English. The translated version of the questionnaire was then compared with the original questionnaire. Although a back translation of the questionnaire is not in exactly the same format as the original questionnaire or occasionally seems artificial or strangely written, it helps to identify differences in meaning between the back translation and the original questionnaire. Based on the differences identified, adjustments were made.

Subsequently, the final version of the questionnaire (translated into Indonesian) was reviewed by a panel of three local experts in paediatric dentistry in Surabaya in order to assess the content and validity of the questionnaire. The questions were revised based on the results of a focus group meeting of these local experts to enhance their clarification and appropriateness. The questionnaire was then pilot tested among 10% of the sample size (155 parents of young children aged two to six years old in Surabaya) to determine the feasibility of the study and to examine the extent to which parents/guardians could easily understand the content of the questionnaires. On the basis of the pilot testing, the researcher modified the wording of some of the questions. The parents of young children aged two to six years old who participated in the pilot test would not be eligible for the real test.

After piloting the questionnaires, class teachers in 62 selected preschools were asked to distribute the questionnaires to parents/guardians of the eligible children with a letter explaining the nature and the purpose of the study and a form by which they could give consent for their children to take part in the study. The participants were asked to return the signed consent form and completed questionnaire to a secure collection box at the respective schools within seven days of receiving an invitation to participate in the study. No follow-up attempts were made to contact the parents/guardians of those who did not return the consent forms and questionnaires.

After consent to their children's participation was obtained from the parents/guardians, dental examinations were carried out with the preschool children to measure the prevalence and the severity of dental caries. Dental examinations were carried out in the open schoolyard while sitting on an ordinary chair, using natural daylight for illumination. The procedures and diagnostic criteria of dental caries in preschool children followed the recommendation of the World Health Organization's dmft index for deciduous teeth (WHO, 1997, 2013). The dmft index is a tool used by oral health professionals in epidemiologic studies for recording the dental condition of

deciduous teeth (Appendix 2). The dental caries experience was recorded by counting the number of primary teeth that were decayed (dt); missing, extracted, or showed an indication of extraction (mt); or filled (ft) due to caries in order to calculate the dmft score (WHO, 1997, 2013). Each tooth was recorded only once, either decayed, missing, or filled tooth. Non-cavitation lesions were not measured in this study, because drying of the tooth could not be performed. Dental caries was detected by visual inspection only; no X-rays were taken. If the children were comfortable, a disposable mouth-mirror and dental probe were used to assist in the examination for dental caries. The diagnostic criteria for dental caries are presented in Table 11.

Table 11. Diagnostic criteria for dental caries

Category	Diagnostic criteria
Decayed teeth (dt)	- Decayed teeth because of caries. - A tooth that was both decayed and filled. - Decayed teeth because of trauma and a tooth with a temporary filling were not considered as decayed teeth.
Missing teeth (mt)	- Missing or extracted teeth because of caries - Teeth that are indicated for extraction because of caries. - Unerupted teeth and missing teeth because of trauma or congenital factors are not considered as missing teeth.
Filled teeth (ft)	- Filled teeth because of caries - Filled teeth because of trauma are not considered as filled teeth.

Four qualified dentists, also lecturers in the Faculty of Dental Medicine at the University in Surabaya, carried out the dental examination. These examiners are all specialists in paediatric dentistry. Prior to the survey, they were trained using pictures of clinical cases of dental caries in children and were also calibrated to minimise potential variation in dental caries diagnosis and to ensure accurate results. The purpose of the calibration was to assess the degree of agreement on the dental caries diagnosis between examiners (inter-examiner reliability) and the degree of consistency of replicate dental caries examinations of the same panel of subjects by the same examiner (intra-examiner reliability) within an interval of one week. The intra-examiner reliability was established using a pool of extracted carious teeth obtained from the paediatric dentist clinics, whereas the inter-examiner reliability was determined by examining 10% of the sample size (155 children aged two to six years old). These children were not included in the actual study. The value of the Kappa statistic for diagnosis of tooth status was then calculated using the reliability analysis command in the SPSS v22. The mean Kappa values for inter-examiner reliability (interval of variation) according to teeth ranged from 0.87 to 0.98. This indicates good agreement on dental caries diagnosis (McHugh, 2012).

3.2.2 Qualitative methods

In the second phase of the study, the researcher undertook in-depth semi-structured interviews with the parents/guardians of young children aged two to six years old who had caries and those who were caries-free (Appendix 3). The aim of this phase was to illuminate and obtain the in-depth qualitative descriptions of the results that were outlined as relevant by the preliminary quantitative study. The questions emphasised the process by which the parents/guardians adopted particular oral health behaviours that impacted the dental caries status of their children. The questions were developed based on the results of interviews with parents.

Therefore, the results of the qualitative studies provide a complete and thorough understanding of the difference in the parents' personal and socio-environmental factors that have influenced their children's oral health behaviours between children in the caries and caries-free groups. A summary of the phases of the sequential explanatory mixed-method study are presented in Table 12.

Table 12. The summary of the phases of the sequential explanatory mixed method study

	Phase	Procedure	Output
The first phase	Quantitative data collection	Cross-sectional survey design (dental caries examination and self-administered questionnaire)	Numerical and categorical data
	Quantitative data analysis	Univariate, bivariate and multivariate analysis using SPSS v.22.0	Descriptive statistics (frequencies and distribution) and inferential statistics (significant/insignificant results between variables)
The second phase	Interface for mixing quantitative and qualitative approach.	• Purposefully identifying and recruiting participants who participated in the quantitative study for in-depth interviews (parents/guardians with children who have caries and who are caries free). • Developing appropriate questions to be asked in the interviews, based on the quantitative results.	• Appropriate participants for qualitative comparison interviews. • Interview schedule/protocol.
	Qualitative data collection	Individual in-depth interviews with two groups of parents/guardians.	Interview transcripts
	Qualitative data analysis	Thematic analysis using NVivo 10.	Themes and sub-themes (Qualitative results)
	Interface for mixing quantitative and qualitative approach	Integrating the results of the quantitative and the qualitative phase.	The synthesis results (the results of the qualitative phase explained the results of the results from the quantitative phase).

3.3 Participants

3.3.1 Target population

3.3.1.1 Quantitative study

In the first phase of the study, the participants were young children aged two to six years old who were attending preschools (playgroups, kindergartens, and other early education establishments) in Surabaya and their parents (either the father, mother, or a guardian). Preschools were selected because most children aged two to six years old in Surabaya attend some form of preschool. Furthermore, in this age range, the children's primary teeth have fully erupted, meaning that this age range may represent typical dental conditions in early childhood. A list of preschools in Surabaya and the number of children attending them was obtained from the Department of Education, which recorded a total of 2,599 preschools (playgroups, kindergartens, and early childhood education) in Surabaya, with 127,716 children aged two to six years old enrolled in total.

3.3.1.2 Qualitative study

In the second phase of the study, the participants were the parents (either the father, mother, or guardian) of the young children aged two to six years old who participated in the quantitative study. The participants are divided into two groups based on their children's caries status (caries and caries-free) as identified in the quantitative study.

3.3.2 Selection and recruitments

3.3.2.1 Quantitative study

In the first phase of the study, the potential participants were young children aged two to six years old who were enrolled in preschools in Surabaya and their parents (the father, mother, or guardian). The participants who met the following inclusion criteria at the time of the survey were eligible to participate in this study. First, the participants were all required to be within the age range of two to six years old. Second, the participants were required to have a good physical and mental health condition. Third, the participants were required to be willing to have their teeth examined by a dentist. Fourth, the parents/guardians of the participants were willing to give their consent for their children to participate in this study. Participants with any of the following exclusion criteria at the time of the survey were excluded from the study. First, participants who were under two or over six years old were excluded from the

study. Second, participants who had systemic diseases or children with special needs such as Attention Deficit Hyperactivity Disorder (ADHD), autism, and Down's syndrome (as informed by the teachers) were excluded from the study. This decision was made because such children commonly have different patterns of oral and dental health conditions as a result of their own conditions. Third, participants who refused to have their teeth examined by a dentist were excluded from the study. Finally, children whose parents refused to give consent to their participation in the study were also excluded from it.

3.3.2.2 Qualitative study

In the second phase of the study, the researcher approached parents/guardians who had provided their contact details and had typical or remarkable responses in the questionnaire. They were considered as the leading exemplars or outliers who might provide useful information about the psychosocial factors influencing their choices of particular oral health behaviours for their children that have impacted their children's dental caries status (Creswell and Clark, 2011). The participants were parents/guardians with children who had caries and parents/guardians with children who were caries-free from five regions in Surabaya in equal proportions. The participants who agreed to participate were interviewed. The interviews were conducted at the location of their choice. All interviews were audio recorded with the participants' permission.

3.3.3 Sampling technique and sample size

3.3.3.1 Quantitative study

In the first phase of the study, a cluster sampling technique was used to recruit the participants in order to gain a representative sample. Preschools in Surabaya were the primary sampling unit. The preschools in Surabaya were divided into five clusters: preschools in Central Surabaya, West Surabaya, East Surabaya, South Surabaya, and North Surabaya. All districts in each cluster were included (31 in total).

The distribution of children according to preschool in each district in Surabaya was uneven. There were some districts that only had a few preschools. If a sample was taken with proportional allocation based on this distribution, there would be very few participants from certain preschools. Too few participants in each school would therefore not give sufficiently precise

data. Therefore, to increase the representativeness of the sample, two preschools were randomly selected from each district based on the updated lists obtained from the Department of Education in Surabaya. The school principals of those selected preschools were asked to consent to their preschools participating in the study. If the school principals declined, another preschool in the same district was randomly selected. From each selected preschool, 25 children were randomly selected with five children for each age group. In total, 1,550 children aged two to six years old among 62 preschools were included in this study (Table 13). Considering the possibility of loss of participants and the need to achieve the required number of participants for the study, 40 children, with 8 for each age group, were approached in each selected preschool.

Table 13. Sample size

Cluster	District	Number of schools selected	Number of children selected
Central Surabaya	Tegal Sari	2	25
	Simokerto	2	25
	Genteng	2	25
	Bubutan	2	25
East Surabaya	Gubeng	2	25
	Gunung Anyar	2	25
	Sukolilo	2	25
	Tambak Sari	2	25
	Mulyorejo	2	25
	Rungkut	2	25
	Tenggilis Mejoyo	2	25
West Surabaya	Benowo	2	25
	Pakal	2	25
	Asem Rowo	2	25
	Suko Manunggal	2	25
	Tandes	2	25
	Sambi Kerep	2	25
	Lakarsantri	2	25
North Surabaya	Bulak	2	25
	Kenjeran	2	25
	Semampir	2	25
	Pabean Cantikan	2	25
	Krembangan	2	25
South Surabaya	Wonokromo	2	25
	Wonocolo	2	25
	Wiyung	2	25
	Karang Pilang	2	25
	Jambangan	2	25
	Gayungan	2	25
	Dukuh Pakis	2	25
	Sawahan	2	25
Total	**31 Districts**	**62 preschools**	**1,550 children**

3.3.3.2 Qualitative study

In the second phase of the study, purposive sampling was used as the sampling technique. This technique considers the participants as those who can provide rich information about the phenomenon being studied (Carpenter

and Suto, 2008). In this study, the potential participants were parents (either the father, mother, or guardian) of the children examined in the first phase who had provided their contact details upon completion of the questionnaire in the quantitative study that indicated their willingness to be interviewed. Among these potential participants, the researcher purposefully approached participants who provided typical or remarkable responses in the questionnaire. They were considered the leading exemplars or outliers who could explain in detail the psychosocial factors influencing their choices of particular oral health behaviours for their children that have impacted their children's dental caries status (Creswell and Clark, 2011). The number of participants in the qualitative study are justified by means of data saturation. The interviews were continuously undertaken until data saturation was achieved. Data saturation is achieved if gathering more data would give no new insights or show no new properties in the emerging themes within the data, so that data can be considered saturated and can then be sorted to develop a theory (Liamputtong, 2013).

3.4 Ethical consideration

Ethics approval for this study was granted by the Flinders University Social and Behavioural Research Ethics Committee (SBREC Project Number: 6907) (Apendix 3). All eligible preschool students' parents or guardians in the selected schools received a personal written invitation to take part in the study (Appendix 4 and 5). There was no risk of injury to the children during the dental caries examination. Well-trained, experienced, and calibrated professional dentists performed all clinical examinations. All eligible participants were also well informed about the purpose of the study and the fact that they were voluntary participants (Appendix 6 and 7). Parents who agreed to participate in this study were asked to give their consent to such participation (Appendix 8 and 9). The confidentiality of the participants was protected by concealing their true identities. Names and any identifying details were removed from relevant documentation.

3.5 Procedures

The general procedure of this study after ethical approval was granted is shown in Figure 4. The study started with the training and calibration of the dental caries examiners and the pilot study. Thereafter, the quantitative study was conducted. The results of the quantitative study then informed the development of the interview schedule and the recruitment of

participants for the qualitative study. Subsequently, the results of the quantitative and qualitative studies were integrated.

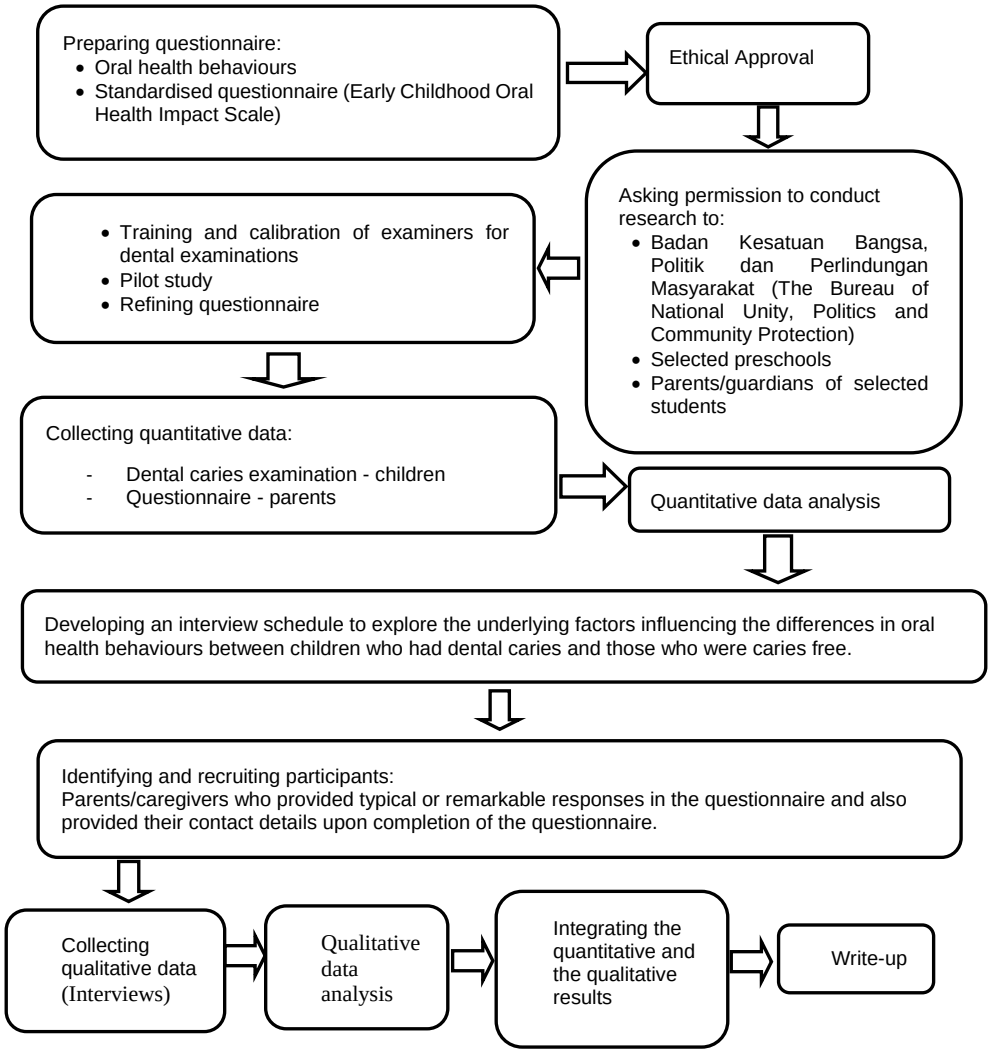

Figure 4. The procedure of the study

3.6 Data Analysis

3.6.1 Quantitative study

The information from the questionnaire and dental examination record forms were coded and entered into a spreadsheet for analysis using SPSS v.22. Data analysis was first undertaken to determine the prevalence of dental caries (represented by the percentage of children who had one or more dmft) and the severity of dental caries (represented by the mean dmft). After computing the descriptive statistics, a bivariate analysis was performed. The level of statistical significance was set at $p < 0.05$, and P values of less than 0.05 were considered to be statistically significant. Concerning the prevalence of caries, a chi-squared test was used to investigate the

association between oral health behaviours and the incidence of dental caries. Univariate and multivariable logistic regressions were also included for building a theoretical model of factors that could possibly influence the development of dental caries in children. Only those variables exhibiting $p < 0.05$ in the bivariate analysis were included in the model. Concerning caries severity, the Kolmogorov-Smirnov test was used to consider the normality distribution of the dmft values. The Mann-Whitney U test or the Kruskal-Wallis H test was applied, where appropriate, to examine oral health-related behaviours that could contribute to the differences in the severity of dental caries in children. Variables, which were statistically significant in the bivariate analysis with dental caries severity, were tested using negative binomial models to control for potential confounding variables and to determine whether differences in dental caries severity remained after adjusting for individual characteristics together (age, gender, parent's/caregiver's education and household income).

3.6.2 Qualitative Study

The qualitative study applied the method of thematic data analysis. Thematic analysis is a technique that is used for analysing the qualitative data by identifying the repeated pattern of meaning (Braun and Clarke, 2006). The researcher followed the six phases of thematic analysis proposed by Braun and Clarke (2006). First, the researcher familiarised themselves with the content of the data by manually transcribing the data from the interviews into transcripts. Each transcript was then checked against the audio records to ensure that the words exactly matched the audio interviews. Subsequently, the researcher read and re-read the entire set of the transcripts, taking notes on all the initial ideas and possible patterns of children's oral health behaviours and factors influencing these behaviours. This was helpful in the coding process in the subsequent phase.

In the second phase, initial codes were developed from the data. The researcher approached the data bearing in mind the research question: What are the factors influencing oral health behaviours among young children aged two to six years old in Surabaya who suffer from dental caries and those who are caries-free? To make initial codes from the data, the relevant text in the data was highlighted manually using highlighters. The researcher took notes besides any text that indicated potential patterns of children's oral health behaviours and factors influencing those behaviours. After all the initial codes were identified across the dataset, the researcher used NVIVO 10 to help collate the codes and then matched them with the extracts of data that were relevant to those codes.

In the third phase, themes were developed. The different codes identified during

the second phase were sorted into potential themes. All extracts of the coded data that were relevant to each of the identified themes were collated. The codes were checked across all the identified themes and refined as necessary. Subsequently, using a thematic map, the researcher organised all the identified themes to form different theme levels (the main themes and sub-themes).

In the fourth phase, the researcher reviewed all potential themes identified during the third phase to ensure the themes matched the data extracts and the entire dataset. In the fifth phase, the researcher defined and named each theme to ensure that the themes could describe the pattern of children's oral health behaviours and explain the factors influencing these behaviours, which was the focus of the research question for the qualitative phase of this study. In the final phase, the researcher wrote the results of the thematic analysis in the form of the qualitative results chapter (Chapter 5) to answer the research question: What are the factors influencing oral health behaviours among young children aged two to six years old in Surabaya, Indonesia who suffer from dental caries and those who are caries-free? A summary of the phases of the thematic analysis is presented in Table 14.

Table 14. The summary of phases of thematic analysis

Phase	Description
1. Being familiar with the data	- Transcribing the interviews into transcripts - Reading and re-reading the data (transcripts) - Taking notes of the initial ideas.
2. Developing the initial codes from the data.	- Coding potential patterns of children's oral health behaviours and factors influencing these behaviours. - Collating the codes and matching them with the relevant data extracts (using NVIVO 10).
3. Developing themes	- Sorting and combining the different codes into potential themes. - Collating all relevant data extracts for each potential theme. - Organising all potential themes using a thematic map (main themes and sub-themes).
4. Reviewing themes	- Ensuring the themes matched with data extracts and also the entire data set.
5. Defining and naming themes	- Ensuring that the themes could address the research question.
6. Write-up	- Writing the results of the thematic analysis.

In summary, this chapter has justified the use of the mixed-method approach for this research. This chapter also explained, in detail, the procedure of conducting a mixed-method study and how a mixed-method study can answer the research questions. The next chapters present the results of this study. Chapter 4 presents the quantitative results; Chapter 5 presents the qualitative results; and Chapter 6 presents the synthesis results i.e. the integration of the quantitative and the qualitative results.

CHAPTER 4
QUANTITATIVE RESULTS

This chapter presents the results of the quantitative component of this study, with the aim of answering two research questions, as presented in Table 15. In this stage of the study, a total of 1,606 preschool children and their mothers (86.6%), fathers (10.5%), or other caregivers (2.9%) in 62 preschools in Surabaya were enrolled. Caregivers of the children enrolled in this study also completed all questions in the questionnaire regarding the sociodemographic characteristics, oral health-related quality of life, and oral health behaviours, comprising dietary behaviours, oral hygiene practices, and dental visits. No questionnaires were excluded from the data analysis due to incompleteness of data. This chapter presents the children's dental caries experience, sociodemographic characteristics, oral health-related quality of life, and oral health behaviours, consisting of dietary behaviours, oral hygiene practices, and dental visits, in turn. The results start with the descriptive statistics and are followed by the analytical (inferential) statistics.

Table 15. Research questions and the corresponding research aims, quantitative research methods, and quantitative results

Research questions	Research aims	Quantitative research methods	Quantitative results
1. Is there an association between the oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya?	1. To assess the prevalence and severity of dental caries in young children aged two to six years old in Surabaya.	1. Dental examination aiming to record dental caries experience using decayed, missing, and filled teeth (dmft) index based on the World Health Organization's criteria.	1. The prevalence of dental caries (dmft>0) was 79.8%, with the mean dmft score (the severity of dental caries) of 5.54 (±4.90).
	2. To examine the association between the oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya.	2. Questionnaire survey	2. Dietary behaviours (sugar snacking, type of snacks, frequency of sugar snacking, bedtime bottle habit, and age of bottle weaning) and dental visits (dental visit history, last dental visits, perceived delays in dental care, the types of dental care delays, cost-related dental care delay, time-related dental care delay, child-related dental care delay, other dental care delay, and dental fear) were significantly associated with dental caries. No significant association was found between oral hygiene practices (initial age of cleaning without toothpaste, initial age of cleaning with

			toothpaste, frequency of tooth brushing, toothpaste size, licking toothpaste, and tooth-brushing supervision) and dental caries.
2. Is there an association between the dental caries experience and quality of life of young children aged two to six years old in Surabaya and their families?	To examine the association between the dental caries experience and quality of life of young children aged two to six years old and their families in Surabaya.	Questionnaire survey	Dental caries was significantly associated with a negative impact on the quality of life of the children and their families.

4.1 Dental caries experience

Table 16 presents the dental caries experience of the participants. A total of 1,281 (79.8%) children had dental caries. The mean dmft score was 5.54 (±4.90). The distribution of the dental caries experience according to the number of decayed, missing, and filled teeth showed that decayed teeth contributed to the major component of the dmft score. The prevalence of decayed, missing, and filled teeth among the children was 78.5%, 32.5%, and 1.2% respectively with mean values for decayed, missing, and filled teeth of 4.21 (±3.714), 1.32 (±2.518), and 0.02 (±0.264), respectively.

Table 16. The dental caries experience of the participants

Dental caries experience	Frequency n (%)	Mean	SD	Minimum	Maximum
Decayed teeth (dt)	1,260 (78.5%)	4.21	3.714	0	20
Missing teeth (mt)	522 (32.5%)	1.32	2.518	0	20
Filled teeth (ft)	20 (1.2%)	0.02	0.264	0	6
dmft	1,281 (79.8%)	5.54	4.896	0	20

4.2 Sociodemographic characteristics

Table 17 presents the sociodemographic characteristics of the participants. 51.4% of the participants were male. The mean age of the participants was 4.01 (±1.40) years old, whereas the mean age of the caregivers was 33.23 (±6.23). The majority of the children were of Javanese ethnicity (87%). 55.4% of the caregivers had a secondary educational level, and 38% had a tertiary educational level. Only a few caregivers only had a primary educational level. Most children came from middle- and low middle-income families (31.4% and 26%, respectively).

Table 17. Sociodemographic characteristics of the participants (N=1,606)

Characteristics	Frequency n (%)
Child's gender	
Male	826 (51.4%)
Female	780 (48.6%)
Child's age (years)	
2 years old	320 (19.9%)
3 years old	326 (20.3%)
4 years old	334 (20.8%)
5 years old	320 (19.9%)
6 years old	306 (19.1%)
Caregivers' age	
19-29 years old (young adults)	402 (25.0%)
30-37 years old (middle age adults)	859 (53.5%)
37-65 years old (older adults)	345 (21.5%)
Caregiver-child relationship	
Parents	1,559 (97.1%)
Other than parents	47 (2.9%)
Ethnicity	
Javanese	1,398 (87%)
Madurese	87 (5.4%)
Chinese	57 (3.5%)
Others	64 (4%)
Caregivers' educational level	
Primary educational level	106 (6.6%)
Secondary educational level	890 (55.4%)
Tertiary educational level	610 (38%)
Caregivers' monthly household income	
Low income	152 (9.5%)
Low middle income	417 (26%)
Middle income	504 (31.4%)
High middle income	256 (15.9%)
High income	277 (17.2%)

A statistically significant association was found between the children's ages and the presence of dental caries ($\chi^2_{(4)} = 43.635$, $p = 0.000$). Older children were found to have a higher proportion of dental caries than younger children, 68.4%, 77.0%, 81.4%, 85%, and 87.3% for children aged two, three, four, five, and six years old, respectively. However, no statistically significant association was found between the caregivers' ages and the presence of dental caries ($\chi^2_{(2)} = 1.418$, $p = 0.492$). The likelihood of developing dental caries was also higher among children with Javanese ethnicity than in other ethnic groups. The prevalence of dental caries in children with Javanese ethnicity was 81% compared to 69.4% of children with Madurese ethnicity, 49.1% of children with Chinese ethnicity, 16.7% of children with Arab ethnicity, and 74.1% of children with another ethnicity. The association between ethnicity and dental caries was statistically significant ($\chi^2_{(4)} = 52.911$, $p = 0.000$). Both the caregiver's educational level and their monthly household income were also significantly associated with dental caries ($\chi^2_{(2)} = 22.714$, $p = 0.000$ and $\chi^2_{(4)} = 12.479$, $p = 0.014$, respectively). The prevalence of dental caries was higher among children whose caregivers had only a primary educational level rather than a secondary or tertiary educational level. Similarly, children who lived in low-income families were found to have a higher proportion of dental caries than

children from high middle-income, middle-income, and low middle-income families. Almost 85% of children from low-income families had dental caries, compared to 83.7% of children from low-middle income families, 79.6% from middle-income families, 77.3% from high middle-income families, and 74.0% from high-income families. However, a statistically significant association was not observed between males and females ($\chi^2_{(1)} = 1.592$, $p = 0.207$) or between children who were cared for by their parents and those who were cared for by caregivers, other than their parents ($\chi^2_{(1)} = 0.841$, $p = 0.359$). The distribution of dental caries according to sociodemographic characteristics is presented in Table 18.

Table 18. Distribution of dental caries according to sociodemographic variables

Sociodemographic variables	Dental caries		*p*-value
	Yes n (%)	No n (%)	
Child's gender			
Male	669 (81.0%)	157 (19.0%)	0.207
Female	612 (78.5%)	168 (21.5%)	
Child's age (years)			
2 years old	219 (68.4%)	101 (31.6%)	**0.000**
3 years old	251 (77.0%)	75 (23.0%)	
4 years old	272 (81.4%)	62 (18.6%)	
5 years old	272 (85%)	48 (15%)	
6 years old	267 (87.3%)	39 (12.7%)	
Caregiver's age			
19-29 years old (young adult)	322 (80.1%)	80 (19.9%)	0.605
30-37 years old (middle age adult)	678 (78.9%)	181 (21.1%)	
37-65 years old (older adult)	281 (81.4%)	64 (18.6%)	
Caregiver-child relationship			
Parents	1,246 (79.9%)	313 (20.1%)	0.359
Other than parents	35 (74.5%)	12 (25.5%)	
Ethnicity			
Javanese	1,134 (81.1%)	264 (18.9%)	**0.000**
Madurese	75 (69.4%)	12 (17.6%)	
Chinese	28 (49.1%)	29 (50.9%)	
Others	44 (68.8%)	20 (31.3%)	
Caregivers' educational level			
Primary educational level	92 (86.8%)	14 (13.2%)	**0.000**
Secondary educational level	739 (83.0%)	151 (17.0%)	
Tertiary educational level	450 (73.8%)	160 (26.2%)	
Caregivers' monthly household income			
Low income	128 (84.2%)	24 (15.8%)	**0.014**
Low middle income	349 (83.7%)	68 (16.3%)	
Middle income	401 (79.6%)	103 (20.4%)	
High middle income	198 (77.3%)	58 (22.7%)	
High income	205 (74.0%)	72 (26.0%)	

In the logistic regression analysis, only the caregiver's monthly household income lost its significance after the adjusted analysis. The likelihood of having dental caries was found to increase with age. Compared to children aged two years old, children aged six years old had a risk of developing dental caries that was 3.17 times higher (OR: 3.17, 95%CI: 2.07-4.83). Furthermore, Chinese children had a tendency to have less dental caries than Javanese children (OR: 0.22, 95%CI: 0.13-0.39). The risk of developing dental caries was also higher among children of caregivers who had a secondary educational level than among children of

caregivers who had a tertiary educational level (OR: 1.64, 95%CI: 1.22-2.19) (Table 19).

Table 19. Logistic regression models for caries experience against sociodemographic variables

Sociodemographic variables	Crude OR (95% CI)	Adjusted OR (95% CI)
Child's gender		
Male	1.17 (0.92-1.49)	-
Female	(ref)	
Child's age		
2	(ref)	(ref)
3	1.54 (1.09-2.19)*	1.57 (1.10-2.26)*
4	2.02 (1.41-2.91)*	2.05 (1.42-2.98)*
5	2.61 (1.78-3.85)*	2.61 (1.76-3.89)*
6	3.16 (2.09-4.76)*	3.17 (2.07-4.83)*
Caregiver's age		
Young adults	1.53 (0.48-4.92)	-
Middle-age adults	1.73 (0.53-5.66)	
Older adults	(ref)	
Child-caregiver relationship		
Parents	(ref)	-
Other than parents	0.73 (0.38-1.43)	
Ethnicity		
Javanese	(ref)	(ref)
Madurese	1.46 (0.78-2.72)	1.19 (0.62-2.26)
Chinese	0.23 (0.13-0.38)*	0.22 (0.13-0.39)*
Others	0.51 (0.30-0.88)*	0.61 (0.34-1.07)
Caregiver's educational level		
Primary education	2.34 (1.30-4.22)*	1.85 (0.96-3.56)
Secondary education	1.74 (1.35-2.24)*	1.64 (1.22-2.19)*
Tertiary education	(ref)	(ref)
Caregiver's monthly household income		
Low income	1.84 (1.12-3.22)*	0.99 (0.56-1.77)
Low-middle income	1.80 (1.24-2.62)*	1.09 (0.70-1.67)
Middle income	1.37 (0.97-1.93)	1.04 (0.71-1.53)
High-middle income	1.20 (0.81-1.78)	1.02 (0.67-1.54)
High income	(ref)	(ref)

Dependent variable: caries experience (dmft = 0 or dmft ≥ 1)
CI: confidence interval
ref: reference

Table 20 shows the mean dmft score according to the sociodemographic variables. The results of a bivariate analysis showed that the difference in the mean dmft score was statistically significant concerning gender, age, ethnicity, c'regivers' educational level, and their monthly household income. A higher mean dmft score was found among the male children (5.80±4.96) than among the female children (5.27±4.82). The mean dmft score also increased with age. Children aged six years old had a higher mean dmft score (6.75±4.89) than the younger children. Furthermore, compared to children of other ethnicities, Javanese children presented a higher mean dmft score (5.72±4.91). A higher mean dmft score was also found among children of caregivers who had a primary educational level (6.15±4.83) and who had a lower monthly household income (6.31±4.96) than their counterparts.

Table 20. Mean dmft scores according to the sociodemographic variables

Sociodemographic variables	Mean dmft score (SD)	*p*-value
Child's gender		
Male	5.80 (4.96)	**0.029**
Female	5.27 (4.82)	
Child's age (years)		
2 years old	3.89 (4.52)	
3 years old	4.88 (4.50)	**0.000**
4 years old	5.83 (5.01)	
5 years old	6.42 (5.02)	
6 years old	6.75 (4.89)	
Caregivers' age		
19-29 years old (young adults)	5.42 (4.86)	0.356
30-37 years old (middle age adults)	5.45 (4.84)	
37-65 years old (older adults)	5.91 (5.08)	
Caregiver-child relationship		
Parents	5.56 (4.90)	0.255
Other than parents	4.83 (4.90)	
Ethnicity		
Javanese	5.72 (4.91)	
Madurese	5.40 (4.25)	**0.000**
Chinese	2.63 (4.37)	
Other	4.53 (5.01)	
Caregivers' educational level		
Primary educational level	6.15 (4.83)	**0.000**
Secondary educational level	5.98 (5.00)	
Tertiary educational level	4.80 (4.670)	
Caregivers' monthly household income		
Low income	6.31 (4.96)	
Low middle income	5.98 (5.01)	**0.003**
Middle income	5.39 (4.90)	
High middle income	5.50 (4.84)	
High income	4.78 (4.65)	

In the negative binomial analysis (Table 21), the significant difference in the mean dmft score only remained for the age, ethnicity, and caregiver's educational level variables. The chance of having a higher mean dmft score increased with age. Children aged six years old were 1.71 times more likely to have a higher mean dmft score than children aged two years old (RR: 1.71, 95%CI: 1.44-2.04). Being a child of caregiver who had a secondary educational level increased the likelihood of having a higher mean dmft score by 1.20 times (RR: 1.20, 95%CI: 1.06-1.37) compared to being a child of a caregiver who had a tertiary educational level. With regard to ethnicity, the mean dmft score was lower among Madurese children compared to Javanese children (RR: 0.55, 95%CI: 0.36-0.83). In contrast, gender and caregiver's monthly household income lost their significance after the adjusted analysis.

Table 21. The association between the mean dmft score and the sociodemographic variables

Sociodemographic variables	Crude RR (95% CI)	Adjusted RR (95% CI)
Child's gender		
Male	1.10 (4.89-5.69)	-
Female	(ref)	

Child's age		
2	(ref)	(ref)
3	1.25 (1.06-1.49)*	1.26 (1.06-1.50)*
4	1.50 (1.27-1.77)*	1.50 (1.26-1.77)*
5	1.65 (1.39-1.95)*	1.67 (1.41-1.98)*
6	1.73 (1.46-2.06)*	1.71 (1.44-2.04)*
Caregiver's age		
Young adults	0.92 (0.79-1.07)	-
Middle-age adults	0.92 (0.81-1.06)	
Older adults	(ref)	
Child-caregiver relationship		
Parents	(ref)	-
Other than parents	0.87 (0.63-1.19)	
Ethnicity		
Javanese	(ref)	(ref)
Madurese	0.95 (0.75-1.20)	0.55 (0.36-0.83)*
Chinese	0.46 (0.34-0.63)*	1.07 (0.74-1.55)
Others	0.79 (0.60-1.05)	1.21 (0.91-1.60)
Caregiver's educational level		
Primary education	1.28 (1.03-1.60)*	1.21 (0.94-1.56)
Secondary education	1.24 (1.11-1.39)*	1.20 (1.06-1.37)*
Tertiary education	(ref)	(ref)
Caregiver's monthly household income		
Low income	1.32 (1.07-1.64)*	1.09 (0.86-1.38)
Low-middle income	1.25 (1.06-1.48)*	1.07 (0.89-1.29)
Middle income	1.13 (0.96-1.32)	1.04 (0.88-1.24)
High-middle income	1.15 (0.96-1.39)	1.08 (0.90-1.31)
High income	(ref)	(ref)

4.3 Oral health-related quality of life (OHRQoL)

Table 22 shows the distribution of responses to each question about oral health-related quality of life. Overall, a total of 1,494 (93%) caregivers reported impacts of dental caries in children on the quality of life of the children and their families. Items related to food retention, bad breath, and difficulty in biting/chewing solid foods were the most frequently reported impacts of dental caries on the children. Items related to requiring more attention, having less time for other family members, and feeling guilty were frequently reported impacts of dental caries in children on their families.

