Studies to explore the association between health-related behaviours and HbA1c among Kuwaiti young people at risk of T2DM

by

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Abstract

Introduction: Non-communicable diseases in children and adolescents are a global issue, with no country successfully addressing this issue to date. Over the last 20 years, the incidence of such diseases in adolescents and young people has increased. This growing burden presents an even greater risk of younger generations in Kuwait developing type 2 diabetes mellitus. Assessing the health-related behaviours that are associated with the development of type 2 diabetes mellitus in young people would provide a clearer picture of the non-communicable diseases that affect this cohort and present possible solutions that could assist in overcoming cultural barriers and the inability to adopt a healthier lifestyle among this population.

Aim: This study investigated the current situation regarding prediabetes and type 2 diabetes mellitus among the at-risk population in Kuwait. This study hypothesised that young adults aged 10–24 years at risk of type 2 diabetes mellitus: (1) will have an elevated level of glycated haemoglobin A1c, and (2) there is a significant relationship between health-related behaviours and glycated haemoglobin A1c.

Methods: This study followed a positivist approach to quantitative research and a repeated cross-sectional observational design. A convenience sampling strategy was used to recruit participants. Data collection was conducted over two phases. The baseline was in September 2021, and the follow up at 6-months started on March 2022. Stata® software version 17 was used to analyse the data.

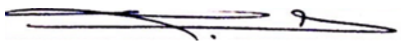
Results: One hundred and forty-six young people aged between 10 and 24 years completed the baseline assessment. Of them, 60 participants (41.10 %) were in the prediabetes stage, and three participants (2.05 %) were newly diagnosed with type 2 diabetes mellitus by abiding with the American Diabetes Association’s criteria for diagnosing prediabetes and type 2 diabetes mellitus. A total of 123 participants responded to the health-related behaviours questionnaire and completed the baseline and follow-up assessments. Almost all participants had a family history of diabetes, and were obese or overweight. Young Kuwaitis have a high prevalence of prediabetes and type 2 diabetes mellitus compared to regional and international countries. Body mass index and daily screen time both significantly influenced the mean glycated haemoglobin A1c levels among the participants of this study. Furthermore, higher sleep disturbance predicted higher glycated haemoglobin A1c, whereas higher physical activity and healthier eating predicted lower glycated haemoglobin A1c.

Conclusion: This repeated cross-sectional study design lays the foundation for the association between health-related behaviours and glycated haemoglobin A1c among young people at risk of type 2 diabetes mellitus in Kuwait. Young people's behaviours are likely to be encouraged by their environment. Thus, the Kuwaiti Government has a responsibility to promote healthy environments to adopt healthy lifestyles. School nurses can play an important role in implementing intervention strategies to prevent type 2 diabetes mellitus and promote health-related behaviours. It is important that stakeholders ensure that school clinics are equipped with medical devices and materials. These materials help school nurses to early detect prediabetes and type 2 diabetes mellitus in school clinics. As a matter of priority, the type 2 diabetes mellitus prevention program should start early, as young people's behaviours could be shaped at a very early age, and it is possible for unhealthy behaviours to continue into adulthood.

Declaration

I certify that this thesis:

1. does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and
2. 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: 21 June 2023

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To Dr Meshari Alkoot and Mr Abdullah Najeeb, thank you for your support with data collection by providing me with the facilities I need to complete this stage, and for teaching me business tricks on how to deal with companies.

Professional editor, Rosemary Purcell, provided copyediting and proofreading services, according to the guidelines laid out in the university-endorsed national Guidelines for Editing Research Theses.

Dedications

I would like to dedicate this thesis to my parents (may they rest in peace) for believing that I was smart and that I was destined for larger and better things I never thought I could be. For allowing me to be a better son and a better person. For teaching me how to survive in life and how to become independent and a responsible father and husband.

To my wife, Alanoud, thank you for putting up with my moody and depressive self. Even when times were tough, you always found a brighter side to things, and believed that tough times were only temporary. You've always encouraged me and helped me see that the best is yet to come. To my precious daughter, Misk who only knows how to love me unconditionally. I know that it's taken longer than we wanted and seemed like a never-ending project, but I'm done now.

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To my siblings Yousef, Jassim, Zainab and Abdulaziz. Yes, I'm always studying, but this is the last (maybe!). I'm done (for now) and on my way home, and yes you can call me Dr brother.

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List of Publications and Posters

Oral Presentations

- Hasan, A. Woodman, R. Button, D. Parry, Y. (2023) School nurse-led, clinical trial to evaluate the effectiveness of an educational program in the prevention of T2DM among adolescents with elevated hba1c in Kuwait (protocol). Poster discussed at 29th ICN Congress that held in Montreal, Canada.

Poster presentations

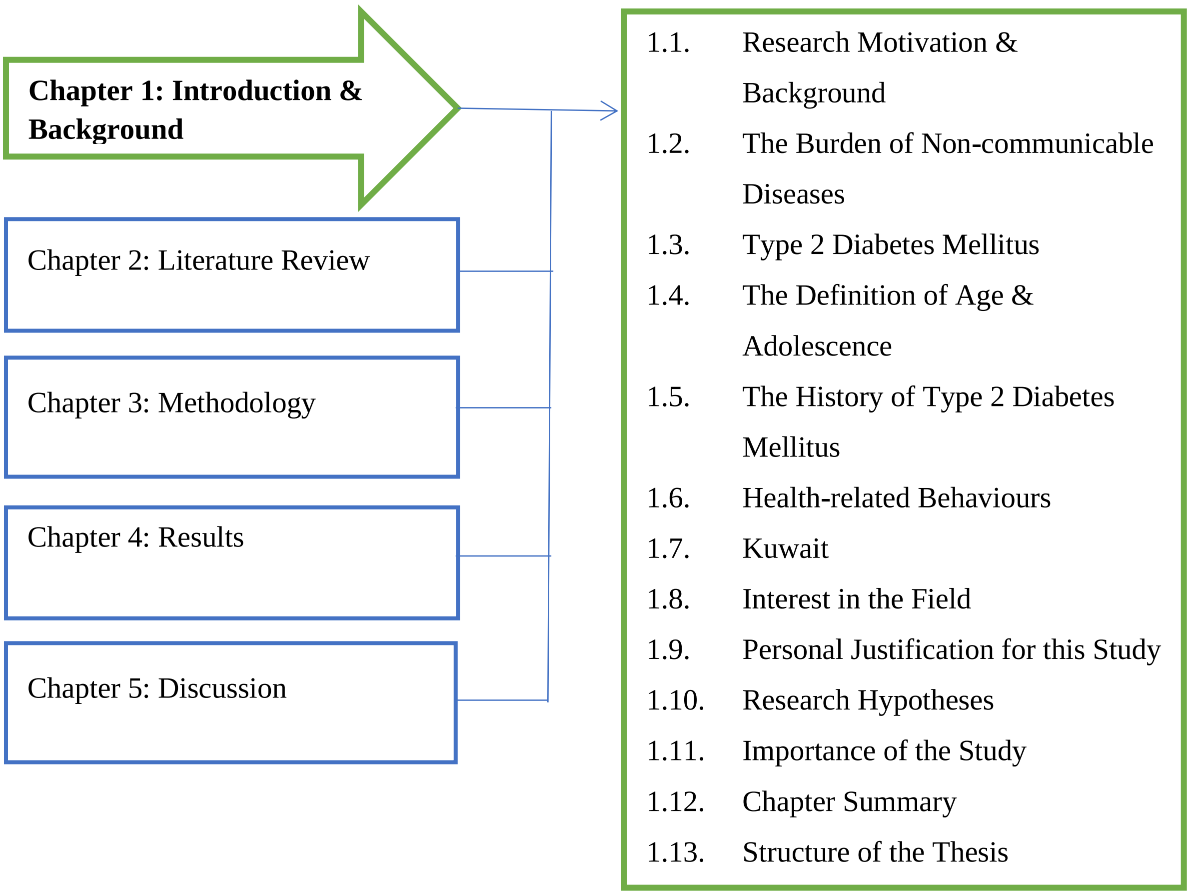
- Hasan, A. Woodman, R. Button, D, Parry, Y. (2023) The history of type 2 diabetes in children and adolescents in the MENA region – A scoping review. Poster presented at 29th ICN Congress that held in Montreal, Canada.
- Hasan, A. Button, D. Woodman, R. Parry, Y. (2022) Screening Kuwaiti young people aged 10–24 years for prediabetes and T2DM – A cross-sectional descriptive study. Poster presented at 25th IDF Congress held in Lisbon, Portugal.
- Hasan, A. Woodman, R. Button, D. Parry, Y. (2022) Association between HbA1c and health-related behaviours among Kuwaiti young people at risk of T2DM – Study protocol. Poster presented at 25th IDF Congress held in Lisbon, Portugal.
- Hasan, A. Woodman, R. Button, D, Parry, Y. (2022) An integrative literature review on the prevention of T2DM among children and adolescents in Kuwaiti schools' settings. Poster presented at 25th IDF Congress held in Lisbon, Portugal.
- Hasan, A. Alobaidly, Whitehead, D. Abigail, W. Hall, A. (2022) Evaluating the Healthy Lifestyle Behaviours of Nursing Students in Kuwait. Poster presented at 1st International Conference of Bahrain Nursing Society.