Table 22. The frequency distribution of the responses to each item in OHRQoL (N=1,606)

Impact	Responses n(%)				
	Never	Once or twice	Sometimes	Often	Very often
Child impact					
Pain	685 (42.7%)	329 (20.5%)	353 (22%)	136 (8.5%)	103 (6.4%)
Gingival bleeding	602 (37.5%)	415 (25.8%	454 (28.3%)	43 (2.7%)	92 (5.7%)
Bad breath	486 (30.3%)	333 (20.7%)	362 (22.5%)	193 (12%)	232 (14.4%)
Food stuck	310 (19.3%)	209 (13%)	240 (14.9%)	383 (23.8%)	464 (28.9%)
Mouth breathing	595 (37%)	382 (23.8%)	434 (27%)	94 (5.9%)	101 (6.3%)
Sleeping difficulty	608	412	461	57	68

	(37.9%)	(25.7%)	(28.7%)	(3.5%)	(4.2%)
Difficulty in biting or chewing solid foods	488 (30.4%)	373 (23.2%)	396 (24.7%)	145 (9%)	204 (12.7%)
Difficulty in eating hot or cold foods	508 (31.6%)	375 (23.3%)	368 (22.9%)	147 (9.2%)	208 (13%)
Difficulty in drinking hot or cold beverages	553 (34.4%)	368 (22.9%)	410 (25.5%)	144 (9%)	131 (8.2%)
Difficulty in pronouncing some words	558 (34.7%)	386 (24%)	409 (25.5%)	117 (7.3%)	136 (8.5%)
Difficulty in concentration	643 (40%)	437 (27.2%)	461 (28.7%)	36 (2.2%)	29 (1.8%)
Being angry or frustrated	594 (37%)	397 (24.7%)	424 (26.4%)	92 (5.7%)	99 (6.2%)
Worrying about health	635 (39.5%)	427 (26.6%)	450 (28%)	41 (2.6%)	53 (3.3%)
Worrying about being different from others	631 (39.3%)	423 (26.3%)	460 (28.6%)	41 (2.6%)	51 (3.2%)
Being ashamed	556 (34.6%)	382 (23.8%)	397 (24.7%)	123 (7.7%)	148 (9.2%)
Avoiding smiling or laughing	649 (40.4%)	435 (27.1%)	459 (28.6%)	30 (1.9%)	33 (2.1%)
Being reluctant to spend time with others	644 (40.1%)	446 (27.8%)	462 (28.8%)	31 (1.9%)	23 (1.4%)
Being reluctant to talk or read aloud in class	553 (34.4%)	403 (25.1%)	426 (26.5%)	139 (8.7%)	85 (5.3%)
Being reluctant to talk to others	637 (39.7%)	433 (27%)	460 (28.6%)	51 (3.2%)	25 (1.6%)
Been asked about oral condition	612 (38.1%)	411 (25.6%)	426 (26.5%)	96 (6%)	61 (3.8%)
Absent from school due to dental problems	641 (39.9%)	437 (27.2%)	478 (29.8%)	28 (1.7%)	22 (1.4%)
Absent from school due to dental appointments	654 (40.7%)	447 (27.8%)	461 (28.7%)	29 (1.8%)	15 (0.9%)
Family impacts					
Required more attention	430 (26.8%)	286 (17.8%)	288 (17.9%)	404 (25.2%)	198 (12.3%)
Sleeping disturbance	599 (37.3%)	415 (25.8%)	449 (28%)	88 (5.5%)	55 (3.4%)
Absent from work	532 (33.1%)	346 (21.5%)	368 (22.9%)	234 (14.6%)	126 (7.8%)
Less time for others	506 (31.5%)	342 (21.3%)	360 (22.4%)	260 (16.2%)	138 (8.6%)
Feeling annoyed	536 (33.4%)	383 (23.8%)	403 (25.1%)	177 (11%)	107 (6.7%)
Feeling guilty	514 (32%)	330 (20.5%)	341 (21.2%)	278 (17.3%)	143 (8.9%)
Worrying about the future	561 (34.9%)	376 (23.4%)	417 (26%)	161 (10%)	91 (5.7%)
Blaming others	630 (39.2%)	425 (26.5%)	453 (28.2%)	66 (4.1%)	32 (2%)
Arguing with others	553 (34.4%)	384 (23.9%)	414 (25.8%)	169 (10.5%)	86 (5.4%)

Table 23 shows the difference in the mean scores between children who had dental caries experience and children who were caries free for each domain of the OHRQoL scale. For the child impact, only the functional limitations domain showed a significant difference, whereas for the family impact, significant differences were found in the family activities and parental emotions domain ($p<0.05$). The results indicate that having dental caries had a negative impact on functional limitations for the child impact and on family activities and

parental emotion for the family impact. Children who had dental caries were more likely to have more profound functional limitations, their family activities were poorer, and their parents' emotions were poorer than children who were caries free.

Table 24 presents the mean score difference between children who had dental caries and children who were caries free for the child impact, family impact, and overall OHRQoL impact scales. The differences in the mean scores for these scales were statistically significant. A higher mean score for children who had dental caries compared to children who were caries free indicated that having dental caries negatively impacted the quality of life of both the child and their family. Children who had dental caries were more likely to have a poorer quality of life than children who were caries free.

The linear regression analysis included the child's age, gender, parent's/caregiver's education, and household income in the model (Table 25). The results showed that having dental caries was significantly associated with higher OHRQoL scores, compared to those who were caries free. This indicated that dental caries negatively impacted the quality of life of the children and their families. Children who had dental caries had poorer quality of life than children who were caries free.

Table 23. Mean domain scores for oral health-related quality of life (OHRQoL) by caries

	Child Impact				Family Impact		
	Oral symptoms	**Functional limitations**	**Emotional wellbeing**	**Social wellbeing**	**Family activities**	**Parental emotions**	**Family conflict**
Caries experience :							
dmft = 0	6.10 (3.01)	8.08 (3.61)*	4.57 (2.56)	6.99 (2.72)	5.39 (2.79)*	3.55 (2.24)*	2.25 (1.67)
dmft ≥ 1	6.21 (3.09)	9.14 (4.16)	4.61 (2.63)	7.30 (3.00)	5.93 (3.04)	4.27 (2.62)	2.33 (1.71)

Values are expressed as mean (standard deviation).
Analysis of variance, *P<0.05.
dmft, decayed, missing and filled primary tooth.

Table 24. Mean overall scale scores for oral health-related quality of life (OHRQoL) by caries

	Mean child impact scale scores for OHRQoL	**Mean family impact scale scores for OHRQoL**	**Mean overall impact scale scores for OHRQoL**
Caries experience:			
dmft = 0	25.75 (6.40)*	11.19 (4.58)*	36.94 (9.02)*
dmft ≥ 1	27.25 (7.35)	12.53 (5.19)	39.78 (10.05)

Values are expressed as mean (standard deviation).
Analysis of variance, *P<0.05.
dmft, decayed, missing and filled primary tooth.

Table 25. Linear regression model for overall scale scores for oral health-related quality of life (OHRQoL) by caries experience

	Child impact scale		**Family impact scale**		**Overall impact scale**	
	Un-Std B	***P***	**Un-Std B**	***P***	**Un-Std B**	***P***
Caries experience:						
dmft = 0	ref		ref		ref	
dmft ≥ 1	1.29	<0.05	1.34	<0.05	2.71	<0.05

Dependent variable: sum of all OHRQoL items in child impact scale, family impact scale and overall scale
Higher value indicates poorer OHRQoL
Other variables in the model: age, gender, parent's/caregiver's education and household income
Un-std B, unstandardized coefficient
dmft, decayed, missing and filled primary teeth.
Ref, reference

4.4 Oral health behaviours

4.4.1 Dietary behaviours

Table 26 summarises the distribution of the participants in relation to their dietary behaviours. More than half of the children in this study had a bedtime bottle habit (60.1%), and 54.4% of children had not been weaned off the bottle at the time of the study. With regard to the age of bottle weaning, 19.2% of children were weaned from the bottle after the age of 18 months old, whereas only 8.2% of the children were weaned from the bottle before the age of 18 months old. In addition, the majority of the children (97.8%) consumed sugary snacks in between meals. The most frequently reported type of snacks was sweet snacks (51.9%). More than 75% of children consumed sugary snacks and drinks more than three times a day.

Table 26. The distribution of the dietary behaviours of participants

`Dietary Behaviours	Frequency n (%)
Bedtime bottle habit	
Yes	966 (60.1%)
No	640 (39.9%)
Age of bottle weaning	
18 months old or younger	132 (8.2%)
Older than 18 months old	308 (19.2%)
Still bottle-feeding	873 (54.4%)
Never bottle-feeding	293 (18.2%)
Sugar snacking	
Yes	1,571 (97.8%)
No	35 (2.2%)
The type of snacks	
Sweet snacks	834 (51.9%)
Savoury snacks	227 (14.1%)
Both sweet and savoury snacks	510 (31.8%)
Never consuming snacks	35 (2.2%)
Frequency of sweet snack and drink consumption	
Twice or less a day	181 (11.3%)
Three times a day	195 (12.1%)
More than three times a day	1,230 (76.6%)

In the bivariate analysis (Table 27), the occurrence of dental caries was significantly associated with a bedtime bottle habit and the age of bottle weaning ($\chi^2_{(1)}$ = 5.499, p = 0.019 and $\chi^2_{(1)}$ = 9.985, p = 0.009 respectively). Children who had a bedtime bottle habit were more likely to suffer dental caries (81.7%) than children who did not (76.9%). The results of the logistic regression analysis also confirmed that a bedtime bottle habit was significantly associated with dental caries in both the unadjusted and adjusted analyses (Table 28). Compared to children who did not have a bedtime bottle habit, children who consumed sugary drinks at bedtime had a risk of developing dental caries that was 1.80 times higher (OR: 1.80, 95% CI: 1.39-2.34).

Furthermore, children who were weaned off the bottle after 18 months of age had a tendency to have a higher prevalence of dental caries (86.0%) compared to children who were weaned off the bottle before 18 months of age (73.05%). The significant association between the age of bottle weaning and dental caries remained in the adjusted logistic regression analysis (Table 28). Children who were weaned from the bottle after 18 months old were 1.69 times more likely to develop dental caries than children who were never bottle fed (OR: 1.69, 95% CI: 1.09-2.63).

Snacking in between meals, sugar snacking, the type of snacks consumed, and the total frequency of sugar snacking were significantly associated with dental caries ($\chi^2_{(1)}$ = 4.375, p = 0.036, $\chi^2_{(1)}$ = 53.161, p = 0.045 and $\chi^2_{(2)}$ = 9.530, p = 0.009, respectively) in the bivariate analysis. The prevalence of dental caries was higher among children who consumed sugary snacks in between meals (80.1%), those who consumed both sweet and savoury snacks (82.7%), and those who consumed sugary snacks three times a day (82.6%) than among children who did not engage in those behaviours (Table 27). A significant association between sugar snacking and dental caries and a significant association between the type of snacks consumed and dental caries remained in the logistic regression analysis. Children who consumed sugary snacks in between meals were 2.29 times (OR: 2.29, 95% CI: 1.11-4.73) more likely to develop dental caries than children who never consumed sugary snacks in between meals. In similar, compared to children who never consumed snacks, the risk of developing dental caries was also 2.71 times (OR: 2.71, 95% CI: 1.27-5.75) higher among children who consumed both sweet and savoury snacks. A significant association between the total frequency of sugar snacking and dental caries was only found in the adjusted analysis of the logistic regression model. Children who consumed sugary snacks three times or more per day had a higher risk of developing dental caries than children who never consumed snacks (OR: 2.17, 95% CI: 1.30-3.60 and OR: 1.76, 95% CI: 1.22-2.53 respectively) (Table 28).

Table 27. Distribution of dental caries according to the dietary behaviours of the participants

Dietary behaviours	Dental caries		*p*-value
	Yes n (%)	No n (%)	
Bedtime bottle habit			
Yes	789 (81.7%)	177 (18.3%)	**0.019**
No	492 (76.9%)	148 (23.1%)	
Age of bottle weaning			
18 months old or younger	97 (73.5%)	35 (26.5%)	
Older than 18 months old	265 (86.0%)	43 (14.0%)	**0.009**
Still bottle feeding	691 (79.2%)	182 (20.8%)	
Never bottle-feeding	228 (77.8%)	65 (22.2%)	
Sugar snacking			
Yes	1,258 (80.1%)	313 (19.9%)	**0.036**
No	23 (65.7%)	12 (34.3%)	

The type of snacks			
Sweet snacks	654 (78.4%)	180 (21.6%)	**0.045**
Savoury snacks	182 (80.2%)	45 (19.8%)	
Both sweet and savoury snacks	422 (82.7%)	88 (17.3%)	
Never consuming snacks	23 (65.7%)	12 (34.3%)	
Frequency of sugar snacking			
Twice or less a day	129 (71.3%)	52 (28.7%)	**0.009**
Three times a day	161 (82.6%)	34 (17.4%)	
More than three times a day	991 (80.6%)	239 (19.4%)	

*Fisher's exact test

Table 28. Logistic regression analysis for caries experience against dietary behaviours

Dietary behaviours	Crude OR (95% CI)	Adjusted OR (95% CI)
Bedtime bottle habit		
Yes	1.34 (1.05-1.71)*	1.80 (1.39-2.34)*
No	(ref)	(ref)
Age of bottle-weaning		
18 months old or younger	0.79 (0.49-1.27)	0.81 (0.49-1.31)
Older than 18 months old	1.76 (1.15-2.69)*	1.69 (1.09-2.63)*
Still bottle-feeding	1.08 (0.79-1.49)	1.47 (1.05-2.06)*
Never bottle-feeding	(ref)	(ref)
Sugar snacking		
Yes	2.10 (1.03-4.26)*	2.29 (1.11-4.73)*
No	(ref)	(ref)
The type of snacks		
Sweet snacks	1.90 (0.93-3.88)	2.12 (1.02-4.42)*
Savoury snacks	2.11 (0.98-4.56)	2.13 (0.97-4.69)
Both sweet and savoury snacks	2.50 (1.20-5.22)*	2.71 (1.27-5.75)*
Never consuming snacks	(ref)	(ref)
Frequency of sugar snacking		
Twice or less a day	(ref)	(ref)
Three times a day	1.91 (1.17-3.12)	2.17 (1.30-3.60)*
More than three times a day	1.67 (1.18-2.38)	1.76 (1.22-253)*

Dependent variable: caries experience (dmft = 0 or dmft ≥ 1)
Other variables in the model: gender, age, parent's/caregiver's education, and household income
CI : confidence interval
ref : reference

In addition, a bedtime bottle habit was not significantly associated with the mean dmft score in the bivariate analysis (Table 29); however, a significant association appeared in the negative binomial analysis after adjusting for gender, age, parent's/caregiver's education, and household income. Children who had a bedtime bottle habit had 1.25 times higher chance of having a higher mean dmft score compared to children who did not have a bedtime bottle habit (RR: 1.25, 95% CI: 1.12-1.40) (Table 30). A significant association was also found between the age of bottle weaning and the mean dmft score in both the bivariate and negative binomial analyses (p = 0.000). Children who were weaned from the bottle after 18 months of age were 1.25 times more likely to have a higher mean dmft score than children who were never bottle-fed (RR: 1.25, 95%CI: 1.05-1.50) (Table 29 and 30).

Similarly, sugar snacking, the type of snacks, and the frequency of sugar snacking were significantly associated with the mean dmft score in the bivariate analysis (Table 29). The associations remained significant in the adjusted analysis of

the negative binomial model. Children who had sugar snacking habits were 1.54 times more likely to have a higher mean dmft score (RR: 1.54, 95%CI: 1.05-2.27). The likelihood of having a higher mean dmft score was also higher among children who consumed both sweet and savoury snacks (RR: 1.61, 95%CI: 1.09-2.39) than the other children. Furthermore, children who consumed snacks three times or more per day were more likely to have a higher mean dmft score compared to children who consumed sugary snacks twice or less a day (RR: 1.46, 95%CI: 1.16-1.83 and RR: 1.36, 95%CI: 1.14-1.63, respectively) (Table 30).

Table 29. Distribution of the mean dmft score according to the dietary behaviours of the participants

Dietary behaviours	Mean dmft score (SD)	*p*-value
Bedtime bottle		
Yes	5.72 (5.04)	0.135
No	5.27 (4.66)	
Age of bottle weaning		
18 months old or younger	5.33 (5.04)	**0.000**
Older than 18 months old	6.46 (4.91)	
Never bottle-feeding	5.32 (4.85)	
Sugar snacking		
Yes	5.59 (4.90)	**0.007**
No	3.57 (4.41)	
The type of snacks		
Sweet snacks	5.45 (4.85)	
Savoury snacks	5.37 (4.77)	**0.016**
Both sweet and savoury snacks	5.91 (5.03)	
Never consuming snacks	3.57 (4.41)	
Frequency of sugar snacking		
Twice or less a day	4.19 (4.23)	**0.000**
Three times a day	5.86 (5.07)	
More than three times a day	5.69 (4.93)	

Table 30. Negative binomial models for the mean dmft scores against dietary behaviours

Dietary behaviours	Crude RR (95% CI)	Adjusted RR (95% CI)
Bedtime bottle habit	1.09 (0.97-1.21)	1.25 (1.12-1.40)*
Yes	(ref)	(ref)
No		
Age of bottle-weaning		
18 months old or younger	1.03 (0.82-1.29)	1.11 (0.89-1.40)
Older than 18 months old	1.25 (1.05-1.49)*	1.25 (1.05-1.50)*
Still bottle feeding	1.04 (0.90-1.20)	1.23 (1.06-1.43)*
Never bottle-feeding	(ref)	(ref)
Sugar snacking		
Yes	1.56 (1.07-2.28)	1.54 (1.05-2.27)*
No	(ref)	(ref)
The type of snacks		
Sweet snacks	1.53 (1.04-2.24)*	1.54 (1.05-2.27)*
Savoury snacks	1.50 (1.01-2.25)*	1.42 (0.94-2.12)
Both sweet and savoury snacks	1.65 (1.12-2.43)*	1.61 (1.09-2.39)*
Never consuming snacks	(ref)	(ref)
Frequency of sugar snacking		
Twice or less a day	(ref)	(ref)
Three times a day	1.40 (1.12-1.75)*	1.46 (1.16-1.83)*
More than three times a day	1.36 (1.14-1.61)*	1.36 (1.14-1.63)*

Dependent variable: mean dmft score

Other variables in the model: gender, age, parent's/caregiver's education, and household income
CI: confidence interval
dmft: decayed, missing, and filled primary tooth
ref: reference

4.4.2 Oral hygiene practices

The most commonly reported age ranges for introducing cleaning without toothpaste were 6-12 months old (33.7%) and 12-24 months old (30.2%). 401 (25%) children had never cleaned their teeth without toothpaste. For the initial age for cleaning with toothpaste, 49.9% of children were in the age range of 12-24 months old, and 26.1% children were in the age range of 24-36 months old. Only a few children (3.2%) had never cleaned their teeth with toothpaste. Most children brushed their teeth twice or more a day (70.1%). Nearly half of the children used a pea-sized amount of toothpaste (49.8%), and more than half of the children sometimes licked toothpaste (55.6%). A total of 897 (55.9%) caregivers supervised their child's tooth brushing by applying toothpaste and help their child to brush (Table 31).

Table 31. Distribution of dental caries according to oral hygiene practices

Oral hygiene practices	Frequency n (%)
Initial age of cleaning ***without*** toothpaste	
0-6 months old	113 (7%)
6-12 months old	542 (33.7%)
12-24 months old	485 (30.2%)
24-36 months old	47 (2.9%)
36 months old or older	18 (1.1%)
Never cleaning ***without*** toothpaste	401 (25%)
Initial age of cleaning ***with*** toothpaste	
0-12 months old	110 (6.8%)
12-24 months old	801 (49.9%)
24-36 months old	419 (26.1%)
36 months old or older	224 (13.9%)
Never cleaning ***with*** toothpaste	52 (3.2%)
Frequency of tooth brushing	
Less than twice a day	428 (26.7%)
Twice or more a day	1,126 (70.1%)
Never tooth brushing	52 (3.2%)
Toothpaste size	
Smear layer	403 (25.1%)
Pea size	800 (49.8%)
Half of the brush head	351 (21.9%)
Never tooth brushing	52 (3.2%)
Licking toothpaste	
Never licking toothpaste	442 (27.5%)
Sometimes licking toothpaste	893 (55.6%)
Often licking toothpaste	271 (16.9%)
Tooth-brushing supervision	
Never give any supervision	10 (0.6%)
Apply toothpaste and help brushing	897(55.9%)
Only put toothpaste on toothbrush	358 (22.3%)
Only watch and give advice	261 (16.3%)
Other kind of supervision	28 (1.7%)
Never tooth brushing	52 (3.2%)

Dental caries was only significantly associated with the initial age of cleaning with toothpaste and tooth-brushing supervision in the bivariate analysis ($\chi^2_{(4)} = 18.088$, $p = 0.001$ and $\chi^2_{(4)} = 10.007$, $p = 0.040$, respectively). The prevalence of dental caries was higher among children who started brushing with toothpaste in the age range of 0-12 months old (87.7%) and 36 months old or older (87.1%), compared to other children. Children of caregivers who supervised tooth brushing by other means of supervision (96.4%) and only watching and giving advice (83.5%) were more likely to experience a higher prevalence of dental caries than their counterparts (Table 32). However, those associations lost their significance in the adjusted analysis of the logistic regression model (Table 33). The initial age of cleaning without toothpaste, frequency of tooth brushing, toothpaste size, and licking of toothpaste were not significantly associated with the occurrence of dental caries in the bivariate analysis ($\chi^2_{(5)} = 9.661$, $p = 0.085$; $\chi^2_{(1)} = 0.014$, $p = 0.907$; $\chi^2_{(2)} = 5.950$, $p = 0.051$; and $\chi^2_{(2)} = 0.933$, $p = 0.627$, respectively) (Table 32). Those associations remained insignificant even after the adjusted analysis in the logistic regression model (Table 33).

Table 32 Association between oral hygiene practices and dental caries

Oral hygiene practices	Dental Caries		*p*-value
	Yes n (%)	No n (%)	
Initial age of cleaning ***without*** toothpaste			
0-6 months old	85 (75.2%)	28 (24.8%)	
6-12 months old	413 (76.2%)	129 (23.8%)	
12-24 months old	398 (82.1%)	87 (17.9%)	0.085
24-36 months old	39 (83.0%)	8 (17.0%)	
36 months old or older	15 (83.3%)	3 (16.7%)	
Never cleaning ***without*** toothpaste	331 (82.5%)	70 (17.5%)	
Initial age of cleaning ***with*** toothpaste			
0-12 months old	84 (87.7%)	26 (22.3%)	
12-24 months old	614 (76.7%)	187 (23.3%)	**0.001**
24-36 months old	350 (83.5%)	69 (16.5%)	
36 months old or older	195 (87.1%)	29 (12.9%)	
Never cleaning ***with*** toothpaste	38 (73.1%)	14 (26.9%)	
Frequency of tooth brushing			
Less than twice a day	344 (80.4%)	84 (19.6%)	0.462
Twice or more a day	899 (79.8%)	227 (20.2%)	
Never tooth brushing	38 (73.1%)	14 (26.9%)	
Toothpaste size			
Smear layer	325 (80.6%)	78 (19.4%)	
Pea size	623 (77.9%)	177 (22.1%)	0.060
Half of the brush head	295 (84.0%)	56 (16.0%)	
Never tooth brushing	38 (73.1%)	14 (26.9%)	
Licking toothpaste			
Never licking toothpaste	355 (80.3%)	87 (19.7%)	0.779
Sometimes licking toothpaste	714 (80.0%)	179 (20.0%)	
Often licking toothpaste	212 (78.2%)	59 (21.8%)	
Tooth-brushing supervision			
Never give any supervision	9 (90%)	1 (10%)	
Apply toothpaste and help brushing	699 (77.9%)	198 (22.1%)	
Only put toothpaste on tooth brush	290 (81.0%)	68 (19.0%)	**0.040**
Only watch and give advice	218 (83.5%)	43 (16.5%)	
Other kind of supervision	27 (96.4%)	1 (3.65%)	
Never tooth brushing	38 (73.1%)	14 (26.9%)	

*fisher's exact test

Table 33. Logistic regression models for caries experience against oral hygiene practices

Oral hygiene practices	Crude OR (95% CI)	Adjusted OR (95% CI)
Initial age of cleaning ***without*** toothpaste		
0-6 months old	0.64 (0.39-1.06)	0.75 (0.45-1.25)
6-12 months old	0.68 (0.49-0.94)*	0.76 (0.54-1.06)
12-24 months old	0.97 (0.68-1.37)	0.93 (0.65-1.33)
24-36 months old	1.03 (0.46-2.30)	0.91 (0.40-2.07)
36 months old or older	1.06 (0.30-3.75)	0.86 (0.24-3.09)
Never cleaning ***without*** toothpaste	(ref)	(ref)
Initial age of cleaning ***with*** toothpaste		
0-12 months old	1.19 (0.56-2.53)	1.02 (0.46-2.23)
12-24 months old	1.21 (0.64-2.28)	1.09 (0.57-2.10)
24-36 months old	1.87 (0.96-3.63)	1.29 (0.64-2.58)
36 months old or older	2.48 (1.20-5.12)*	1.36 (0.62-2.98)
Never cleaning ***with*** toothpaste	(ref)	(ref)
Frequency of tooth brushing		
Less than twice a day	1.51 (0.78-2.91)	-
Twice or more a day	1.46 (0.78-2.74)	
Never tooth brushing	(ref)	
Toothpaste size		
Smear layer	1.54 (0.79-2.97)	-
Pea size	1.30 (0.69-2.45)	
Half of the brush head	1.94 (0.99-3.82)	
Never tooth brushing	(ref)	
Licking toothpaste		
Never licking toothpaste	(ref)	-
Sometimes licking toothpaste	0.92 (0.68-1.24)	
Often licking toothpaste	0.83 (0.56-1.22)	
Tooth brushing supervision		
Never give any supervision	3.32 (0.38-28.61)	1.79 (0.20-15.86)
Apply toothpaste and help brushing	1.30 (0.69-2.45)	1.06 (0.55-2.05)
Only put toothpaste on toothbrush	1.57 (0.81-3.06)	1.15 (0.57-2.31)
Only watch and give advice	1.87 (0.93-3.74)	1.31 (0.64-2.71)
Other kind of supervision	9.95 (1.23-80.25)*	8.20 (0.99-67.65)
Never tooth brushing	(ref)	(ref)

Dependent variable: caries experience (dmft = 0 or dmft ≥ 1)
Other variables in the model: gender, age, parent's/caregiver's education and household income
CI: confidence interval
ref: reference

In addition, in the bivariate analysis, the mean dmft score was associated with the initial age of cleaning without toothpaste, the initial age of cleaning with toothpaste, and tooth brushing supervision. The mean of dmft score was higher in children who started cleaning without toothpaste at the age of 24-36 months old (6.62±5.36, p=0.001), who started cleaning with toothpaste after 36 months old (7.12±5.15, p=0.000), and children of caregivers who supervised tooth brushing by using other kind of supervision (6.93±4.10, p=0.013) and only watching and giving advice (5.97±5.03, p=0.013) (Table 34). However, in the adjusted analysis of the logistic regression model, none of oral hygiene practice variables were found to have a statistically significant association with the mean of dmft score (Table 35).

Table 34. The distribution of the mean of dmft score according to oral hygiene practices

Oral Hygiene Practices	Mean dmft score (SD)	*p*-value
Initial age of cleaning ***without*** toothpaste		
0-6 months old	4.28 (4.14)	
6-12 months old	5.10 (4.88)	
12-24 months old	5.97 (4.94)	**0.001**
24-36 months old	6.62 (5.36)	
36 months old or older	4.78 (4.31)	
Never cleaning ***without*** toothpaste	5.89 (4.93)	
Initial age of cleaning ***with*** toothpaste		
0-12 months old	4.12 (4.02)	
12-24 months old	5.07 (4.86)	**0.000**
24-36 months old	6.03 (4.79)	
36 months old or older	7.12 (5.15)	
Never cleaning ***with*** toothpaste	5.12 (4.92)	
Frequency of tooth brushing		
Less than twice a day	5.56 (4.92)	0.740
Twice or more a day	5.56 (4.89)	
Never tooth brushing	5.12 (4.92)	
Toothpaste size		
Smear layer	5.37 (4.80)	
Pea size	5.49 (4.98)	0.193
Half of the brush head	5.94 (4.81)	
Never tooth brushing	5.12 (4.92)	
Licking toothpaste		
Never licking toothpaste	5.87 (5.05)	0.120
Sometimes licking toothpaste	5.54 (4.89)	
Often licking toothpaste	5.03 (4.63)	
Tooth brushing supervision		
Never give any supervision	5.70 (4.69)	
Apply toothpaste and help brushing	5.22 (4.83)	
Only put toothpaste on tooth brush	6.00 (4.99)	**0.013**
Only watch and give advice	5.97 (5.03)	
Other kind of supervision	6.93 (4.10)	
Never tooth brushing	5.12 (4.92)	

Table 35. Negative binomial models for the mean dmft score against oral hygiene practices

Oral hygiene practices	Crude RR (95% CI)	Adjusted RR (95% CI)
Initial age of cleaning ***without*** toothpaste		
0-6 months old	0.73 (0.58-0.92)*	0.79 (0.63-1.00)
6-12 months old	0.87 (0.75-1.00)*	0.90 (0.78-1.04)
12-24 months old	1.01 (0.88-1.17)	1.03 (0.89-1.19)
24-36 months old	1.12 (0.81-1.55)	1.04 (0.75-1.44)
36 months old or older	0.81 (0.48-1.36)	0.79 (0.47-1.33)
Never cleaning ***without*** toothpaste	(ref)	(ref)
Initial age of cleaning ***with*** toothpaste		
0-12 months old	0.81 (0.56-1.16)	0.71 (0.49-1.04)
12-24 months old	0.99 (0.73-1.35)	0.90 (0.66-1.24)
24-36 months old	1.18 (0.86-1.62)	0.97 (0.70-1.35)
36 months old or older	1.40 (1.00-1.93)*	1.04 (0.73-1.48)
Never cleaning ***with*** toothpaste	(ref)	(ref)
Frequency of tooth brushing		
Less than twice a day	1.09 (0.79-1.49)	0.94 (0.68-1.30)
Twice or more a day	1.09 (0.80-1.47)	0.89 (0.65-1.22)
Never tooth brushing	(ref)	(ref)
Toothpaste size		
Smear layer	1.05 (0.77-1.44)	0.92 (0.67-1.27)
Pea size	1.07 (0.79-1.46)	0.89 (0.65-1.22)
Half of the brush head	1.16 (0.85-1.60)	0.94 (0.68-1.31)
Never tooth brushing	(ref)	(ref)

Licking toothpaste		
Never	(ref)	(ref)
Sometimes	0.94 (0.83-1.07)	0.95 (0.80-1.12)
Often	0.86 (0.73-1.01)	0.93 (0.82-1.06)
Tooth-brushing supervision		
Never give any supervision	1.11 (0.53-2.32)	0.84 (0.40-1.76)
Apply toothpaste and help brushing	1.02 (0.75-1.38)	0.88 (0.64-1.20)
Only put toothpaste on toothbrush	1.17 (0.85-1.61)	0.96 (0.69-1.33)
Only watch and give advice	1.17 (0.84-1.62)	0.96 (0.69-1.35)
Other kind of supervision	1.35 (0.83-2.22)	1.27 (0.76-2.10)
Never tooth brushing	(ref)	(ref)

4.4.3 Dental visits

Only 348 (21.7%) of the children had visited a dentist, and 245 (15.3%) of the children had visited a dentist in the past six months. The most common reason for the last dental visit was for non-preventive dental care (13.7%). Furthermore, more than half of the caregivers perceived delays in having their children visit a dentist for preventive dental care. Child- and time-related delays were the most common reasons given by caregivers for delays in securing the dental care required by their children, with a total of 1,240 (77.2%) children having experienced dental fear (Table 36).

Table 36. Distribution of dental visits

Dental Visits	Frequency n (%)
Dental visit history	
Yes	348 (21.7%)
No	1,258 (78.3%)
Last dental visit	
Less than 6 months ago	245 (15.3%)
6 months to less than 12 months ago	103 (6.4%)
Never visited a dentist	1,258 (78.3%)
Reason of last dental visit	
Preventive dental visit	128 (8.0%)
Non-preventive dental visit	220 (13.7%)
Never visited a dentist	1,258 (78.3%)
Perceived delays in dental care	
Yes	1,056 (65.8%)
No	550 (34.2%)
The types of dental care delay	
Preventive dental care	710 (44.2%)
Non-preventive dental care	249 (15.5%)
Both preventive and non-preventive dental care	97 (6.0%)
No delays in dental care	550 (34.2%)
The reason for the dental care delay	
Cost-related dental care delay	
Yes	182 (11.3%)
No	874 (54.4%)
No delays in dental care	550 (34.2%)
Time-related dental care delay	
Yes	343 (21.4%)
No	713 (44.4%)
No delays in dental care	550 (34.2%)
Child-related dental care delay	
Yes	507 (31.6%)
No	549 (34.2%)
No delays in dental care	550 (34.2%)
Other reasons for dental care delay	
Yes	89 (5.5%)
No	967 (60.2%)
No delays in dental care	550 (34.2%)

Dental fear	
Yes	1,240 (77.2%)
No	366 (22.8%)

In the bivariate analysis, a statistically significant association was found between dental visits and dental caries ($\chi^2_{(1)} = 12.469$, $p = 0.000$). Children who had seen a dentist were more likely to develop dental caries (86.5%) than children who had never seen a dentist (77.9%) (Table 37). The association between a dental visit and dental caries remained significant in the unadjusted and adjusted analysis of the logistic regression model. Children who had a dental visit history were 1.70 times more likely to have dental caries (OR: 1.70, 95%CI: 1.20-2.42) than children who did not have a dental visit history (Table 38). Although the association between the last dental visit and dental caries did not appear in the bivariate analysis ($\chi^2_{(1)} = 0.098$, $p = 0.754$) (Table 37), the results of the unadjusted and adjusted analyses of the logistic regression model indicated a significant association between the last dental visit and dental caries. Children who visited a dentist in the past six months were 1.68 times more likely to have dental caries, compared to children who had never visited a dentist (OR: 1.68, 95% CI:1.12-2.51) (Table 38). Furthermore, a statistically significant association was found between the reason for the last dental visit and dental caries in the bivariate analysis ($\chi^2_{(1)} = 8.030$, $p = 0.005$) (Table 37). This result was also confirmed in the unadjusted and adjusted analyses of the logistic regression model. Compared to children who never visited a dentist, children who had visited a dentist for a non-preventive purpose in their last dental visit had a 2.37 times (OR: 2.37, 95% CI: 1.46-3.84) (Table 38) higher risk of development of dental caries than the other children.

In addition, perceived delays in dental care and the type of dental care delay were significantly associated with dental caries in both the bivariate and the logistic regression analyses ($\chi^2_{(1)} = 4.777$, $p = 0.029$ and $\chi^2_{(2)} = 14.510$, $p = 0.000$ respectively) (Tables 37 and 38). Children of caregivers who perceived delays in having their children receive dental care were 1.33 times more likely to have dental caries (OR: 1.33, 95%CI: 1.02-1.72) than their counterparts. The likelihood of developing dental caries was also 2.20 times (OR: 2.20, 95%CI: 1.40-3.45) higher among children of caregivers who perceived non-preventive dental care than children of caregivers who did not perceive delays in having their children receive dental care (Table 38).

With regard to the reasons for the delays in securing dental care, time-related dental care delay, child-related dental care delay, and other reasons for dental care delay were significantly associated with dental caries in the bivariate analysis, whereas no significant association was found between cost-related dental care delay and dental caries (Table 37). However, in the unadjusted and adjusted analyses of the logistic

regression model, cost-related dental care delay, time-related dental care delay, child-related dental care delay, and other reasons for dental care delays were significantly associated with dental caries (Table 38). Children of caregivers who did not perceive a cost-related dental care delay, a time-related dental care delay, and other reasons for dental care delay had a tendency to have more dental caries than children of caregivers who had no perceived delay in dental care (OR: 1.38, 95%CI: 1.06-1.81, OR: 1.38, 95%CI: 1.04-1.83, and OR: 1.38, 95%CI: 1.06-1.80, respectively). On the contrary, the presence of dental caries was 1.58 times (OR: 1.58, 95%CI: 1.15-2.18) (Table 37) higher among children of caregivers who perceived a child-related dental care delay than among other children. Furthermore, dental fear among the children was also significantly associated with dental caries in the bivariate analysis ($\chi^2_{(1)} = 10.547$, $p = 0.001$) (Table 37). The association remained significant in the logistic regression analysis. Children who reported dental fear were 1.44 times (OR: 1.44, 95%CI: 1.08-1.92) (Table 38) more likely to have dental caries than children who did not have dental fear.