List of Abbreviations

ADA	The American Diabetes Association
BMI	Body Mass Index
CDC	The Centers for Disease Control and Prevention
CI	Confidence Interval
DDI	Dasman Diabetes Institute
EFA	Exploratory Factor Analysis
EMR	The Eastern Mediterranean Region
HbA1c	Glycated Haemoglobin A1c
ID	Identification Number
IDDM	Insulin-Dependent Diabetes Mellitus
IDF	International Diabetes Federation
JHNEBP	The Johns Hopkins Nursing Evidence-Based Practice
KDS	Kuwait Diabetes Society
KNA	Kuwait Nursing Association
KSA	Kingdom of Saudi Arabia
MENA	Middle East and North Africa

MODY	Maturity-Onset Diabetes of the Young
NCDs	Non-communicable diseases
NHMRC	The National Health and Medical Research Council
NIDDM	Non Insulin-Dependent Diabetes Mellitus
OGTT	Oral Glucose Tolerance Test
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT	Randomised Controlled Trial
SMS	Short Message Service
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
TODAY	Treatment Options for Type 2 Diabetes in Adolescents and Youth
UAE	United Arab Emirates
UK	United Kingdom
USA	United States of America
WHO	World Health Organization

Chapter 1: Introduction and Background



This is the first chapter of this thesis outlines the research project on the association between health-related behaviours and glycated haemoglobin A_{1c} (HbA1c) among Kuwaiti young people at risk of type 2 diabetes mellitus (T2DM). This chapter begins with a brief explanation of the significance of this research project, followed by the burdens of non-communicable diseases (NCDs) experienced by young people. T2DM in young people is then defined and elaborated, and the long-term impacts of T2DM and health expenditure on T2DM are presented. The health-related behaviours of young people are then described.

Kuwait is presented as the research setting, which includes discussion of its religion and culture, the health system and the economic shift that occurred from the 1960s. As the principal researcher, my interest in the field follows, which briefly describes my community nursing and research experiences related to this research project, as well as my personal justification for undertaking such a study. Finally, this chapter presents the research hypotheses, objectives and aim, the importance of the study, a chapter summary and an overview of the chapters in this thesis.

1.1 Research Motivation and Background

According to the World Health Organization (WHO), there is a growing public health crisis in the form of NCDs that requires attention and action from the international community (WHO, 2021). The annual global mortality ratio from NCDs is seven out of 10, accounting for 71% of all deaths (Bennett et al., 2018). There are four main NCDs responsible for significant levels of illness: cardiovascular disease, cancer, chronic respiratory disease and T2DM (W. H. O. WHO, 2019). These NCDs are characterised by a number of risk factors, including overweight/obesity, sedentary lifestyle, physical inactivity, unhealthy eating habits and substance abuse, for example, cigarettes and alcohol (Uddin et al., 2020). Moreover, Stanaway et al. (2018) state that high blood pressure, high blood glucose levels (hyperglycaemia), high levels of fat in the blood (hyperlipidemia) and overweight/obesity are metabolic changes that increase the risk of NCDs.

In the past, NCDs were considered as a group of diseases related to older adults and not as paediatric health issues. However, over the last 20 years, the incidence of NCDs in adolescents and young people has increased and has become a public health problem worldwide (Akseer et al., 2020; Organization, 2020). Mental disorders, substance abuse disorders and chronic physical illnesses are the leading causes of disability and mortality in adolescents and young people (Patton et al., 2016). Reducing the incidence of NCDs in adolescents and young people is a global priority in the Sustainable Development Goals developed by the United Nations in

2015 (Alfvén et al., 2019). The adolescent developmental period is marked by rapid physical growth, psychological development and social change, which can have considerable health consequences (Armocida et al., 2022). Developmentally, adolescents are more susceptible to adopting unhealthy lifestyle behaviours (Uddin et al., 2020). For example, adolescents and young people are more likely to undertake risky behaviours like alcohol and drug misuse, unprotected sexual activity and smoking, and these unhealthy behaviours might be expected within an adolescent's social development. Furthermore, Viner et al. (2012) acknowledge that 'adolescence is a second sensitive developmental period in which puberty and rapid brain maturation lead to new sets of behaviours and capacities that trigger or enable transitions in family, peer, and educational domains, and in health behaviours' (Viner et al., 2012, p. 1641). Young people share the same risk factors for NCDs as older adults, including overweight/obesity, sedentary lifestyle, physical inactivity and smoking (Alkatan et al., 2021).

While NCDs are a global issue, in some areas there is increasing prevalence. For example, countries in the Middle East and North Africa (MENA) have witnessed a rise in rates of NCDs in the last decades (Salti, 2020). With Kuwait being part of this region, this also predicts the rise of NCDs among its population. The next section shows how the prevalence of NCDs is a burden on this region.

1.2 The Burden of Non-communicable Diseases in North Africa and the Middle East

It is evident that MENA countries are not immune to the increase in NCD mortality and morbidity rates. Moreover, the trends in metabolic characteristics and health-related behaviours of the MENA region populations show that NCD mortality rates will continue to increase in the future (Salti, 2020). The reason for this increase is the growing prevalence of key modifiable behaviours such as a sedentary lifestyle, including a lack of physical activity; poor eating habits with an increase in the consumption of high calorific foods; inadequate sleeping routine with not enough hours of sleep or quality of sleep; and increased alcohol consumption. Second, there has been a rapid growth in the population of MENA regions (McKee et al., 2017). Figure 1.1 illustrates the estimated population growth Europe (excluding Russia), and MENA countries from 1950 to 2100.

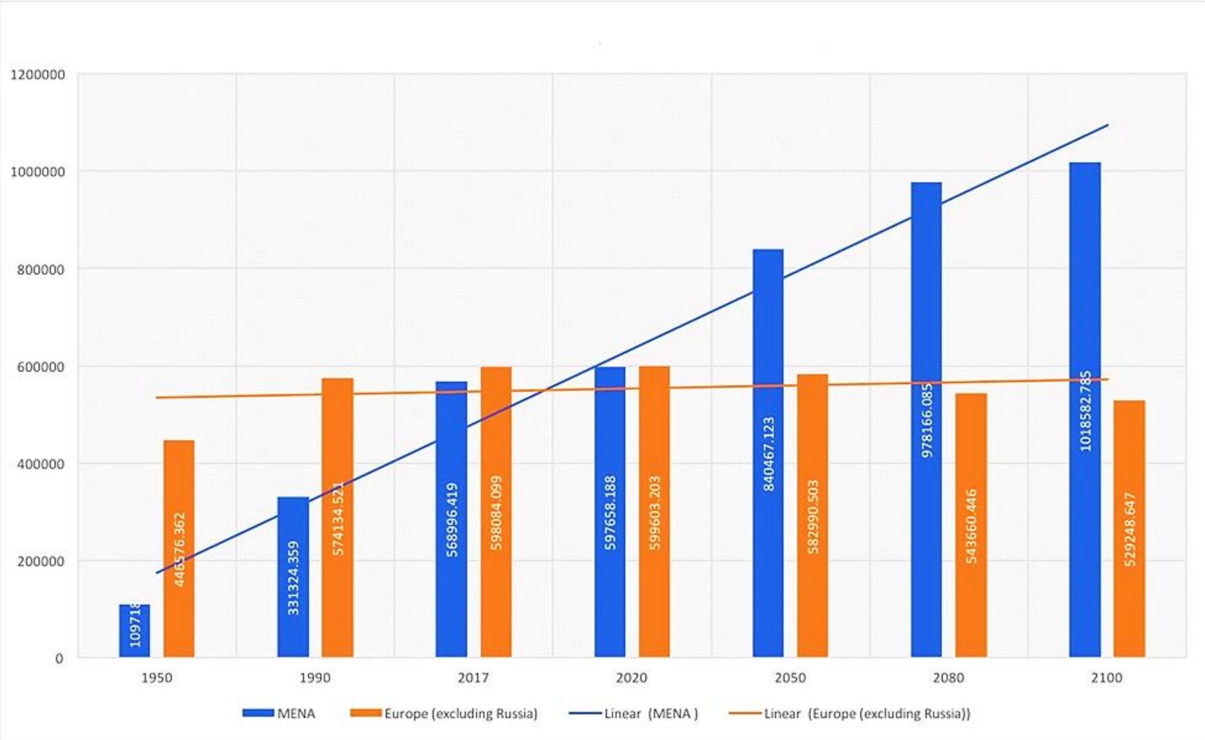


Figure 1.1: Estimated total regional population Europe (excluding Russia), and Middle East and North Africa 1950–2100

Note. Source: McKee et al. (2017)

Over the past five decades, the population of the MENA region has grown fivefold, from 110 million to 569 million, and, by 2100, the total number of inhabitants is expected to reach over 1 billion based on data from the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (McKee et al., 2017). This growth is accompanied by unplanned urbanisation in most of the region's countries (Bollyky et al., 2017). Karch and Collaborators (2018) state that youth aged 10–24 years make up a significant proportion of the population of this region. Despite the increase in NCD risk factors and NCD mortality rates, regional public health policy responses and regional research agendas have been insufficient (Aggarwal et al., 2020).