Table 37. The association between dental visits and dental caries

Dental visits	Dental caries		*p*-value
	Yes n (%)	No n (%)	
Dental visit history			
Yes	301 (86.5%)	47 (13.5%)	**0.000**
No	980 (77.9%)	278 (22.1%)	
Last dental visit			
Less than 6 months ago	211 (86.1%)	34 (13.9%)	0.002
6 months to less than 12 months ago	90 (87.4%)	13 (12.6%)	
Never visited a dentist	980 (77.9%)	278 (22.1%)	
Reason of last dental visit			
Preventive dental visit	102 (79.7%)	26 (20.3%)	**0.000**
Non-preventive dental visit	199 (90.5%)	21 (9.5%)	
Never visited a dentist	980 (77.9%)	278 (22.1%)	
Perceived delays in dental care			
Yes	859 (81.3%)	197 (18.7%)	**0.029**
No	422 (76.7%)	128 (23.3%)	
The types of dental care delay			
Preventive dental care	556 (78.3%)	154 (21.7%)	
Non-preventive dental care	221 (88.8%)	28 (11.2%)	**0.000**
Both preventive and non-preventive dental care	83 (85.6%)	14 (14.4%)	
No perceived delays in dental care	421 (76.5%)	129 (23.5%)	

The reason for the dental care delay			
Cost-related dental care delay			
Yes	146 (80.2%)	36 (19.8%)	0.062
No	714 (81.7%)	160 (18.3%)	
No perceived delays in dental care	421 (76.5%)	129 (23.5%)	
Time-related dental care delay			
Yes	271 (79.0%)	72 (21.0%)	**0.027**
No	589 (82.6%)	124 (17.4%)	
No perceived delays in dental care	421 (76.5%)	129 (23.5%)	
Child-related dental care delay			
Yes	430 (84.8%)	77 (15.2%)	**0.002**
No	430 (78.3%)	119 (21.7%)	
No perceived delays in dental care	421 (76.5%)	129 (23.5%)	
Other reasons for dental care delay			
Yes	67 (75.3%)	22 (24.7%)	**0.022**
No	793 (82.0%)	174 (18.0%)	
No perceived delays in dental care	421 (76.5%)	129 (23.5%)	
Dental fear			
Yes	1,011 (81.5%)	229 (18.5%)	**0.001**
No	270 (73.8%)	96 (26.2%)	

*Fisher's exact test

Table 38. Logistic regression models for caries experience against dental visits

Dental visits	Crude OR (95% CI)	Adjusted OR (95% CI)
Dental visit history		
Yes	1.82 (1.30-2.54)*	1.70 (1.20-2.42)*
No	(ref)	(ref)
Last dental visit		
Less than 6 months ago	1.76 (1.20-2.59)*	1.68 (1.12-2.51)*
6 months to less than 12 months ago	1.96 (1.08-3.57)*	1.77 (0.96-3.26)
Never visited a dentist	(ref)	(ref)
Reason of last dental visit		
Preventive dental visit	1.11 (0.71-1.75)	1.13 (0.71-1.81)
Non-preventive dental visit	2.69 (1.68-4.30)*	2.37 (1.46-3.84)*
Never visited a dentist	(ref)	(ref)
Perceived delays in dental care		
Yes	1.32 (1.03-1.70)*	1.33 (1.02-1.72)*
No	(ref)	(ref)
The types of dental care delay		
Preventive dental care	1.11 (0.85-1.44)	1.14 (0.86-1.50)
Non-preventive dental care	2.42 (1.56-3.76)*	2.20 (1.40-3.45)*
Both preventive and non-preventive dental care	1.82 (1.00-3.31)	1.87 (1.02-3.46)*
No perceived delays in dental care	(ref)	(ref)
The reason for the dental care delay		
Cost-related dental care delay		
Yes	1.24 (0.82-1.88)	1.18 (0.77-1.81)
No	1.37 (1.05-1.78)*	1.38 (1.06-1.81)*
No perceived delays in dental care	(ref)	(ref)
Time-related dental care delay		
Yes	1.15 (0.83-1.60)	1.29 (0.92-1.80)
No	1.46 (1.10-1.92)*	1.38 (1.04-1.83)*
No perceived delays in dental care	(ref)	(ref)
Child-related dental care delay		
Yes	1.71 (1.25-2.34)*	1.58 (1.15-2.18)*
No	1.11 (0.83-1.47)	1.19 (0.88-1.59)
No perceived delays in dental care	(ref)	(ref)
Other reasons-related dental care delay		
Yes	0.93 (0.56-1.57)	1.05 (0.61-1.81)
No	1.40 (1.08-1.81)*	1.38 (1.06-1.80)*
No perceived delays in dental care	(ref)	(ref)
Dental fear		
Yes	1.57 (1.19-2.06)*	1.44 (1.08-1.92)*
No	(ref)	(ref)

Dependent variable: caries experience (dmft = 0 or dmft ≥ 1)
Other variables in the model: gender, age, parent's/caregiver's education and household income
CI: confidence interval
ref: reference

In addition, all variables of the utilization of dental health services showed statistically significant differences in the mean of dmft score in the bivariate analysis (Table 39). The differences in the mean of dmft score remained significant in the unadjusted and adjusted analysis of the negative binomial model, except for the reason of last dental visit and dental fear variables that lost their significance after adjusting for gender, age, parent's/ caregiver's education and household income. Children who had dental visit history and visited a dentist in the last 6 months of age were more likely to have higher mean of the dmft score (RR:1.30, 95%CI: 1.14-1.49 and RR: 1.32, 95%CI: 1.13-1.53 respectively) than their counterpart. Higher mean of the dmft score was also found among children of caregivers who, children of caregivers who perceived delays in having their children receive non-preventive dental care (RR: 1.15, 95%CI: 1.03-1.29 and RR: 1.41, 95% CI: 1.20-1.66 respectively). Furthermore, the mean of the dmft score tended to be higher when the cost and time were not the reasons of perceived dental care delay (RR: 1.18, 95%CI: 1.05-1.33 and RR: 1.19, 95% CI: 1.05-1.34 respectively). When the reason of perceived dental care delay was related to the child factor, the mean of the dmft score was 1.23 had no perceived delays in having their children receive dental care (Table 40).

Table 39. The distribution of the mean of dmft score according to dental visits

Dental Visits	Mean dmft score (SD)	*p*-value
Dental visit history		
Yes	7.06 (5.21)	**0.000**
No	5.12 (4.72)	
Last dental visit		
Less than 6 months ago	7.11 (5.41)	**0.000**
6 months to less than 12 months ago	6.92 (4.73)	
Never visit a dentist	5.12 (4.72)	
Reason of last dental visit		
Preventive dental visit	5.45 (4.92)	**0.000**
Non-preventive dental visit	8.05 (5.18)	
Never visit a dentist	5.11 (4.71)	
Perceived delays in dental care		
Yes	5.77 (4.85)	**0.002**
No	5.11 (4.96)	
The types of dental care delay		
Preventive dental care	5.25 (4.80)	**0.000**
Non-preventive dental care	7.30 (4.97)	
Both preventive and non-preventive dental care	5.87 (4.28)	
No delays in dental care	5.07 (4.92)	
The reason for the dental care delay		
Cost-related dental care delay		
Yes	5.42 (4.59)	

No	5.87 (4.92)	**0.003**
No delays in dental care	5.07 (4.92)	
Time-related dental care delay		
Yes	5.24 (4.68)	
No	6.05 (4.94)	**0.000**
No delays in dental care	5.07 (4.92)	
Child-related dental care delay		
Yes	6.36 (4.95)	
No	5.26 (4.74)	**0.000**
No delays in dental care	5.07 (4.92)	
Other reasons for dental care delay		
Yes	4.47 (4.57)	
No	5.91 (4.88)	
No delays in dental care	5.07 (4.92)	**0.000**
Dental fear		
Yes	5.74 (4.90)	**0.001**
No	4.88 (4.84)	

Table 40. Negative binomial models for the mean of dmft score against dental visits

Dental visits	Crude RR (95% CI)	Adjusted RR (95% CI)
Dental visit history		
Yes	1.38 (1.21-1.57)*	1.30 (1.14-1.49)*
No	(ref)	(ref)
Last dental visit		
Less than 6 months ago	1.39 (1.20-1.61)*	1.32 (1.13-1.53)*
6 months to less than 12 months ago	1.35 (1.09-1.68)*	1.26 (1.01-1.57)*
Never visited a dentist	(ref)	(ref)
Reason of last dental visit		
Preventive dental visit	1.07 (0.88-1.30)	1.04 (0.85-1.27)
Non-preventive dental visit	1.58 (1.35-1.84)*	1.46 (1.25-1.71)
Never visited a dentist	(ref)	(ref)
Perceived delays in dental care		
Yes	1.13 (1.01-1.27)*	1.15 (1.03-1.29)*
No	(ref)	(ref)
The types of dental care delay		
Preventive dental care	1.04 (0.92-1.17)	1.07 (0.95-1.21)
Non-preventive dental care	1.44 (1.23-1.69)*	1.41 (1.20-1.66)*
Both preventive and non-preventive dental care	1.16 (0.92-1.46)	1.19 (0.94-1.51)
No delays in dental care	(ref)	(ref)
The reason for the dental care delay		
Cost-related dental care delay		
Yes	1.07 (0.89-1.28)	1.07 (0.89-1.29)
No	1.16 (1.03-1.30)*	1.18 (1.05-1.33)*
No delays in dental care	(ref)	(ref)
Time-related dental care delay		
Yes	1.04 (0.89-1.20)	1.11 (0.95-1.29)
No	1.20 (1.06-1.35)*	1.19 (1.05-1.34)*
No delays in dental care	(ref)	(ref)
Child-related dental care delay		
Yes	1.26 (1.10-1.43)*	1.23 (1.08-1.41)*
No	1.04 (0.91-1.18)	1.09 (0.96-1.25)
No delays in dental care	(ref)	(ref)
Other reasons for dental care delay		
Yes	0.88 (0.69-1.13)	0.94 (0.73-1.21)
No	1.17 (1.04-1.31)*	1.18 (1.05-1.33)*
No delays in dental care	(ref)	(ref)
Dental fear		
Yes	1.18 (1.04-1.34)*	1.14 (1.00-1.30)
No	(ref)	(ref)

To sum up, this chapter has provided a detailed account of the quantitative results of the study. It has shown a general picture of the problem of dental caries

among preschool children aged two to six years old in Surabaya. The results of the quantitative part of this study show a high prevalence and severity of dental caries among children aged two to six years old in Surabaya, with a high percentage of untreated dental caries. In relation to sociodemographic characteristics, the prevalence and severity of dental caries increased with age and among children whose parents had low educational status. Furthermore, Chinese ethnicity was found to be significantly associated with a high prevalence of dental caries, while the severity of dental caries was significantly associated with the Javanese ethnicity. Higher mean OHRQoL scores among children who had dental caries than those who were caries-free indicated that dental caries negatively impacted the quality of life of the children and their families. In the context of oral health behaviours, all variables of dietary behaviours (including sugar snacking and bedtime bottle habits) and dental visits were significantly associated with dental caries. On the contrary, none of the variables of oral hygiene practices were significantly associated with dental caries in the multivariate analysis. However, it is necessary to further explain the results in order to completely understand the problems of dental caries among preschool children in Surabaya. The next chapter presents the results of the qualitative component of this study concerning what parents in the caries and caries-free groups said themselves about their experiences, particularly in the process of making a decision to adopt particular oral health behaviours for their child that might impact their child's dental health outcomes.

CHAPTER 5
QUALITATIVE RESULTS

This chapter presents the results of the qualitative component of this study. The results will answer the third research question of this study: What are the factors influencing oral health behaviours among young children aged two to six years old in Surabaya, Indonesia who suffer from dental caries and those who are caries-free? The answer to this question corresponds with the final aim of this study: to explore and explain parents' personal and socio-environmental factors that influence oral health behaviours and dental health outcomes in young children aged two to six years old in Surabaya. The results give an understanding of the association between oral health behaviours and dental caries found in the quantitative study.

A total of 31 mothers/caregivers of children aged two to six years old in Surabaya participated in the interviews, consisting of 16 participants from the caries group and 15 participants from the caries-free group. Each interview lasted for 40-60 minutes. During the interviews, the participants discussed in detail their views towards the children's oral health and their perceptions and experiences of facilitating their children's oral health behaviours. They provided diverse reasons and explanations for their attitudes and actions.

The majority of participants in both the caries and caries-free groups were aware of their children's dental health conditions, with many of them regarding toothache and changes in tooth colour to black or brown as the initial signs of dental caries. The results of the interviews brought out four broad themes related to the key findings of the quantitative study: sugar snacking, bottle-feeding, oral hygiene practices, and utilisation of dental services. For each theme, oral health behaviours between children in the caries and caries-free group are compared and contrasted, and the factors influencing their oral health behaviours are explored. Table 41 shows the main themes and sub-categories that emerged from the interview data analysis. Each theme is discussed in turn.

Table 41. The main themes and sub-categories

Themes	Sub categories
1. Sugar snacking	a. Parenting practices concerning sugar snacking b.Family influence on sugar snacking c.Sociocultural influences on sugar snacking
2. Bottle-feeding	a.Parents' ability to manage child's behaviours in relation to bedtime bottle b.Family influences on bedtime bottle c.Sociocultural influence on bottle drinking
3. Oral hygiene	a.Parents' perceived needs of early oral hygiene practices b.Family and sociocultural influence on oral hygiene practices c.Parents' perceived ability to manage child behaviours in relation to tooth brushing d.Parents' perceived knowledge and skills concerning tooth brushing e.Parenting practices concerning tooth brushing.
d. Dental service use	a.Parents' perceived importance of dental visits b.Family and sociocultural influences on dental visits c.Parents' perceived ability to manage the child's behaviours during dental visits d.Access to dental health services

5.1 Sugar snacking

The first theme that emerged from the interviews was sugar snacking. In this study, the term 'sugar snacking' refers to a small portion of food, particularly sugar-containing foods, consumed between meals, such as sweets, chocolate, biscuits, crisps, etc. Beverages (tea, sweetened and flavoured milk, ice cream, instant powder drink, etc.) are also considered as sugary snacks. Sugar snacking is known to be an important risk factor of dental caries, because sugar from food and beverages consumed between meals significantly contributes to damage to the teeth and dental caries. This section compares and contrasts sugar-snacking behaviours between children in the caries and caries-free groups, and it describes the factors influencing those sugar-snacking behaviours. This section covers the parenting styles related to children's sugar-snacking behaviours, family influence on sugar snacking, access to sugary snacks, the sociocultural environment, and parents' income.

5.1.1 Parenting practices concerning sugar snacking

Many parents of children in the caries group were aware that their child suffered dental caries, and they showed their intention to restrict their child from sugar snacking. However, they perceived difficulties in resisting their child's craving for sugary snacks. The parents' perceived inability to control their child's emotions when they crave sugary snacks was the most frequent issue raised during the interviews. As an example, one participant in the caries group perceived difficulty in situations where her daughter started crying or showed some kind of embarrassing behaviour in public when asking for sugary snacks. As a result, she felt pressured to give in to her daughter. She said:

She always cries, and she will be angry if I restrict her from sugary snacks. I don't have any choice to make her stop crying except giving her what she wants. If I don't do that, she will keep crying all day (C17).

Another participant also said that her son is defiant and stubbornly refuses to cooperate. He ignores her requests to reduce his consumption of sugary snacks. So, she has struggled to make her son comply with her requests. She said:

I have explained to him that he should not eat candies, because candies will not only cause toothache, but also a cough. I told him several times, but he doesn't want to listen to me. He just eats it. So, I just let him eat it... He always disobeys me… (C6)

A feeling of guilt related to maternal employment was also cited as one of the barriers to sugar-snacking restriction. One participant admitted that despite her awareness of the negative impacts of sugary snacks on her son's dental health, she is too lenient with sugar snacking. She feels guilty for refusing to give sugary snacks to her son, and she cannot bear to see her son crying. As she explained:

I realised that my child got dental cavities because of chocolate and candy consumption. So, I thought that I should restrict him from eating chocolate and candies. It is important to restrict him from eating chocolate and candies so he can get good and healthy teeth and have no more dental cavities. However, [laughing], in the end, I always fail. I give up easily and let him eat chocolate and candies as much as he wants…I could not resist my child's craving for chocolate and candies…(C1)

Some participants also reasoned that they give in quickly because they feel overstressed and have little energy or patience after working or because of daily life issues. They find it difficult to confront their child and want to avoid tears and battles. One participant explained:

I can't restrict her from snacking. It is impossible. She can't. She always wants to eat something. She must have snacks everyday… If I force her to stop eating snacks, she will be angry, and there will be chaos in the house [laughing]… (C18)

In addition, rewarding children with sugary treats was found to be common among the parents of children in the caries group. They commonly give their child sweet treats when the child is upset to make their child feel better. They are tempted to present sugar as a reward to their child, because it gives a quick result. One participant said:

I am used to giving him a candy every time he is fussy or cries, and it makes him calm. Sometimes, I change candies to flavoured UHT milk, but it is also sweet... If I don't do that, I don't know how to make him calm (C26).

Furthermore, many parents of children in the caries group tend to make sugary snacks available at home. Some of them argued that restrict their child's access to them. For example, they keep sugary snacks out of children's reach or only place a limited amount of them within the children's reach. Other participants seemed to have little or even no control of their children's consumption of those sugary snacks. One participant explained:

I always have choki-choki [a brand of chocolate paste stick] available at home, because he [her son] loves it. I never limit the number and frequency of his consumption of choki-choki. He usually eats 10 packs of choki-choki a day. If I restrict his access, he will be upset and stay in his room all day. I think he will definitely stop eating it once he gets bored with it (C7).

One participant in the caries group also gave a different reason for being permissive to sugar snacking. She said that she is lenient with snacks because she is concerned about her son's eating problem that has been ongoing since he first started to eat food. She revealed that her son never ate proper meals because he refused to eat meals, and therefore, she offered various snacks to her son as a substitute for his meals. As she explained, '…if I restrict him from eating those snacks, he will not eat anything. So, it is not good. That's why I let him to eat anything he wants…' (C12).

In contrast to the majority of parents of children in the caries group, many parents of children in the caries-free group had reasonably clear thoughts on restricting sugary snacks, with some expressing the view that sugary snacks were not healthy for

their children. Most of them decided to restrict their child from sugar snacking due to general health concerns. As an example, one participant said:

I restrict her snacks, such as not to eat chiki [flavored snacks] or other snacks, because she has suffered pharyngitis, so I worry that she will suffer pharyngitis again. It is important to restrict our children from consuming sugary foods and beverages… (CF2)

There appeared to be a number of strategies adopted by parents of children in the caries-free group to restrict their child from sugar snacking. Although some parents of children in the caries-free group still allowed their child to eat sugary snacks, they set a rule to limit the amount of sugary snacks that their child could eat. Most of them reasoned that they set a rule because they perceive sugary snacks as unhealthy snacks for their child's health. One participant explained:

It is not healthy. It usually contains a lot of sugar, preservatives, colour agents, or flavour enhancers that are not healthy for children. However, I can't really forbid her from eating sugary snacks. If I do that, her curiosity will increase. She will hide behind me to eat sugary snacks, and she may excessively eat sugary snacks. I don't want it to happen. So, I allow her to eat sugary snacks, but I have to limit the amount and the frequency of her sugar snacking. (CF31)

She restricts her younger daughter from sugar snacking because she learned from her first experience with her elder daughter. She felt guilty when she realised that her elder daughter suffered dental caries due to excessive sugar consumption. Given a second chance to look after her younger daughter herself, she set rules and boundaries for sugar snacking to prevent dental caries. In the process of setting up sugar-snacking rules, she involved her daughter in deciding the allowed amount and frequency of sugary snacks consumption. Once her daughter accepted the rule, she stuck to the rules of sugar snacking she had established. She emphasises the importance of limiting the availability of sugar snacking at home and gives the child consistent rules for sugar snacking. When asked about her rules for sugar snacking, she explained:

Once a month, we go to the supermarket. She and her sister can buy snacks to be kept at home, but I limit the number of snacks that she and her sister can buy… they usually buy four or five types of snacks, and they have to share those snacks. Those snacks should last for at least a month. I only allow them to open one type of snack every day… they only can take one piece of a snack that they open. If those snacks run out in less than a month, they will have no more snacks. They have to wait until the next month (CF31).

Some parents of children in the caries-free group also highlighted the importance of establishing rules and boundaries for sugar snacking from a very young age. The most common perceived benefit was that their children were not easily tempted to eat sugary snacks. They also perceived no difficulty in restricting their child from sugar snacking, because their child never got used to eat sugary snacks. One participant said:

I never experienced barriers in restricting my child from consuming sweet foods and beverages. It is may be because she is not used to consuming sweet foods and beverages since she was little. I never introduced it to my daughter... She even never wants to taste some sweet foods and beverages… For other parents, they have to fight with their children, because they made their children used to consuming sweet foods and beverages when their children were still very young. It has become their children's habits. So, they will find it difficult to restrict their children from consuming sweet foods and beverages, and the children usually win the battle against their parents (CF2).

Furthermore, instead of making sugary snacks available at home, several participants provided healthy alternatives to snacking. As one participant explained:

I prepare fresh and natural fruit juice every day, without sugar. I put it in the fridge. I buy a lot of fruit to make fruit juice for her. So, she got used to opening the fridge and taking the juice. I prepare two or three kinds of fruit juice every day.... She doesn't like instant flavoured drinks, such as nutrisari [a brand of powder-based fruit drinks] or ready-to-drink packaged beverages…it is maybe because she didn't get used to it from when she was little (CF10).

Some participants also chose to give a context for controlling the consumption of sugary snacks. She only allowed her child to have sugary snacks on a special occasion, such as at a birthday party, on holiday, or at a family gathering. She explained:

He rarely has sweet snacks. I never let him have sweet snacks. I only allow him to have sweet beverages when we eat in a restaurant. He also can eat candies and chocolate at a friend's birthday party. If he gets chocolate and candies in the goody bag, he usually will only eat one snack a day (CF27).

Another participant involved her older children in her efforts to restrict her youngest child from sugar snaking. She believed that siblings could serve as role models to give a positive influence on sugary-snack restriction, as she explained:

He always wants to follow his older sister and brother. If they eat candies, he will ask to eat candies as well. If they don't eat candies, he won't eat candies either. So, my strategy is that I approached his older brother and sister to be role models for him by not excessively eating sugary snacks, and it works (CF5).

5.1.2 Family influence on sugar snacking

Sugar-snacking habits also seem to be determined by the person who has primary control of child rearing on a daily basis. Some parents of children in the caries group viewed living with parents or in-laws as having a great influence on their child's sugar snacking. Most of them perceived that their parents or in-laws undermined their authority as a parent, because their parents or in-laws imposed their own sugar snacking notions on their child. As an example, one participant in the caries group said that her son suffered dental caries because of sugar-snacking habits influenced by her parents-in-law. She had lived with her parents-in-law from when her son was born until he was four years old. By the time her son was 18 months old, she realised that her parents-in-law were very lenient with sugar snacking. They had introduced sugary

snacks and soda to her son, but she had no courage to refuse it. Consequently, despite her awareness of the needs to limit sugary snacks, she perceived a lack of ability to change her son's sugar-snacking habits. As she explained:

My parents-in-law are too permissive. We have a very different parenting style. They gave him soda and many kinds of sugary foods and beverages from when he was 18 months old… I know that it will be difficult to change his snacking habits, because he has lived there for four years. I have to change his snacking habits gradually. Now, he rarely drinks soda. I also never buy ready-to-drink beverages, but if he visits his grandparents, he will definitely drink it again (C6).

She made a concerted effort to restrict her son from sugar snacking, but she failed in her attempt to change his son's sugar-snacking habits. She perceived that the family influence on her son's sugar snacking made it difficult for her to resist.

Some parents of children in the caries group also mentioned that they were not able to resist the influence of parents or in-laws on their child's sugar snacking, because they had no courage to argue with them. They commonly referred to family values, according to which children are expected to obey their parents and older siblings unquestioningly; otherwise they are criticised for their impropriety. One participant said:

I often visit her [her daughter's] grandparents, because they live near my house. Every time we visit them, she [her daughter] always asks for candies from them, and they always give her what she wants. I can't say no to them or prevent them from giving candies to her. If I do, they will scold me (C17).

Several parents of children in the caries group discussed the difficulty of being a working mother and taking responsibility for looking after their children. They commonly relied on their parents to look after their children when going out to work. However, the leniency and spoiling of grandparents became a barrier to sugary-snack restriction, as their children often coaxed sugary snacks out of the grandparents when the parents were away. One participant said:

His grandmother always buys him chocolate and ice cream every day when I go to work, because she knows that her grandson loves chocolate. Sometimes, I say 'no' to buying chocolate, but my mother allows him to buy chocolate because she is soft hearted and she easily moves to pity. She always reasons that it is a pity my son is not allowed to eat chocolate. That's the problem (C3).

Another cited barrier to restricting children from sugar snacking was the situation in which two parents did not follow the same set of sugar-snacking rules and boundaries, and this made it that sugar-snacking rules could not be consistently established. One participant in the caries group explained:

I didn't allow my son to eat candies and chocolate. Then, he [her husband] came back home and brought chocolate. The chocolate was very sticky... He knew that I would be mad at him because he brought chocolate for my son. So, before I was mad at him, he said to me, 'I only wanna see him [son] happy. I don't have the heart to not buy it for him, because I know he loves it, and he will be happy when he eats it. Let him eat it for now'. He said it like that. So, what can I do if he said it like that? I just said 'ok, it's up to you' (C16).

In contrast, in the caries-free group, many participants took a number of

approaches to resist their parents' influence on their child's sugar snacking. Being assertive was considered as the key to success in resisting the pressures their parents placed upon THEM. As an example, one participant in the caries-free group said that her mother often insisted on giving sugary snacks to her daughter. She perceived that giving in to her mother's pressure on her daughter's sugar snacking would be a detriment to her daughter's health. Hence, she asserted herself in standing up to her mother. As she explained:

My family often puts pressure on me to give sweet food and beverages to my daughter. The pressure frequently comes from my mother… My concern is only about my daughter's health. I also want her to have good teeth. What my mother said will have no impact on me. It will not change my decision to not introduce sweet snacks to my daughter. I will even go against my mother if it is related to my child's health (CF2).

Another approach used by parents of children in the caries-free group is communication. The parents talking to the grandparents about sugar-snacking rules and boundaries seemed to be tough, particularly if they had different views and opinions. However, most of them chose to face the issue and share their thoughts, telling the grandparents in a clear manner about their sugar-snacking rules for their child and discussing the benefits of sugary-snack restriction. In cases in which this approach did not work, they did not give up. They would keep reminding the grandparents until an agreement was reached and the parents were willing to follow the same set rules of sugar snacking, as one participant said:

I explained to my parents that I restrict my daughters from sugar snacking until they agreed with it. So, none of us are permissive towards sugar snacking. We hide all candies and chocolate, and we never introduce sugary snacks to my daughter (CF4).

Furthermore, some participants emphasised the importance of having all family members and other caregivers follow the same set of rules and boundaries of sugar snacking in order to give the child consistent rules of sugar snacking.

Some parents of children in the caries-free group also perceived the importance of monitoring to control their child's sugar snacking in the face of family pressure on sugar snacking. As an example, one participant chose to let her son receive sugary snacks from his grandparents, but she emphasised the need for consistency in enforcing the rules of sugar snacking to her son, as she explained:

When we visit his grandmother, his grandmother always gives him candies and chocolates. For me, it doesn't matter if his grandmother gives him candies and chocolate, but I have to keep limiting the number of candies and chocolates he eats. If I see he has eaten one candy, I will stop him eating other candies (CF14).

5.1.3 Sociocultural influences on sugar snacking

The sociocultural environment appeared to have a great influence on children's sugar snacking. A feeling of powerlessness in the face of social norms of sugar snacking was often perceived by some parents of children in the caries group as one of the barriers preventing them from restricting their child's snacking. One participant explained that in her local area, people often give sugary snacks to children because sugar snacking was regarded as a normal behaviour among children, and they would be offended if she refused to take what they give to her son. As she said:

Almost all children here love eating candies. My neighbours often give him [her son] sugary snacks...I can't refuse it, because I have to respect them. If I refuse when they give something to my son, I worry that they will be irritated (C6).

Another sociocultural barrier to sugar-snacking restriction perceived by parents of children in the caries group was social pressure. One participant emphasised how social pressure and feelings of obligation had contributed to shaping her son's sugar-snacking habits:

For me, the most frequent influence comes from my child's friends here… If I refuse to buy them [sugary snacks], he will cry. Other parents will say to me that I am not a good mother or that I do not love my child, because I refuse to give my child what he wants. That is terrible. I feel shy with other people surrounding me. So, I am forced to buy it for him to make him stop crying. That is why I have to give my child whatever he wants (C1).

During the interview, she described her specific circumstances, which seemed to become a reason for giving in to social pressure. She lived in an area in which the house is attached to its direct neighbours, which she perceived as making people intrude often into their neighbour's affairs. Furthermore, being a minority ethnic group in her local area made her try hard to fit in with other people and avoid problems with them. Therefore, the perceived need to be accepted by others in her community, her feelings of guilt, and her fear of being judged by others as a 'bad parent' disrupt her efforts to restrict her son from sugar snacking. As she said:

I actually know that it is important to restrict him from eating chocolate and candies, it is good for his teeth, so he will not have dental cavities or suffer pain due to dental problems. But, you know, he always cries and cries. Sometimes, he even screams out for attention. Here, I live in a village area. So, when my child cries or screams like that, my neighbours or even people who are just walking in front of my house will hear that. My child will not stop crying until I give him what he wants. So, I am shy concerning the people surrounding me. They will think that I am not a good mother because I can't give my child what he child wants, and I make him cry. They do not really know what happens. That is why I often give up and give him what he wants to make him stop crying, and people will not think something bad about me (C1).

In addition, in some areas, particularly areas of low socioeconomic status, many parents of children in the caries group believed that widespread access to and consumption of sugary snacks and beverages in their local areas have facilitated sugar-

snacking behaviours among children and has made it difficult for them to restrict their child from sugar snacking. One participant said that the emergence of food stalls in her local area, which mostly sold cheap sweet foods and beverages, had given their child easy access to sugary snacks. Furthermore, they perceived that their child was tempted to have sugary snacks as a result of increased consumption of sugary snacks among children in her local area, as she said:

Here, almost all children often consume ready-to-drink packaged beverages. It is easy to buy them here. There are many stalls here selling various foods and drinks that are attractive for children. They buy them and consume them, so it is difficult to prevent my child from consuming them (C1).

Several parents of children in the caries group also mentioned that the nature of the school canteens contributed to their children's sugar-snacking behaviours. The easy access to the school canteen and the availability of tempting sugary snacks seemed to make children have a desire for sugar snacking. One participant said:

In the school canteen, they sell candies, chocolate, snacks like chiki [a brand of flavoured snack], milk, ready-to-drink tea, something like that. They display those snacks in a glass cabinet. It does have an influence on children's snacking habits, because they see those snacks every day. So, they are tempted to buy them (C18).

In contrast, in the caries-free group, being consistent with sugar snacking rules appeared to become an important contributor to their ability to resist social pressure. As an example, one participant said that she stood firm and refused to give in to the pressure from other parents to let her child have sugary snacks. She also never let herself feel pressured by her own concerns about what other parents thought of her. She explained:

Many parents here often give her [her daughter] sugary snacks…because they know that I never give her sugary snacks. I will usually talk to them and clearly tell them that I never want my child to get used to sugar snacking. I have a rule for sugar snacking for my child that I ask them to respect. So, I really ask them not to give anything to my child. I don't care what they will think of me, because I know better than them what is the best thing to do for my child (CF15).

Giving children something else to do is also another strategy commonly adopted by some parents in the caries-free group to divert their child's attention away from sugary snacks. One participant perceived that distraction was a good way of keeping her son away from sugar snacking without having to give in. It helped her avoid situations in which she had to deal with her son's difficult behaviours due to sugar-snacking temptation. She said:

My son always asks for snacks every day. It is because there are so many stalls near my house… Sometimes he becomes fussy and keeps asking for snacks. Then, I distract him from snacking, such as by playing with him or giving him water to make him full so he doesn't want a snack anymore. Sometimes he cries, then I will carry him and we play, or I ride a motorbike with him to go outside. I will persuade him not to cry and I try to keep him away from the stalls. It is essential to be firm with our children. Don't give them anything they want just to please them (CF19).

In addition, some parents of children in the caries-free group perceived that school plays an important role in supporting parents' efforts in sugar-snacking restriction. Some schools appeared to have established a policy concerning sugar snacking, through setting limits on sugar snacking at school, having regulations regarding foods and drinks sold in the school canteen and other stalls around the schools, and promoting healthy snacks. One participant in the caries-free group explained:

In his school, there is no canteen, and food stalls are not allowed in his [son's] school. Students can bring their own lunch from home or they can order lunch from the school's catering service. If they bring lunch from home, the teacher checks their lunch. They are not allowed to bring fast food, such as Kentucky Fried Chicken. Their lunch must be homemade food, such as rice and spinach soup or bread. They are also not allowed to bring sweet snacks, such as chocolate, candies, wafers, biscuits, or flavored snacks, such as chiki [a brand of flavoured snack]. If they order lunch from the school's catering service, the food will be definitely be healthy (CF28).

To support the school's policy on sugar snacking, some schools also provide dental health education to the students, aiming to increase the students' awareness of the importance of limiting the consumption of sugary snacks. One participant in the caries-free group perceived the positive influence of dental health education on her child's snacking behaviour, as she explained:

… When she was invited to her friend's birthday party, she got candies. Then, she said, 'I don't wanna eat candies.' I asked, 'why?' She replied, 'the dentist in the school said not to eat candies because they cause dental cavities' (CF10).

5.2 Bedtime bottle habits

The second theme emerging from the interviews was bedtime bottle habits. In this study, 'bedtime bottle habits' refers to the habits of drinking sweetened milk or any liquids other than water with a bottle at bedtime. Sugar content in the liquids in the bottle can lead to dental caries. Children who are commonly given sweetened milk in a bottle at bedtime and on-demand at night are at risk. When children fall asleep with a bottle, the sugar content in the milk stays on the children's teeth for a long time and can damage the teeth, causing dental caries. A prolonged bedtime bottle habit can put children at greater risk of dental caries. The longer parents delay bottle weaning, the more likely the children are to have dental caries. This section compares and contrasts bedtime bottle habits between children in the caries and caries-free groups and demonstrates the factors influencing bedtime bottle habits. Parents' ability to manage their child's behaviours in relation to bedtime bottles, family influences on children's bedtime bottles, and sociocultural influences on children's bedtime bottles are discussed.

5.2.1 Parents' ability to manage children's behaviours in relation to bedtime bottle

Many parents of children in the caries group had children with bedtime bottle habits. A child's dependency on a bottle to sleep throughout the night was the most common reason for a bedtime bottle habit. Parents were commonly convinced that their child had to have a bottle of milk before bed. They perceived that handing their child a bottle of milk before bed was the only way they could help their child fall asleep. One participant in the caries group said, 'he cannot sleep at night if he doesn't take the bottle to bed. So, I let him fall asleep with a bottle' (C26). A child's dependency on a bottle also occurred during sleep at night, because the child still woke every few hours for bottles during the night, as one participant in the caries group said:

He always has a bottle before bed at night, and then he will wake up six or eight times throughout the night for a bottle. He has become dependent on bottles to make him fall asleep (C24).

A bedtime bottle was believed to make their child rely on sucking on a bottle, as the easiest and quickest way, in order to get to sleep, rather than considering long-term consequences.

In addition, breaking their child's bedtime bottle habits seemed to be a challenge for most parents of children in the caries group. Some of them admitted that they never started bottle weaning, but others failed in their attempts to wean their child off the bottles. A lack of guidance on how to successfully wean the child off bottle was apparent and made the parents feel reluctant to start bottle weaning, as one participant said:

I actually want to completely get rid of the bottle, but I am still trying to figure out how to wean her off the bottle. I haven't got any idea how to do it yet (C18).

A perceived inability to deal with a child's resistance to bottle weaning was also frequently reported by parents of children in the caries group as one of the barriers to successful bottle weaning. For some parents of children in the caries group, the thought of abruptly taking the bottles away from the child was daunting and made them feel like they were not ready for bottle weaning. They mostly reasoned that they could not bear to see their child crying when they took away the bottle. One participant said, "He is still too young. He is still three years old. It will break my heart to see him cry if I have to wean him off of his bottle" (C1). Some parents of children in the caries group also perceived having trouble with the child's insistence on a bedtime bottle. One participant said that no matter how much they tried to replace the bottle with a cup, their child was not willing to give up the bottle, as she said:

I have told him to drink milk with a cup. I also have bought a cup with his favourite cartoon character. He chose the cup himself, but he still doesn't want to drink with the cup (C3).

Furthermore, during the process of bottle weaning, most parents of children in the caries group reported having some pushback from their child, because their child was not getting to drink milk from a bottle at bedtime. They considered it as an overwhelming obstacle. One participant in the caries group said:

It is difficult to take away the bottle at bedtime. I tried once. I persuaded him to not drink milk from the bottle, but he cried all the night, and he couldn't sleep. It is a pity. Then, I gave him a bottle to help him sleep through the night (C21).

She also admitted that she gave in rather than having to deal with her child's behaviours in response to bottle weaning particularly when she was feeling drained of energy because of perceived stress during the day.

In addition, a huge decrease in children's desire for milk after bottle weaning became a matter of great concern to some parents of children in the caries group. They eventually decided to give the bottles back to the child to ensure their child was getting a sufficient amount of milk, as one participant in the caries group explained:

When he still drank from a bottle, he could drink up to six to eight bottles a day, but the frequency of drinking milk reduced after he drank from a cup. I worry it will impact his weight. So, I think it doesn't matter if he had to go back to a bottle. His health is more important for me (C23).

On the contrary, in the caries-free group, some participants reported that they never introduced a bottle to their child. One participant reasoned that she was not convinced to serve milk after she weaned her son from breastfeeding at two years old. Rather, she preferred to encourage her son to eat healthy foods to get essential nutrients as a replacement for milk, as she said:

I never wanted him to get used to drinking milk. I prefer that he eats instead of drinking milk. If he needs vitamins, he can get them straight from the foods, like fruits or vegetables... He was never introduced to a bottle or formula milk... I have allowed him to drink full-cream milk since he was two years old, but I won't let him drink it on a regular basis (CF28).

She also never got her son used to drinking milk or having any other food or drink, except water, before bed. She believes that those habits have allowed her to keep her son free from dental caries.

In addition, many parents of children in the caries-free group whose children had drank milk from a bottle found success in weaning their child from a bottle. They acknowledged that bottle weaning is not an easy process. They also had trouble in getting their child to give up the bottle. However, compared to the parents of children in the caries group, they were less inclined to give up weaning in the face of difficulties during the weaning process. Many parents of children in the caries group cited that being consistent and sticking to their weaning plan was the key to successful weaning. One participant in the caries-free group shared a story about how her daughter was eventually willing to switch from a bottle to a cup. Like most parents of children in the

caries group, she also had some pushback from her daughter during the weaning process. Her daughter put up a fuss when she gradually cut out the bottles during the day and at bedtime. Her daughter whined or threw a tantrum in order to get the bottle. In this situation, she stayed firm and did not waiver. She would not turn to a bottle to calm her daughter down, as she explained:

I must be consistent in not giving her milk from a bottle. It was not easy, but I knew I could do it. She has stopped bottle drinking since last year... Sometimes, she was upset and cried. She begged for her bottles, and she asked me to let her drink milk from her bottle, but I said 'no, bottle drinking is only for a baby, and you are not a baby anymore. If you still want to drink milk from your bottle, I won't give you milk'. Then, maybe she thought about what I said... After that, she was willing to drink milk from a cup (CF22).

Instead of gradual bottle weaning, another participant in the caries-free group chose sudden bottle weaning. She believed that the only way to break bottle drinking habits was by ceasing to offer them. She simply kept all the bottles out of her child's sight and cut off bottles all at once. She explained:

I threw out all of her bottles at once. She was resistant to giving it up in the beginning. She was upset. She kept crying and begging for her bottles. I offered her a cup of milk as a replacement. I let her decide. Whether she wanted to take it or leave it was up to her (CF22).

To address the issue of reduced milk consumption after bottle weaning, instead of giving a bottle back, one participant in the caries-free group worked on increasing her child's milk consumption by combining milk with other foods, as she explained:

The only issue was just that the amount of milk she drank reduced. Then one year later, she did not want to drink milk at all. So, to make her drink milk again, every morning, I changed her breakfast into cereal with Greenfields fresh milk or Greenfields strawberry milk [a brand of pasteurised milk]. (CF10)

5.2.2 Family influences on bedtime bottle habits

Families might positively or negatively influence bedtime bottle habits. In the caries group, family was reported as one of the barriers to bottle weaning. One participant in the caries group perceived that the leniency and spoiling of grandparents could ruin the success of bottle weaning. They sneaked in a bottle when she was not around, and made her son re-attached to the bottles. She explained:

I often told my son to drink milk from a cup because he is now six years old… when he visits his grandparents and stays there for several days, I don't bring him bottles. I hope that he will drink milk from a cup, because there are no bottles. However, his grandparents always offer him to drink milk from a bottle, and they buy new bottles for him. I asked them why they buy new bottles for him, even though they know my reasons for why I don't bring him bottles. They just said, 'let him drink milk using a bottle. He can't sleep without it'. It is difficult if we have different parenting styles (C6).

In contrast, in the caries-free group, a family culture of a bedtime routine appeared to contribute to the child's independent sleep. The child was able to sleep throughout the night without bottles. One participant said that in her family, there are no bedtime bottle habits. The child never got used to having a bottle at bedtime. The

child is encouraged to finish their milk and brush their teeth before going to bed, and they are not allowed to have any food or drink after that. One participant said:

My daughter drinks milk only in the morning before going to school and in the evening. After she brushes her teeth at night, she will go straight to bed and sleep (CF9).

Some participants also highlighted the importance of parental support for bottle-weaning success. One participant in the caries-free group believes that parental support and encouragement to take away the bottle is important in the weaning process:

At home, her [her daughter's] father also often encouraged her to take away the bottles. He said that she has grown up, and it is time to drink milk out of a cup instead of a bottle. I thought she listened to her father more than she listened to me [giggling], because after that, she was willing to take away the bottles (CF27).

Furthermore, another participant involved older children in being role models to the youngest child, aiming to encourage the youngest child to give up the bottles. She perceived that seeing older children drink milk from a cup would motivate the youngest child to learn to drink milk from a cup. She explained:

When she was one-year-old, she had to go to the dining room for eating and drinking, including milk. In the dining room, she would look at her older brothers and sisters drinking milk from a cup... In the beginning, sometimes, she still asked me to drink from her bottle, but I always encouraged her to drink from a cup, and her older brothers and sisters also encouraged her to drink from a cup. She eventually gave up her bottles perfectly when she was 18 months old. It didn't take too long to wean her from the bottle as there were role models (CF15).

5.2.3 Sociocultural influence on bottle drinking

The sociocultural environment appears to have an influence on bottle drinking. Bottle drinking is a culture in some areas. One participant in the caries group reported that she failed in her attempts to wean her child off bottles. During the process of bottle weaning, she went through a rough patch to get her child to completely give up the bottle. This occurred when her child saw most children in her living environment still drinking milk with a bottle, and this made her child beg her for a bottle. She said:

Here, almost all children of her age were still attached to a bottle. They toted their bottles around. I found it difficult to completely wean her from the bottles. She was always tempted to drink from a bottle every time she saw other children drink from a bottle (C3).

Many parents of children in the caries group commonly had a notion about the optimal age for bottle weaning. They seemed to rely more on social pressure directly put on their children to make their children give up the bottles on their own, rather than putting some efforts into initiating bottle weaning. This was demonstrated by many parents in the caries group explaining that age four or five is the right age to make the transition from a bottle to a cup. They commonly related this age range to the age at

which most children begin to attend kindergarten and to have feelings of shame at drinking milk from a bottle, as one participant said:

Maybe he will be willing to drink milk using a cup when he attends kindergarten, maybe at around age four or five, because he will feel ashamed with his friends if he still drinks milk from a bottle (C3).

In contrast, in the caries-free group, one participant emphasised the importance of early bottle weaning. She reasoned that weaning off the bottle early made it easier to get the child off of it. When asked about how she got rid of the bottle, she said:

Soon after he was born, I breastfed him, but I also bottle-fed him with formula milk. When he was three months old, I tried to hand him a sippy cup containing formula milk, and he was willing to drink the milk from the sippy cup. Since then, I never used a bottle again to serve formula milk (CF30).

She perceived that delaying bottle weaning until the child is older would only give the parents more troubles. This is not only because the child might have been a lot more dependent on bottles, but also because there had been other barriers coming from their social environment. She explained:

When children start making friends, they might be exposed to their friends' bottle-drinking behaviours. This would make it more difficult to get rid of bottles, as their friends' bottle drinking behaviours usually will have a powerful influence on them. They will always look for their bottles to have milk as their friends do. So, it is better to break the bottle habits as early as possible (C30).

5.3 Oral hygiene practice

The third theme emerging from the interviews is oral hygiene practice. Dental caries is clearly related to oral hygiene practice. The risk of having dental caries decrease with improvements in oral hygiene. In this study, oral hygiene practice refers to the practice of brushing the teeth for the purpose of maintaining oral hygiene. This section compares and contrasts how parents of children in the caries and caries-free groups performed oral hygiene practices for their child, and it describes the factors influencing those oral hygiene practices. This section discusses parents' perceived needs of oral hygiene practices, family and sociocultural influences on oral hygiene practices, parents' perceived ability to manage child's behaviours in relation to tooth brushing, parents' perceived knowledge and skills of tooth brushing, and parenting practices concerning tooth brushing.

5.3.1 Parents' perceived needs for early oral hygiene practices

Parents of children in both the caries and caries-free groups displayed a range of beliefs about the first oral hygiene practices for their child. They generally acknowledged the value and importance of maintaining oral hygiene. In the caries-free group, many participants believed that the first oral hygiene practices started before the first tooth came through. They described early oral cleaning as involving them wiping

their children's tongue and gum pad to remove milk residue from the tongue and to make the baby become accustomed to oral hygiene. One participant in the caries-free group explained:

She was used to oral cleaning since she was around two or three months old, before her first tooth came out. I wiped her tongue and gum pad with gauze pads and warm water every time after breastfeeding. It was to remove the white coating from her tongue. I think it was the milk residue (CF31).

In contrast, in the caries group, some participants perceived no need for oral cleaning, including cleaning the tongue, before the first tooth came through. They were aware of a white coating over their baby's tongue, but they saw it as a normal thing that would happen regardless of their efforts and that would disappear by itself. The first oral hygiene practice established by some parents of children in the caries group was at around sixth months to one year of age, after the first tooth appeared. Like any 'new object', they were prompted to keep it clean following exposure to any food and drink, including milk. Gauze, cotton cloth, or a silicone rubber fingertip toothbrush were frequently mentioned by parents of children in the caries group as the first tooth cleaning methods because of their texture. Child compliance with parents' attempts to clean their tooth also seemed to determine the selection of the tooth-cleaning methods. As an example, one participant in the caries group reported that since her son's first tooth came out, she was vigilant with cleaning her son's teeth using a damp cloth. She explained:

When he was around one-year-old, it was after his first tooth come out, I started cleaning his tooth. I tried to use a small toothbrush for babies without toothpaste, but he didn't like it. He refused it. Then, I tried to use a cloth and warm water to clean his teeth, and there was no problem. He could accept it (C1).

Other parents of children in the caries group perceived no need to clean their children's teeth when their children still had only a few teeth. They also perceived that their child was still eating only baby foods that caused no damage to the teeth. Therefore, they chose to delay brushing their child's teeth until more teeth came through, at around one year or two years of age.

The practice of tooth brushing was viewed as a challenge for many participants in both the caries and caries-free groups, specifically when toothpaste began to be introduced to the child. Most of them started introducing an age-appropriate toothbrush to their child by around the age of one year old, as part of a normal and expected activity in the child's development and routines. However, at this stage, the use of toothpaste varied among participants in both groups. In the caries-free group, some participants viewed toothpaste as a foreign substance containing chemical ingredients that would be harmful if their child accidentally swallowed it. Therefore, they considered delaying using toothpaste until their child was able to spit it out, at around the age of two. One

participant said:

I didn't give her toothpaste until I was sure that she could rinse her mouth and spit it out. It was probably until she was around two years old. I worried that she would swallow it. So, I only used drinking water (CF31).

Despite awareness of the possibility of the child swallowing toothpaste during tooth brushing, some parents of children in the caries-free group were still inclined to introducing toothpaste directly to their child by the age of one-year-old. These participants used toothpaste that was developed to be age appropriate and safe. One participant in the caries-free group explained:

I gave a bit of toothpaste on her toothbrush when she was one year- old. It wouldn't harm her. It was specially designed for babies aged one year old, and I also gave drinking water to rinse her mouth after tooth brushing. So, it doesn't matter if she swallowed it (CF15)

They also perceived no difficulty in brushing their child's teeth with toothpaste, because they treated the introduction of toothpaste as a 'normal' step in the child's routine. They also portrayed this expectation (without anxiety) to the child. Some of them actively used their own tooth-brushing habits to role model tooth brushing as a 'normal' expected behaviour to their child. One participant in the caries-free group said:

I used toothpaste for kids. It is not difficult to encourage and teach her to brush her teeth. I just let her imitate me when I brush my teeth. She never refuses to brush her teeth (CF27).

On the contrary, in the caries group, participants' decisions about when and how to introduce toothpaste appeared to be based upon beliefs about their child's potential reactions to it. Ultimately, many parents of children in the caries group chose to delay using toothpaste to maximise their child's acceptance of toothpaste and avoid any resistance to its use by the child. They commonly established the use of toothpaste when their child was around two to three years old, as one participant in the caries group said:

She didn't like the taste of toothpaste. She was willing to brush her teeth, but without toothpaste. I found it difficult to make her accept toothpaste. She eventually accepted it when she was around 2.5 years old. I gave her toothpaste without mint flavour (C13).

Adding toothpaste use also appeared to alter their beliefs about children's oral hygiene practices. They perceived this to be a more complex developmental task, requiring a more nuanced set of skills and approaches towards the child to encourage them to accept the use of toothpaste in their oral hygiene routine.

In addition, in the caries group, the child's aversion to toothpaste appeared to be the common reason for some participants using a small amount of toothpaste to avoid their child's resistance to tooth brushing. They were reluctant to applying toothpaste to the full length of the brush head until after their child could accept the use

of toothpaste. One participant said:

She only refused the toothpaste. She was willing to brush her teeth, but without toothpaste. So, in the beginning, I gave just a little bit of toothpaste, until she got used to it, then I gave her toothpaste on the full length of the brush head (C13).

On the contrary, in the caries-free group, none of participants reported that they applied toothpaste more than one small drop. Instead, they applied a small amount of toothpaste to prevent their children from swallowing it. Some of them also seemed to take advice from the dentist on the use of toothpaste for their children. One participant said:

I only apply a small amount of toothpaste after I am quite sure that she could spit it out. I worry she will swallow it. That's not good. I also have ever taken her to a dentist just for a dental check-up, and the dentist also told me to give only a small amount of toothpaste (CF31).

Unintentional swallowing of toothpaste and mouth-rinsing water during the first few weeks of the introduction of toothpaste was often reported by parents of children in the caries and caries-free group, instead of licking of toothpaste. However, compared to parents of children in the caries group, parents of children in the caries-free group were less likely to allow their child to swallow toothpaste while tooth brushing. They persistently kept reminding their child to always spit toothpaste out. One participant in the caries-free group said:

She sometimes forgets and swallows it [toothpaste] and the rinsing water while brushing her teeth, but I always remind her to not swallow it and spit it out (CF29).

In contrast, in the caries group, some participants saw unintentional swallowing of toothpaste and rinsing water as a normal behaviour in children. Participants who lived in areas in which the tap water quality was poor, expressed more concern about swallowing the mouth-rinsing water than the toothpaste itself, as one participant in the caries group said:

The tap water is not good for tooth brushing. I always give her drinking water instead of tap water when she brushes her teeth, because sometimes she still swallows the mouth-rinsing water after tooth brushing. It doesn't matter if she swallows the drinking water. I won't worry (C18).

Licking toothpaste was also more prevalent among children in the caries group than in the caries-free group. Some parents of children in the caries group explained that their child did not like the taste of toothpaste in the beginning, but then their child often licked toothpaste since they started liking the taste of it. One participant in the caries group said:

I just felt happy that he finally was willing to brush his teeth with toothpaste. He tasted it, licked it, and swallowed it. It happened too quickly. He licked it before I reminded him (C28).

5.3.2 Family and sociocultural influences on oral hygiene practices

Most parents of the children in the caries and caries-free groups perceived the importance of tooth brushing in terms of its benefits in maintaining good oral hygiene for their child. They viewed tooth brushing as a practice of keeping their child's teeth clean and free of debris, which was believed to help to prevent dental caries and bad breath and to enhance the aesthetic appearance of their children's teeth. During the interviews, the parents' perceptions about how frequently other parents brush their children's teeth appeared to influence their children's tooth-brushing routines. Concerning children in the caries group, many parents tried to manage twice daily tooth brushing in terms of morning and afternoon shower routines, which was perceived as a generally recognised routine hygiene behavioural standard in their social environment. Embedding tooth brushing in their children's daily shower routine was also believed to make their children's tooth-brushing practices convenient and manageable. When asked about the children's tooth-brushing routines, one parent of a child in the caries group said:

For me, tooth brushing is a part of the shower routine. I brush his [their son's] teeth twice a day, in the morning and in the afternoon, after he has a shower. I think it is what people usually expect in shower routines, and it makes it easy to remember to brush (C1).

Furthermore, compared to the parents of children in the caries-free group, parents of children in the caries group were less likely to brush their children's teeth before bed at night. Some of them admitted that they never taught their child about night tooth brushing. They commonly reasoned that night tooth brushing is not a culture in their family; therefore, they also do not have night tooth-brushing habits that could be taught to their child, as one parent of a child in the caries group explained:

He brushes his teeth just for a shower routine. It is like me. For me, tooth brushing is just a shower routine. Until now, I have only reminded him to brush his teeth in the morning and evening when he has had a shower. I never encourage him to brush his teeth before sleeping at night, because I also never brush my teeth before sleeping at night [laughing] (C16).

On the contrary, in the caries-free group, besides establishing twice daily tooth brushing, in the morning and afternoon shower routines, many parents of children in the caries-free group were accustomed to brushing their children's teeth before bed at night. Family culture appeared to contribute to the development of participants' own night tooth-brushing habit, which was believed to make them get their children into a night tooth-brushing habit. When asked about night tooth brushing, one parent said:

It is a must. I won't let her go to sleep before she brushes her teeth. She also has got used to it, since she was little. She saw me brush my teeth before going to bed, and she imitated me. Now, I don't need to remind her. Night tooth brushing has become a part of her bedtime routine. It is the same as me (CF2).

Some parents of children in the caries-free group perceived the benefits of

tooth-brushing exercises at the children's schools. Such exercises appeared to be more prevalent in some schools than others, particularly among those representing the caries-free group than the caries group. Most parents of children in the caries-free group described tooth-brushing exercises as a part of oral health promotion programs at school, which are taught to the students every three, six, or twelve months, depending on the school initiative. Some of them said that the school even invited a dentist to come to the school to teach the students about tooth brushing and deliver dental health education, whereas others mentioned that it was the teacher who taught the students about tooth brushing and dental health education. Some parents of children in the caries-free group believed that oral health promotion programs at school could help their children comply with tooth-brushing routines. One parent of a child in the caries-free group reasoned:

Sometimes, children have more trust in what they learn in school than what they learn from their parents. They will be more obedient to their teachers at school than their parents (CF2).

Another participant in the caries-free group also mentioned the important role of oral health promotion programs at school in encouraging her child to brush her teeth before bed at night. She said:

She [her daughter] never wants to sleep before brushing her teeth. Even if she is tired and sleepy, she won't skip night brushing. She doesn't want to have bad teeth because she doesn't brush her teeth before bed at night. She knows it from the dentist, who regularly came to her school to deliver dental health education. She said that she will have a bad dream if she skips night brushing (CF10).

5.3.3 Parents' perceived ability to manage child behaviours in relation to tooth brushing

Compared to parents of children in the caries-free group, parents of children in the caries group encountered more obstacles in brushing their children's teeth. They described situations in which they experienced difficulties with tooth brushing. In the face of those difficulties, they chose to avoid conflict with the children rather than insisting on tooth brushing. It is clear that the children's emotional response to tooth brushing is the most common obstacle to tooth brushing as perceived by the parents of the children under study. They described their struggles with difficult child behaviours and non-compliance with tooth brushing. They perceive brushing their children's teeth as a battle. They often struggle with brushing their children's teeth because of the resistant behaviours, tantrums, and fussiness of the children. One parent of a child in the caries group said:

It is always difficult to brush his teeth. He never likes to brush his teeth. I force him and try to persuade him to let me brush his teeth, but if he is still not willing to brush his teeth, I will let him not brush his teeth. I don't want to make him upset (C3).

A child's refusal to brush their teeth was also commonly cited by parents of children in the caries group as the most common reason for skipping night tooth brushing. Night-time or bedtime tooth brushing seemed to be particularly difficult to accomplish by most parents of children in the caries group. They perceived difficulty to encourage their child to do night tooth brushing. One parent of a child in the caries group said:

He [her son] rarely brushes his teeth at night. He always refuses if I want to brush his teeth. He wants to go straight to bed and sleep (C20).

In contrast, in the face of barriers related to child's behaviours, many parents of children in the caries-free group were confident in their ability to successfully establish their children's tooth-brushing routines. They commonly make great efforts to get their children to brush their teeth. Unlike most parents of children in the caries group who tended to be lenient with their children's tooth-brushing routines, many parents of children in the caries-free group chose to persist in brushing their children's teeth. Many participants believed that when tooth brushing was embedded in the children's other routines, such as the shower and bedtime routine, consistency was considered essential for the child's compliance with tooth-brushing routines. One parent of a child in the caries-free group said:

In the beginning, when I introduced tooth brushing to him, he always cried. I had to make him comply with tooth brushing. He must brush his teeth no matter what, and I must be consistent with that (CF30).

Many parents of children in the caries-free group also described a variety of skills and parenting strategies they used to cope with their children's non-compliant behaviours and to encourage their children's compliance with tooth brushing. Some participants tried to maximise compliance using positive reinforcement. Child-oriented tooth-brushing kits, such as cartoon character toothbrushes and flavoured toothpaste, were effective enticements. One parent said:

I asked him to choose his toothbrush and toothpaste. I bought it based on his preference. It was to motivate him to brush his teeth (CF14).

Other strategies commonly used by parents of children in the caries-free group to encourage their children to brush their teeth included incorporating songs in the children's tooth-brushing routines or using an amusing children's book or video. These strategies were believed to help children retain information and understand the importance of tooth brushing and eventually instil tooth-brushing habits in the children's minds. When asked about how to deal with child's behaviours towards tooth brushing, one parent of a child in the caries-free group explained:

I used a video to explain it to my children. They watched the video about tooth cavities, and then they asked me why the teeth were like that. I told them that it was because they rarely brushed their teeth. Since then, my children always ask to brush their teeth. Sometimes, they seem reluctant to brush their teeth, but I remind them about the video, about the consequences of not brushing their teeth. Then, they are willing to brush their teeth. I never have to force them to brush their teeth (CF4).

Parents and older siblings as role models for younger children were also effective strategies used by some parents of children in the caries-free group to encourage the younger children to brush their teeth. As an example, one participant in the caries-free group said that her older children served as role models for their younger siblings through brushing their own teeth in their younger siblings' presence. She believed that younger siblings would look up to their older siblings as role models and imitate their behaviours, including tooth brushing. She said:

I think the most effective way to encourage him to brush his teeth is when his older brother and sister brush their teeth. He is willing to brush his teeth because he watches his older brother and sister brush their teeth. Then, they brush their teeth together in the bathroom (CF5).

5.3.4 Parents' perceived knowledge and skills of tooth brushing

Parents' perceived confidence in brushing their children's teeth appeared to be influenced by their perceived knowledge and skills of tooth brushing. As an example, one participant in the caries group admitted that she perceived that she lacked the necessary knowledge and skills for how to properly brush her child's teeth, which reduced her confidence in establishing her child's tooth-brushing routines. The fear of hurting her child's mouth while brushing made her become more lenient with her child's tooth-brushing routines, resulting in her child having less frequency in tooth brushing. She explained:

I think there must be a technique for brushing teeth for children under five, but I don't know about it. I don't know how to brush his teeth properly. If I insist or force him to brush his teeth, I am afraid that I will hurt his mouth. So, if he refuses to brush his teeth, I will let him go (C11).

One parent of a child in the caries-free group also perceived that her knowledge of tooth-brushing techniques had helped build her confidence in brushing her child's teeth and successfully establishing her child's tooth-brushing routines. She said:

From the dentist, I know how to perform proper tooth brushing…one by one…the dentist showed me how to brush teeth correctly using a dental phantom…I use this tooth brushing technique to brush my daughter's teeth. I don't have any difficulties in performing her daily tooth-brushing routines (CF2).

Participants in both the caries and caries-free groups had varying levels of knowledge of tooth-brushing techniques and gained that knowledge from a range of different sources and experiences. Compared to parents of children in the caries group, many parents of children in the caries-free group gained knowledge and skills of tooth brushing from a dentist or other health professionals. They got advice about how to properly brush their children's teeth either when they attended community oral health

programs held by community health services in their local areas or when they used dental health services. One parent of a child in the caries-free group said:

It was only once; there was oral health education here. I am not sure whether the person who taught us about the tooth-brushing technique was a dentist or a midwife, but I perceived a benefit from it. I became aware how to brush my son's teeth properly (CF14).

On the contrary, some parents of children in the caries group seemed to learn and retain information about tooth-brushing techniques from when they were in primary school. They took that knowledge into their adult lives and applied it with their own children. One parent said:

When I was a child in primary school, I can clearly remember, there were regular health check-ups and health education from the community health service near the school. It was not only a general health check-up, but also a dental check-up. I can still remember, at that time, the dentist came to the school quite often. The dentist showed dummy teeth to us and taught us how to do proper tooth brushing, from the upper jaw to the lower jaw. I used this tooth-brushing technique until now (C13).

Other participants chose to rely on self-learning to gain knowledge of tooth-brushing techniques. They perceived it as a parenting skill that they had to work out on their own. For most, they learned it from reading a magazine, reading the health section of a newspaper, or watching health information television shows or toothpaste advertising. One parent of a child in the caries group said:

I learned about how to brush teeth properly from watching the Dr. Oz show on TV, and I used this technique until now (C17).

Another participant in the caries group used her own tooth-brushing technique to brush her child's teeth, which seemed to have been inherited from her parents. When asked about the tooth-brushing technique she used to brush her child's teeth, she said:

It is just like how I usually brush my teeth, since I was little. There is no difference. I don't know who taught me about that. I am sure it was not a dentist. I have never seen a dentist yet. I think my parents did. That is the only knowledge of tooth brushing that I have, since I was little (C18).

However, this knowledge about proper tooth-brushing techniques was sometimes not put into practice. One parent of a child in the caries group reasoned that her child was still very young and unable to comply with proper tooth brushing. Hence, she was flexible with her child's tooth-brushing technique. One parent of a child in the caries group explained:

I know how to brush teeth properly, but in practice, I find it difficult to follow the rule. Sometimes, he doesn't want to brush his teeth if it is too complicated. So, I make it simple. It doesn't matter how he brushes his teeth. As long as he brushes his teeth every day, that would be fine (C20).

5.3.5 Parenting practices concerning tooth brushing

In both the caries and caries-free groups, mothers were commonly expected to play a vital role in tooth-brushing supervision, with the purpose of establishing their

children's tooth-brushing routine. This phenomenon appears to have been influenced by the participants' traditional beliefs about gender roles in the family, according to which mothers take the main responsibility for child care, including tooth-brushing routines. In dual-career families, where both parents work full-time outside the home, the responsibility for child care seemed to continue to be assigned to mothers. Compared to parents of children in the caries group, many parents of children in the caries-free group often described themselves as physically present during tooth brushing as a form of tooth-brushing supervision, with the express purpose of actively teaching their children how to brush their teeth properly. One participant in the caries-free group explained:

She brushes her teeth by herself, but I always supervise her to teach her how to brush her teeth properly, because sometimes she only bites her toothbrush [giggling]. So, I have to tell her to not just bite her toothbrush. I have to show her how to brush her teeth properly and also help her to brush her teeth (CF15).

This supervisory role was also often demonstrated by acknowledging the child's need to develop autonomy in the task, but then the parents saw it as their role to check that it was done correctly. As one parent of a child in the caries-free group said:

He brushes his teeth himself, because I've taught him how to brush his teeth, but I still have to supervise him. He's still little. Sometimes, he brushes his teeth as he likes. So, I have to see whether the way he brushes his teeth is right or not (CF14).

Some parents of children in the caries-free group also expressed their role in tooth brushing supervision in terms of re-brushing their child's teeth thoroughly. They realise that even though their children might not be able to brush their own teeth properly, they should give their children the opportunity to learn and develop their tooth-brushing skills. They saw this as a learning process whereby their children were given more control over their oral hygiene. They allowed their children to brush their own teeth, but then perceived it as their responsibility to provide an accountability check as a safeguard to ensure that their children's teeth are cleaned properly. When asked about who brushed their child's teeth, one parent of a child in the caries-free group replied:

I still brush his teeth, even now. I have actually started teaching him to brush his teeth himself, but I watch him when he brushes his teeth. After he brushes his teeth himself, I will brush his teeth again, because I am still not sure that his teeth have been cleaned (CF27).

This level of supervision and checking also extended to other people with responsibility for providing care for the child, including the child's nanny:

She always brushes her teeth with her nanny. I never allow my daughter to brush her teeth by herself. I teach my daughter's nanny about the rules, including how to brush her teeth (CF10).

On the contrary, for children in the caries group, many parents acknowledged

that they entrusted their children to brush their own teeth unsupervised. They revealed that they only gave direct supervision when their children were very young. By the time their children were four years of age or started attending kindergarten, they perceived that their children were sufficiently autonomous and able to take on the task for themselves. This resulted in less supervision. One parent of a child in the caries group said:

Perhaps tooth brushing has become a part of his shower routine. So, after he has a shower, he will take his toothbrush and brush his teeth by himself. He loves tooth brushing. He also loves gargling. He always plays with the water inside his mouth when he gargles. So, he loves it. I think that because he loves tooth brushing, I don't need to supervise him. I never saw how he brushes his teeth. I don't know whether he did it right or wrong. As long as he brushes his teeth, it doesn't matter [C16].

Some of those participants also perceived that their children are able to perform the task by themselves. They believe that their children brush their own teeth properly, because they have taught their children about proper tooth brushing or because their children know proper tooth-brushing techniques. Consequently, they do not perceive tooth-brushing supervision as their primary concern.

In addition, the time constraints associated with being a working mother was perceived by some parents of children in the caries group as a barrier to successfully establishing their child's tooth-brushing routines, particularly night tooth brushing. They commonly reported that they often get home from work too late to supervise tooth brushing, and their child might already be asleep. Another reason given was that they are stressed and exhausted by the time they return home from work to then ensure that their children have brushed their teeth, as the following parent's comment explains:

It is maybe because I get back home from working too late, at six or seven pm. Then, I have dinner with my children. After that, I go to their bedroom. We talk, joke, and play until they fall asleep at nine pm. I am reluctant to wake them up just to brush their teeth. I am tired already, and I want to have a rest too (C16).

Another participant in the caries group who did not have a full-time job outside the home also cited time-related barriers to establishing her child's tooth-brushing routines. Her daily routines were perceived to keep her busy the whole day. Besides that, she also does anything that in some way could make her earn extra money for her family, such as collecting and selling recycled bottles. She perceives that her busy life has made her neglect her child's dental health needs, as she explained:

I never pay attention to his teeth, since he was born. I only wash his body and hair, but I never brush his teeth. I never even see his teeth. I want to bathe him as quickly as possible, so I can work and do something else (C7).

Furthermore, her prior experience with her older children, who she perceived as having had no dental health problems without performing proper tooth-brushing routines, seemed to contribute to her ignorance of her youngest child's dental care. She never

expected that her youngest child was afflicted with dental caries, as there had never been a problem like that among her older children, as she said:

I don't know why there are cavities in his teeth. I also never take care of his older siblings' teeth, and they are just fine (C7).

5.4 Dental visits

The fourth theme emerging from the interviews is dental visits. In this study, 'dental visits' refers to the pattern of visiting a dentist to get professional dental care. Dental visits are key in the prevention of dental caries by keeping the teeth clean and healthy. Furthermore, dentists can identify the first signs of dental caries and treat them before they get worse. This section compares and contrasts the patterns of dental visits between children in the caries and caries-free groups, and it describes the factors influencing those behaviours. These include parents' perceived importance of dental visits, family and sociocultural influences on dental visits, the parents' perceived ability to manage the children's behaviours, and access to dental health services.

5.4.1 Parents' perceived importance of dental visits

Problem-oriented dental visits (visiting a dentist only when a problem is apparent) were apparent during the interviews. In the caries group, many participants regarded toothache as the first alert of having dental health problems that required emergency dental treatment. One parent of a child in the caries group was forced to seek urgent dental treatment for her child, after her child complained of a toothache, as they explained:

It was when he suddenly complained of a toothache. I saw four tooth cavities in his mouth, and the gums around the teeth were swollen and red. So, I was sure that his toothache came from his tooth cavities. That was why I took him to a dentist to get dental treatment and relieve his toothache (C6).

The intensity of the toothache also seemed to determine her willingness to attend her child's follow-up dental treatment. She weighed the pros and cons of having follow-up dental treatment:

He has four dental cavities, and only one has been treated. His dental treatment actually has not finished yet. He should be back at the dentist. He should continue his dental treatment, but I still don't have time to take him to the dentist again…and he has never complained about a toothache again (C6).

The mindset of only seeking dental treatment in an emergency was also demonstrated by the participants' inclination to delay seeking dental treatment for their children until their children presented with a toothache. Another parent of a child in the caries group chose to delay seeking dental treatment for her child, even though she was aware that her child had dental caries. She did not see her child's dental caries as a problem that required urgent treatment, because of the absence of her child's

complaint of a toothache. She exemplified her point with her past experience of taking her older son to a dentist and perceiving it as a one-off problem that could then be fixed:

My older son…visited the dentist for the first time when he had a problem with his tooth. You know, it was when he had a wobbly tooth, at age eight. At that time, he also had dental cavities, but he never complained of it. So, I thought there was still no problem with it, and there was no dental treatment required. For his wobbly tooth, it was different. He complained about his wobbly tooth. He felt discomfort. That is why I took him to the dentist—to pull out his wobbly tooth. So, yeah, if there is a dental problem or there is a symptom of a dental problem, such as pain or a wobbly tooth, I will take my children to the dentist to fix the problems with their teeth (C1).

Delays in seeking dental treatment were also demonstrated by the participants' inclination to seek alternatives to dental visits despite the child's complaint of a toothache. Many parents of children in the caries group seemed to be more concerned about relieving a toothache rather than treating the cause of the toothache through adequate dental treatment. They tended to put off visiting a dentist if the toothache subsided. This further demonstrates a lack of knowledge about many aspects of child dental care. For example, one parent of a child in the caries group was aware that her child had dental cavities, since age two. Her child often complained of a toothache. Instead of going to a dentist, she chose to use over-the-counter medicine to relieve her child's toothache, as she described:

When he complained of a toothache, I just bought a powder in the pharmacy. It was like antalgin [a painkiller] powder, or something like that. After he drank it twice, his toothache was gone (C26).

Tooth brushing was also often perceived by parents of children in the caries group as an alternative to a dental visit. They assumed that tooth brushing could prevent and arrest the progression of dental caries, as exemplified by one parent of a child in the caries group:

I don't take him to the dentist... He is still too young. So, I only encourage him to brush his teeth more frequently. He actually always brushes his teeth regularly, but I don't know why dental cavities have remained present and continue to develop. That is why I think that he has to brush his teeth more frequently (C11).

Another parent of a child in the caries group also believed that the mint flavour contained in the toothpaste had an effect on a pain relief and prevent dental caries. When asked about what she did after finding out that her child suffered from dental caries, she said:

I only changed her toothpaste. She is used to use, like, kodomo [a brand of child's toothpaste] that has no mint flavour. I am just a layperson. I don't understand. I don't know. I think mint flavour in the toothpaste can reduce her toothache or can slow the progress of dental cavities. So, she will not have more dental cavities. I give her, like, Pepsodent [a brand of toothpaste], only a small amount, especially for the cavities (C20).