According to World Bank Group, the total population's life expectancy in Kuwait is 76 years. When reviewing the statistics on the Kuwaiti life expectancy by sex, men's life expectancy is lower than women's (75 years and 77 years, respectively) (Worldometer, 2022). This lower life expectancy for men is attributed to the rise in NCDs in Kuwait, where NCDs are the leading cause of death (WHO, 2020a).

From 2016, the burden of NCDs has increased rapidly in Kuwait, accounting for approximately 72% of all deaths (WHO, 2020a). Additionally, around 25% of adults suffer from two or more NCDs (Awad & Al-Nafisi, 2014). Peltzer et al. (2014) report that approximately 42% of undergraduate students in Kuwait are overweight and obese, which they attribute to low physical activity and poor nutritional habits. Some intervention strategies have been proposed to promote a change in the Kuwaiti lifestyle for adolescents, young people and adults (Behbehani, 2014). There are other authors who emphasise the need to develop health education programs to prevent the further spread of NCDs, such as cardiovascular disease, hypertension and diabetes in Kuwait (Al-Isa & Akanji, 2013; Alibrahim et al., 2021).

One of the most prevalent NCDs is diabetes mellitus. Diabetes mellitus is defined as a chronic disease that occurs either when the pancreas does not produce enough insulin (type 1 diabetes mellitus (T1DM), or when the body cannot effectively use the insulin it produces (T2DM. Table 1.1 shows the major classifications of diabetes mellitus: T1DM, T2DM, gestational diabetes mellitus (GDM) and maturity-onset diabetes mellitus in the young (MODY). The WHO suggests there are now multiple numbers of diabetes classifications from different genetic and metabolic pathways, and are other more or less common than type 2 diabetes in young people (WHO, 2019a).

Table 1.1: Etiological classification of diabetes mellitus

Type	Causes	Risk factors
T1DM*	Immune-mediated	Genetic susceptibility
T2DM*	Insulin resistance/hepatic glucose production/ insulin secretory deficiency/dysregulation of fat metabolism (Valaiyapathi et al., 2020)	Overweight/ethnicity/diet/factors inherent to the pancreas (Valaiyapathi et al., 2020)
GDM*	Insulin resistance during pregnancy	Age/Overweight/ Polycystic ovary syndrome
MODY*	Genetic defects of β cell function	Inherited defective gene
Diabetes-related to diseases	Exocrine pancreas/endocrinopathy	Age/high blood pressure/psychiatric conditions
Drug or chemically induced	Nicotinic acid/glucocorticoids/thyroid hormone	Age/infections/transparent

**Note.* T1DM = type 1 diabetes mellitus; T2DM = type 2 diabetes mellitus; GDM = gestational diabetes mellitus; MODY = maturity-onset diabetes mellitus in the young

Approximately 3% increase in the mortality rates in people with diabetes between 2000 and 2019. Lower to middle-income countries reported an increase of 13% mortality related to the diagnosis of diabetes mellitus (WHO, 2023). However, mortality rates related to other communicable disease such as cardiovascular diseases, cancer, chronic respiratory diseases or diabetes in people aged 30 to 70 has decreased by 22% globally during this time (WHO, 2023).

1.3 Type 2 Diabetes Mellitus

This section starts with the prevalence of T2DM in the MENA region. Moreover, this section presents the pathophysiology, etiology and risk factors for T2DM, including as they relate to children and adolescents. The long-term impacts of T2DM on children and adolescents follow. The section continues with a discussion about prediabetes, and concludes with information about the healthcare system and healthcare expenditure in Kuwait.

1.3.1 The prevalence of type 2 diabetes mellitus in the Middle East and North Africa region

T2DM is a common and significant health problem worldwide, and is responsible for almost 95% of diabetes cases (WHO, 2019). There are approximately 537 million people living with diabetes worldwide (aged 20–79 years); the number is projected to reach 643 million by 2030 and 783 million by 2045, according to the International Diabetes Federation (IDF, 2022). Based on age-adjusted comparative diabetes prevalence, the MENA region had the highest comparative prevalence of diabetes at 18.1% in 2021, and it is projected that it will reach 20.4% by 2045. This prediction places the MENA region at the top of all IDF regions. There are three countries that have reported the highest comparative diabetes prevalence rates in 2021: Pakistan 30.8%, French Polynesia 25.2% and Kuwait 24.9%. In 2045, Pakistan, with 33.6% of the comparative diabetes prevalence rate, is expected to have the highest overall prevalence of diabetes, followed by Kuwait and French Polynesia with 29.8% and 28.2%, respectively (see Table 1.2) (IDF, 2022).

Table 1.2: Top 10 countries or territories with age-adjusted comparative diabetes prevalence in adults (20–79 years) in 2021 and predictions for 2045

2021			2045		
Rank	**Country or territory**	**Comparative diabetes prevalence (%)**	**Rank**	**Country or territory**	**Comparative diabetes prevalence (%)**
1	Pakistan	30.8%	1	Pakistan	33.6%
2	French Polynesia	25.2%	2	**Kuwait**	29.8%
3	**Kuwait**	24.9%	3	French Polynesia	28.2%
4	New Caledonia	23.4%	4	Mauritius	26.6%
5	Northern Mariana Islands	23.4%	5	New Caledonia	26.2%
6	Nauru	23.4%	6	Northern Mariana Islands	26.2%
7	Marshall Islands	23.0%	7	Nauru	26.2%
8	Mauritius	22.6%	8	Marshall Islands	26.0%
9	Kiribati	22.1%	9	Kiribati	24.1%
10	Egypt	20.9%	10	Egypt	23.4%

Note. Adapted from International Diabetes Federation Diabetes Atlas (IDF, 2022)

Based on a survey conducted in 2016 by the Kuwaiti Ministry of Health and the WHO, 572,124 Kuwaiti citizens have diabetes, out of an overall population of 3,892,000 which means that the prevalence of diabetes was 14.7% (WHO, 2016). Alowayesh et al. (2022) state that the estimations of the IDF Diabetes Atlas 9th edition, indicates that the prevalence of diabetes among Kuwaiti adults is 22.0%, which is more than twice the estimated prevalence of diabetes around the world of 9.3%. Moreover, the authors acknowledge that the prevalence of diabetes in Kuwait, which had been predicted to be 16.9% by 2030, has already exceeded expectations (El-Kebbi et al., 2021). It has been reported that between 2000 and 2014, the prevalence of diabetes among the adult population of some MENA region countries increased. Kuwait maintained the highest prevalence among these countries, with a prevalence of 19.6% (El-Kebbi et al., 2021). Figure 1.2 illustrates the comparative ranking of the prevalence of T2DM between 2000 and 2014.