In addition, a lack of knowledge about how dentists actually provide their role in giving dental care to young children was evident across the interviews in the caries

group. This lack of knowledge appeared to contribute to the participants' inclination to delay making dental visits for their child. As an example, considering the very young age of her child, one parent perceived that the dentist could not treat her child's dental caries, and therefore, she chose to ignore her child's complaint of a toothache. She reasoned:

…nothing I can do to help relieve his toothache. I can't take him to the dentist. He is still too young. I don't think the dentist can do a dental filling to his teeth (C7).

In the caries-free group, the lack of concern for preventive child dental health due to the perception of a lack of any dental health problems was also apparent, and this seemed to influence the participants' decisions to skip early dental visits for the child. One parent of a child in the caries-free group said:

She has never seen a dentist. I don't think she needs to visit a dentist now. She doesn't have any dental health problems. She doesn't have dental cavities. All her teeth are still intact and healthy. I would definitely take her to a dentist if she had dental health problems, but for now, she still doesn't need it (CF27).

Many parents of children in the caries-free group admitted that the pressure of time led them to make a decision to prioritise their work rather than make preventive dental visits for their child. They seemed to lack a sense of urgency about their child's preventive dental visits, regardless of whether they were aware of the importance of preventive dental visits for the child or not. As an example, despite having awareness of the importance of early dental visits for children and having easy access to dental health services, one parent of a child in the caries-free group had never taken her child to a dentist. Being a single mother and the household's income earner made her perceive that she had no time to take her daughter to a dentist, as she said:

It is important to take her to a dentist, but I work every day. My husband has passed away. So I am the only one who has to earn our living now (CF9).

5.4.2. Family and sociocultural influences on dental visits

In the caries group, sociocultural beliefs and practices about when and how to engage with dental care seemed to have implications for recognition of dental care-seeking behaviours. Many parents of children in the caries group perceived that the mindset of problem-oriented dental visits was common in Indonesian society, where people mostly focus on curative rather than preventive dental care. This is demonstrated by the participants' inclination to make a dental visit for the child only when the symptoms of dental health problems, such as pain and discomfort, became more apparent. One parent of a child in the caries group explained:

…perhaps it is Indonesian culture. It is what most Indonesian people normally do. We are more likely to visit a dentist due to a curative reason than for a preventive reason. So, most Indonesian people will wait until dental cavities are present to take their children to see a dentist (C16).

In addition, the sociocultural environment appeared to influence participants' perceptions about the importance of baby teeth. They perceived dental caries in baby teeth as a normal condition in their social environment. The temporary nature of baby teeth, meaning these teeth will fall out and be replaced by permanent teeth, made them give a low value to baby teeth. This perception was commonly translated into an ignorance of dental care for baby teeth. One parent of a child in the caries group said:

It doesn't matter if he has dental cavities now, because his teeth are still baby teeth that will fall out and will be replaced by permanent teeth. So, I don't think I need to do anything with his current dental cavities. The teeth will fall out (C16).

Another perceived barrier to dental care-seeking behaviours among parents of children in the caries group was cultural-related beliefs about the impact of dental treatment on other nerves in the body, particularly related to eyesight and mobility. This belief has prevented some parents of children in the caries group from seeking dental treatment for the child, as one participant explained:

As far as I know, there are a lot of nerves in the teeth. So, if there is a dental cavity, and the tooth has to be pulled out, it will have an impact on the nerves. One of my family members, he is old. He looks like he has had a stroke. He has, like, a crooked smile. He said that when he was young, he got a toothache, and he went to a dentist. He shouldn't have gone to a dentist when he felt a toothache. He should have waited until he didn't feel the toothache. Then, although he still felt a toothache, he forced the dentist to pull out his tooth. That is why he is like this now (C18).

Some parents of children in the caries group also perceived their own fear of visiting a dentist (dental fear) as a barrier to seeking dental treatment for their children. Most of them commonly linked their dental fear to their own past traumatic experience of a dental visit. One parent of a child in the caries group recounted a situation in which she tried to tell the dentist about her pain during dental treatment, but she felt powerless, because the dentist did not listen to her, and this appeared to invoke fear towards visiting the dentist in future. She explained:

I think I haven't taken her to a dentist yet because of my trauma with a dentist. I had a bad experience. I was really scared to go to a dentist. At that time, I had a tooth cavity in my molar... The dentist suggested pulling out the tooth... The dentist injected me twice. I said to the dentist, 'why do I feel sore in my ear?'. The dentist said, 'no'. I said, 'yes, it is sore in my ear', but the dentist kept saying 'no'. Then, the dentist gave me one more injection, and I felt sorer in my ear. Then, I left the dentist without saying anything [giggling], it was really sore in my ear… So I did nothing with that tooth since then. So, maybe that experience made me a bit scared to go to the dentist. I had a trauma with a dentist (C18).

In the caries-free group, the lack of concern for preventive dental care among the participants seemed to be more influenced by family culture than social environment. One parent of a child in the caries-free group revealed that prevention was not a cultural mindset in her family. She was brought up in a family whose only focus was curative rather than preventive care. This influenced her perception about when to visit a dentist. Although she knew the importance of early dental visits for her

child, she perceived no urgency in taking her child to a dentist, unless there was a dental health problem. She explained:

I don't place a high importance on dental visits, but it also doesn't mean that I ignore my children's dental health. If they do need dental care, I will definitely take them to a dentist. If there is no problem with their teeth, going to the dentist is nothing out of the ordinary. I think that this perception is formed by the environment. My parents also never placed a high value on dental visits, so neither do I. As long as my children regularly brush their teeth, it is enough for me (CF5).

Some parents of children in the caries-free group also saw dental care as a negative experience generally, because dental procedures were mostly perceived as painful. This made them dread going to a dentist. They demonstrated their own dental fear by delaying dental visits for their child until a dental health problem was present. One parent of a child in the caries-free group explained:

I always feel that I don't want to go to a dentist. For adults, dental treatment is always painful. It may be more painful for a child. He [her son] doesn't have problems with his teeth. His teeth are healthy. I don't think I should take him to a dentist at this stage, just to make him feel how painful the dental care is, but in fact, nothing needs to be done with his teeth because there are no problems with his teeth. I will take him to a dentist if he has a problem with his teeth that really needs dental treatment, because there is no choice then but to visit the dentist (CF28).

5.4.3 Parents' perceived ability to manage the child's behaviours during dental visits

Besides the perceived lack of need of urgent dental treatment, many parents of children in the caries group perceived a difficulty in managing their children's behaviour during dental visits as the most common reason for delaying seeking dental treatment for their children. Child resistance to dental visit and uncooperative behaviours of the child were perceived by many parents/caregivers in the caries group as big hurdles to overcome. These behaviours were often linked to their children's dental fear (the fear of receiving dental care). One parent of children in the caries group explained:

My child refuses to go to a dentist. He gets angry and fussy. For example, several weeks ago, I went to a dentist to fix my dental problems. It's a dental cavity. He accompanied me on the visit. I asked the dentist to examine his teeth as well. He cried and refused to open his mouth. Because of his temperament and because he is also a stubborn child, it will be difficult to take him to a dentist (C1).

Some participants perceived that the child's defiant attitudes towards dental visits made them find it difficult to handle. The child would even behave more impulsively if they tried to control their child's behaviours during dental visits. The parents' perceived limited ability to control their children's behaviours or give support in alleviating their children's stress and anxiety made them choose to do something they could control as an alternative to a dental visit, such as brushing their children's teeth more frequently, as one parent of a child in the caries group said:

My son is afraid of the dentist. He will run away if I take him to the dentist. He will scream and cry. That is why I just brush his teeth more frequently. (C3)

On the contrary, compared to parents of children in the caries group, parents of children in the caries-free group were more likely to have confidence in their ability to manage their children's behaviours during dental visits. Even though most of them had never taken their child to a dentist, they already had thought about how their child would react in the dental office, and they knew what they should do in the face of their child's resistance to a dental visit. One parent of a child in the caries-free group said:

I had never tried to take him [her son] to a dentist. He might cry if he had to see a dentist. However, if one day he has a dental problem and needs to get dental treatment, I will definitely take him to a dentist no matter what (CF30).

Another participant in the caries-free group perceived that their child would have no fear of visiting a dentist, as she said:

I think there will be no difficulty in taking him to the dentist. He is very brave. He won't refuse. We have even attended an event where there was a free dental check-up. At that time, I asked him to get a dental check-up, and he did it. (CF19)

Besides having less of a perceived need for a dental visit because of the absence of dental caries in their child, many parents of children in the caries-free group also seemed to consider their child's readiness for dental care in determining when to initiate the first dental visit, regardless of whether their child had dental fear or not. They linked the most appropriate age for the initial dental visit to the development of and capacity for their children to understand and cope with dental care. Most of them commonly delayed their children's first dental visit until their child was more able to understand what was happening, around age five. They perceived that at this age, a child is typically able to recognise the appropriateness of their behaviours, and therefore, this would enable the parents to give explanations and control their children's behaviours. One participant in the caries-free group explained:

By age five, he will understand the concept of good or bad and right or wrong. So, at least, he will know the consequences if he doesn't want to do something. However, under five years old, he will still only know that something is pleasant or unpleasant (CF28).

5.4.4 Access to dental health services

The options of dental health services available in the local areas appear to have influenced the participants' dental care-seeking behaviours. For children in the caries-free group, parents commonly reported several options of dental health services available in their local area. Convenience was cited as one of the reasons participants chose a dental health service. As an example, one participant in the caries-free group preferred to visit a private dental clinic in their neighbourhood because it was close to their house. She said:

I prefer taking her to a dentist who is also my neighbour. Her dental practice is only within walking distance of my house, so it is convenient (CF10).

A high level of patient satisfaction with dental health services also appeared to be another consideration when selecting a dental health service provider. Patients who are satisfied with the quality of dental health services commonly come back to the same dental health services provider and also refer it to others. One parent of a child in the caries-free group chose a dental health service in a community health centre where many of her friends were satisfied with the services provided and recommended it to her, even though it was far from her house, as she said:

I never go to dental health services at the community health centre near here. I usually go to Ketabang community health centre. It is a bit far from here, but my friends said that Ketabang community health centre has a nice building and good services. The dentists are also friendly for children and make children feel comfortable during the treatment (CF5).

For children in the caries group, the parents, particularly those who lived in village areas, frequently complained about the limited options of dental care service providers in their local area. They commonly referred to community health centres when asked about the nearest location of dental health services. Community health centres were commonly located within a short distance of the participants' houses, whereas private dental clinics were mostly located in urban areas, as one parent of a child in the caries group said:

The private dental clinics are far from here. We can't go there by foot. Alternatively, there is a dental health service at the community health centre. It is very close to here (C18).

Some participants also seemed to be unaware of the dental care services available in their local areas. Even though there were several options of dental care services available in their local areas, including paediatric dental care, the community health centre was the only dental care service in their local areas that they were aware of. One parent of a child in the caries group said:

I don't know where there is a private dental clinic near here. I only know the dental health service at the community health centre. It is near here, near the market. It is just within walking distance of my house (C17).

In addition, public and individual trust issues were perceived to hinder participants' willingness to visit to dental care services at the community health centre. For children in the caries group, the participants' dissatisfaction with dental care services at the community health centre was often linked to the long waiting time to see a dentist once there and the quality of dental healthcare provided by the dentist, as one parent of a child in the caries group described:

I actually felt reluctant to take him to a dentist at the community health centre, but I don't have any choice. The private dental clinics are too far from here. One time, he [her son] complained of a toothache, so I

eventually took him to a dentist at the community health centre. I queued up from the morning, but even at noon, my child was not called into the dentist's room. When it was my son's turn to be called to the dentist's room, I was very disappointed. The dentist did nothing. She [the dentist] even didn't ask my son to open his mouth and see the tooth that made my son suffer a toothache. It was like the dentist didn't care and she didn't pay attention to my child's dental problem. She just prescribed medicine. That's why I am reluctant to visit the community health centre (C20).

In the caries-free group, the poor communication skills of the dentist was the most common reason for participants avoiding visiting the dentist in community health centres. The results of the interviews indicated that parents of children in the caries-free group wanted more communication with the dentist at the community health centre. They were actually willing to raise questions to or ask for information from the dentist. However, the time for consultation was not long enough or there was no time allocated for a consultation. As a result, the dentist did not take the time to provide them with the further advice and information that they sought, because the dentist seemed to be in a rush. One parent of a child in the caries-free group explained:

I visited a dentist at the community health service. For me, I am not satisfied. The dentist was reluctant to answer my questions about my teeth. I have less knowledge about dental health, so when I visit a dentist, I would like to ask about what I don't know, but the dentist was reluctant to communicate with me. The dentist gave me a poor-quality service (CF19).

The negative impression from her interaction with the dentist at the community health centre might become the most memorable aspect of dental care for her. Although she might not voice her complaints, the feeling of being dismissed when she was relying on the dentist's expertise to ask for advice seemed to impact on her willingness to go back to the dentist at the community health service.

Another parent of a child in the caries-free group raised concerns that she also did not trust the quality of dental health services at the community health centre. She said that she observed a different dental health service quality between a community health centre and a private dental clinic. Agreeing with other people surrounding her, she questions the expertise and credibility of the dentists at the community health centre and does not trust their clinical skills and competence. She said:

I never go to a dentist at the community health centre. I am afraid that the dentist at the community health centre is not good enough for dental care. Also, if something happened with our teeth after dental treatment, a dentist in the private dental clinic will be more likely to take responsibility than the dentist at the community health centre. If something happened with our teeth after dental treatment at the community health centre, most people surrounding me will say, 'why did you go to the community health centre? Take your consequence. It's a mistake to go there' (CF28).

A lack of trust and confidence in the quality of dental care at the community health centre was evident in the caries-free group. Another parent admitted that she was used to visiting the dental health service at the community health centre, but now she is reluctant to return because of hygienic issues. As she said:

I heard from my friend that the dental tools in that community health centre are sterilized after 20 patients

used those tools. That makes me scared to go back there. You know, it is not hygienic, is it? Now, there are diseases, like AIDS or other infectious diseases, and we might get infected with those diseases because we used the same tools as the person who brought those diseases there (CF5).

In addition, access to dental health services hinged on the capacity to pay for dental care. For children in the caries group, many parents perceived that the cost of dental care is affordable regardless of their income, and therefore, do not see the cost of dental care as a barrier to accessing dental care services. Compared to parents of children in the caries group, some parents of children in the caries-free group, particularly those of low socioeconomic status, were concerned about the cost of dental care. Even though they admitted that the cost of dental care is affordable, they perceive it as not good value for money. This became one of the factors discouraging them from using dental care services. One parent of a child in the caries-free group explained:

I never take my youngest son to a dentist…The last time I went to the dentist was when my older son had dental problems. I took him to a dentist at the community health centre near the city hall… At that time, I asked the dentist to clean my son's dental caries. There were two teeth that were decayed… It cost me around Rp. 90.000 [approximately AUD 9]. Although in the private dental clinic it might cost more than that, in my opinion, Rp. 90.000 is still expensive for the cost of dental care in a community health centre. When we go to a community health centre, we assume that the cost will be very cheap, because most people of low social economic status usually go there. If we have to pay Rp. 90.000 for the cost of dental care at a community health centre, it is expensive. It may still be affordable for some people because they might set aside money to pay for it, but I think it is not worth spending Rp. 90.000 just on teeth (CF5).

Many parents of children in both the caries and caries-free groups reported that their family had been enrolled in the publicly available national health insurance called Jaminan Kesehatan Nasional (JKN) organised by *BPJS-Kesehatan* (*Badan Penyelenggara Jaminan Sosial-Kesehatan*/Health Social Security Institution). However, none of them had used it for dental care. Their responses indicated that they were commonly sceptical about and had no trust in the National Health Insurance scheme. They also hold the view that people who use the National Health Insurance to get healthcare services are often regarded as poor people by healthcare service staff. They would be treated differently and would receive poor-quality service. They therefore decide to pay to get a better-quality service, including for dental care. One parent of a child in the caries group shared her experience:

I have a disappointing experience when using BPJS. It was when I needed a treadmill test for my heart disease. I came to one of the public hospitals. They said that the machine was out of order. However, when I said that I would pay out of pocket, they suddenly said they would fix it straight away. I don't mind paying out of pocket if I can get better services, including for dental care if I need it (C7).

Similarly, parents of children in the caries-free group who hold private health insurance have also had to pay out of pocket for their dental expenses. This is because either dental care is not covered by their private health insurance, or they are reluctant to claim for reimbursement, which is perceived as a complicated process. One parent of a child in the caries group said:

> *I don't have BPJS, but I have private health insurance from my husband's office. I never used it for dental care, because I have to pay upfront and then claim for reimbursement. It is a bit complicated and takes time. My family has never had dental health problems yet, and I hope we will never have dental health problems. So, I don't need to go to a dentist and pay out of pocket (CF4).*

In summary, the qualitative results of this study demonstrate four key oral health behaviours influencing the development of dental caries in children, including sugar snacking, bedtime bottle habits, oral hygiene practice, and dental visits. The results also revealed factors influencing the differences in those oral health behaviours between children in the caries and caries-free groups. Parenting skills were one of the most important factors in shaping oral health behaviours in children. The ability to manage children's behaviour appeared to play a vital role in establishing favourable oral health behaviours. Another factor influencing children's oral health behaviours derived from family and social environment. The ability to resist pressure from family and social environments, such as the pressure to be 'good parents' and appease children, was apparent in facilitating more favourable oral health behaviours. In terms of oral hygiene practice, the establishment of children's oral hygiene routines depended on parents'/caregivers' perceived needs of oral hygiene practice and their knowledge and skills of tooth brushing. Other factors influencing dental care-seeking behaviours were parents' perceived importance of dental visits, access to dental health services, and trust in the competency of dental staff. The next chapter presents a synthesis of the results from both the quantitative and qualitative parts of the study and shows how the qualitative results have helped in explaining the association between oral health behaviours and dental caries, which was found in the quantitative results. Specifically, the differences in the parents' personal and socio-environmental factors between children in the caries and caries-free groups could explain why children in the caries group were found to be more likely than children in the caries-free group to engage in poor oral health behaviours.

CHAPTER 6
SYNTHESIS RESULTS

This chapter draws together the quantitative and qualitative results of this study. In this chapter, the qualitative results are used to help explain the associations between the oral health behaviours and dental caries in children found in the quantitative study, comparing the factors influencing the oral health behaviours of children in the caries and caries-free groups. The qualitative results are also reviewed in order to provide an understanding of the cases in which the expected associations were not found in the quantitative study. Consideration is then given to how and whether these synthesised results answer the initial research questions of this study. This chapter is divided into four sections: sugar snacking, bottle drinking, oral hygiene practices, and dental visits. Each section starts with a brief statement of the quantitative results, followed by a more detailed synthesis of the findings, informed by the qualitative results.

6.1 Sugar snacking

The quantitative results of this study showed that dental caries was significantly associated with the consumption of sugary snacks, the type of snacks, and the frequency of sugar snacking. Children who consumed sugary snacks in between meals, children who consumed both sweet and savoury snacks, and children who consumed snacks three or more times per day were found to be more likely to suffer dental caries than children who did not. The qualitative results of this study explain those quantitative results by addressing the question of why children in the caries group were more likely to have sugar-snacking habits than children in the caries-free group. The qualitative results of this study clearly revealed different parenting practices concerning sugar snacking between participants in the caries and caries-free groups, which are influenced by personal and socio-environmental factors. In the caries group, few or no rules or limits on sugar snacking because of the parents' perceived difficulties in coping with children's behaviours appeared to contribute to the children's frequent consumption of sugary snacks in between meals. Some parents/caregivers tried to be firm, but they ended up letting their children have the desired snack to avoid arguments with them, to make them stay quiet, and to get some peace. Other parents/caregivers were found to be permissive with sugar snacking out of guilt. Most parents/caregivers in the caries group find it hard to stick to their rules on sugar snacking, and consequently, they give in to their children's demands for sugar snacks to feel better emotionally, even though they wanted to be firm.

In contrast, giving the child a supportive structure through reasonable, clear, and consistent rules and limits on sugar snacking was evident in the caries-free group. This appeared to have led to less frequency of sugar snacking in between meals among children in the caries-free group. Parents/caregivers in the caries-free group developed a variety of

strategies to control the children's sugar snacking. They believed that being consistent with the rules they had established was the key to their success in controlling their children's sugar snacking. Furthermore, concern about the adverse effect of sugary snacks on the children's health prompted parents/caregivers in the caries-free group to put a great deal of effort into controlling their children's sugar snacking. Most parents/caregivers in the caries-free group who were interviewed also showed a positive attitude towards their children's oral health and believed that they were able to influence their children's oral health by reducing the consumption of sugary snacks.

The type of snacks frequently consumed by the children was found to depend on what snacks were readily available and could be easily accessed by them. In the caries group, many parents tended to make various snacks, both sugary and savoury, readily available at home, without sufficient rules on sugar snacking. They also commonly offered sugary snacks to reward behaviours, to occupy, to comfort, or to calm children, because they perceived sugary snacks as having an immediate effect on modifying their children's behaviour. As a result, children in the caries group got used to consuming both sugary and savoury snacks. On the other hand, participants in the caries-free group tended to create a supportive environment for their children that encourages healthy snacking behaviours, such as limiting the availability of snacks at home, providing healthy alternatives to snacking, avoiding places that offer sugary snacks, and role modelling healthy snacking. This made children in the caries-free group less likely to snack than children in the caries group.

Differences were found among the parents of children in the caries and caries-free groups concerning resisting family influence on sugar snacking. In the caries group, increased frequency of sugary snack consumption among children was attributed to having grandparents as daytime caregivers, who were perceived as too lenient with sugar snacking. Many parents of children in the caries group perceived an inability to withstand the influence of grandparents on their children's sugar snacking, because family values concerning child obedience made the parents have no courage to argue with their own parents. In contrast, in the caries-free group, many parents emphasised the importance of assertiveness in overcoming family-related barriers to control the children's sugar snacking. They put a great deal of effort into getting all family members and other caregivers to follow the same set of rules for sugar snacking for their children. They held firm and made it clear that they were standing their ground with their rules and boundaries concerning sugar snacking for their children. Parental ability to resist family influence on sugar snacking appeared to elicit a positive effect on the children's sugar snacking, which was demonstrated by a lower frequency of sugar snacking among their children.

In addition, parental ability to resist sociocultural influences on sugar snacking was different between those in the caries and caries-free groups. In the caries group, the

emergence of food stalls and grocery shops selling cheap sugary foods and beverages, social norms concerning the sugar snacking of children, and social pressure to give sugary snacks to children were perceived by many parents as barriers to controlling their children's sugar snacking. They commonly perceived a difficulty in resisting pressure from their sociocultural environment because of a fear of being judged, a desire to be accepted by others, or a disposition to please others. This appeared to result in high-frequency sugar snacking among children in the caries group. On the contrary, in the caries-free group, in the face of such an unsupportive sociocultural environment, being consistent with the rules of sugar snacking was the key to success in controlling the children's sugar snacking. This finding is reinforced by the parents' ability to implement strategies to manage their children's behaviours. Furthermore, supportive regulations concerning sugar snacking at the children's school aiming to reduce the consumption of sugary snacks and promote healthy snacking were perceived by parents as having a positive influence on their children's sugar snacking, as demonstrated by the lower frequency of sugar snacking among their children. A summary of the findings of this study on sugar snacking are presented in Table 42.

Table 42. Summary of findings on sugar snacking

Quantitative results	**Qualitative results**	
Dental caries was found to be significantly associated with: - the consumption of sugary snacks in between meals; - the consumption of both sweet and savoury snacks; and - the consumption of snacks three or more times per a day.	**Factors influencing sugar snacking in children**	
	Caries group	**Caries-free group**
	Unsupportive/permissive parenting practices	Supportive parenting practices
	Few or no rules on sugar snacking and inconsistency in implementing rules on sugar snacking.	Setting reasonable, clear, and consistent rules and limits on sugar snacking
	Parents' perceived inability to control their child's sugar snacking and snacks as a tool to manage children's behaviours.	Parents' perceived ability to control their children's sugar snacking by developing a variety of strategies.
	Showing weak attitudes towards the importance of restricting their children from sugar snacking.	Showing strong attitudes towards the importance of restricting their children from sugar snacking.
	Making snacks readily available at home.	Creating a supportive environment to encourage healthy snacking behaviour, such as limiting the availability of snacks at home, providing healthy snacks as alternatives, and role modelling healthy snacking.
	Perceived inability to resist pressure within families and communities.	Some parents were assertive in dealing with pressure from families and communities, whereas others perceived no or less pressure within families and communities.
	Unsupportive family and social environment, such as easy access to sugary snacks and norms and cultures within families and communities.	Some parents were assertive and kept consistent with the rules of sugar snacking in the face of an unsupportive family and social environment, whereas others perceived that they had a supportive family and social environment.
	The absence or inconsistency of supportive regulations concerning	Supportive regulations concerning sugar snacking at the children's

	sugar snacking at the children's schools.	schools.

In addition, there appeared to be an interaction between parents' personal and socio-cultural factors in influencing their parenting practices concerning sugar snacking. For example, in the caries group, social norms and culture potentially affect parents' attitudes toward their children's sugar-snacking habits. Some parents were forced to give in to pressure from their family and community. Uncomfortable feelings, such as the fear of being judged, got in the way of their efforts to restrict their children from sugar snacking. As a result, their children consumed sugary snacks unrestricted, which could increase the risk of developing dental caries. On the contrary, in the caries-free group, parents who demonstrated a strong attitude towards the importance of restricting their children from sugar snacking and who had a perceived ability to manage their children's behaviours were able to resist pressure within families and communities and to keep consistent with the rules of sugar snacking for their children. According to the parents, being brave and assertive in standing up to pressure concerning sugar snacking for their children could stop such pressure. As a result, in the same pressurised situation, their children are less likely than other children to consume sugary snacks, which could reduce the risk of developing dental caries.

6.2 Bottle drinking

The quantitative results of this study confirmed that dental caries was significantly associated with a bedtime bottle habit and the age of bottle weaning. Children who had a bedtime bottle habit or who were weaned off the bottle after 18 months of age were more likely to suffer dental caries than other children. The qualitative results of this study explain those quantitative results in terms of why children in the caries group were found to be more likely to have bedtime bottle habits and prolonged bottle drinking than children in the caries-free group. The results of interviews with parents/caregivers of children in the caries and caries-free groups revealed different personal and socio-environmental factors among the parents, which influenced different parenting practices concerning a bedtime bottle habit and bottle drinking in general between parents of children in the caries and caries-free groups. Parents of children in the caries group appeared to be more permissive towards bedtime bottle drinking than parents of children in the caries-free group. The most common reason why parents of children in the caries group allowed their child to have a bottle before bed was their child's dependency on a bottle to sleep throughout the night. This made the bedtime bottle became a part of the child's bedtime routine. In contrast, in the caries-free group, the absence of bedtime bottle habits among some children was because some parents never got their child used to bedtime bottles since infancy. Most of them reasoned that bottle-feeding was not a common practice in

their family culture or their child refused to drink from bottles.

In addition, prolonged bottle drinking, including bedtime bottle drinking, was found to be more common among children in the caries group than in the caries-free group. In the caries group, the parents' attempts to wean their children from the bottle often ended in failure due to the parents'/caregivers' perceived inability to deal with children's resistance to bottle weaning, perceived to cause the children's sleep problems and a huge decrease in children's appetite for milk. Furthermore, the parents' perceived stress because of work, busy lives, or other stressors also seemed to make them feel drained of energy to start bottle weaning and to deal with their children's behaviours concerning bottle weaning. In contrast, in the caries-free group, being firm and consistent in adhering to their weaning plan was their key to success in bottle weaning. To resettle the children without a bottle, many parents chose to gradually reduce the frequency of bottle drinking until complete weaning, while a few parents preferred abrupt weaning by disposing of all of the bottles at one time to make the children have no choice but to give up the bottles.

Differences in family and social influence on bottle drinking between parents of children in the caries and caries-free groups were found. In the caries group, grandparents were perceived by many parents as contributing to their failure to wean their children from bottle drinking because of their inclination to spoil and pamper their grandchildren, including bottle drinking. Another big hurdle in the process of bottle weaning perceived by parents was the sociocultural environment, where bottle drinking is a part of their culture. Furthermore, many parents seemed to rely on the social pressure to which the children themselves are exposed to encourage their children to give up the bottles on their own. This was demonstrated by prolonged bottle drinking until the children were four or five years old, considered by parents of children in the caries group as the right age to wean them from bottles because at this age, children started having a feeling of shame about bottle drinking. On the contrary, many parents of children in the caries-free group perceived their family as having a positive influence on bottle weaning. The absence of a culture of a bedtime bottle in the family made some parents of children in the caries-free group never get the child used to a bedtime bottle. Involving older children as role models concerning bottle weaning for the younger children was also a strategy commonly adopted by parents of children in the caries-free group. Furthermore, to avoid sociocultural influence on bottle drinking, some parents perceived a child's first birthday as the right time for bottle weaning. They reasoned that starting bottle weaning at an older age would be difficult as children might have become dependent on bottles. Table 43 presents a summary of the findings of this study concerning bottle drinking.

Table 43. Summary of findings on bottle drinking

Quantitative results	**Qualitative results**	
Dental caries was found to be significantly associated with:	**Factors influencing bottle drinking among children**	
	Caries group	**Caries-free group**

- bedtime bottle habit - the age of bottle weaning	Parents were permissive towards bedtime bottle drinking because of the children's dependency on a bottle to sleep through the night.	Parents never got their children used to a bedtime bottle, since infancy.
	Prolonged bottle drinking was because of the parents' perceived inability to deal with the children's resistance to bottle weaning.	Parents were consistent with the weaning plans. Some parents chose gradual weaning, whereas others chose abrupt weaning.
	Parents relied on the social pressure directly put on the child to initiate bottle weaning.	Parents were inclined to put a great deal of effort into initiating bottle weaning as early as possible.
	Unsupportive family and social environments for bottle weaning, particularly related to the culture of bottle drinking among children.	A supportive family and social environment, no culture of bottle drinking or bedtime bottle.

Similar to sugar snacking, there also appeared to be an interaction between parents' personal and sociocultural factors and their parenting practices concerning bedtime bottle and general bottle-drinking habits. For example, in the caries group, the parents' attitudes towards bottle weaning were influenced by a culture of bottle drinking in their social circle, which was perceived by parents to have made their children more resistant to bottle weaning and made bottle weaning difficult. This resulted in prolonged bottle drinking, which could expose the children to a high risk of developing dental caries. On the contrary, in the caries-free group, parents who had strong attitudes in favour of early bottle weaning were able to encourage other family members to support their efforts to wean their children off bottles. A supportive family environment during the process of bottle weaning was perceived by some parents as one of the keys to success with bottle weaning, which could reduce the risk of developing dental caries.

6.3 Oral hygiene practices

Interestingly, in the quantitative results, none of the oral hygiene practices variables (the initial age of cleaning without toothpaste, the initial age of cleaning with toothpaste, toothpaste size, licking of toothpaste, the frequency of tooth brushing, and tooth-brushing supervision) were found to be significantly associated with the presence of dental caries in the multivariate analysis. The qualitative results of this study explain those quantitative results by addressing the question of why some children had dental caries whereas others were caries-free even though they had similar oral hygiene practices. The qualitative results of this study clearly reveal that even though the oral hygiene practices of children in both the caries and caries-free groups were similar, there appeared to be some difference in parenting practices concerning the way in which those oral hygiene practices were established, which were also influenced by different personal and socio-environmental factors affecting the parents. For example, the quantitative results of this study found no significant association between the initial age of cleaning without toothpaste and the development of dental caries. This finding is

supported by the qualitative results that show that most parents of children in the caries and caries-free groups initiated their children's first oral hygiene practices before their first birthday. They generally acknowledged the value and importance of maintaining good oral hygiene for their child. However, there appeared to be differences in the parents' perceived notions concerning the need for early oral hygiene practices. In the caries-free group, the first oral cleaning was mostly before the child's first tooth came in. Early oral cleaning was described by parents as involving them wiping the children's gums and tongue to remove milk residue and to accustom the children to oral cleaning. On the contrary, in the caries group, parents seemed to start their children's first oral hygiene practice when their children's first tooth appeared, at approximately six months of age. Some of them also chose to delay brushing their children's teeth until more teeth came through, at around one or two years of age. They commonly reasoned that there was no need to clean their children's teeth when their children still had only a few teeth or were still eating only baby foods and table foods that were not perceived to be able to cause any damage to the teeth.

The qualitative results also showed that the use of toothpaste in the children's oral hygiene routine was perceived as a challenge for many participants in both the caries and caries-free groups. This perception made parents in both groups choose to delay the use of toothpaste. The quantitative results of this study also found no significant association between the initial age of cleaning with toothpaste and dental caries. However, there were differences in the reasons for delaying the introduction of toothpaste to the children. In the caries group, the most frequently reported barrier to the introduction of toothpaste was due to the children's distaste for toothpaste. They mostly delayed introducing toothpaste to their child until age two or three years old with the aim of maximising their children's acceptance of toothpaste and avoiding any resistance to tooth brushing. This belief appears to be related to the parents' perceived inability to deal with the children's resistance to tooth brushing. On the other hand, in the caries-free group, the barrier was commonly related to the parents' concerns about the harmful side effects of swallowing toothpaste and the poor quality of water used for rinsing their children's mouths after tooth brushing. Some parents of children in the caries-free groups chose to delay introducing toothpaste until the age of two years old, while others chose to use age-appropriate toothpaste that is safe for use by a one-year-old child.

The qualitative results of this study also showed that the use of a small amount of toothpaste was common among children in both the caries and caries-free groups for different reasons. In the caries group, parents used a small drop of toothpaste to avoid the children's aversion to the taste of toothpaste, whereas in the caries-free group, the parents tended to take advice from a dentist. This might explain the quantitative result that found no significant association between toothpaste size and the presence of dental caries. However, even though parents of children in both groups mostly chose to use a small amount of toothpaste for their

children, parents of children in the caries group seemed to be more inclined than parents of children in the caries-free group to apply toothpaste to the full length of the toothbrush head after their children could accept the taste of toothpaste, because they perceived it as a standard practice.

In addition, based on the interviews with the parents, licking toothpaste was not a common habit among children in both the caries and caries-free groups. This appeared to support the quantitative results, which found no significant association between licking toothpaste and the development of dental caries. However, in the qualitative results, there were a few children in the caries group who had a habit of licking toothpaste due to their liking for the taste thereof, whereas this was not a reason for this habit among children in the caries-free group. Furthermore, parents of children in the caries group were more likely than those in the caries-free group to allow their children to swallow toothpaste and the rinsing water while tooth brushing. The only concern of parents in the caries group was about the quality of the rinsing water rather than the toothpaste itself.

In the qualitative results, family and social culture were found to influence the frequency of tooth brushing. Most parents of children in the caries and caries-free groups managed twice-daily tooth brushing in the context of the morning and afternoon shower routines, which was considered as a generally accepted oral hygiene routine in their social environment. The culture of tooth brushing, which integrated tooth brushing into the daily shower routine, was considered effective in making their children's tooth-brushing routine convenient and manageable. This may support the quantitative results, which found no significant association between the frequency of tooth brushing and dental caries. However, the qualitative results revealed that in addition to twice-daily tooth brushing in the context of the morning and afternoon shower routines, parents of children in the caries-free group were more likely than parents of children in the caries group to get their child used to brushing their teeth before bed at night. Parents'/caregivers' own nightly tooth-brushing habits, commonly influenced by their family culture on oral hygiene practices, appeared to contribute to the formation of their children's nightly tooth-brushing habit. They would commonly put a great deal of effort into getting their children used to brushing their teeth before bed at night. This finding is confirmed by the admittance of some parents/caregivers of children in the caries group that they never taught their children to brush their teeth before bed at night because they also did not have a nightly tooth-brushing habit. Furthermore, parents of children in the caries-free group were more likely than parents of children in the caries group to benefit from tooth-brushing exercises at the children's school, which was perceived as helping the child comply with tooth-brushing routines, including tooth brushing before bed at night.

The parents' success in establishing twice-daily tooth brushing was also determined by their level of knowledge and skills concerning tooth brushing. Parents of children in the caries

group were more likely than parents of children in the caries-free group to lack such knowledge and skills. This made them lack confidence in brushing their children's teeth, resulting in a lower frequency of tooth brushing for their children. Furthermore, most parents of children in the caries-free group had access to oral health education programs to learn proper tooth-brushing techniques, whereas parents of children in the caries group relied more on their own tooth-brushing techniques.

In addition to these differences, there also appeared to be a difference in the parents' perceived ability to manage their children's behaviours related to tooth brushing. In the caries group, the common barriers preventing the performance of the children's tooth-brushing routine were associated with the children's resistance and non-compliance in response to tooth brushing as well as time constraints. In the face of those difficulties, most parents became more flexible towards their children's oral hygiene practices and tended to skip brushing their children's teeth to avoid conflict with their children. On the other hand, in the caries-free group, parents commonly persisted in brushing their children's teeth, regardless of their children's responses to tooth brushing. They believed that consistency in the tooth-brushing routine would facilitate their children's compliance with tooth brushing. To overcome the child-related barrier to tooth brushing, they used a variety of strategies to increase their children's compliance with tooth brushing, such as using child-oriented tooth-brushing kits as an enticement and incorporating songs into their children's tooth-brushing routines. Some parents/caregivers also used an amusing book or video about tooth brushing to help the children retain the information and understand the importance of tooth brushing. Functioning parents and older siblings acted as role models for their younger siblings; for example, through brushing their own teeth in their younger siblings' presence. This method was also considered effective in encouraging younger children to brush their teeth. Therefore, parents of children in the caries-free group were more likely to successfully establish their children's tooth-brushing routines than those in the caries group.

The qualitative results of this study also showed that parents of children in both the caries and caries-free groups perceived the importance of active parental supervision of the children's tooth-brushing routines, with the purpose of establishing their children's tooth-brushing routine. Parents of children in both groups described 'parental supervision' as being physically present during tooth brushing to actively teach their children about proper tooth-brushing techniques. This finding appears to support the quantitative results, which found no significant association between tooth-brushing supervision and dental caries. However, the qualitative results of this study further revealed a difference in the ways in which parents of children in the caries and caries-free groups provided tooth-brushing supervision for their children. In the caries-free group, the tooth-brushing routine was regarded by parents as a learning process for their children. They allowed their children to brush their own teeth for the

purpose of giving their children more control over their oral hygiene practice and developing their children's tooth-brushing skills. Then, they re-brushed their children's teeth thoroughly as a part of their supervisory role, which they described as a responsibility for ensuring that their children's teeth were cleaned properly. This supervisory responsibility was also assigned to other people who provided care to the children. In contrast, in the caries group, direct tooth-brushing supervision was mostly given by parents only during the first few weeks of their children starting to learn to brush their teeth. By the time they perceived that their children were sufficiently autonomous and able to take on the task for themselves, they became less involved in their children's tooth-brushing routines. Furthermore, time constraints often acted as the barrier to giving effective tooth-brushing supervision. A summary of the findings of this study regarding oral hygiene practices is presented in Table 44.

Table 44. Summary of findings concerning oral hygiene practices

Quantitative results	**Qualitative results**	
Dental caries was not found to be significantly associated with: - the initial age of cleaning without toothpaste; - the initial age of cleaning with toothpaste; - toothpaste size; - licking of toothpaste; - the frequency of tooth brushing; and - tooth-brushing supervision.	**Factors influencing oral hygiene practices in children**	
	Caries group	**Caries-free group**
	Parents' perception was that early oral hygiene practices should be established after their child's first tooth appeared or until more teeth came through, at around one year or two years of age, because the parents perceived a low risk of their children developing dental caries.	Parents perceived the need for early oral hygiene practices before the child's first tooth came in, including wiping the child's gum and tongue to remove milk residue and to make the child become accustomed to oral cleaning.
	Children's distaste for toothpaste and avoiding any resistance to tooth brushing were the reasons for delaying introducing toothpaste.	Parents' concerns about the harmful side effects of swallowing toothpaste and the poor quality of water used for mouth rinsing were the reasons for delaying introducing toothpaste. Some parents chose to use age-appropriate toothpaste that is safe for use by a one-year-old.
	Parents used a small drop of toothpaste to avoid the children's aversion to the taste of toothpaste. Parents tended to apply toothpaste to the full length of the brush head after their children could accept the taste of toothpaste, and they perceived this as a standard practice.	Parents took advice from a dentist to use a small drop of toothpaste.
	The parents of a few children allowed them to lick the toothpaste after they started liking the taste of toothpaste. They also allowed their children to swallow the toothpaste and the rinsing water while tooth brushing. They were only concerned about the quality of the rinsing water rather than the toothpaste.	None of the parents allowed their children to lick or swallow toothpaste or rinsing water, because they were concerned about the harmful side effects of swallowing toothpaste and the poor quality of the rinsing water.
	Parents only managed twice-daily tooth brushing in the context of the morning and afternoon shower routines. There was no culture of nightly tooth brushing in the family. There were no role models to show	In addition to twice-daily tooth brushing in the context of the morning and afternoon shower routines, the culture of nightly tooth brushing in the family appeared to facilitate the establishment of tooth

	the young children that they should brush their teeth before going to bed at night.	brushing before going to bed at night among children. Parents and older siblings were role models for the younger children.
	Parent did not get adequate support from their children's schools in terms of oral health education for their child.	Parents got adequate support from school in the form of tooth-brushing exercises.
	Parents relied on their own tooth-brushing techniques.	Parents had access to oral health education programs to learn about proper tooth-brushing techniques.
	Parents lacked tooth brushing knowledge and skills	Parents had adequate knowledge of proper tooth-brushing techniques.
	Parents lacked confidence in their ability to brush their children's teeth.	Parents were confident in successfully performing their children's tooth-brushing routines.
	Parents were more flexible towards their children's oral hygiene practices.	Parents persisted in their children's tooth-brushing routines.
	Parents perceived an inability to manage their children's resistance and non-compliance concerning tooth brushing.	Parents were able to overcome the child-related barrier to tooth brushing by using a variety of strategies to increase their children's compliance with tooth brushing.
	Parents perceived the importance of parental tooth-brushing supervision, but only give direct tooth-brushing supervision during the first few weeks of their children starting to learn to brush their teeth and became less involved when their children had been able to brush their teeth themselves.	Parents perceived the importance of parental tooth-brushing supervision and were physically present during tooth brushing to actively teach their children about proper tooth brushing and re-brushed their children's teeth thoroughly to ensure proper cleaning.
	Time constraints were a barrier to the provision of tooth-brushing supervision.	In the face of time constraints, parents assigned the supervisory responsibility to other people who provided care to their children.

Similar to sugar snacking and bedtime bottle habits, the interaction between parents' personal and sociocultural factors also appeared to influence parenting practices concerning oral hygiene practices. For example, in the caries-free group, a family culture of night tooth-brushing seemed to have a great influence on parents' positive attitudes towards the importance of nightly tooth brushing and made parents put a great deal of effort into brushing their children's teeth before going to bed at night. This habit could reduce the risk of developing dental caries. In contrast, in the caries group, parents' negative attitudes towards the importance of nightly tooth brushing might have created an unsupportive family environment for their children to develop nightly tooth-brushing habits, such as the absence of a role model for their children, either from parents or siblings, to brush their teeth before going to bed at night. This was reinforced by parents' reluctance to get their child used to nightly tooth brushing. As a result, the risk of developing dental caries increased.

6.4 Dental visits

The results from the quantitative phase of this study showed that dental caries was significantly associated with a dental visit history, the last dental visit, the reason for the last dental visit, the perceived delays in dental care, the type of dental care delay, the reasons for the dental care delay, and dental fear. Children who had a dental visit history, who had visited a dentist in the past six months, and who had visited a dentist for a non-preventive purpose at their last dental visit were more likely to suffer dental caries than children who had never seen a dentist. The qualitative results of this study explain those quantitative results by revealing that problem-oriented dental visits (i.e. visiting a dentist only when a problem is apparent) were a common parenting practice concerning dental visits among parents of children in both groups. Most parents/caregivers of children in the caries and caries-free groups regarded dental problems, such as a toothache, as being caused by tooth decay, which requires emergency dental treatment. As a result, children who had had dental visits were mostly those who were in pain because of dental caries, and their parents sought dental treatment. This seemed to be the reason why children who had visited a dentist were more likely to have dental caries than children who had not visited a dentist, as demonstrated in the quantitative results. The practice of problem-oriented dental visits and the lack of preventive concern in both the caries and caries-free groups appeared to be influenced by personal and sociocultural factors, which mostly focused on curative rather than preventive dental care. Cultural beliefs and practices about when and how to engage with dental care practitioners seemed to have implications for the recognition of dental care-seeking behaviours. Furthermore, the temporary nature of baby teeth also influenced parents'/caregivers' perceived low value of dental care for baby teeth, which was also commonly derived from family and social culture.

In addition, the quantitative results of this study showed that the likelihood of developing dental caries was higher among children of parents who perceived delays in having their children receive dental care and who perceived non-preventive dental care delay for their children than children of parents who did not perceive delays in having their children receive dental care. With regard to the reason for delays in seeking dental care, dental caries was significantly associated with cost-related dental care delay, time-related dental care delay, child-related dental care delay, and other reasons for dental care delays. Children of parents who perceived a child-related dental care delay but did not perceive cost-related dental care delay, time-related dental care delay, or other dental care delay were more likely to develop dental caries than children of caregivers who had no perceived delay in seeking dental care for their children. Furthermore, the likelihood of developing dental caries was also higher among children who had dental fear than those who did not have dental fear.

The interviews with parents showed that in the caries group, the mindset of a problem-oriented dental visit was demonstrated by parents' inclination to delay seeking dental treatment

for their child until their children presented with a toothache. Besides the lack of a perceived need for dental treatment, parents of children in the caries group cited a number of barriers causing delays in seeking dental treatment for their child. The child-related barrier was the most common reason for delaying seeking dental treatment for their children. Children's resistance to dental visits and the uncooperative behaviour of the children were perceived by many parents/caregivers in the caries group as a big hurdle to overcome. Their perceived inability to control their children's behaviours during a dental visit made the parents/caregivers in the caries group delay visiting the dentist. Children were also sometimes given a choice as an alternative to a dental visit. Dental fear (the fear of receiving dental care) was often linked to the children's resistance to a dental visit. Time constraints and the cost of dental treatment were considered less discouraging among parents of children in the caries group in terms of seeking dental treatment for their children. Parents of children in the caries group commonly expressed their willingness to take their children to a dentist if there was a dental problem that required urgent dental treatment, and they perceived that the cost of dental care was affordable. Instead of the time and cost constraints, the most apparent barrier to a dental visit was the parents' perception of the dental problem itself. In addition, other reasons for not seeking dental treatment included limited access to dental health service providers other than the local community health centres, trust issues, parents'/caregivers' misconceptions about dental care, and parents'/caregivers negative past experiences with dental treatment.

In the caries-free group, the lack of concern for preventive dental care was reflected by parents'/caregivers' perceived low importance of a dental visit because of the absence of dental caries in their children. Some of them also appeared to lack knowledge about preventive dental visits and the recommended age for the first dental visit for their children. This appeared to account for the low rate of dental visits among children in the caries-free group. In contrast to parents/caregivers in the caries group, even though they had never taken their child to a dentist, they perceived no difficulty in taking their children to a dentist if required. A lack of a sense of urgency about their children's preventive dental visits due to the parents' perception of not having dental health problems appeared to lead parents to prioritise their work rather than making preventive dental visits for their children. Furthermore, some parents of children in the caries-free group were concerned about the cost of dental care. They perceived the cost of dental care as not good value for money, despite that it is affordable. Compared to parents of children in the caries group, access to dental health services also did not seem to be a problem for parents of children in the caries-free group because they had a range of options of dental health service providers. The only perceived concern was related to their dissatisfaction with dental health services in community health centres, such as the poor communication skills of the dentist, the limited time allocated for a consultation with the dentist, and trust issues. Furthermore, one participant questioned the expertise and credibility of the dentists in the

community health centres and did not trust in their clinical skills and competence. Their negative impression of dental health services in the community health centres seemed to be the most memorable aspect of dental care for them and made them lose trust and confidence in using such services. Table 45 presents a summary of the findings of this study concerning dental visits.

Table 45. Summary of findings concerning dental visits

<table>
<tr><th>Quantitative results</th><th colspan="2">Qualitative results</th></tr>
<tr><td rowspan="3">Dental caries was found to be significantly associated with children who:
- had a dental visit history;
- visited a dentist in the past six months;
- visited a dentist for a non-preventive purpose in their last dental visit;
- had parents who perceived delays in having their children receive dental care;
- had parents who perceived non-preventive dental care delay for their children;
- had parents who perceived child-related dental care delay;
- had parents who did not perceive cost-related dental care delay;
- had parents who did not perceive time-related dental care delay;
- had parents who did not perceive other reasons for dental care delay; and
- had dental fear.</td><td colspan="2">Factors influencing dental visits in children</td></tr>
<tr><td>Caries group</td><td>Caries-free group</td></tr>
<tr><td>Cultural beliefs and practices within families and communities influenced problem-oriented dental visits [visiting a dentist only when a problem is apparent]:
- Parents regarded dental caries as a problem if there was a toothache.
- Parents delayed dental visits until their children had a toothache that required an emergency dental treatment.
- Parents' perceived need for a dental visit to get dental treatment for their children's toothache.</td><td>Parents perceived need for dental visits in the absence of dental caries less than when such a problem is present:
- Cultural beliefs and practices within families and communities influenced the lack of concern for preventive treatment.
- A lack of knowledge about preventive dental visits and the recommended age for the first dental visit for their children.</td></tr>
<tr><td>Parents perceived delays in seeking dental treatment for their child:
- Parents' perceived inability to control their children's behaviours during dental visits, such as the children's resistance, uncooperative behaviour, and dental fear.
- Time and cost constraints concerning dental treatment did not discourage parents from seeking dental treatment for their child.
- Other common reasons for delaying a dental visit, such as access to dental health service providers, trust issues, misconceptions about dental care, and negative past experiences with dental treatment, were not cited as barriers to making dental visits for children.</td><td>Parents' perceived no delays in dental visits because they did not perceive need for dental visits in the absence of dental caries:
- Parents perceived no difficulty in taking their children to visit a dentist if necessary.
- Parents were willing to take their children to visit a dentist if required, but they prioritised their work, as they lacked a sense of urgency about their children's dental visits.
- Parents perceived the cost of dental care as affordable but not good value for money.
- Despite having dissatisfaction and trust issues with dental health service in community health centres, access to dental health services was not a problem for the parents, because they had a range of options of dental health service providers.</td></tr>
</table>

Similar to sugar snacking, bedtime bottle habits, and oral hygiene practices, there appeared to be an interaction between parents' personal and sociocultural factors in influencing their parenting practices concerning dental visits. For example, social norms and culture concerning dental care-seeking behaviours, which mostly problem-driven dental visits, appeared to influence parents' negative attitudes towards the importance of early dental visits.

This was commonly reflected by parents' inclination to delay their children's dental visits. On the contrary, parents who had a positive experience with dental treatment and were satisfied with the quality of dental care provided might have a positive attitude towards dental visits for their children. They demonstrated their positive attitude by seeking dental treatment for their children. Parents' positive attitudes to and experience of dental visits were likely to inform and influence other parents to access dental health services, because the parents commonly relied on other parents in their social networks to get information about dental health services options in their decision-making process concerning utilisation of dental health services.

In summary, the results of this study have answered the research questions:

Research question 1: Is there an association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia?

The quantitative results of this study showed a high prevalence and severity of dental caries among young children aged two to six years old in Surabaya. Dental caries was found to be significantly associated with dietary behaviours (the consumption of sugary snacks, the type of snacks, and the frequency of sugar snacking; a bedtime bottle habit and the age of bottle weaning) and dental visits (dental visit history, last dental visit, the reason for the last dental visit, perceived delays in dental care, the type of dental care delay, the reasons for the dental care delay, and dental fear). None of the variables concerning oral hygiene practices (the initial age of cleaning without toothpaste, the initial age of cleaning with toothpaste, toothpaste size, licking of toothpaste, the frequency of tooth brushing, and tooth-brushing supervision) were found to be significantly associated with dental caries.

Research question 2: Is there an association between the dental caries experience and quality of life of young children aged two to six years old in Surabaya, Indonesia and their families?

The quantitative results of this study showed that dental caries has significantly impacted the quality of life of the affected children and their families. Children who suffered dental caries were found to be more likely than children who were caries-free to have poor quality of life as a result of their dental health condition.

Research question 3: What are the factors influencing oral health behaviours among young children aged two to six years old in Surabaya, Indonesia who suffer from dental caries and those who are caries-free?

The qualitative results of this study found some clear differences in the parent's personal and sociocultural factors between parents of children in the caries and caries-free groups, such as oral health attitudes; knowledge and skills; perceived ability to manage their children's behaviours; family

and social influences; and social support. Those personal and sociocultural factors appeared to serve as either barriers or enablers for parents to successfully establish and maintain supportive oral health-related parenting practices, which have a likely implication on children's oral health behaviours and dental health outcomes.

Considering the overall purpose of this study, to develop an explanatory model of the factors underlying inequality in dental caries in young children aged two to six years old in Surabaya, Indonesia in relation to oral health behaviours, the qualitative results of this study suggested the pathways through which parents' personal and sociocultural factors have influenced oral health-related parenting practices. There appeared to be an interaction between parents' personal and sociocultural factors in influencing their oral health-related parenting practices, which then affect the children's oral health behaviours and dental health outcomes. Understanding parents' personal and sociocultural factors and the process through which those factors have influenced their oral health-related parenting practices was necessary to comprehensively address the problems of oral health behaviours and dental caries outcomes in children.

CHAPTER 7
DISCUSSION

Dental caries is prevalent in young children worldwide (Moreira, 2012). In this study, a significant proportion of young Indonesian children aged two to six years old were found to have dental caries. The prevalence of dental caries was 79.8%, with the mean of dmft (decayed, missing and filled teeth) score was 5.54 (±4.90). Similar values have been observed in other developing countries, such as in San-Ming District of Kaohsiung City, Taiwan (76.6%) (Lin, et al., 2017) and in the Emirate of Ras of Al Khaimah, in the U.A.E., (74.1%) (Kowash, et al., 2017). Furthermore, as in previous studies (Cortes, et al., 2017; Sun, et al., 2017b; Chandan, et al., 2018), untreated decay was the most common dental condition in this current study (78.5%). This decay component indicated a high proportion of untreated dental caries or other unmet dental treatment needs among Indonesia's young children.

The quantitative results of this current study confirmed the impact of dental caries on the quality of life of children and their family at all stages of early childhood. Profound differences were found between children in the caries and caries-free groups in terms of the quality of life of the children and their families. As in many other studies (Abanto, et al., 2018; Piva, et al., 2018; Vollu, et al., 2018), this current study found that dental caries negatively affected the quality of life of the affected children and their families. Food retention, bad breath, and difficulty in biting/chewing solids were the most frequently reported quality of life-related impacts on the child experiencing caries. Interestingly, pain, which is a common symptom of dental caries, was the least frequently reported impact. This could be attributed to the fact that young children might not be able to verbalize and interpret the dental pain they were feeling. This creates a problem, as most parents/caregivers in the caries group might not seek dental treatment for their child unless they are aware of the presence of pain. With regard to the impact on the family, the most frequently reported impact of children's dental caries was related to family activities, as children who suffered dental caries require more attention from their family than those who do not suffer from caries. This finding supports the conclusions of previous studies (Baghdadi, 2014; Nicol, et al., 2014). The impacts related to parental distress, such as parents feeling upset and guilty because of their child's dental caries, were also more frequently reported than the practical impacts, such as parents taking time off from work and the consequent financial impact of their child's dental caries. Similar results were found in other studies (Jankauskiene, et al., 2017; Wong, et al., 2017; Corrêa-Faria, et al., 2018).

Evidence is mounting for the association between oral health behaviours and dental caries in children (Levin, et al., 2017; Lin, et al., 2017; Wagner and Heinrich-Weltzien, 2017). The quantitative results of this current study also confirmed that children in the caries group were more likely to engage in poor oral health behaviours than children in the caries-free group. The results of the interviews with parents/caregivers indicated that they had the most dominant influence on

shaping their child's oral health behaviours. They set rules for the amount and frequency of sugar snacking by their child. They determined when their child could have a bottle of milk and when they should wean their child from the bottle. They played a leading role in developing their child's tooth-brushing habits and promoting early dental visits. These qualitative results might imply that at this early age, the child's gender did not appear to influence how parents exercised control over their child's oral health behaviours (Agarwal, et al., 2012). This might also explain the quantitative results of this current study, which found no significant association between a child's gender and dental caries, as supported by other studies (Turton, et al., 2015; Antunes, Ornellas, Fraga, and Antunes, 2018).

In contrast, age did appear to influence whether the children suffered from dental caries or not. The results of this current study support the conclusions of previous studies, which found that the risk of developing dental caries increases with age (Jiang, 2017; Nguyen, et al., 2018). Older children are exposed to the risk factors for dental caries for longer periods of time than younger children. The risk of developing dental caries also increases as a result of increased exposure to the behavioural risk factors that negatively impact on children's dental health following the emergence of the child first primary tooth (Wen, et al., 2012).

Inequalities in dental caries among children are evitable. Dental caries is not caused by natural biological variation (Sanders, 2007). Furthermore, even though susceptibility to dental caries varies with different exposures to behavioural risk factors, oral health behaviours are not the primary determinants of dental caries; such behaviours are not always freely chosen. Some favourable oral health behaviours seem to be restricted to children of parents experiencing socioeconomic disadvantage (Sanders, 2007). The findings of this study suggest different patterns of oral health behaviours among children in the caries and caries-free groups that may reflect differences in parenting practices concerning oral health influenced by a range of parents'/caregivers' personal and socio-environmental factors. The socioeconomic conditions of parents/caregivers may also influence the exposure to those factors, as they are known to be socially patterned.

This chapter discusses and compares the personal conditions and socio-environmental circumstances of the parents/caregivers of children in the caries and caries-free groups. It also links those conditions with oral health-related parenting practices that differentially influence oral health behaviours and dental caries outcomes in preschool children. This chapter begins with a discussion of the strengths and limitations of this study. It then briefly describes how oral health-related parenting practices might differ between parents/caregivers of children in the caries and caries-free groups. A discussion of the specific characteristics of parents/caregivers that have influenced their oral health-related parenting practices follows. This discussion draws primarily on a discussion of the psychological conditions and socio-environmental circumstances of parents/caregivers that affect oral health-related parenting practices. The chapter concludes with recommendations for future research.

7.1 Limitations of this study

This study has some potential methodological limitations that should be taken into account. First, since the data about dental caries experience and oral health behaviours was all collected at one point in time using a cross-sectional design, conclusions regarding the causal association of the variables could not be made in this study. Second, considering that non-cavitated carious lesions were not recorded in this study because the caries diagnosis was performed under field conditions, the prevalence and the severity of dental caries found in this study might be underestimations. Therefore, direct comparisons with previous studies should be made with caution. Third, this study has limited scope for generalisability, since the multivariate regression analysis was not run on the weighted data. The results of this study, therefore, cannot be extrapolated to the wider population of children in Surabaya. Weighting was considered necessary to adjust the biases of the sample selection. However, data regarding the number of children aged two to six years old in each region in Surabaya was unavailable, and this was required for weighting the sample data. Furthermore, the slight overrepresentation of parents/caregivers of Javanese ethnicity in both the quantitative and the qualitative methodological approaches might have influenced the study findings; therefore, the results might not be entirely representative of the actual situation in Surabaya. Fourth, desirability bias may also be present in the study, as there may have been a tendency for parents/caregivers to answer questions in a socially desirable manner that might be quite distinct from their actual behaviours or beliefs. This might have led to the underreporting of socially undesirable behaviours. Fifth, as with any other self-administrated questionnaires, the responses were influenced by the participants' interpretation of the questions. Furthermore, information obtained from parents/caregivers concerning the oral health-related quality of life of their child may differ from information obtained directly from the children. However, valid and reliable information would be difficult to obtain from young children due to their ability to understand the questions. This might have been avoided by using an age-appropriate technique.

7.2 Strengths of this study

The primary strength of this study is that, to the best of the researcher's knowledge, this study is the first mixed-method study undertaken in Indonesia investigating the factors influencing parents' choice to adopt particular oral health behaviours for their child that may affect their child's dental health. Both quantitative and qualitative methodological approaches were used, which provided a thorough understanding of the occurrence of dental caries in young children. Presently, most literature on oral health inequality in Indonesia has relied on a quantitative methodological approach, with efforts aimed at documenting rather than

understanding variations. Few studies have used a qualitative methodological approach. The results of the quantitative methodological approach of this study provide a snapshot of oral health behaviours that are associated with dental caries in young children in Surabaya, while the qualitative methodological approach gave a more in-depth understanding of the factors contributing to those oral health behaviours. Another evident strength of this study is that the sample used for each methodological approach was representative of all five regions in Surabaya. An additional strength of this study is that, even though the measurement of dental caries in this study did not include non-cavitated carious lesions, the diagnostic criteria were uniform across the sample. These strengths need to be weighed against the study limitations.

7.3 Oral health-related parenting practices

Early childhood is a crucial stage in which health behaviour patterns established during this stage may have lasting implications on health outcomes throughout life (Nanjappa, et al., 2015). In the early years of life, patterns of health behaviours commonly begin at home (Nanjappa, et al., 2015; Phantumvanit, et al., 2018). It is widely acknowledged in the dental literature that parents, particularly the child's mother, play an important role in initiating, shaping, and maintaining their children's oral health behaviours (Hooley, et al., 2012; Castilho, et al., 2013; de Jong-Lenters, Dujister, Bruist, Thijssen, and de Ruiter, 2014). Given the role of parents in the establishment of their children's oral health behaviours, it is reasonable that parenting practices, in the context of oral health behaviours in the early years of children's lives, are important in the establishment of long-term oral health behaviours that will impact their children's oral health outcomes (Hooley, et al., 2012; de Jong-Lenters, et al., 2014). Accordingly, this chapter focuses on issues concerning parents that may influence their parenting practices.

7.3.1 Parenting styles

Parenting practices are parental behaviours specifically directed towards caring and raising a child. The term describes how parents approach their child to engage in particular behaviours and predicts parents' success in establishing those behaviours (Rhee, 2008). Parenting styles represent the behavioural patterns and strategies that parents use to control their children. Parenting styles also describe the ways in which parents engage with their children, through interaction and disciplinary strategies (Sooriya, 2017). Parenting styles can be categorised as either responsiveness or demandingness. Responsiveness represents the extent to which parents are responsive to and supportive of their child's needs and demands. It describes parental nurturance expressed by warmth and approval during their interactions with their

children. Parents also gain their child's compliance through reasoning. They are willing to communicate with their child, respect their child's opinions and feelings, and foster their child's independence. On the other hand, demandingness refers to the extent of parental control and expectations of parents about their child's behaviours. Parental control is shown by setting rules, demands, and expectations for behaviours, monitoring the child's behaviours and using a discipline and punishment approach to persistently gain the child's compliance. Parental responsiveness and demandingness should be well balanced in order to raise children who can build their self-esteem while also respecting authority (Baumrind, 1966; Baumrind, 1971; Maccoby and Martin, 1983; Baumrind, 1991).

Based on a clear balance between parental responsiveness and demandingness, in general, there are four different types of parenting styles: authoritative, authoritarian, permissive/indulgent, and neglectful (Baumrind, 1966; Baumrind, 1971; Maccoby and Martin, 1983; Baumrind, 1991). The authoritative parenting style equally involves both parental responsiveness and demandingness. Parents who use an authoritative parenting style are willing to communicate with their child. They recognise their child's own desires and opinions while exerting control over their child's behaviours by setting rules and enforcing discipline. An authoritarian parenting style involves more parental demandingness, but less parental responsiveness. Parents who use an authoritarian parenting style emphasise the child's obedience. They are not willing to communicate with their child and believe that their child should obey their rules. Their discipline is strict and consistent, with the aim of controlling their child's behaviours. In contrast to the authoritarian parenting style, a permissive/indulgent parenting style involves more parental responsiveness, but less parental demandingness. Parents who use a permissive/indulgent parenting style tend to be affirmative and non-punitive towards their child's behaviours. They allow their child to regulate their own behaviours without making much of an attempt to control it. They may make a few demands on their child's behaviour, but they do not encourage their child to obey all of these demands. Lastly, neglectful/uninvolved parenting styles involve neither parental demandingness nor parental responsiveness (Baumrind, 1966; Baumrind, 1971; Maccoby and Martin, 1983; Baumrind, 1991). In fact, parenting practices may not be stable over time (Shaffer, Lindhiem, Kolko, and Trentacosta, 2013). Most parents may not just follow one parenting style. They behave according to the demands of individual situations. They may primarily use one parenting style in most situations and change into another parenting style or even create their own parenting style in different or unusual situations (Sooriya, 2017).

7.3.2 The effects of parenting styles on children's oral health behaviours

Parenting practices, whether positive or negative, may have an impact on the oral health behaviours of children. In dental research, authoritative parenting styles are commonly associated with a child's compliance (Aminabadi and Farahani, 2008) and positive oral health outcomes (Albino, et al., 2014; Dujister, et al., 2015a), whereas the authoritarian, permissive/indulgent, or neglectful parenting styles are often related to children's resistant and non-compliant behaviours (Lytton, 1977; Kuczynski, et al., 1987; Rhee, 2008), poor health behaviours, and negative health outcomes (Maccoby and Martin, 1983; Rhee, 2008).

Concerning the qualitative results of this current study, it appeared in the interviews that parents of children in the caries-free group were inclined to using the authoritative parenting styles, which were commonly described as supportive/effective parenting practices (Sanders, et al., 2000; Rhee, 2008). They were more likely than parents of children in the caries group to have children who engaged in favourable oral health behaviours, such as less sugar snacking, having no bedtime bottle habit, having at least twice daily tooth-brushing (including before bed at night), and having no dental fear. Similar results were found in previous studies (Albino, et al., 2014; de Jong-Lenters, et al., 2014; Howenstein, et al., 2015).

On the contrary, parents of children in the caries group adopted the permissive or neglectful parenting styles, which are commonly described as unsupportive parenting practices (Skeie, Riordan, Klock, and Espelid, 2006). None of participants in the qualitative phase of this current study seemed to use the authoritarian parenting styles. Similar to the qualitative results of this current study, a prior study in The Netherlands of a sample of children aged 4- to 12-years old demonstrated that children of parents with the permissive/indulgent and neglectful parenting styles were more likely to engage in poor oral health behaviours than favourable oral health behaviours (Krikken and Veerkamp, 2008). A lack of parental demands, as in the permissive/indulgent and neglectful parenting styles, may lead to parents having limited or even no control over their child's behaviours (Skeie, et al., 2006). As a result, parents practising permissive or neglectful parenting styles are likely to have difficulties restricting their children from sugar snacking, because they are not capable of establishing adequate limits on their children's sugar snacking or have lower levels of inhibitory control. They also tend to let their child sleep with a bottle (Naidu, et al., 2012) and to be flexible with their children's oral hygiene practices (Skeie, et al., 2006; de Jong-Lenters, et al., 2014). Children of parents practising permissive/indulgent and neglectful parenting styles are also commonly not able to cooperate during dental treatment, as they are not used to being directed (Casamassimo, Wilson, and Gross,

2002).

In the context of children's sugar snacking, parental selection of snacks in the child's early years is critical to their child's long-term snacking behaviours. It influences the establishment of their child's taste preferences. Exposures to sugary snacks prior to school age may drive the child's consumption of more sugar in later years (Hooley, et al., 2012) and may become a key risk factor associated with dental caries in children (Scaglioni, Salvioni, and Galimberti, 2008; Rai and Tiwari, 2018). In agreement with previous studies (Mejàre, et al., 2014; Riggs, et al., 2015), the quantitative results of this current study also found a positive association between sugar consumption and dental caries.

Snacking-related parenting practices are the ways in which parents socialise their children towards snacking-related behaviours. These practices may influence the types and amounts of snacks available to their children that, in turn, shape their children's snacking behaviours (Birch and Fisher, 1998; Rhee, 2008; Esposito, Fisher, Mennella, Hoelscher, and Huang, 2009; Blissett, 2011). The qualitative results of this current study identified different snacking-related parenting practices between parents/caregivers in the caries and caries-free groups in relation to the availability of snacks at home. In the caries-free group, parents commonly limited the availability of sugary snacks or never kept sugary snacks at home. Removing the availability of sugary snacks at home is considered effective in moderating sugary snack consumption among children than attempting to restrict children's access to sugary snacks that are available at home (Rollins, Loken, Savage, and Birch, 2014b; Boots, Tiggemann, Corsini, and Mattiske, 2015). On the contrary, in the caries group, parents chose to restrict their children's access to sugary snacks that were available at home. The most common strategy was keeping sugary snacks out of children's reach and only placing limited amounts of them within the children's reach. Using parental restriction on children's access to sugary snacks as a snack-related parenting practice is often associated with increasing consumption of sugary snacks among children. When sugary snacks are available in children's sight but with access to those snacks restricted, those snacks will become more reinforcing for children. As a result, the consumption of those snacks increases when the child then has access to those snacks (Rollins, Loken, Savage, and Birch, 2014a; Park, Li, and Birch, 2015; Blaine, Kachurak, Davison, Klabunde, and Fisher 2017).

In addition, the qualitative results of this current study also revealed that in the caries-free group, most parents appeared to use more covert approaches to restriction, which were commonly described as setting a supportive structure through clear, reasonable rules and limits on snack intake (Grolnick and Pomerantz, 2009). They were

also willing to communicate with their child to bring their child to understand the restriction. A systematic review of 47 studies about the snacking behaviour of children aged 2 to 18 years old retrieved from six electronic databases also found a negative association between the establishment of reasonable rules and limits on sugar snacking and snack consumption in children (Blaine, et al., 2017). A covert approach to restriction establishes a supportive environment for moderating children's liking and intake of snacks (Gevers, Kremers, de Vries, and van Assema, 2015). However, overt approaches to restriction, which are characterised by hostility and coercive control, may lead a child to be more interested in snacking, because they may pay more attention to the restricted snacks (Fisher and Birch, 1999; Ogden, Reynolds, and Smith, 2006; Ventura and Birch, 2008; Grolnick and Pomerantz, 2009; Joyce and Zimmer-Gembeck, 2009; Vollmer and Mobley, 2013) and it enhances the perceived value of the snacks (Epstein, Leddy, Temple, and Faith, 2007).

In contrast to parents of children in the caries-free group, many parents of children in the caries group appeared to set few or no rules or limits on their children's snack intake. They commonly made snacks readily available to their child and let their child snack on demand without limit. Few parents not only had no rules or limits on snack intake, but also were not aware of what snacks their child was consuming. Parents' struggles to set rules and limits on children's snack intake might also indicate a lack of positive, health-promoting parenting skills, particularly concerning children's snacking (Herman, et al., 2012). Furthermore, emotion-based snack provision (e.g. to make the child happy or avoid upsetting the child) was common among parents of children in the caries group. They also tended to use snacks as a tool to reward behaviour (e.g. after the child was well behaved), to manage behaviour (e.g. to calm down/comfort the child), and to occupy the child (e.g. keep the child quiet or distracted). The use of food or snacks a tool of parenting has also been found in previous studies (Cooke, Chambers, Añez, and Wardle, 2011; Hendy and Williams, 2012; Davison, et al., 2015).

The use of food or snacks as a tool in parenting is often related to permissive parenting practices (Davison, et al., 2015) and was found to be apparent in children who often requested or nagged their parents for snacks (Herman, et al., 2012; Malhotra, et al., 2013). In permissive snacking-related parenting practices, parents commonly use appealing snacks or treats (Fisher, et al., 2015). Occasional snacks may not be a cause for health concern, but if these events are frequent, ultimately, the aggregate effect on children's health is negative, including an increased risk of dental caries (Blaine, et al., 2015). Using appealing or palatable snacks as a tool in parenting, particularly as a reward, may increase children's liking of and preference for those snacks. A prior

experimental study showed that giving foods or snacks as a reward made children increase the perceived value of the reward (Birch, Zimmerman, and Hind, 1980); however, the children may lose interest in performing the task when the reward disappears. In this situation, parents may then feel trapped into continuing to use this strategy.

In addition, children commonly mimic and learn behaviours from parents or other people who are regularly present in their lives (Poutanen, Lahti, Tolvanen, and Hausen, 2006; Blaine, et al., 2017; Rai and Tiwari, 2018). Parents function as examples or role models for their child (Dujister, de Jong-Lenters, Verrips, and van Loveren; 2015b). The qualitative results of this current study clearly show that parents' own oral health behaviours have an influence on their child's oral health behaviours. This is either because parents have consciously or unconsciously taught their child oral health behaviours that are the same as their own oral health behaviours, or the child frequently watched and learned to mimic their parents' oral health behaviours.