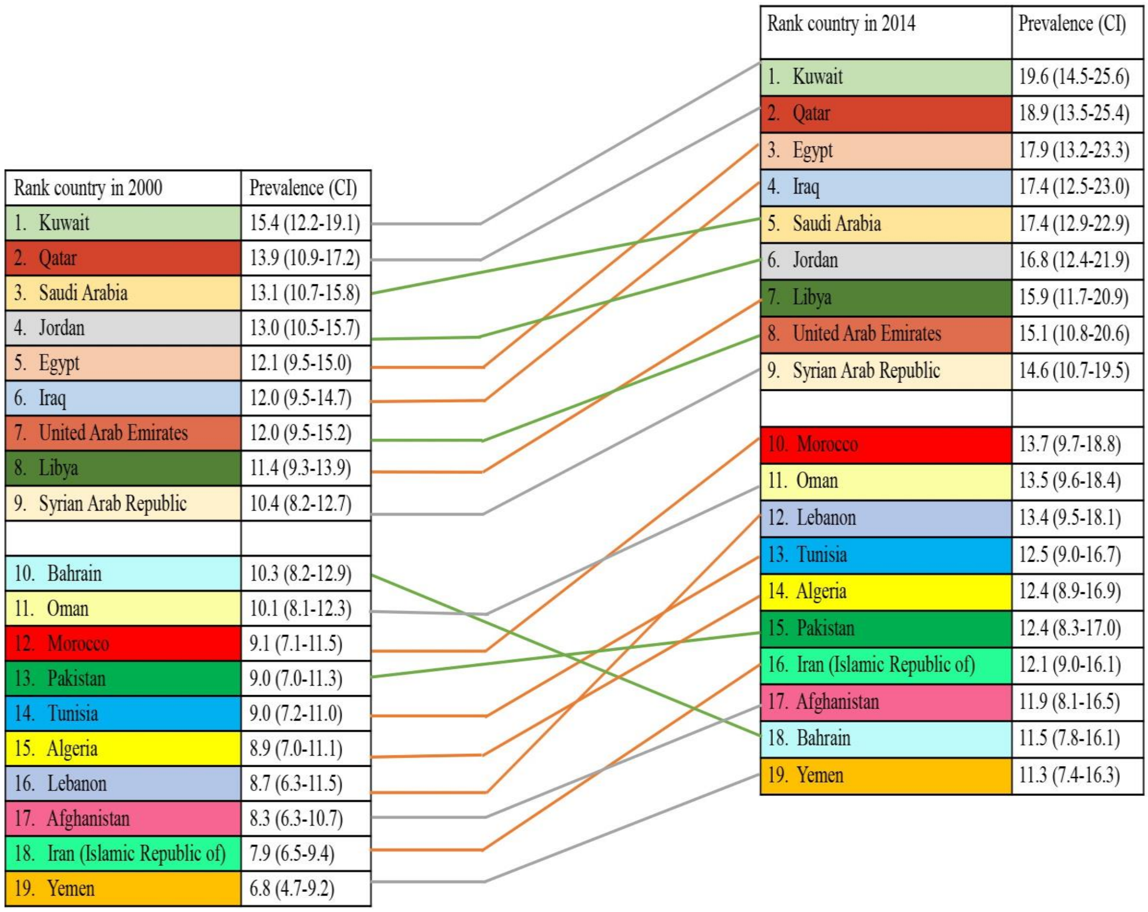


Figure 1.2: *Middle East and North Africa countries ranked by prevalence of type 2 diabetes in 2000 and 2014*

Note. Source: (El-Kebbi et al., 2021. Reproduced under the CC-BY-NC licence)

It is no longer accurate to believe that T2DM occurs only in adults and type 1 diabetes (T1DM) occurs only in children, as, according the American Diabetes Association (ADA), both types of this disease can occur in any age group (Association, 2019). In general, T2DM is diagnosed during adulthood; however, recently, there have been increasing incidents during childhood linked to the global rise in the prevalence of overweight and obesity (Low et al., 2009; WHO, 2020b).

There is a growing concern globally regarding the health impacts of the increasing number of cases of T2DM among children and adolescents in Canada (Amed et al., 2010). The incidence of T2DM among Canadian children and adolescents between 2002 and 2013 increased from 3.45 per 100,000 to 5.16 per 100,000, and these rates are expected to increase by five -fold by

2030 (Amed et al., 2018). In the United States of America (USA), the prevalence of T2DM increased by 30% between 2001 and 2009 among the youth population (Vijayakumar et al., 2017). In addition to the USA and Canada, an increased incidence of T2DM among children has also been noticed in countries like Japan, China, Bangladesh, Taiwan and Australia (Temneanu et al., 2016).

In the MENA regions, T2DM's prevalence is considered to be one of the highest worldwide (Abuyassin & Laher, 2016). Health behaviour factors, such as obesity (a body mass index (BMI) of over 25) (Aschner, 2017) from an unhealthy lifestyle, and genetic characteristics are the main factors that Arabic children with T2DM share (Abuyassin & Laher, 2016). Two studies conducted in Sudan and Egypt found an increase in the incidence of T2DM in their youth population aged between 7 and 18 years (Ali et al., 2013). The Saudi Abnormal Glucose Metabolic and Diabetes Impact study is a nationwide cross-sectional study that evaluated 23,535 Saudi children and adolescents aged 18 years and below from 2007 to 2009. It found that about 10% of participants were known cases of diabetes or had been newly diagnosed with diabetes (Al-Rubeaan, 2015).

In Kuwait, the prevalence of T2DM among children and adolescents aged between 6 and 18 years is 34.9 per 100,000, of which one-half of the diagnosed children have a family history of the condition (Moussa et al., 2008). While a family history of T2DM indicates a genetic predisposition, it can also indicate unhealthy eating and exercise behaviours.

1.3.2 The pathophysiology of type 2 diabetes mellitus

The pathophysiology and etiology of T2DM are multifactorial, encompassing genetic, environmental and lifestyle factors. T2DM is known as a metabolic disorder characterised by hyperglycemia (high blood glucose levels) resulting from insulin resistance and impaired insulin secretion. Insulin is a type of hormone that is responsible for regulating glucose in the blood. An increase in glucose levels triggers insulin production by beta cells in the pancreas.

Figure 1.3 illustrate the pathophysiology of T2DM.

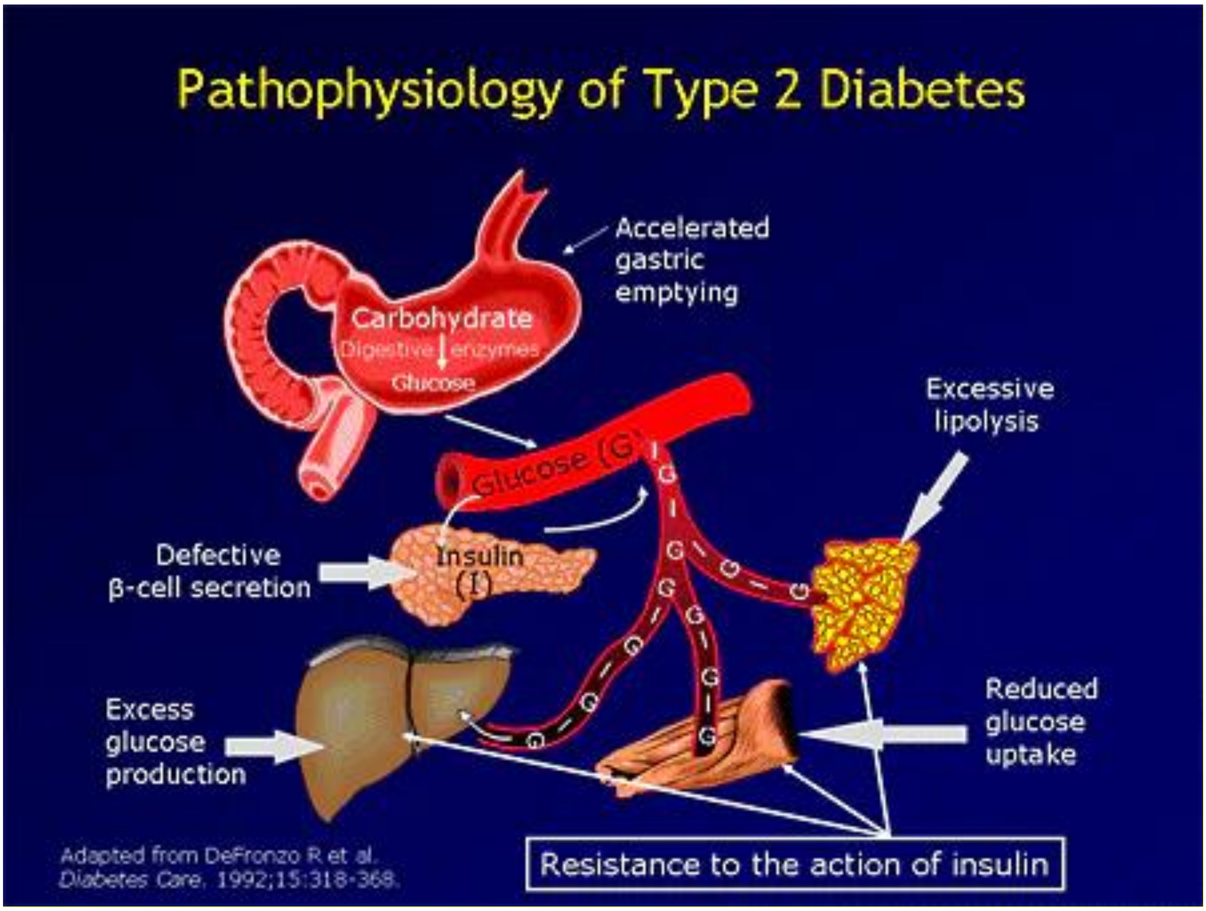


Figure 1.3: Pathophysiology of T2DM

Note source: (DeFronzo et al., 1992)

Insulin binds to the insulin receptors on target cells (liver, muscle, adipose tissue) and promotes glucose uptake and glycogen synthesis. In T2DM, insulin sensitivity (the ability of target cells to respond to insulin) is reduced due to several mechanisms, including impaired insulin receptor signalling, intracellular lipid accumulation and chronic inflammation (Taylor, 2012; Wondmkun, 2020). If T2DM is left unmanaged, it would lead to microvascular and macrovascular complications, which means damaging the nerves and blood vessels that support the body’s vital organs (WHO, 2023). In people with T2DM, elevated blood glucose levels in the kidney cause glucose and sodium to be reabsorbed into the kidney. This leads to an increase in weight and blood pressure. In addition, people who are undiagnosed with T2DM are able to live for a long time without knowing their disease. This is particularly important for adolescents and young people because they could be left without treatment for a long time, which could contribute to the development of more severe diabetes-related complications.

T2DM is commonly found in adults but has recently begun to appear in childhood and adolescence (Lascar et al., 2018). Compared to adults, these children and adolescents, even with current diabetes management protocols, were found to have a rapid rate of acquiring clinical diabetes complications (Valaiyapathi et al., 2020). Approximately 30% to 80% of people who live with diabetes remain undiagnosed, because symptoms such as polyuria (excessive production of urine) and polyphagia (feeling of extreme and insatiable hunger) are unrecognised (WHO, 2023).

The development of T2DM has been associated with a number of genetic and environmental risk factors. In genetic studies, a number of gene variants have been associated with T2DM (Mahajan et al., 2018). Aside from this, environmental risk factors include unhealthy diets, physical inactivity, sleep disorders, being overweight, a sedentary lifestyle and aging (Association, 2020). The pathophysiology and etiology of T2DM are complex and multifactorial, involving impaired insulin secretion and insulin resistance, as well as genetic and environmental risk factors. However, early detection and appropriate management of T2DM using lifestyle modifications can decrease the prevalence of T2DM, improve outcomes and mitigate complications.

1.3.3 Etiology and risk factors associated with the development of type 2 diabetes mellitus

Several risk factors have been found to be associated with the development of T2DM. These include obesity and overweight, family history, sleep disorder, mental health, physical inactivity, unhealthy eating habits and smoking. These risk factors, including in relation to young people, are presented in detail in the following sections.

1.3.3.1 Overweight and obesity

Overweight and obese is defined by BMI. A BMI of ≥25–<30 kg/m2 is considered overweight, and ≥ 30 kg/m2 obese (Weir & Jan, 2019). Compared to individuals with an average weight or less, people with obesity have a six-fold increased risk of developing T2DM, while people who are overweight have a 2.4-fold increased risk (McSharry et al., 2020). Recent studies have shown that measuring waist circumference instead of BMI is a more accurate means of identifying obesity in patients with T2DM compared to measuring BMI (Terencio et al., 2017), where abdominal fat accumulation was found to be associated with insulin resistance (Hardy et al., 2012). Menke et al. (2015) state that 85% to 90% of the participants in their study were overweight or obese because of the accumulation excess of fat in their abdomen.

Obesity/overweight in adolescents and young people: The global prevalence of obese/overweight children and adolescents has increased dramatically over the past 40 years. Globally, developed and developing countries have been affected by the impacts of increasing obesity and overweight populations. The WHO statistics state that the worldwide prevalence of obese and overweight children and adolescents aged 5–9 years had grown from 4% in 1975 to approximately 18% in 2016 (WHO, 2020b). Developed and developing countries have high rates of obese/overweight children and adolescents. For example, in developed countries, the study evaluated rates of overweight and obesity in 15 European countries, finding that the prevalence of adolescent obesity ranged between 18% and 57% (WHO, 2018).

According to the Canada Health Survey, one in seven adolescents (approximately 14%) are overweight or obese (Bancej et al., 2015). Furthermore, Gupta et al. (2013) reported statistics from several developing countries showing the prevalence of obesity/overweight among adolescents found in Mexico as 42%, Brazil as 22%, India as 22% and Argentina as 19%. In the Eastern Mediterranean Region (EMR), a study reported that the prevalence of overweight and obesity ranged from 7% to 45% among adolescents (Musaiger, 2011).

Kuwait has one of the highest obesity rates in the EMR. The statistics in Kuwait have followed the global trend of increasing obesity in adolescents. Several studies have claimed that one-third of this population in Kuwait is considered to be overweight or obese (Musaiger et al., 2012; Zaghloul et al., 2013). Allafi et al. (2014) report that about 50% of Kuwaiti adolescents aged between 10 and 19 years are considered overweight or obese based on the Kuwait National Nutrition Surveillance System.

These findings parallel data from the WHO, which state that 42.4% of Kuwaiti children and adolescents were overweight between 2007 and 2012. This is supported by a study conducted across 22 Arabic countries indicating the percentage among children aged 13–15 years, reporting that 46.8% of Kuwaiti girls and 55.8% of Kuwaiti boys are overweight or obese (Obermeyer et al., 2015). Figure 1.3 below provides a summary across several MENA countries on the rates of overweight and obesity in children aged 13–15 years Based on the WHO Global School-Based Health Surveys.

Image removed due to copyright restriction.

Figure 1.3: Percentage of girls and boys aged 13–15 years who were overweight or obese in the most recent World Health Organization Global School-Based Health Surveys, 2007–2012. Countries are displayed in alphabetical order

Note. Source: (Obermeyer et al., 2015, p. 3)

The comparison from Obermeyer et al. (2015) in Figure 1.3 above illustrates the percentage of children who are overweight or obese in some MENA countries. The children in Kuwait represented the greatest percentage of overweight or obese children in this grouping, followed by the United Arab Emirates (UAE) with 35.9% of girls and 42% of boys. Furthermore, the prevalence of obesity in children has increased from 7.1% in 1975 to almost 23% in 2016 (WHO, 2020b). A study evaluating the prevalence of obesity among children in eight Arabic countries found that 21.1% of girls and 28.6% of boys were obese in Kuwait (Musaiger et al., 2016). Kuwait ranks at the top of childhood overweight and obesity in the EMR (Musaiger et al., 2016; Obermeyer et al., 2015). The prevalence of overweight and obesity among Kuwaiti children is high, and this population practices poor health-related behaviours (Alrashidi, Shahwan-Akl, James, et al., 2015). In addition, parents and caregivers of children in Kuwait underestimate the impact of childhood obesity (Alrashidi, Shahwan-Akl, Jones, et al., 2015). Childhood obesity has serious public health issues with short and long-term health consequences (Elkum et al., 2016). The short-term health consequences of obesity in children include psychological and psychiatric health issues, as well as low self-esteem and behavioural problems (Reilly et al., 2003). In addition, asthma has been found to be associated with childhood obesity (Castro-Rodriguez et al., 2001). The long-term health consequences are polycystic ovary syndrome symptoms, cardiometabolic diseases (Reilly & Kelly, 2011), and a strong association between childhood obesity and metabolic syndrome (A. M. Lee et al., 2016; Nehus & Mitsnefes, 2019).

Figure 1.4 shows that the prevalence of obesity in Kuwait has been steadily increasing from 1975 until 2016.

Image removed due to copyright restriction.

Figure 1.4: Prevalence of obesity in Kuwait

Note. Source: Global Health Observatory - World Health Organization, 2017

1.3.3.2 Family history

Studies have shown that there might be a genetic component that is passed down through families that could contribute to the development of T2DM and diabetes complications (Cole & Florez, 2020; Harrison et al., 2003; van't Riet et al., 2010). Findings from a German study that involved a large sample (8,106 adults without diabetes) from four centres for diabetes research, found that there is a strong association between prediabetes and T2DM and a first-degree family member who has diabetes (Wagner et al., 2013). Moreover, a high HbA1c level was associated with a family history of diabetes in adults with and without diabetes (Lee et al., 2018). Therefore, it is imperative that all members of a family are screened for T2DM as a form of early intervention in order to map the prevalence within the family and avoid progression to the condition.

Family history of T2DM in adolescents and young people: In terms of family history, there is an inverse correlation between the strength of the family history and the age at which the disease is diagnosed (Aguilar-Salinas et al., 2001; Frayling et al., 2003; Molyneaux et al., 2004; Ng et al., 2001). In a comparison study of early onset of T2DM between young adults (<40 years) and adults (≥40 years), results revealed that young adults had a more frequent positive family history of T2DM and higher HbA1c (Kim et al., 2010). Rosenbaum et al. (2004) claim that familial influence on T2DM susceptibility was found to be associated with impaired β-cell function and insulin resistance among adolescents aged 11–15 years. Even though family history strongly influences the early onset of T2DM, it is crucial to investigate other factors such as physical, psychological and social factors that might lead to T2DM, particularly in adolescents and young people (Lascar et al., 2018).

1.3.3.3 Sleep disorders

The prevalence of T2DM is high among adult patients with insomnia, and the risk may be increased between 30% and 60% among patients with prediabetes (LeBlanc et al., 2018). A higher level of cortisol in the blood serum is linked to an increase in insulin resistance in the body (Spiegel et al., 2004). Furthermore, inadequate sleep quality can be considered an independent risk factor for increasing the incidence of T2DM (J. A. Lee et al., 2016). Thus, sleeping for less than six hours a day was found to be correlated with an increased incidence of

T2DM (Lou et al., 2012). Despite the growing body of evidence supporting an independent association between obstructive sleep apnoea and T2DM, a causal link between them remains to be identified (Pamidi & Tasali, 2012).

Sleep disorders in adolescents and young people: The lack of quality sleep in adolescence increases the risk of T2DM, directly by impacting glucose sensitivity and indirectly by increasing dietary intake, adopting a sedentary lifestyle and gaining extra weight (Monzon et al., 2022; Simon et al., 2021). Evidence from observational studies suggests that short sleep duration and poor sleep quality contribute to insulin resistance and T2DM in this age group (Dutil & Chaput, 2017). Moreover, a higher HbA1c was associated with daytime sleepiness and poor sleep quality among overweight youth at risk for T2DM (Mokhlesi et al., 2019).