In a child's early years, parents' own oral health behaviours may influence how parents care for their children's oral health and eventually determine their children's oral health outcomes (Mattila, Rautava, Sillanpää, and Paunio, 2000; Kleinberg, 2002). For example, parents' tooth-brushing habits influence how they will perform tooth-brushing routines for their children (Castilho, et al., 2013). Young children are dependent on their parents or other caregivers to perform, teach, and supervise their oral hygiene routines (Ng, Demopoulos, Mobley, and Ditmyer, 2013). Good oral hygiene habits established at an early age are important to prevent dental caries (Castilho, et al., 2013). It was obvious in the qualitative results of this current study that oral hygiene practices were more likely to be reinforced among children in the caries-free group than children in the caries group, because parents of children in the caries-free group were more likely to have good oral hygiene habits than parents of children in the caries group. For example, in the caries group, parents were more likely to let their children fall asleep without brushing their teeth, because they also did not have tooth-brushing habits before bed at night. This reflected a permissive parenting practice characterised by a lack of demands for night tooth brushing because of the absence of night tooth-brushing habits among the parents themselves. Compared to parents of children in the caries group, in the caries-free group, the parents put a great deal of effort in successfully establishing their child's oral hygiene routine, including night tooth brushing. Some of them used role modelling as a parenting tool for establishing their children's oral hygiene practices. They intentionally brushed their own teeth in their child's presence to encourage their child to brush their teeth. This reflected authoritative or supportive parenting practices. They gave autonomy, through role modelling, to their

child in order to foster independent tooth brushing while teaching their child proper tooth brushing. This parenting practice may also be applied to sugary snack restriction, bottle weaning, and the child's compliance with dental visits.

In the context of dental visits, parents' utilization of dental health services is also commonly associated with the utilisation of dental health services among their children (Hooley, et al., 2012). Parents without a dental visit history have been found to be likely to also delay dental visits for their child (Isong, et al., 2010). The qualitative results of this current study also showed that deferring dental treatment has become a common practice among parents of children in the caries group. This confirmed the quantitative results, which found a significant association between a delay in dental care and dental caries. Similar results were also found in other studies conducted in a Saudi community (Murshid, 2016) and in the US (Kelly, Binkley, Neace, and Gale, 2005). One previous study reported that the low utilisation of dental health services among parents is because of parental neglect of their own dental health (Kelly, et al., 2005).

The qualitative results of this current study also show permissive parenting practices in the context of dental visits, characterised by the low level of parental demands. Children in the caries group were often allowed to refuse dental treatment. They were given choices as alternatives to dental visit, commonly by performing more frequent tooth brushing. As most dental procedures require the cooperation of the patients, the low level of parental demands may result in children who are unaccustomed to being directed. As a consequence, they may not be able to cooperate with the dentist when they need dental treatment (Casamassimo, et al., 2002; Ng, et al., 2013).

To sum up, this section has highlighted the importance of striking a balance between parental demandingness and responsiveness in oral health-related parenting practices in order to gain the child's compliance with favourable oral health behaviours. Parents need to set clear expectations for their child's behaviours, which is termed parental demandingness, and at the same time, they must respect their child's own desires and support their child's autonomy, which is termed parental responsiveness. A child needs parental guidance and support to give sufficient oral health knowledge and skills to the child, which are required to make proper oral health behaviour-related choices (for example, through good parent-child interaction and communication).

7.3.3 Parents' oral health-related attitudes and parenting practices

The term 'attitude' represents a person's thoughts and feelings in response to a certain situation (Ajzen, 2005). A person's attitudes are often expressed through their

behaviour (Jones and Prinz, 2005; Vaughan and Hogg, 2014). In dental health, parents' attitudes towards oral health may positively or negatively impact how they care for their children's oral health (Jones and Prinz, 2005; Scaglioni, et al., 2008; Ventura and Birch, 2008). In turn, this influences their children's oral health outcomes (Scaglioni, et al., 2008; Ventura and Birch, 2008; Castilho, et al., 2013). For example, in the context of oral hygiene practices, a positive attitude on the part of the parents towards their children's oral health is commonly reflected by their insistence on twice-daily tooth brushing and tooth-brushing supervision, which can be protective against dental caries among children (Rai and Tiwari, 2018). For young children, parental supervision with tooth-brushing routines is important, as they lack the skill needed to brush their teeth themselves (AAP, 2014; AAPD, 2018a). Unsupervised tooth brushing may increase the risk of dental caries among children (Rai and Tiwari, 2018).

In some circumstances, attitudes do not always coincide with the expected behaviour. It depends on the strength of the attitude. The less strong the attitude, the less likely the attitude is expressed through corresponding behaviours (Burton, Westen, and Kowalski, 2014). For example, in the qualitative part of this study, even though parents in both the caries and caries-free groups perceived the importance of twice-daily tooth brushing, this attitude seemed to be less strong among parents of children in the caries group than among parents of children in the caries-free group. This was shown by the parents' leniency towards their child's refusal to brush their teeth in the caries group, whereas parents of children in the caries-free group put a great deal of effort in establishing their child's oral hygiene routine. Parents of children in the caries group also commonly supervised the tooth brushing only during the first few weeks that their children started learning to brush their teeth. They became less involved in their children's tooth brushing routines once they perceived that their children had become able to brush their teeth themselves. On the contrary, parents of children in the caries-free group actively and consistently supervised tooth brushing, aiming to ensure proper tooth brushing for their child. These qualitative results might also explain why the quantitative results of this current study did not find a significant association between oral hygiene practices and dental caries. Oral hygiene practices among children in the caries and caries-free group looked similar, but in fact, the methods by which parents of children in the caries and caries-free group established oral hygiene practices for their child were different. Furthermore, conflict sometimes arises if attitudes were not followed by the corresponding behaviours. Under these circumstances, the parent may experience of psychological tension or an unpleasant feeling that is similar to anxiety. (McLeod, 2018). For example, in the qualitative results of this current study, several parents of children in the caries group sometimes felt guilty about their leniency towards

their child's sugar snacking, because they were aware of the effects of sugar snacking on their child's dental health. They saw this as problematic because of their perceived inability to restricting their child from sugar snacking.

In addition, parents' oral health knowledge may influence their oral health attitudes. Their attitudes guide the transformation of their oral health knowledge into practice, which may affect their children's oral health behaviours (Ashkanani and Al-Sane, 2013; Castilho, et al., 2013). Parents' choice of certain oral health behaviours and the extent to which they establish these behaviours for their child may reflect their knowledge and attitudes (Hooley, et al., 2012), with consequent impacts on their children's oral health outcomes (Albino, et al., 2014). A low risk of dental caries was found among children whose parents had good oral health knowledge and positive oral health attitudes (Rai and Tiwari, 2018). In this current study, even though the oral health knowledge of the parents of the children in both groups was not actively measured, the qualitative results of the current study indicated that parents who demonstrated adequate oral health knowledge were likely to have positive attitudes to oral health, which informed their performance of favourable oral health behaviours for their child, including sugary snack restriction, bottle weaning, and regular oral hygiene practice. This reflected supportive parenting practices that might prevent their child from dental caries; whereas parents who demonstrated poor oral health knowledge were more likely to possess permissive or indulgent attitudes that made them more lenient towards their child's sugar snacking, bedtime bottle, and oral hygiene practices. These attitudes might then predispose their children to the risk of dental caries. Similar findings were also found in other previous studies (Hoeft, et al., 2010; Vann, et al., 2010; Hooley, et al., 2012).

In the context of dental visits, in this current study, the quantitative findings showed that children who had a dental visit history were more likely to have dental caries than children who did not have a dental visit history. In agreement with other studies (Freeman, 1999; Kelly, et al., 2005; Divaris, et al., 2014), the qualitative results of this current study explain this quantitative finding by highlighting the tendency among parents to seek dental care for their child only in the presence of dental problems. Most parents of children in the caries group appeared to delay seeking dental treatment for their child until there was a symptom of a toothache. Some of them also perceived sugary snack restriction and regular tooth-brushing routines as alternatives to dental visits. On the contrary, in the caries-free group, the absence of dental caries was the main reason for the delay in their child's dental visit. They also appeared to lack guidance about the recommended age of the first dental visit for preventive dental care. Delays in a child's dental visits might reflect that the parents lack knowledge about the

importance of early dental visits for their child, which made them ascribe a low value to their child's dental health. Furthermore, parents who view children's oral health as not particularly important (for example, because of the temporary nature of the primary teeth) are not likely to adopt parenting practices that promote children's oral health (National Academies of Sciences Engineering and Medicine, 2016), including delaying or never taking their children to a dentist (Divaris, et al., 2014).

In some circumstances, adequate oral health knowledge may not always result in positive oral health attitudes, behaviours, and outcomes (Kay and Locker, 1996, 1998; Castilho, et al., 2013; National Academies of Sciences Engineering and Medicine, 2016). Attitudes are more likely to be translated to certain behaviours when shaped by personal experience (Burton, et al., 2014). For example, a previous study conducted in the US on a sample of children aged 4 to 12 years old found that parents' positive attitudes towards the importance of their child's oral health did not always match their dental care-seeking behaviours, as only 10% of those parents transformed their attitudes into making the first dental visit for their child. In particular, parents' own childhood experiences with dental care appeared to influence their beliefs about and practices of dental care for their child (Kelly, et al., 2005). Parents' trauma or negative experiences with dental treatment were often associated with parents' own fear of the dentist (Freeman, 1999; Kelly, et al., 2005; Divaris, et al., 2014), as well as a fear of the pain accompanying dental treatment or a general anxiety about visiting the dentist (Fisher-Owens, et al., 2007). The qualitative results of this current study also revealed that parents' fear of visiting a dentist also became a common reason for parents of children in the caries group to delay or avoid visiting a dentist, not only for their own dental health needs, but also for their children's dental health needs. Another common reason for delays in children's dental visits found in the qualitative results of this current study was parents' perceived dissatisfaction with dental health services, such as a long waiting time during dental visits, the limited time allocated for counselling, poor-quality dental care, and unfriendly dental staff. These results were similar to the findings of prior studies (Kelly, et al., 2005; Divaris, et al., 2014; Dujister, et al., 2015b). A systematic review of parental influence on dental caries in children aged zero to six years old also reported a high prevalence of dental caries among children of parents who had dental fear and who were dissatisfied with dental health services (Hooley, et al., 2012).

On the contrary, parents' satisfaction with and trust in dental health services may reinforce parents' positive attitudes about the value of oral health and their performance of dental care-seeking behaviours (Milgrom, et al., 1998; Graham, Logan, and Tomar, 2004). The qualitative part of this current study also found similar results.

In addition to satisfaction with dental health services, parents with more than one child may also get experience by learning from their own parenting practices. They gain knowledge and improve their skills through the practice of parenting that then shapes their future attitudes and behaviours (Jones and Prinz, 2005). The qualitative results of this current study showed that some parents of children in the caries-free group started adopting more oral health-promoting behaviours for the children who were born later, in order to prevent dental caries. They learned from the experience with their first child, who suffered dental caries. This result indicated that parents' positive attitude towards oral health-promoting behaviours is likely to become stronger after learning from their own experience. Such a strong attitude appeared to inform their parenting practices concerning oral health-promoting behaviours that might improve for children who were born later, as the parents with prior experience of parenting are commonly more competent in parental roles than those who have none.

A previous study in The Netherlands with a sample of children aged five to six years old also found child's birth order as a significant predictor of dental caries (Dujister, Verrips, and van Loveren, 2014), with the risk of dental caries increasing among the older children (Hooley, et al., 2012; Dabawala, et al., 2017). However, for some parents of children in the caries group, these experiences did not seem to make a difference to their parenting practices concerning oral health. Their positive attitude towards oral health promoting behaviours seemed to be less strong. The perceived low value of their children's dental health, the increased demands on their time, and financial hardship were common reasons for this difference. Therefore, further investigation is needed to understand the conditions in which parents might learn from their own parenting practices and improve those practices to promote their children's oral health.

7.3.4 Parental stress and oral health-related parenting practices

In dental research, parental stress is understood to be a predictor of dental caries in children (Seow, 2012; Menon, et al., 2013; Albino, et al., 2014). High levels of parental stress may affect parents' abilities to properly care for their child, including oral healthcare (Menon, et al., 2013). It may diminish the quality of parenting practices, which can lead to poor oral health behaviours and predispose children to a high risk of dental caries (Sooriya, 2017). In particular, parental stress was linked to permissive parental rules about sugar snacking, poor oral hygiene practices (Seow, 2012), and bedtime bottle habits (Menon, et al., 2013). It also influences parents' trust in and use of healthcare services for both themselves and their children (Litt, Reisine, and Tinanoff; Milgrom, et al., 1998). Furthermore, in the current study, even though parental

stress was not actively measured, it seemed from the qualitative results that compared to parents of children in the caries-free group, parents of children in the caries group had more stressful daily life conditions that needed their attention, which made them have limited time to pay attention to all their child's needs. As a result, they became permissive towards their child's sugar snacking and bedtime bottle, ascribing low importance to their child's oral hygiene practices and delaying dental treatment for their child. The quantitative results of this current study also confirmed that sugar snacking, bedtime bottle habits, and dental visits are significantly associated with dental caries. Even though a significant association between oral hygiene practices and dental caries was not found in the quantitative part of this current study, as discussed in section 7.3.3, the qualitative results have revealed that poor oral hygiene practices were more prevalent among children in the caries group than in the caries-free group.

In addition, the source of parental stress may come from parenting itself (Sooriya, 2017). In the qualitative results of this current study, some parents of children in the caries group regarded their child's uncooperative behaviours concerning sugary snack restriction, bottle weaning, oral hygiene routines, and dental visits as a stressor. In the face of the perceived difficulty and inability to deal with their child's behaviours, they tended to give in to their child to reduce their perceived stress. On the contrary, compared to parents of children in the caries group, parents of children in the caries-free group were more likely to be confident in their ability to manage their child's behaviours. They did not see their child's behaviours as a problem or stressor that could prevent them from establishing oral health-promoting practices. Therefore, they were more likely to put a great deal of effort in attempting to successfully establish favourable oral health behaviours for their child. A prior study in the US of a sample of 981 children aged three to five years old and their parents also showed that parents of children in the caries-free group had less perceived stress and a higher score of sense of coherence than parents of children in the caries group. These parents also perceived having fewer barriers to promoting their children's oral health (Albino, et al., 2014). In the face of stressful encounters, a sense of coherence could be a protective factor towards any stress-relative negative outcomes. Sense of coherence is the psychological condition of a person that affects their ability to deal with stressful circumstances. People who have a strong sense of coherence are less likely to feel stressed, because they are confident in their ability to overcome any stressful encounters (Antonovsky, 1987; Lazarus, 1991). Prior studies have found that having a high sense of coherence predicted the parents' likelihood of adopting positive oral health attitudes and behaviours (Hooley, et al., 2012; Albino, et al., 2014) and therefore reduce the child's susceptibility to dental caries (Hooley, et al., 2012; Albino, et al.,

2014; Rai and Tiwari, 2018).

7.3.5 Parents' locus of control and parenting practices

Parents' belief in their ability to control their child's oral health, which is often conceptualised as parents' locus of control, may predict parents' likelihood of adopting either positive or negative oral health behaviours. Some parents may have, to varying degrees, an external locus of control when they believe their children's oral health is beyond their control and is instead determined by external factors such as genetics, luck, fate, or chance, or where they view the dentist as the primary facilitator of the child's oral health. On the other hand, other parents may have an internal locus of control according to which they believe that their children's oral health is determined by positive oral health behaviours that they can control i.e. that parents have a central role in their children's oral health (Wallston, Wallston, and DeVellis, 1978; Marsh and Richards, 1986; Dujister, et al., 2015b; Albino, et al., 2018).

Previous studies have found a significant linear association between parental locus of control and the development of dental caries in preschool children. Parents of children who are caries-free were more likely to have a strong internal locus of control than parents of children who had dental caries (Lenčová, Pikhart, Broukal, and Tsakos, 2008; Hooley, et al., 2012; Albino, et al., 2014; Dujister, et al., 2015a; Albino, et al., 2018). Even though parental locus of control was not measured outright in this study, the qualitative results of this current study indicated that compared to parents of children in the caries-free group, parents of children in the caries group were more likely to blame external factors for their child's caries. They perceived their children's dental caries at such a young age as being caused by fate, inheritance, or of their naturally having bad teeth. These beliefs reflect their tendency to externalise their locus of control, which has then affected their attitudes towards their children's oral health. These parents therefore perceive that, no matter what efforts they make, their children would have eventually developed dental caries anyway. A systematic literature review concerning parental influence on dental caries in children aged zero to six years found that parents who had a low internal locus of control may have perceived a lack of power to encourage their child to engage in good oral health behaviours (Hooley, et al., 2012).

In contrast, parents who hold a strong internal locus of control commonly show positive attitudes towards their children's oral health. They ascribe a high value to their children's oral health and believe that they are able to influence their children's oral health (Albino, et al., 2014). They may perceive few barriers to dental caries prevention (Lenčová, et al., 2008; Albino, et al., 2014), because they feel confident about their capacity to manage their children's oral health behaviours (Astrøm and Kiwanuka,

2006). These results might indicate high self-efficacy among parents who have a strong internal locus of control, which then influences their attitudes towards their children's oral health (Jones and Prinz, 2005) and predicts the likelihood of the parents fostering their children's oral health through oral health-promoting parenting practices (Albino, et al., 2018).

Parental self-efficacy is defined as the parent's belief of their ability to successfully manage and perform their parenting tasks (Teti and Gelfand, 1991; Bandura, 1997; de Montigny and Lacharité, 2005; Jones and Prinz, 2005). Parental self-efficacy is often associated with parental competence, which reflects parenting behaviours or practices. Parental competence involves parents' skills and strategies meeting their child's needs (Sanders, Markie-Dadds, and Turner, 2003; Jones and Prinz, 2005). In particular, it demonstrates parents' self-regulation and problem-solving skills, which enable parents to implement strategies to manage their child's behaviours (Sanders, et al., 2003) and change those strategies according to the needs and demands of certain circumstances, such as dealing with their child's temperament or characteristics (Azar and Cote, 2002). High parental self-efficacy is also associated with adequate oral health knowledge. Improvement in parents' oral health knowledge is a necessary first step in the promotion of their self-efficacy and favourable oral health behaviours (Castilho, et al., 2013; Albino, et al., 2018). The more parents understand about oral health, the more likely they will perceive that they can take control of it (Albino, et al., 2018).

Despite that parental locus of control and self-efficacy were not measured in this study outright, it seems from the qualitative results of the study that compared to parents of children in the caries group, many parents of children in the caries-free group appear to have higher self-efficacy in establishing favourable oral health behaviours for their child. This was demonstrated by their confidence in their ability to perform sugary snack restriction, bottle weaning, regular tooth brushing, and dental visits. These results support the findings of previous studies (Lenčová, et al., 2008; Albino, et al., 2014; Dujister, et al., 2015a). The qualitative results of this current study also revealed various parenting strategies used by parents of children in the caries-free group to cope with children's resistant and non-compliant behaviours. Many parents regarded consistency as the key strategy to successfully establishing oral health-promoting behaviours.

On the contrary, many parents of children in the caries group described situations in which they experienced difficulties in performing oral health-promoting parenting practices. The common barrier was associated with their child's resistant and non-compliant behaviours. The parents' perceived inability to deal with their child's behaviours made them prefer to give in to their child rather than persisting in performing

oral health-related parenting practices. For example, in the context of dental visits, child's resistant and compliant behaviours were commonly related to dental fear, which was commonly shown by avoidance or other negative behaviours towards dental visits (Baier, Milgrom, Russell, Mancl, and Yoshida, 2004; Lin, et al., 2014b). In this current study, it is clear from the interviews with parents of children in the caries group that children's dental fear is one of the common reasons for parents to delay their child's dental visits. The parents' perceived inability to control their child's non-compliant behaviours during dental visits was often used to justify their decision to delay their child's dental visits. In agreement with a prior study (Lin, et al., 2014b), the quantitative results of this current study confirm the significant association between dental fear and dental caries.

7.4 Socio-environmental factors influencing oral health-related parenting practices

Social environment, 'the immediate physical surroundings, social relationships, and cultural milieus within which defined groups of people function and interact' (Barnett and Casper, 2001), may have either a positive or negative influence on oral health-related parenting practices through the adoption of certain oral health attitudes and behaviours that affect children's oral health. Supportive social environments may reinforce positive behaviours and oral health outcomes, whereas an unsupportive social environment may produce negative behaviours and oral health outcomes (Fisher-Owens, et al., 2007; Castilho, et al., 2013). A person's attitude is likely to be expressed in their behaviour if people in the person's social environment also hold similar attitudes and behaviours. They may make an effort to perform behaviours that are socially acceptable and engaged in by people in their social environment (Burton, et al., 2014).

Culture on both the family and community levels may play an important role in shaping beliefs and norms concerning oral health, which then define behaviours (Dujister, et al., 2015b). Parents' values towards oral health, such as the perceived seriousness of dental caries in children, also depend on parents' beliefs, which are largely influenced by culture (Adair, et al., 2004; Fisher-Owens, et al., 2007). Prior studies have found that culture influences dietary choices, oral hygiene concerns, tooth brushing habits and methods (Adair, et al., 2004; Fisher-Owens, et al., 2007; Hilton, Stephen, Barker, and Weintraub, 2007), dental care-seeking behaviour, and dental fear (Fisher-Owens, et al., 2007). Serving sugary snacks to celebrate special events is a common example of the influence of culture on sugar snacking-related parenting practices, such as a birthday party, holidays, or other special events (Blaine, et al., 2015).

Cultural influences, including social and family norms, may become a barrier to oral health-promoting parenting practices. In the context of sugar snacking, people surrounding parents may become a barrier to sugary snack restriction. They may hold different norms and rules on sugar snacking from the parents, which may have a negative influence on the child's sugar snacking (Fisher, et al., 2015). Considering the qualitative results of this current study, in contrast to parents of children in the caries-free group who were confident in their ability to resist pressure from their social environment, some parents of children in the caries group perceived a difficulty in resisting pressure from other parents who gave sugary snacks to their child. Children's nagging also often resulted in parental guilt driven by social expectations of 'good parenting', which led them to appease the children with treats. Furthermore, some parents of children in the caries group were still lenient with their child's sugar snacking even though they were of the adverse health effects of sugar snacking on children. This was because they saw sugar snacking as a normal behaviour among children in their social environment. On the other hand, in the caries-free group, consistency in rules about sugary snacks was considered one of the keys to their success in restricting their child's sugar snacking.

In addition, the exchange of practical information that parents need often occurred within their social network (Brashers, Goldsmith, and Hsiesh, 2002). Some studies have shown that there is a tendency for people to seek health advice from laypeople in their social network who have relevant experience rather than from healthcare providers (Richmond, Kehoe, Heather, Wodak, and Webster, 1996; Cotten and Gupta, 2004; Dutta-Bergman, 2004). The main reason for this tendency may be language barriers in the healthcare setting that make it difficult to understand health information provided by healthcare providers (Divaris, et al., 2014). Furthermore, information-seeking behaviours may be reinforced by socially constructed norms concerning parenting (Burr, 2003). What parents learn from people around them may influence their parenting practices (Sooriya, 2017). The qualitative results of this current study have demonstrated that parents are often informed through their social networks concerning knowledge about dental care service options and their decision-making process concerning whether and how to use dental care services. Most parents, particularly those of children in the caries group, were concerned about finding a child-friendly dentist. They often waited until they learned from experience of people in their social environment before deciding to take their own child to that dentist.

The risk of having dental caries may also be aggravated by poor access to dental care services (Rai and Tiwari, 2018). Based on the qualitative results of this current study, it might be that there is a lack of dental care services in some areas, particularly paediatric dental care. If this is the case, transportation could also become a barrier to access dental health services. Some parents of children in the caries group who lived in locations of low socioeconomic status were also concerned about public transportation difficulties, as they had to spend a great deal

of time taking their child to the nearest dental care services.

Oral health education through oral health promotion programs also plays an important role in the improvement of children's oral health (Fisher-Owens, et al., 2007). Oral health education may enhance oral health knowledge and may, in turn, help to change oral health attitudes and beliefs (Kay and Locker, 1998; Mattila, et al., 2005). Unfortunately, the qualitative results of this current study showed that compared to parents of children in the caries group, parents of children in the caries-free group were more likely to have access to oral health education programs held by local community health centres. However, oral health education alone may not be sufficient to change behaviours (Kay and Locker, 1998; Watt, 2005; Castilho, et al., 2013). This is either because parents have poor literacy, or they are not able to understand the relevant information. Therefore, parents may need help to assimilate, understand, and implement oral health-related information (Vigild, Petersen, and Hadi, 1999; Castilho, et al., 2013). A culturally appropriate approach to oral health education is also important to increase parents' compliance with the expected behaviours (Nicol, et al., 2014).

Oral health education programs in schools also have high potential to promote favourable oral health behaviours, such as delivering oral health information, organising tooth-brushing activities, and dental check-ups (Dujister, et al., 2015b). The role of school teachers in children's oral health education is also important. They spend a considerable amount of time with children at school (Rajab, Petersen, Bakaeen, and Hamdan, 2002); therefore, they have a unique opportunity to emphasise to the children the importance of engaging in positive oral health behaviours, such as reducing sugary snack consumption, performing routine tooth brushing, avoiding bedtime drinking, and having routine dental check-ups (Vigild, et al., 1999). However, the effectiveness of oral health education programs at school is still debatable, as most of these programs do not involve parents (Dujister, et al., 2015b). To ensure the success of oral health education at school, the program should involve parents in a joint effort to provide adequate oral health knowledge and reinforcement of knowledge and behaviours at home to improve children's oral health.

Similar to the results of a prior study that carried out six focus group interviews with 39 parents of seven-year-old children (Dujister, et al., 2015b), the qualitative results of this current study showed that school policy benefitted some parents, particularly those in the caries-free group. School policy may help to limit the consumption of sugary snacks by regulating snacking at school. The children were not permitted to consume sugary snacks at school. The qualitative results of this current study also revealed that to support this regulation, some schools prohibit the setting up of food stalls at school. Rather, these schools have their own canteen that only sells healthy snacks. As these school policies on snacks were consistent with the snack-related parenting practices at home, most parents perceived this as a facilitator in their efforts to restrict their children's sugar snacking.

In addition, the human-built environment, such as the availability of grocery shopping, food stalls, healthcare services, and transportation resources, may also have an influence on overall health (Evans, Barer, and Marmor, 1994; Spencer, 2003). The qualitative results of this current study also found that the emergence of food stalls, particularly in areas of low socioeconomic status, was considered one of the most important socio-cultural influences on children's sugar snacking. The absence of regulations for setting up a food stall from the local government in Surabaya, may have led to the emergence of a large number of food stalls. Similar to the findings of previous studies (Davison, et al., 2015; Blaine, et al., 2016), the qualitative results of this study found that even though most parents of children in the caries group expressed their intention to restrict their children's sugar snacking, they also identified the circumstances in which they were not able to do so, particularly at food stalls, which commonly sold affordable sugary foods and beverages. In addition to the availability of cheap sugar-containing products in the local environment, the media may also have a negative influence on children's sugar snacking. Television advertisements are the most influential marketing strategy to persuade children to purchase and consume the products (Campbell, Crawford, and Hesketh, 2007; Mehta, et al., 2010). The appealing presentation of snacks has also been found to produce pestering behaviours among children (Nicholls and Cullen, 2004; Marshall, O'Donohoe, and Kline, 2007; Dujister, et al., 2015b).

Socioeconomic conditions also have an influence on the development of dental caries in children (Menon, et al., 2013). A higher prevalence of dental caries is commonly observed among children from families with low socioeconomic status compared with those with higher socioeconomic status (Gupta, Robinson, Marya, and Baker, 2015; Schwendicke, et al., 2015; van der Tas, et al., 2017; Rai and Tiwari, 2018). Lower socioeconomic conditions are associated with poorer oral health behaviours and a higher risk of having dental caries. Lack of time (e.g. due to long working hours) and having a lot of daily life issues to deal with are the most common reasons for such parents not prioritising their child's oral health needs (Divaris, et al., 2014). A high intake of sugar-containing foods and beverages have also been reported among children living in low socioeconomic conditions (Kiefte-de Jong, et al., 2013). Such behaviour may exist, particularly because of a lack of health knowledge among parents of low socioeconomic status. Furthermore, their living conditions may influence their access to dental health services, leading to higher susceptibility to dental caries in their children (Gordon-Larsen, Nelson, Page, and Popkin, et al., 2006; Hooley, et al., 2012). In addition, children who live in poor socioeconomic conditions are more likely to have parents with low dental self-efficacy, a more external locus of control, a lack of problem-solving skills, poor parenting practices (Dujister, et al., 2015a), more stressful events, a low sense of coherence (Gupta, et al., 2015), negative oral health beliefs, and a low perceived need for dental care services utilisation (Menon, et al., 2013). As discussed earlier, these unfavourable parental risk factors

may result in poor oral health-related parenting practices.

Concerning socioeconomic status, parental educational level, particularly the maternal educational level, is an important indicator of dental caries in children because it interfaces with behavioural and psychosocial factors (van der Tas, et al., 2017). The quantitative findings of this current study were in line with those of previous studies, which concluded that there was a significant association between parental educational level and dental caries in children (Bonotto, et al., 2017; van der Tas, et al., 2017; Rai and Tiwari, 2018). Parental educational level is linked with the level of health literacy (Fisher-Owens, et al., 2007; Schwendicke, et al., 2015) and reflects parents' knowledge and skills for making health behaviour choices. The results of a systematic literature review concerning parental influence on dental caries among children aged zero to six years old showed that compared to parents with a higher educational level, parents with a lower educational level are more likely to possess poor oral health knowledge, which may mediate their negative attitudes and beliefs towards their child's oral health (Hooley, et al., 2012) and, in turn, result in poor oral health behaviours (Schwendicke, et al., 2015) and dental caries among their children. Another previous study also found that parents with a low educational level tended to adopt ineffective parenting strategies (Morawska, Winter, and Sanders, 2009) that increased the likelihood of parents choosing poor oral health behaviours for their children, such as high consumption of sugary foods and beverages (Park, et al., 2015; van der Tas, et al., 2017), irregular tooth brushing (Kelly, et al., 2005; van den Branden, et al., 2013), and lower healthcare service utilisation (van den Branden, et al., 2013; Schwendicke, et al., 2015).

In addition, the changing gender roles in Indonesia may also be important. The role of a woman is traditionally that of a housewife who is required to look after the children and manage their family's needs at home. Over the past few decades, women's participation in the labour force has increased. Some of them engage in paid work to help their family finances or even as the sole earners within the household (Schaner and Das, 2016). In Indonesia, while the roles of males and females in the parenting process should be shared equitably in the moral context, most mothers still take responsibility for caring and parenting. This becomes a challenge when they try to juggle their caring and parenting tasks with their full-time jobs. These conditions may increase the level of maternal stress, because they not only carry work burden, but also the major burden of caregiving and parenting. Some studies have also found an association between single parenthood and dental caries in children, linked to low household income and stress (Hallett and O'Rourke, 2003; Hooley, et al., 2012). Being a single parent, particularly with more than one child and low socioeconomic conditions, may disadvantage the mother's psychosocial condition, as they may struggle with meeting their children's needs (Hallett and O'Rourke, 2003; Hooley, et al., 2012). Furthermore, the perceived high cost of dental care may become a barrier preventing access to dental care services for their children.

Feelings of guilt attached to the lack of available time for dedication to the children's oral health due to maternal employment may also influence parenting practices concerning oral health. The qualitative results of this current study showed that some parents of children in the caries group tended to indulge their child with sugary snacks to compensate for working away from the home. Increased consumption of sugary snacks was also attributed to having a grandparent as daytime caregiver while parents were working (Hooley, et al., 2012). Some poor oral health behaviours in children, such as irregular tooth brushing (Dujister, et al., 2015b), and delays in taking children to a dentist (Kelly, et al., 2005; Hooley, et al., 2012), were often attributed to a lack of available time due to maternal employment. Severe forms of dental caries in children may also reflect a lack of adequate care for children as a result of unrestricted sugar snacking. This commonly occurs among children with busy parents, regardless of their socioeconomic status, as their parents/caregivers may not be able to provide adequate supervision and appropriate care (Tinanoff, 1998).

Notably, in contrast to the results of previous studies, which found a high prevalence and severity of dental caries among children in low-income families (Park, et al., 2015; Bonotto, et al., 2017; van der Tas, et al., 2017; Rai and Tiwari, 2018), in the quantitative part of this study, no significant association was found between parental income and dental caries. The absence of an expected association between household income and dental caries could perhaps be attributed to the possibility that participants gave socially desirable responses. However, the results of the qualitative part of this current study appeared to support the quantitative findings. According to the qualitative results of this current study, in low-income families, the availability of cheap, sugar-containing foods and beverages in food stalls in low-income areas caused a high intake of sugary snacks among children, which was perceived by parents to lead to their children's dental caries. Some studies also have found that in low-income families, sugary snacks are often used as a tool to comfort children or as a replacement for other costly pleasures (Pescud and Pettigrew, 2014; Fisher, et al., 2015; Blaine, et al., 2016).

In addition, even though a prior study in the US of a sample of children aged three to five years old and their parents has shown that having good financial conditions was associated with a low risk of dental caries in children as it may support their efforts to maintain oral health (Albino, et al., 2018), a reversal in this pattern was observed in the qualitative part of this current study, which found a high rate of dental caries among children in high-income families. In the qualitative part of this current study, increasing sugar consumption contributed to the explanation of a high prevalence of dental caries in children in high-income families. Shifts in oral health-related parenting practices among some parents of children in the caries group after an improved change in their financial condition appeared to result in the increased purchasing of sugary snacks.

Having health insurance may also play a mediating role in the association between socioeconomic status and access to dental care, as it can reduce the financial barriers preventing dental care for children. Many studies have confirmed that the high risk of dental caries increases for children who do not have health insurance covering dental care and who lack access to dental care (Krikken and Veerkamp, 2008; Ng, et al., 2013). Still, the mere presence of dental care covered in health insurance does not assure improved access to dental care. The qualitative results of this current study highlighted the persistence of dental caries in children despite the introduction of National Health Insurance that has made dental health care freely accessible in Indonesia. The National Social Security System (SJSN/Sistem Jaminan Sosial Nasional) provides National Health Insurance (JKN/Jaminan Kesehatan Nasional) to all Indonesian citizens through the Social Insurance Administration Body for Health (Badan Penyelenggara Jaminan Sosial Kesehatan/BPJS Kesehatan). This National Health Insurance is compulsory for all Indonesian citizens, and it covers dental insurance. For poor people or those who have low income, the insurance is paid for by the government. Therefore, theoretically, there should be no restriction in access to dental care for financial reasons. However, not all Indonesian citizens have applied for the insurance yet. Most parents in both the caries and caries-free group admitted that either they had private health insurance or the Indonesian National Health Insurance, because their employers enrolled or registered them and their dependent family members. However, responsibility for the utilisation of dental care services is left entirely to the parents. Unfortunately, many parents in both groups reported perceived differences in the quality of care and services received when using the Indonesian National Health Insurance and were sceptical of seeking care from the authorised primary care facility, such as community healthcare centres, authorised clinics, or authorised private practices. Most parents in both groups therefore delayed dental visits for their child. On the other hand, among those who had private health insurance, a delay in dental visits was caused by either dental care not being covered in their health insurance or they were reluctant to follow reimbursement processes as they commonly had to pay upfront.

7.5 Recommendations for future research

This study clearly informs future research by identifying predominant constructs concerning oral health behaviours among children that need further examination. In forthcoming work, children's oral health behaviours should be assessed using more fine-grained instruments, such as using a child's diary to obtain the specific quantity, quality, and context in which children engage in these behaviours. This study also points to a need for further study of the quantitative measures of oral health-related parenting practices and empirically testing the possible causal association between oral health-related parenting practices and dental caries in children on a more representative sample in order to generalise

the findings. Furthermore, as it is evident that multiple factors influence oral health-related parenting practices that lead to poor oral health behaviours during a child's early years and, in turn, that affect the development of dental caries, longitudinal multifactorial cohort studies are recommended for a more rigorous investigation of the role of oral health-related parenting practices on the development of dental caries among children. This can be achieved by systematically and comprehensively evaluating factors at various levels (individual, family, and community) that may have mediating and moderating effects in the prediction of oral health-related parenting practices, children's oral health behaviours, and the development of dental caries among children. Future research might also benefit from employing path analysis or Structural Equation Modelling (SEM) to assess direct and indirect pathways leading to inequalities in dental caries in preschool children. Future qualitative studies could also ask parents directly about how barriers to promoting positive oral health behaviours in children as the parents perceive them could be addressed through interventions.

7.6 Practice and policy implications

The findings of this study may inform the design of more appropriate caries-preventative interventions through oral health behavioural intervention programs. Considering oral health-related parenting practices are one of the determinants of dental caries in children, a greater understanding of the factors influencing oral health-related parenting practices that lead to poor oral health behaviours may highlight important intervention targets. Such interventions may include strategies for strengthening parenting capacity through parenting skills training, such as child behavioural management, positive reinforcement and habit formation, and improving parents' dental self-efficacy. In addition, the notion that dental caries in children shares common risk factors with other paediatric diseases (Dooley, et al., 2018) suggests the incorporation of a multi-disciplinary approach to embed oral health in the development of prevention and policy strategies for childhood health in general.