There is evidence that social media use leads to higher rates of depression as well as poor quality sleep among adolescents (Lee et al., 2023). The adolescents who brought their smartphones to bed had poorer sleep quality as compared to those who did not bring smartphones to bed (Lee et al., 2023). The findings of Kortesoja et al. (2023) suggested that the negative effects of late-night social media use are reflected especially in sleep quality and daytime tiredness among adolescents.

1.3.3.4 Physical inactivity

In recent years, the research on the relationship between physical inactivity and NCDs, particularly T2DM, in both adolescents and adults has increased (Cleven et al., 2020; Ding et al., 2020; Kriska et al., 2021; van Sluijs et al., 2021; Wang et al., 2018). Globally, physical inactivity is recognised as a pandemic and the fourth leading cause of death (Kohl 3rd et al., 2012). Researchers have investigated the long-term association between physical activity and metabolic syndrome, as well as the prevention of T2DM, and discovered that the development of T2DM is inversely related to physical activity. In addition, T2DM and metabolic syndrome are strongly associated with physical activity (Kriska et al., 2021; Wang et al., 2018). There is robust evidence to support the argument that physical activity not only prevents or delays the onset of T2DM (Kodama et al., 2013), but also promotes the management of other health conditions such as depression (Kandola et al., 2020), cancer (Cormie et al., 2018; Friedenreich et al., 2016) and coronary heart disease (Anderson et al., 2016).

Physical inactivity in adolescents and young people: Moderate-to-vigorous physical activity of 60 minutes per day is recommended by the WHO for children and adolescents aged younger than 18 years (Bull et al., 2020). Physical inactivity in adolescence is associated with an increase in NCD prevalence and NCD risk factors, for example, T2DM (Lascar et al., 2018), hypertension (Song et al., 2019) and obesity (Johnson et al., 2015). It has been observed that physical inactivity plays a major role in the prevalence of T2DM and prediabetes in the MENA region (El-Kebbi et al., 2021).

Authors claim that despite the evidence supporting the role of physical activity in the prevention of NCDs and NCD risk factors, there is little likelihood that adolescents will change their behaviours in order to benefit their future health (Ding et al., 2020). In addition to NCDs, morbidity and premature mortality, physical inactivity is responsible for a substantial economic burden (Ding et al., 2016).While there has been an increase in research on adolescents, there are still important knowledge gaps, and efforts should be made to improve research, intervention implementation, and policy development related to adolescent physical activity (van Sluijs et al., 2021).

There is, therefore, a need for further research on the immediate health benefits associated with physical activity in older adolescents and young adults (van Sluijs et al., 2021). This thesis reports on the investigation undertaken by the principal researcher into the association between physical inactivity and T2DM and prediabetes among Kuwaiti young people aged between 10 and 24 years.

1.3.3.5 Unhealthy eating habits

Food production and distribution systems have undergone substantial changes as a result of economic growth, which has led to increased access to unhealthy food (Popkin et al., 2012). Diet-associated NCDs and obesity are increasing as a result of massive food production and the availability of unhealthy food (Willett et al., 2019). Moreover, a large share of the global disease burden caused by NCDs is due to unhealthy eating habits and dietary risk factors (Ezzati & Riboli, 2013). These factors increase BMI, increase blood pressure and elevate blood glucose levels (Ezzati & Riboli, 2013). Ley et al. (2014) state that in spite of unhealthy eating habits having long been believed to be a major contributor to T2DM and prediabetes, it is only during the last 20 years that a considerable amount of evidence has been gathered through both observational studies and clinical trials. Findings from the Whitehall II study (McNaughton et al., 2008) show a positive correlation between the likelihood of developing T2DM and dietary patterns that include a lot of soft drinks, burgers, fried foods, jam on white bread and little wholegrain consumption in the adult population. These findings have been confirmed by recent studies where researchers found a high intake of chocolate, sugars, low-fibre bread and butter, and a low intake of fresh fruits and vegetables are associated with a higher incidence of T2DM (Gao et al., 2022; Wu et al., 2021). In addition, the continuous consumption of red meat from childhood to adulthood is strongly associated with a higher risk of impaired fasting glucose levels (Wu et al., 2021). However, Gao et al. (2022) state that in their study the incidence of T2DM was more particularly among younger participants and those who were obese.

Unhealthy eating habits in adolescents and young people: It is becoming increasingly evident that adolescent nutrition plays a crucial role in optimising health and health-related behaviours during this stage of life (Patton et al., 2016). There is a high tendency among adolescents to adopt unhealthy lifestyles, for example, sedentary behaviours, excessive use of smartphones and computers, skipping meals and eating foods that are low in nutrients (Abreu & Kaiser, 2016; Hobbs et al., 2015). In addition, sexual maturation is associated with hormonal changes in this population (Abreu & Kaiser, 2016). As a result, adolescents are considered to be at risk of developing NCDs during their adolescence (Agirbasli et al., 2016; Hobbs et al., 2015). In youth, the consumption of calorie-dense diets, sugar-sweetened beverages and physical inactivity are the main risk factors for developing T2DM (Gow et al., 2016; Lascar et al., 2018). Based on the evidence currently available, diets that are low in carbohydrates may be particularly beneficial for improving risk factors for T2DM in youth (Gow et al., 2016).

1.3.3.6 Mental health

The risk of T2DM is associated with psychological disorders such as anxiety and depression (Lindekilde et al., 2019). Mezuk and colleagues reported a 1.6-fold increased risk of developing T2DM for people with depression when they were followed up for a duration of 3.0 to 15.6 years (Mezuk et al., 2008). It was also found that individuals with anxiety had a 1.3-fold higher risk of developing T2DM in their lifetime than individuals without anxiety (Smith et al., 2013). Those suffering from schizophrenia double their risk of T2DM (Stubbs et al., 2015) as they have an increased rate of eating disorders (Kalra et al., 2018). In addition, a study on health-related behaviours among university students found that mental health issues were associated with developmental transitions from adolescence to young adult, which could also contribute to these individuals' risk of developing chronic health conditions if not appropriately managed (Hasan, 2019).

Mental health in adolescents: There is substantial variation in risk factors for physical morbidities and mental disorders across the life span; however, it is believed that most mental disorders develop during childhood and adolescence (Patel et al., 2018). Risk factors for NCDs and T2DM such as smoking, unhealthy eating habits, a sedentary lifestyle and alcohol abuse, are usually clustered in people suffering from mental illness (Stein et al., 2019). Authors report that childhood depression and anxiety are associated with the risk of early adulthood onset of chronic conditions such as cardiovascular diseases, chronic headache, asthma and T2DM (Cohen et al., 2015; Scott et al., 2011; Vancampfort et al., 2016).

Children and adolescence who suffer from obesity were found to have higher risk for depression (Rao, et. Al., 2020; Lindberg et al, 2020). Recently, young people with depression were found to have increased risk for diabetes (Farooqi et al., 2022). Therefore, this suggests that there is a significant link between depression, obesity and diabetes in young children and adolescents.

Despite there being existing evidence supporting the integration of mental health and NCDs, Stein et al. (2019) emphasise the need for additional research in low and middle-income countries.

1.3.3.7 Smoking

Smoking is a well-known a risk factor for developing T2DM, as well as a significant contributor to cardiovascular diseases (Chang, 2012). Moreover, the US Department of Health and Services claims that the risk of developing T2DM is 30% to 40% higher for smokers than non-smokers (Courtney, 2015). The authors of two studies in the United Kingdom (UK) and Kuwait (Dare et al., 2015; Oguoma et al., 2021) claim that there is a strong association between smoking and central obesity in adults. Moreover, cigarette smoking was also found to increase their waist-to-hip ratios (Yun et al., 2012), which means smoking contributes to fat distribution (Fujiyoshi et al., 2016) and as a result, insulin resistance (Campagna et al., 2019). According to the study by Chasens et al. (2018), cigarette smoking is a predictor of higher HbA1c levels, providing additional support for the cessation of smoking among adults with T2DM. Nonetheless, all of the risk factors are associated with a higher risk of T2DM as people age. The consequences for those with T2DM are exacerbated with age and are higher in those people who develop the condition in adolescence (Bertoni et al., 2018).

Smoking in adolescents: A Longitudinal Survey of USA Youth, conducted over 30 years, investigated the impact of adverse childhood experiences on the early onset of T2DM. It revealed associations between adverse childhood experiences and increased risky health behaviours that could lead to the development of T2DM (Lown et al., 2019). The rise in risky health behaviours such as alcohol abuse and cigarette smoking may partially explain the reason for the increased incidence of T2DM among young people (Lown et al., 2019). Moreover, findings from the SEARCH for Diabetes in Youth study list a few risk factors found in young people with T2DM; sex (male), age (older adolescents) and smoking (Jaiswal et al., 2018). In addition, the NCDs Countdown 2030 collaboration, which aims to decrease the global burden of NCDs, recommends effective policies that target a considerable reduction of smoking and alcohol use to help in a substantial reduction of chronic diseases and their risk factors (Bennett et al., 2018).

The risk factors discussed in this section were found to contribute to the development of T2DM in adolescents and young people. It is important to note that the 2016 Lancet Commission on Adolescent Health and Wellbeing urged investment in preventing NCDs, minimising NCD risk factors and promoting health-related behaviours among adolescents (Patton et al., 2016). The next section presents the long-term impacts that T2DM has been found to have on adolescents and young people where it was not prevented and managed efficiently.

1.3.4 Long-term impacts of type 2 diabetes on adolescents and young people

In youth with T2DM, there are unique characteristics, such as a more rapid decline in β-cell function and accelerated development of complications, that differentiate it from T1DM and

T2DM in adults (Arslanian et al., 2018). Treating T2DM in young people is complex and expensive. Consequently, it may be challenging to maintain health-related behaviour changes and self-management behaviours (American Diabetes, 2021; Copeland et al., 2011). There is limited evidence relating to psychiatric disorders and mental health issues in youth with T2DM (Cefalu, 2013; Reinehr, 2013). However, there is evidence that depression and eating disorders are associated with poorer blood glucose control in this population (Lawrence et al., 2006; Pinhas-Hamiel et al., 2015; Wilfley et al., 2011).

In comparison to T1DM, young-onset T2DM is associated with greater mortality and more disease complications (Constantino et al., 2013). Adolescents and young people with T2DM typically have a more aggressive form of the disease, including less sensitivity to medications to lower glucose levels and greater insulin resistance (Kasmauski, 2018). When individuals are diagnosed with T2DM at an early age, it leads to a long disease exposure and a greater risk of chronic complications. In addition, it is possible that comorbidities are already present at the time of diagnosis (Copeland et al., 2011). It appears that these diabetes comorbidities are also more common in youth with T2DM than youth with T1DM, despite a shorter duration of the disease and lower HbA1c (Eppens et al., 2006). This means increased morbidity and mortality among those of working age, thus aggravating the impact of the disease on society and impacting the quality of life of young people (Lascar et al., 2018).

On exploring the health issues related to T2DM, insufficient research has been found that focuses on preventing T2DM among adolescents and the young population in Kuwait. This current study focuses on the Kuwaiti young people at risk of T2DM, aged between 10 and 24 years, as the target population.

Prior to being diagnosed with T2DM, several signs and symptoms are found among children, adolescents, young people and adults. The next section briefly discusses and explains the prediabetes phase.

1.3.5 Prediabetes

It is common for individuals to experience a period of prediabetes prior to developing T2DM (Khetan & Rajagopalan, 2018). Prediabetes is a state characterised by impaired insulin excretion, insulin resistance and insulin hypersecretion (Khetan & Rajagopalan, 2018). The ADA uses the term ‘prediabetes’ for glucose levels that are too high to be considered normal for an individual but do not meet the criteria for diabetes (Association, 2019). There is little doubt that the transition from prediabetes to T2DM may take many years, but it may also be rapid. Several studies estimate that approximately 70% of individuals who have prediabetes eventually develop T2DM (Buysschaert & Bergman, 2011; Ferrannini et al., 2004; Nathan et al., 2007). Spurr et al. (2020), in a recent systematic review, claim that the prevalence of prediabetes among adolescents could reach up to 14.3% in various regions around the world. The condition of prediabetes should not be considered a clinical entity in itself, instead being viewed as an increased risk factor for heart disease and T2DM (Association, 2019). There is an association between prediabetes, overweight and obesity (especially visceral or truncal obesity), family history, dyslipidemia and hypertension (Hsu et al., 2015). The transition for adolescents from prediabetes to full diabetes is understudied. It may be that the criteria for testing for prediabetes and screening for prediabetes in asymptomatic children, adolescents and young adults is insufficient. This is an important gap in the research and has important implications for adolescents’ future quality of life and is the focus of this thesis. The process for studying diagnostic processes is further explained in Chapter 3, Section 3.7.

Furthermore, the failure to intervene early in the life of the young person and early in the disease process has financial implications for the individual, community and society. Young people with T2DM have poorer health outcomes and disease progression that is more rapid than that of adults. The expenditure by the healthcare system on T2DM is briefly presented in the following paragraphs.

1.3.6 Healthcare expenditure on type 2 diabetes mellitus

Rahman et al. (2018) state that healthcare expenditure is measured based on the share of payments that are made by individuals and governments related to health-related goods and services, which include healthcare for individuals (preventive and curative) and healthcare for communities. There are several factors that contribute to the rise in health expenditure, including:

- Demographic changes: As the population ages, conditions associated with old age are expected to require more care and social services in order to manage them (Cristea et al., 2020).
- New technologies: The introduction of new technology increases the cost of healthcare by increasing the price of medicines and devices (Agha, 2014).
- Expectations: As compared to the previous generation, people now expect more care, including management of diseases and long-term complications, and an increased life expectancy (Watt et al., 2019).
- Healthcare expenses: Due to high healthcare staff salaries, and the cost of education and training, prices for healthcare services increase faster than prices for other sectors (Levit et al., 2002).

Figure 1.5 below illustrates the total health expenditure, per head of population, of various European countries and the USA.

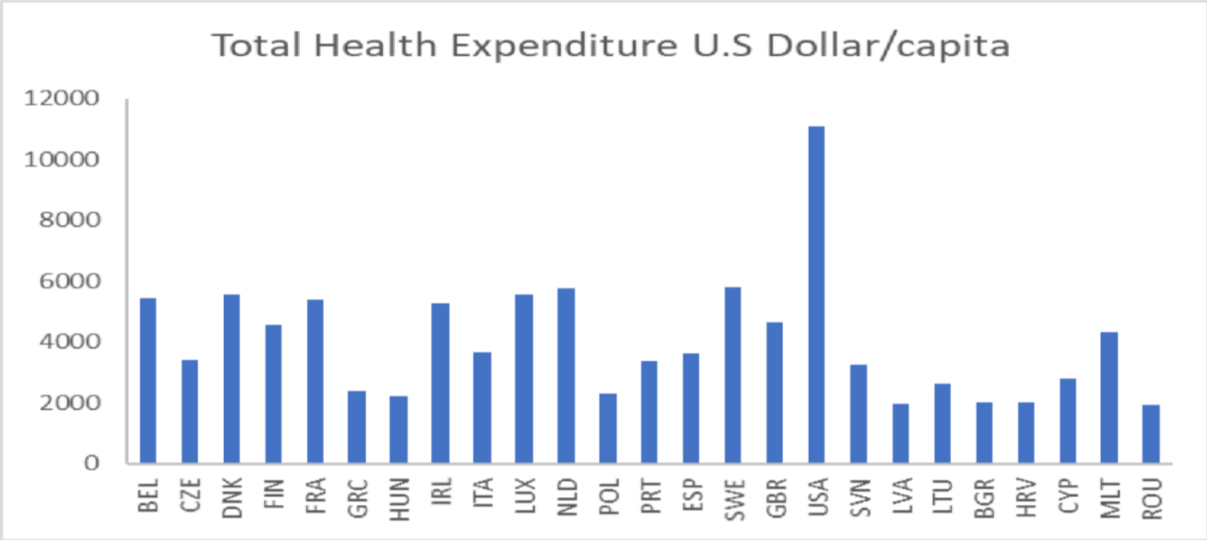


Figure 1.5: *Total health expenditure in European countries and United States of America*

Note. Source: OECD statistics, 2019

As shown in Figure 1.5, the health expenditure in the USA per person in 2019 was estimated to be around US$11,000, while the amount European countries spent per person was about US$5500. Compared to other developed nations, Kuwait spent about US$2075 per capita in 2014, which was much less than the expenditure of European countries the USA in 2014 (Dieleman et al., 2017). Moreover, by 2030 and 2040, it is expected that the health expenditure in Kuwait will be approximately US$3203 and US$4368 per capita, respectively (Dieleman et al., 2017).

International diabetes associations have emphasised the economic impact of diabetes in their campaigns to promote awareness of the disease. In 2021, diabetes was responsible for expenditure of US$966 billion for adults aged 20–79 years globally. Over the past 15 years, this amount has increased by 316%, based on information provided by the (IDF, 2022). Those costs are projected to reach US$1.03 trillion by 2030 and US$1.05 trillion by 2045 (IDF, 2022). In 2021, the North America and the Caribbean region was reported to have the highest diabetes expenditure at US$415 billion; this represents 42.9% of all diabetes-related health expenditure worldwide. The second highest region was the Western Pacific at US$241.3 billion, followed by the European region at US$189 billion; representing 25.0% and 19.6%, respectively, of the total expenditure on diabetes-related health in the world (IDF, 2022).

Diabetes is the leading cause to cardiovascular diseases. Other conditions that were costly were associated with patients who developed cardiovascular diseases, which ranged from US$3418 to US$9705 (Einarson et al., 2018). However, T2DM puts a significant burden on healthcare sectors because of the treatment and management that are typically associated with this disease (Zhuo et al., 2013). There are many factors contributing to the increase in health expenditure across the globe, but the leading cause can be attributed to the enormous prevalence of diabetes worldwide, particularly with the introduction of new expensive anti-hyperglycaemic drugs and devices (Chaudhury et al., 2017; Pichetti et al., 2013). This has led to the conclusion that diabetes management is costly and requires the involvement of healthcare professionals to be effective.