The results of this study also suggested multilevel interventions to improve oral health-relating parenting practices, which influence children's oral health behaviours and dental health outcomes. These are based on the notion that parents' personal and socio-cultural factors do not act in isolation to influence oral health-related parenting practices. Therefore, individual-, family-, school-, and community-based interventions should be considered to comprehensively address the problems of oral health-related parenting practices, which have implications on child's oral health behaviours and dental health outcomes.

CHAPTER 8
CONCLUSION

Dental caries is a prevalent disease among children worldwide. Dental caries in children is a serious public health problem because of its high prevalence, the high cost of dental treatment, and its significant impact on the quality of life of children suffering from it. One of the major determinants of dental caries among children is derived from oral health behaviours. For young children, parents play an important role in establishing oral health behaviours for their child. Parents' personal and socio-cultural factors might influence the parental decision to establish particular oral health behaviours for their child. However, to what extent each factor can influence children's oral health behaviours is still unclear and remains poorly understood. This mixed-method study gives a better understanding of the pathways through which parents' personal and socio-cultural factors could affect children's oral health behaviours. The quantitative results provide a general picture of the association between oral health behaviours and dental caries, whereas the qualitative results explain the quantitative results by exploring and explaining the factors influencing children's oral health behaviours.

This study showed that dental caries remains prevalent among preschool children aged two to six years old in Surabaya, Indonesia. A relatively high prevalence and severity of dental caries was found among these children. The quantitative results also presented a negative impact of dental caries on the oral health-related of quality of life of the affected children and their family. Dental caries did not only affect their physical wellbeing, but also their social and psychological wellbeing. The most commonly reported impact of dental caries on the child was found to be related to food retention, bad breath, and difficulty in biting/chewing solids, whereas the impacts of dental caries on the family were commonly related to family activities and their feeling upset and guilty because of their child's dental caries.

In the context of children's oral health behaviours, the quantitative results of this study showed that sugar snacking, bedtime bottle habits, and dental visits are associated with dental caries. However, no significant association was found between oral hygiene practices and dental caries. In the qualitative results, sugar snacking, bedtime bottle habits, oral hygiene practices, and dental visits were the key oral health behaviours influencing the development of dental caries in preschool children in Surabaya. The results also highlighted the importance of oral health-related parenting practices for the establishment of children's oral health behaviours. There appeared a difference in the oral health-related parenting practices between the caries and caries-free groups, which affected the child's oral health behaviours. Parents in the caries-free group tended to adopt supportive oral health-related parenting practices. They respected their child's preferences for particular behaviours, but they set rules and boundaries to prescribe limits on and to control the

child's behaviours. Therefore, they were more likely to successfully establish favourable oral health behaviours for their child. On the other hand, parents in the caries group were inclined to using permissive oral health-related parenting practices. They let the child decide in which behaviours they could engage, and they had only little or even no control over the child's behaviours, which resulted in the child's poor oral health behaviours.

The qualitative results of this study further revealed parents' personal factors (e.g. parents' attitudes, oral health knowledge, beliefs, experience, stress, locus of control, and self-efficacy) and socio-cultural factors influencing the differences in oral health-related parenting practices between the parents in the caries and caries-free groups. The results indicated that parents' oral health-related parenting practices were shaped by the interaction between social environment factors affecting the parents and the parents' personal factors. For example, the sociocultural environment could have either a positive or negative influence on parents' oral health knowledge and attitudes, which then affects their oral health-related parenting practices. These practices would impact on the children's oral health behaviours and dental health outcomes. However, conversely, parents could also use good parenting skills to resist negative influences from the sociocultural environment and help to successfully establish favourable oral health behaviours.

The significant contribution of the findings of this research to the existing knowledge on this topic is that the integration of the quantitative and qualitative findings of this study may provide a more comprehensive and thorough understanding of children's oral health behaviours and dental health outcomes. Understanding parents' personal and socio-cultural factors and the pathways through which those factors influence oral health-related parenting practices and the likely implications for children's oral health behaviours and dental health outcomes is necessary to predict barriers to and facilitators of establishing favourable oral health behaviours for children.

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Appendices

Appendix 1. Questionnaire

QUESTIONNAIRE

FLINDERS UNIVERSITY
DEPARTMENT OF PUBLIC HEALTH

"The Underlying Causes of Inequality in Dental Caries in Young Children Aged 2-6 Years Old in Surabaya, Indonesia: Oral Health Behaviour Perspective"
2015

A. Socio-Demographic Characteristics

The aim of the following questions is to gather information about your child's social and demographic characteristics.

What is your child gender?
(Tick one box only)
- ☐ Male
- ☐ Female

How old is your child?
(Write age)
____ year ____ month(s)

How old are you?
(Write age)
____ years

White is your relationship with the child?
(Tick one box only)
- ☐ Mother/female guardian
- ☐ Father/male guardian
- ☐ Others, please specified:
  _____

What is your ethnicity?
(Tick one box only)
- ☐ Java
- ☐ Madura
- ☐ Chinese
- ☐ Arab
- ☐ Others, please specify:
  _____

were you born in Surabaya?
(Tick one box only)
- ☐ Surabaya
- ☐ Others, please specify:
  _____

What is your highest education attainment?
(Tick one box only)

- ☐ Primary school or below
- ☐ Junior high school
- ☐ Senior high school
- ☐ Bachelor degree
- ☐ Master degree
- ☐ Doctoral degree
- ☐ Others, please specify: -

_____

How much is your monthly household income in average?
(Tick one box only)

- ☐ < Rp. 1.000.000,-
- ☐ Rp. 1.000.000,- - Rp. 1.500.000
- ☐ Rp. 1.500.000,- - Rp. 1.999.999,-
- ☐ Rp. 2.000.000,- - Rp. 2.499.999,-
- ☐ Rp. 2.500.000,- - Rp. 2.999.999,-
- ☐ Rp. 3.000.000,- - Rp. 4.999.999,-
- ☐ ≥ Rp. 5.000.000,-

Where do you live?
(Tick one box only)

- ☐ Central Surabaya
- ☐ North Surabaya
- ☐ South Surabaya
- ☐ West Surabaya
- ☐ East Surabaya

B. Oral Hygiene Practice

The following questions aims to gather information about your child's tooth brushing habits

1 At what age did your child start cleaning his/her teeth* without toothpaste (with or without the help from an adult)?
(Write age or select "Never")
**Tooth cleaning includes wiping with a cloth or a toothbrush*

- ☐ ..... year(s) ..... month(s)
- ☐ Never cleaned teeth without toothpaste

2 At what age did your child start brushing with toothpaste (with or without the help from an adult)?
(Write age or select "Never")

- ☐ ..... year(s) ..... month(s)
- ☐ Never brushed with toothpaste

→ **GO TO QUESTION NO 7**

3 How often does your child brush his/her teeth with toothpaste? *(Tick one box only)*

- ☐ Less than once a day
- ☐ Once a day
- ☐ Twice a day
- ☐ More than twice a

4 How much toothpaste does your child usually use on his/her toothbrush *(Tick one box only)*

- ☐ 
- ☐ 
- ☐ 

5 Have you ever found your child eat or lick toothpaste? *(Tick one box only)*

- ☐ Often
- ☐ Sometimes
- ☐ Never

6 How do you usually help your child to brush his/her teeth? *(Tick one box only)*

- ☐ Apply the toothpaste and brush his or her teeth.
- ☐ Only apply the toothpaste on the brush

- ☐ Watch and give advice
- ☐ Do not help brushing
- ☐ Other, please specify: _____

C. Dietary behaviours

The following questions aim to gather information about baby feeding, as well as foods and drinks your child has in a usual day

7 What milk does your child consume at the moment? *(Tick as many boxes as applicable)*

- ☐ Breast milk
- ☐ Formula milk
- ☐ Formula soy
- ☐ Plain milk
- ☐ Flavoured milk
- ☐ Never consume milk
- ☐ Other, please specify: _____

8 At what age did your child start bottle feeding? *(Tick one box only)*

- ☐ <6 months
- ☐ 6-12 months
- ☐ 12-24 months
- ☐ ≥ 24 months
- ☐ Never bottle feeding **→GO TO QUESTION NO 12**

9 Do you still bottle-feed your child? *(Tick one box only)*

- ☐ Yes **→ GO TO QUESTION NO 11**
- ☐ No

10 At what age was your child weaned from the bottles? *(Tick one box only)*

- ☐ <2.5 years
- ☐ 2.5 years-3 years
- ☐ ≥ 3 years

11 What kinds of drinks do you usually give to your child using a bottle? *(Tick as many boxes as applicable)*

- ☐ Water
- ☐ Fruit juices
- ☐ Tea
- ☐ Milk
- ☐ Other, please specify:

_____

12 Do you add sugar in your child's beverages? *(Tick one box only)*

- ☐ Yes
- ☐ No

→ GO TO QUESTION NO 15

13 When does your child usually consume sugared beverages? *(Tick as many boxes as applicable)*

- ☐ Between meals
- ☐ At the same time he/she has the meals

14 How often does your child consume sugared beverages between meals? *(Tick one box only)*

- ☐ once
- ☐ twice
- ☐ Three times
- ☐ more than three times
- ☐ Never consume sugared drinks between meals

15 What kind of drinks do you usually give to your child as bedtime drinks (at night)? *(Tick as many boxes as applicable)*

- ☐ None

→GO TO QUESTION 18

- ☐ Water
- ☐ Milk
- ☐ Tea
- ☐ Other, please specify:

_____

16 Do you add sugar in your child's bed time drinks? *(Tick one box only)*

- ☐ Yes
- ☐ No

17 Does your child use a bottle to consume his/her bed time drinks? *(Tick one box only)*

- ☐ Yes
- ☐ No

18 How often does your child consume sugary snack in a day? *(Tick one box only)*

- ☐ Once
- ☐ Twice
- ☐ Three times
- ☐ More than three times
- ☐ Never snacking sugary foods
  → **GO TO QUESTION 20**

19 When does your child usually consume sugary snacks? *(Tick as many boxes as applicable)*

- ☐ Between meals
- ☐ At the same time he/she has a meal

D. Dental Service Utilization

The following questions aim to gather information about your child's use of dental care services.

20 When did the LAST time your child visit a dentist to get a general dental care for his/her own oral health? *(Tick one box only)*

- ☐ Never go to the dentist
  → **GO TO QUESTION NO 25**
- ☐ Less than 6 months ago
- ☐ 6 months to less than 12 months ago
- ☐ 12 months to less than 18 months ago
- ☐ 18 months ago to less than 2 years ago
- ☐ 2 years or more ago

21 What was the reason for your child's last visit to a dentist for his/her own oral health? *(Tick one box only)*

- ☐ A check-up

- ☐ Preventive care (including professional cleaning, fluoride application, and fissure sealants).
- ☐ Treatment for a problem that was causing pain
- ☐ Treatment for a problem that was NOT causing pain

22 Where was your child's last dental visit for his/her own oral health?
(Tick one box only)

- ☐ Community health services
- ☐ Private practice
- ☐ Public hospitals
- ☐ Private hospitals
- ☐ Other, please specify:

_____

23 Why did you choose the dental clinic that your child usually visits for his/her oral health?
(Tick as many boxes as applicable)

- ☐ Convenient location
- ☐ Convenient hours
- ☐ Prompt attention
- ☐ Emphasis on prevention
- ☐ Quality of dental care
- ☐ Personal recommendation
- ☐ Special skills of dentist/clinic
- ☐ Cost
- ☐ Staff attitude
- ☐ Covered by private health insurance
- ☐ Other, please specify:

_____

24 At your child's last dental visit, how do you rate the dental care for your child?
(Tick one box only)

- ☐ Excellent
- ☐ very good
- ☐ good
- ☐ fair
- ☐ poor

25 In the last 12 months, what kind of dental care that your child needs but delayed/avoided? *(Tick as many boxes as applicable)*

- ☐ Check-up
- ☐ Preventive care (Include professional clean, fluoride application, cracks patching).
- ☐ Treatment for a problem that was causing pain
- ☐ Treatment for a problem that was NOT causing pain
- ☐ None
  → **GO TO QUESTION NO 27**

26 What is the reason for delaying/avoiding dental care for your child? *(Tick as many boxes as applicable)*

- ☐ High cost for dental care
- ☐ Don't have time for visiting the dentist
- ☐ Uncomfortable location
- ☐ The child refuses to visit the dentist
- ☐ Other, please specify:
  _____

27 Does your child feel afraid or stressed if he/she is asked to visit a dentist? *(Tick one box)*

- ☐ Not at all
- ☐ A little
- ☐ Moderately
- ☐ Very
- ☐ Extremely

E. The quality of life

E.1 Child domain

The following questions aim to gather information about the symptoms and discomfort that your child may experience due to the condition of his/her teeth, lips, mouth and jaws.

28 How much your child's overall well-beibg is affected by the condition of his/her teeth, lips, mouth or jaws?
(Tick one box only)

- ☐ Not at all
- ☐ Very little
- ☐ Some
- ☐ A lot
- ☐ Very much

29. In the following tables, please tick ONE box that describes your experience.
(Tick one box only for each row)

During the **last three months**, which is caused by the condition of his/her teeth, lips, mouth or jaws, ...					
	Never	Once or twice	Sometimes	Often	Very often
... has your child had pain in teeth, lips, mouth or jaws?	☐	☐	☐	☐	☐
... has your child had bleeding gums?	☐	☐	☐	☐	☐
... has your child had bad breath?	☐	☐	☐	☐	☐
... has your child had food caught between the teeth?	☐	☐	☐	☐	☐
... has your child breathed through the mouth?	☐	☐	☐	☐	☐
... has your child had trouble sleeping?	☐	☐	☐	☐	☐
... has your child had difficulty in biting or chewing firm foods?	☐	☐	☐	☐	☐
... has your child had difficulty in eating hot or cold foods?	☐	☐	☐	☐	☐
... has your child had difficulty in drinking hot or cold beverages?	☐	☐	☐	☐	☐
... has your child had difficulty in pronouncing any words?	☐	☐	☐	☐	☐
... has your child been irritable or frustrated?	☐	☐	☐	☐	☐
... has your child worried that he/she is not as healthy as other people?	☐	☐	☐	☐	☐
... has your child worried he/she is different from other people?	☐	☐	☐	☐	☐
... has your child acted shy or embarrassed?	☐	☐	☐	☐	☐
... has your child avoided smiling or laughing when he/she is around other children?	☐	☐	☐	☐	☐
... has your child not wanted to or been able to spend time with other children?	☐	☐	☐	☐	☐
... has your child not wanted to speak or read out loud in class?	☐	☐	☐	☐	☐
... has your child not wanted to talk to other children?	☐	☐	☐	☐	☐
... has your child been asked questions by other children about his/her teeth, lips, mouth or jaws?	☐	☐	☐	☐	☐

During the **last 12 months**, ...					
... has your child had trouble concentrating in school because of dental problems?	☐	☐	☐	☐	☐
... has your child missed school because of dental problems?	☐	☐	☐	☐	☐
... has your child missed school to visit a dental clinic?	☐	☐	☐	☐	☐

F.2 Family domain

The purpose of the following questions is to gain information about the impacts of your child's oral condition to his/her family

30. In the following tables, please tick ONE box that describes your experience.
(Tick one box only for each row)

During the **last three months**, because of the condition of his/her teeth, lips, mouth or jaws, ...					
	Never	Once or twice	Sometimes	Often	Very often
... has your child blamed you or another person in the family?	☐	☐	☐	☐	☐
... has your child argued with you or others in the family?	☐	☐	☐	☐	☐
... has your child required more attention from you or others in the family?	☐	☐	☐	☐	☐

31. In the the following tables, please tick ONE box that describes your experience.
(Tick one box only for each row)

During the **last three months**, because of the condition of his/her teeth, lips, mouth or jaws, ...					
	Never	Once or twice	Sometimes	Often	Very often
... have you been upset?	☐	☐	☐	☐	☐
... have you felt guilty?	☐	☐	☐	☐	☐
... have you had sleep disrupted?	☐	☐	☐	☐	☐
... have you taken time off work (e.g. due to pain, appointments, surgery)?	☐	☐	☐	☐	☐
... have you had less time for yourself or the family?	☐	☐	☐	☐	☐
... have you worried that your child will have fewer life opportunities (for example dating, getting married, having children, getting a job he/she will like)?	☐	☐	☐	☐	☐

Appendix 2. Oral health assessment form for children

Oral Health Assessment Form for Children
(by tooth)

Identification number : **Date:**
Examiner :
Name of children :
School :
Sex :
Date of Birth :

Right Side	**Left Side**

			55	54	53	52	51	61	62	63	64	65				(Primary teeth)
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28	(Permanent teeth)
■	■	■											■	■	■	(Upper jaw primary teeth)
-	-		-	-	-					-	-	-		-	-	(Upper jaw permanent teeth)
-	-		-	-	-					-	-	-		-	-	(Lower jaw permanent teeth)
■	■	■											■	■	■	(Lower jaw primary teeth)
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38	(Permanent teeth)
			85	84	83	82	81	71	72	73	74	75				(Primary teeth)

Notes:
■ : not applicable

- : not erupted yet
d : decay due to dental caries
m : missing due to caries
f : filling due to caries

Appendix 3. Interview schedule

Interview schedule
PARENTS

FLINDERS UNIVERSITY
DEPARTMENT OF PUBLIC HEALTH

"THE UNDERLYING CAUSES OF INEQUALITY IN DENTAL CARIES IN YOUNG CHILDREN AGED 2-6 YEARS OLD IN SURABAYA, INDONESIA: ORAL HEALTH BEHAVIOR PERSPECTIVE "

2015

Dental caries status: **Caries** ☐
Caries-free ☐

Region: **1. Central Surabaya** ☐
2. North Surabaya ☐
3. South Surabaya ☐
4. East Surabaya ☐
5. West Surabaya ☐

Interviewee identification number: _____

Interviewed by: _____ *Date:* _____

Section One: Young Children's Dental Health

1. In your opinion, how is your child's dental health condition?
2. In your opinion, who should have control over young children's dental health?
3. What do you know about young children's dental caries?

Section Two: Oral Hygiene Practices

4. What do you think about the importance of maintaining your child's dental health?
5. Are there any people around you that teach you about how to maintain your child's dental health? If yes, who are they? What are their suggestions? What do you think about their suggestions? Do you follow their suggestions?
6. How do you think about your ability to maintain your child's dental health?

Section Three: Dietary Intake

7. At what age would you say that most children in your area start consuming snacks/foods/beverages containing sugar?
8. What do you think about controlling child sugar snacking? Who should be responsible for this? What are the barriers you experience to controlling your child's sugar intake? How could it be successful?

9. Is there any policy/program/activity regarding young children's dental health at your child's school, such as restricting snacks/foods/beverages containing sugar and/or tooth brushing after a break at school?

Section Four: Dental Service Utilization

10. Did you ever take your child to a dentist? If yes, do you trust and follow the dentist's advice/recommendations and suggestions? And what kind of dental caries prevention and treatment has your child received?
11. How satisfied are you with the result of dental caries prevention and treatment your child has received?
12. Do you have any experiences of the difficulties to bring your child to a dentist or the barriers to receive dental caries prevention and/or treatment recommended for your child?

Appendix 4. Ethics approval

6907 SBREC final approval notice (17 June 2015) - Dini Setyowati 7/03/2018 3:53 pm

6907 SBREC final approval notice (17 June 2015)

Human Research Ethics

Wed 17/06/2015 2:47 PM

To: Dini Setyowati <sett0007@flinders.edu.au>; Mariastella Pulvirenti <mariastella.pulvirenti@flinders.edu.au>; Sharon Lawn <sharon.lawn@flinders.edu.au>; loc.do@adelaide.edu.au <loc.do@adelaide.edu.au>;

Importance: High

Dear Dini,

The Chair of the Social and Behavioural Research Ethics Committee (SBREC) at Flinders University considered your response to conditional approval out of session and your project has now been granted final ethics approval. This means that you now have approval to commence your research. Your ethics final approval notice can be found below.

FINAL APPROVAL NOTICE

Project No.:	**6907**
Project Title:	The underlying causes of inequality in dental caries in young children aged 2-6 years old in Surabaya, Indonesia: dental behaviour perspective
Principal Researcher:	Ms Dini Setyowati
Email:	sett0007@flinders.edu.au

Approval Date:	17 June 2015	Ethics Approval Expiry Date:	**31 July 2019**

The above proposed project has been **approved** on the basis of the information contained in the application, its attachments and the information subsequently provided.

Appendix 5. Letter of introduction for oral health survey (Quantitative study)

Dr. Mariastella Pulvirenti
Health Sciences Building
GPO Box 2100
Adelaide SA 5001
Tel: +61 8 72218491
mariastella.pulvirenti@flinders.edu.au
http://www.flinders.edu.au/people/mariastella.pulvirenti
CRICOS Provider No. 00114A

LETTER OF INTRODUCTION

Dear Parents/Guardian

This letter is to introduce Dini Setyowati who is a PhD student in the School of Health Sciences at Flinders University. She leaves a copy of her student card, which carries a photograph, as proof of identity, in the school.

She is undertaking research leading to the production of a thesis, report or other publications on the subject of dental caries in preschool children. The overall purpose of her study is to find out the underlying causes of inequality in dental caries in young children aged 2-6 years old in Surabaya, Indonesia, from oral health behaviour perspective.

She would like to invite you to assist with this study by giving your consent, on the attached form, for your child to participate in this study. You will also be asked to complete a questionnaire about socio demographic characteristics, oral hygiene practices, dietary intake and dental service utilization for your child. Your child will receive dental examination in school from a qualified dentist. The dental examination will take no more than 10 minutes and no more than 30 minutes is required to complete the questionnaire.

Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting thesis, report or other publications. You and your child are, of course, entirely free to discontinue your participation at any time or to decline to answer particular questions.

If you would like to consent to your child being involved, please sign the consent form attached, complete the questionnaire and return it to a secure collection box at school.

Any enquiries you may have concerning this study should be directed to me at the address given above or by telephone on +61 8 72218491 or e-mail mariastella.pulvirenti@flinders.edu.au

Thank you for your attention and assistance.

Yours sincerely

Dr. Mariastella Pulvirenti
Lecturer
Discipline of Public Heath
School of Health Sciences

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number 6907). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

Appendix 6. Letter of introduction for interviews (Qualitative study)

Dr. Mariastella Pulvirenti
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Tel: +61 8 72218491
mariastella.pulvirenti@flinders.edu.au
http://www.flinders.edu.au/people/mariastella.pulvirenti
CRICOS Provider No. 00114A

LETTER OF INTRODUCTION

Dear Sir/Madam

This letter is to introduce Dini Setyowati who is a PhD student in the School of Health Sciences at Flinders University. She will produce her student card, which carries a photograph, as proof of identity, in the school.

She is undertaking research leading to the production of a thesis, report or other publications on the subject of dental caries in preschool children. The overall purpose of her study is to find out the underlying causes of inequality in dental caries in young children aged 2-6 years old in Surabaya, Indonesia, from oral health behaviour perspective.

She would like to invite you to assist with this study by being involved in an interview, which cover certain aspects of this topic. No more than 30 minutes on one occasion would be required.

Be assured that any information provided will be treated in the strictest confidence and none of the participants will be individually identifiable in the resulting thesis, report or other publications. You are, of course, entirely free to discontinue your participation at any time or to decline to answer particular questions.

Since she intends to make a tape recording of the interview, she will seek your consent, on the attached form, to record the interview, to use the recording or a transcription in preparing the thesis, report or other publications, on condition that your name or identity is not revealed, and that the recording will not be made available to any other person.

Any enquiries you may have concerning this study should be directed to me at the address given above or by telephone on +61 8 72218491 or e-mail mariastella.pulvirenti@flinders.edu.au

Thank you for your attention and assistance.

Yours sincerely

Dr. Mariastella Pulvirenti
Lecturer
Discipline of Public Heath
School of Health Sciences

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number 6907). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

Appendix 7. Information sheet for oral health survey (Quantitative study)

Dr. Mariastella Pulvirenti
Health Sciences Building
GPO Box 2100
Adelaide SA 5001
Tel: +61 8 72218491
mariastella.pulvirenti@flinders.edu.au
http://www.flinders.edu.au/people/mariastella.pulvirenti
CRICOS Provider No. 00114A

INFORMATION SHEET

Title: The underlying causes of inequality in dental caries in young children aged 2-6 years old in Surabaya, Indonesia: oral health behaviour perspective

Investigators:
Ms Dini Setyowati
PhD student
Discipline of Public Health, School of Health Sciences
Flinders University
Ph: +61 451 481 281

Supervisor:
Dr. Mariastella Pulvirenti
Lecturer
Discipline of Public Health, School of Health Sciences
Flinders University
Ph: +61 8 72218491

Supervisor:
Assoc. Prof. Sharon Lawn
Lecturer
Department of Psychiatry-Flinders Human Behaviour and Health Research Unit, School of Medicine
Flinders University
+61 8 8404 2321

Supervisor:
Assoc. Prof. Loc Do
Lecturer
Australian Research Centre for Population Oral health (ARCPOH), School of Dentistry
The University of Adelaide
Ph: +61 8 8313 3964

Description of the study:
This study is part of the project entitled '*The underlying causes of inequality in dental caries in young children aged 2-6 years old in Surabaya, Indonesia: oral health behaviour perspective*'. Young children are vulnerable to dental caries. Some children may have a higher risk of developing dental caries than others. A large number of studies demonstrate the significant role of behaviour in the development of dental caries among young children. Studying levels and emerging patterns of behaviours in relation to early childhood caries and its causes may provide a valuable perspective on why some young children suffer dental caries whereas others are caries-free. This perspective is fundamental to the design of appropriate oral health promotion and dental caries prevention programs and activities for young children. This project will investigate the underlying causes of the differences of dental caries between young children aged 3-5 years old who have caries and those who are caries free in Surabaya, from dental behaviour perspective. This project is supported by the Discipline of Public Health, School of Health Sciences, Flinders University.

Purpose of the study:
This project aims:

1. To assess the prevalence and the severity of dental caries in young children aged two to six years old in Surabaya, Indonesia.
2. To examine the association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia.
3. To examine the association between the dental caries experience and quality of life of young children aged two to six years old and their families in Surabaya, Indonesia.
4. To explore and explain parents' personal and socio-environmental factors influencing oral health behaviours and dental health outcomes in young children aged two to six years old in Surabaya, Indonesia.

What will I be asked to do?
You are invited to fill in the attached questionnaire, which asks you about socio demographic characteristics, oral hygiene practices, dietary intake and dental service utilization for your child. No more than 30 minutes would be required to complete the questionnaire. Once the questionnaire is returned to your child's school, your child will receive a dental examination in the school to assess their dental caries status. Your child's dental caries will only be detected by a visual inspection. Disposable mouth-mirror and dental probe will be used to assist in the examination. This will take no more than 10 minutes. All examiners are dentists who are well trained and well experienced. Your responses in the questionnaire and the result of dental examination of your child will be stored in the password-protected computer files. Participation in this study is voluntary.

What benefit will I gain from being involved in this study?
You may not directly benefit from participation in this study. However, you may have an opportunity to have your child's teeth examined by a dentist. You may also ask the dentist on the day of dental examination of your child about your child's dental condition. If required, the dentist will seek your consent to make the referral to the community health services that are close from the school area for your child's dental treatment. The sharing

of your experiences may contribute to the future planning and delivery of oral health promotion and dental caries prevention programs for young children in Surabaya.

Are there any risks or discomforts if I am involved?
The investigator anticipates few risks from the involvement in this study. The risks and/or discomforts that you may experience are:

1. You may feel guilty realising that your children suffer from dental caries
2. You may feel discomfort of particular topics during the completion of the questionnaire.
3. You may feel worried about effects or consequences if you refuse to participate in the study or honestly answer the questions in the questionnaire.
4. You may have an expectation that the researcher will solve your young child's dental problems

If you have any other concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

Will I be identifiable by being involved in this study?
Any identifying information will be removed during data analysis. You will be anonymous. You will not be identifiable in the resulting thesis, report or other publications. All data will be stored in password protected computer files.

How do I agree to participate?
A consent form accompanies this information sheet. If you agree to participate in this study, please read and sign the form, fill in the attached questionnaire and return it to the secure collection box in the school. Your child will receive a small tube of toothpaste and a toothbrush as a form of appreciation. Participation is voluntary. You may refuse to answer any questions in the questionnaire. You and your child are free to discontinue your participation at any time without any effects or consequences.

How will I receive feedback?
You may not directly receive the outcomes from the project. However, you may directly ask the dentist on the day of your child's dental examination about your child's dental condition, and you may be referred to the community health services for your child's dental treatment if necessary. You will also receive dental information fact sheets after the projects are completed.

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number 6907). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

Appendix 8. Information sheet for interviews (Qualitative study)

Dr. Mariastella Pulvirenti
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mariastella.pulvirenti@flinders.edu.au
http://www.flinders.edu.au/people/mariastella.pulvirenti
CRICOS Provider No. 00114A

INFORMATION SHEET

Title: The underlying causes of inequality in dental caries in young children aged 2-6 years old in Surabaya, Indonesia: oral health behaviour perspective

Investigators:
Ms Dini Setyowati
PhD student
Discipline of Public Health, School of Health Sciences
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Ph: +61 451 481 281

Supervisor:
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Lecturer
Discipline of Public Health, School of Health Sciences
Flinders University
Ph: +61 8 72218491

Supervisor:
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Lecturer
Department of Psychiatry-Flinders Human Behaviour and Health Research Unit, School of Medicine
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Supervisor:
Assoc. Prof. Loc Do
Lecturer
Australian Research Centre for Population Oral health (ARCPOH), School of Dentistry
The University of Adelaide
Ph: +61 8 8313 3964

Description of the study:
This study is part of the project entitled '*The underlying causes of inequality in dental caries in young children aged 2-6 years old in Surabaya, Indonesia: oral health behaviour perspective*'. Young children are vulnerable to dental caries. Some children may have a higher risk of developing dental caries than others. A large number of studies demonstrate the significant role of behaviour in the development of dental caries among young children. Studying levels and emerging patterns of behaviours in relation to early childhood caries and its causes may provide a valuable perspective on why some young children suffer dental caries whereas others are caries-free. This perspective is fundamental to the design of appropriate oral health promotion and dental caries prevention programs and activities for young children. This project will investigate the underlying causes of the differences of dental caries between young children aged 3-5 years old who have caries and those who are caries free in Surabaya, from dental behaviour perspective. This project is supported by the Discipline of Public Health, School of Health Sciences, Flinders University.

Purpose of the study:
This project aims:

1. To assess the prevalence and the severity of dental caries in young children aged two to six years old in Surabaya, Indonesia.
2. To examine the association between oral health behaviours and dental caries experience among young children aged two to six years old in Surabaya, Indonesia
3. To examine the association between the dental caries experience and quality of life of young children aged two to six years old and their families in Surabaya, Indonesia.
4. To explore and explain parents' personal and socio-environmental factors influencing oral health behaviours and dental health outcomes in young children aged two to six years old in Surabaya, Indonesia.

What will I be asked to do?
You are invited to attend a one-on-one interview with the investigator who will ask you a few questions about why you adopt particular dental health behaviours for your children? and how decision making to select those particular oral health behaviours is embedded in your own circumstances? The interview will take no more than 30 minutes. The interview will be recorded using a digital voice recorder to help with looking at the results. Once recorded, the interview will be transcribed (typed-up) and stored in password protected computer files. The interview will be recorded using a digital voice recorder to help with looking at the results. Once recorded, the interview will be transcribed (typed-up) and stored in password-protected computer files. The participation in this study is voluntary.

What benefit will I gain from being involved in this study?
You may not directly benefit from the participation in this study. However, you may value the opportunity to share your experience in introducing oral health-related behaviour to your child, as it will assist in increasing understanding about factors that influence parents' decision to adopt particular oral health-related behaviours. The sharing of your experiences may contribute to the future planning and delivery of oral health promotion and dental caries prevention programs for young children in Surabaya.

Are there any risks or discomforts if I am involved?
The investigator anticipates few risks from the involvement in this study. It is possible that you may feel discomfort while discussing some topics during the interview. You will be reminded that you can discontinue the interview at anytime without any effects or consequences or refuse to answer particular questions if you feel discomfort. Participation is voluntary. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

Will I be identifiable by being involved in this study?
Any information that you provide will be treated in the strictest confidence. Any identifying information will be removed during the transcription process. You will be anonymous. You will not be identifiable in the resulting thesis, report or other publications. The interview's transcripts and records will be stored in password protected computer files.

How do I agree to participate?
A consent form accompanies this information sheet. If you agree to participate in this study, please read and sign the form and return it to the investigator. You will be reimbursed for your time and possible travel costs through the provision of Rp. 50.000,- in cash. Participation is voluntary. You may refuse to answer any questions in the questionnaire. You and your child are free to discontinue your participation any times without any effects or consequences.

How will I receive feedback?
You may not directly receive the outcomes from the project. However, you have an opportunity to discuss about any issues of your children's oral health-related behaviours and dental health with the researcher. You will also receive dental information fact sheets at the end of the interview.

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number 6907). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

Appendix 9. Parents consent form for child participation (Oral Health Survey-Quantitative study)

PARENTS CONSENT FORM FOR CHILD PARTICIPATION IN RESEARCH

CONSENT FORM FOR PARTICIPATION IN RESARCH

(by dental examination and questionnaire survey)

The Underlying Causes of Inequality in Dental Caries in Young Children Aged 2-6 Years Old in Surabaya, Indonesia: Oral Health Behaviour Perspective

I .....

being over 28, hereby consent to my child .....

participating, as requested in the letter of introduction and information sheet for the research project on dental caries in preschool children.

1. I have read the information provided.
2. Details of procedures and all the risks have been explained clearly.
3. I agree to fill in the questionnaire and my child receive dental examination in school..
4. I am aware that I should keep a copy of the information sheet and consent form for future reference.
5. I understand that:
   - My child may not benefit from his/her participation in this research.
   - My child is free to withdraw from this research at any time and I am free to decline to answer certain questions in questionnaire.
   - Although the information obtained from this study will be published as explained earlier, my child will not be identified and any personal information will remain confidential.
   - Whether my child participate or not, or withdraw after participating, will not affect the progress of the study, or to the results obtained.
   - I may decline to answer certain questions and I and my child may also ask to stop participating at any time without any disadvantage.
7. I agree/disagree to the publication of my information as reported in the published researcher's report. **delete as appropriate*

Participant's signature.....Date.....

I certify that I have explained this research to the volunteer and consider that he/she understands what is going to be involved and freely consent to participate.

Researcher's name: DINI SETYOWATI

Researcher's signature.....Date.....

NB: Two signed copies should be obtained. The copy kept by the researcher may then be used for authorization of Item 8 and 9, as appropriate.

Appendix 10. Consent form for participation in interviews (Qualitative study)

CONSENT FORM FOR PARTICIPATION IN RESEARCH

(by interview)

THE UNDERLYING CAUSES OF INEQUALITY IN DENTAL CARIES IN YOUNG CHILDREN AGED 2-6 YEARS OLD IN SURABAYA, INDONESIA: ORAL HEALTH BEHAVIOR PERSPECTIVE

I .....

being over the age of 18 years hereby consent to participate as requested in the letter of introduction and information sheet for the research project on "the underlying causes of inequality in dental caries in young children aged 2-6 years old in Surabaya, Indonesia : oral health behaviour perspective".

1. I have read the information provided.
2. Details of procedures and any risks have been explained to my satisfaction.
3. I agree to audio recording of my information and participation.
4. I am aware that I should retain a copy of the Information Sheet and Consent Form for future reference.
5. I understand that:
   - ☐ I may not directly benefit from taking part in this research.
   - ☐ I am free to withdraw from the project at any time and am free to decline to answer particular questions.
   - ☐ While the information gained in this study will be published as explained, I will not be identified, and individual information will remain confidential.
   - ☐ Whether I participate or not, or withdraw after participating, will have no any effects or consequences.
   - ☐ I may ask that the recording be stopped at any time, and that I may withdraw at any time from the session or the research without disadvantage.
6. I agree/do not agree* to the tape/transcript* being made available to other researchers who are not members of this research team, but who are judged by the research team to be doing related research, on condition that my identity is not revealed. ** delete as appropriate*
7. I have had the opportunity to discuss taking part in this research with a family member or friend.

Participant's signature.....Date.....

I certify that I have explained the study to the volunteer and consider that she/he understands what is involved and freely consents to participation.

Researcher's name.....

Researcher's signature.....**Date**.....