1.3.7 Expenditure on type 2 diabetes mellitus in the Middle East and North Africa region (apart from Kuwait)

The MENA, South and Central American, and African regions account for only 12.5% of global diabetes-related health expenditure, despite having 40.8% of the world’s population living with diabetes (IDF, 2022). The African region spent only US$3.4 billion, and the MENA region spent US$24.9 billion on total health spending in 2019 (Williams et al., 2020). As well as the disease itself, diabetes is associated with more complications impacting the care sectors and costing money, for example: US$1816.30 per person for diabetic ketoacidosis, US$8473 per person for chronic kidney disease and US$8659 per person for diabetic foot ulcers (Dhatariya et al., 2019; Ozieh et al., 2015; Ragnarson Tennvall & Apelqvist, 2004).

1.3.8 Expenditure on type 2 diabetes mellitus in Kuwait

Kuwait spent about US$2075 per capita on health in 2014, which is much less than the amount spent by other countries in 2014 (Dieleman et al., 2017). Moreover, by 2030 and 2040, it is expected that the health expenditure in Kuwait will only be approximately US$3203 and US$4368 per capita, respectively (Dieleman et al., 2017). The cost of drugs for diabetes and the cost of treating complications and comorbidities related to diabetes in Kuwait in 2018 was estimated by Alowayesh et al. (2022). This study found that 22.8% of Kuwait's drug expenditure in 2018 was devoted to the treatment of diabetes and its comorbidities and complications. In addition, the average drug cost per patient with diabetes increased by 44.7% due to comorbid conditions and diabetic complications (Alowayesh et al., 2022).

Diabetes has been known to be a disease seen in late adulthood. However, adolescents have been found to have similar symptoms as those of adults with T2DM, concluding that T2DM can happen in adolescence. The following section narrates the history of how T2DM was diagnosed in adolescents.

1.4 The Definition of Age and Adolescence

Adolescence is a period of transition between childhood and adulthood in human life. For a long time, there has been confusion regarding the classification and definition of adolescence (Sawyer et al., 2018). The term 'adolescence' was defined at the beginning of the 20th century as the developmental period from the age of 14 to 24 years (Hall, 1905). In the early 1950s, the WHO originally suggested that the adolescence period transited the period from the age of 10 to 20 years (Organization, 1977). During the world congress on youth in Barcelona in 1985, the United Nations started to use the term 'youth' to define the period between the age of 15 and 24 years (Gerontopoulos, 1985). Preparations for the International Youth Year (in 1985) led to the emergence of this definition. The United Nations officially defines the adolescence period as being from 10 to 19 years (Sawyer et al., 2018). In the last 20 years, the term ‘young adulthood’ and ‘emerging adulthood’ have been defined as the period of approximately 18 to 26 years (Arnett, 2000; Bonnie et al., 2014; Council, 2015). Sawyer et al. (2018) claim that the variation in the definition of adolescence resulted from the incorporation of factors such as biological growth and major transitions in social roles over time. Moreover, these factors could be changed across different contexts, countries and cultures (Sawyer et al., 2018).

The Lancet Commission on Adolescent Health and Wellbeing highlighted the importance of a unified approach to naming the adolescence period because the current disorganised approach had led to fragmented policy, practice and research (Bonnie et al., 2014). Experts in the field agreed on a unified definition and expanded the age group as being from 10 to 24 years, and people at this period of life are named ‘young people’ (Kinghorn et al., 2018; McDonagh et al., 2018; Sawyer et al., 2018). However, there has been an ongoing argument regarding categorising this age group in research and data analysis. For example, Kinghorn et al. (2018) divided young people into three age groups; young adolescents (10–14 years), middle adolescents (15–19 years) and late adolescents (20–24 years). On the other hand, McDonagh et al. (2018) prefer the use of the term young people within two age groups; adolescence (10–19 years) and young or emerging adulthood (20–24 years). The term ‘young people’ has been frequently used to describe adolescents between the ages of 10 and 24 years over the past few years in medical and nursing research (Armocida et al., 2022; Cohen Kadosh et al., 2021; Haylock et al., 2020; Heris et al., 2020; Hill et al., 2022; Lester et al., 2018; Ward et al., 2021).

1.5 The History of Type 2 Diabetes Mellitus in Children and Adolescents

T2DM was once a common disease among adults, rather than children. However, this changed when children with similar symptoms to adults with T2DM started to appear. This occurrence forced clinicians to look at T2DM as a disease that also affects children. Prior to 1975, the terms for diabetes were juvenile-onset diabetes and adult-onset diabetes. In 1980, the terms changed to insulin-dependent diabetes mellitus (IDDM) and non insulin-dependent diabetes mellitus (NIDDM) by the National Diabetes Surveillance System. In 1985, the international community agreed upon using the terms T1DM and T2DM, which remain to the present day.

1.5.1 Prior to 1985: Type 2 diabetes mellitus is found in adults

T2DM was first found among the elders of indigenous populations of the USA where it was described as a rare disease that was associated with genetic abnormality (Saiki & Rimoin, 1968). By the mid-1970s, T2DM was found in indigenous populations such as Nauruans, Samoans and American Indians, including the Pima, Cocopah and Cherokee of the Midwest USA. Moreover, T2DM complications were rarely found (Saiki & Rimoin, 1968). Children showed symptoms of diabetes that were not consistent with those children with T1DM, and T1DM was considered a rare autosomal dominant transcription factors diabetes, also known as MODY (Saiki & Rimoin, 1968). In 1965, the rates of T2DM in the Pima Indians of Arizona was increasing rapidly (Sharkey, 1966). At that time, the most popular theory to explain the higher rates of T2DM in indigenous populations in the world was that there was a gene or genes that conferred a survival advantage for metabolic adjustment to alternating periods of feast and famine, the ‘thifty gene’ hypothesis (Hales & Barker, 1992).

Before 1985, the focus of research among children and adolescents was on IDDM, also known as juvenile-onset diabetes mellitus in many European and Western countries, including Canada and New Zealand (Christau et al., 1981; Christau et al., 1977; Crossley & Upsdell, 1980; Ehrlich et al., 1982; Lestradet, 1977; Reunanen et al., 1982; Sterky et al., 1978). However, no published studies were found on T2DM among the same population. Among adolescents and young people in Germany, T2DM was first reported in 1983 (Panzram & Adolph, 1983).

In the MENA region, there was only one study, from 1983 by Taha et al. (1983) conducted a prospective investigation into the incidence of new cases of diabetes mellitus in the Kuwaiti population aged between 0 and 29 years between 1980 and 1981. Results of this study revealed that there were 190 newly diagnosed patients aged between 0 and 29 years (77 male, 113 female). The majority of newly diagnosed cases of T2DM were in the 20–29 year age group (n = 152), representing 80% of all new cases and accounting for the majority of cases that did not require insulin (n = 106). Despite Taha et al. (1983) not classifying the type of diabetes among the study population, the data on the types of treatment of the newly diagnosed patients could suggest that T2DM was the dominant type of diabetes among this 20–29 year age group (Taha et al., 1983).

1.5.2 Between 1985 and 1995: Scepticism about type 2 diabetes mellitus occurring in children

The earliest publications on diabetes in children reported on studies conducted in North America (Savage et al., 1979) and central Canada (Young et al., 1985), which included children aged over 15 years. In 1987, NIDDM was found in African-American children, especially females and Mexican American teenagers (Gaunder, 1984). Children with T2DM were also seen by clinicians in their clinics. However, these cases were not reported in high impact medical journals. In 1984, 12 children from the black American community in Florida were characterised as having ‘atypical’ diabetes, due to the discontinuation of insulin after a few months. These children had a family history of T2DM, and 50% of them were obese. The authors proved that this was not T1DM via crude examinations for islet specific immune markers and βcell reserves (Winter et al., 1987).

Nine indigenous children aged 7–15 years in Manitoba, Canada, were diagnosed with T2DM between 1982 and 1987 (Dean & Moffatt, 1988). This case series was expanded with additional clinical data on 12 children in a later publication (Dean et al., 1992). In a Canadian clinical study of the regional diabetes registry and hospital discharge records from 1978 to 1994 in Ontario, 15 cases of T2DM in children aged 0–16 years (14 females, one male) were found (Harris et al., 1996). Female children presented the highest cases of T2DM in all indigenous populations. The number of indigenous children diagnosed with T2DM in Canada increased noticeably in this decade. However, T2DM was still rare among indigenous children in other communities in Canada (Dean et al., 1998; Young et al., 1985).

T2DM in children was first included in the International Conferences on Diabetes in Indigenous Peoples in Hawaii in 1993, in Winnipeg, Manitoba, Canada in 1995, and in San Diego, California in 1997 (Dean & Sellers, 2015). Health professionals working with indigenous people had already been convinced that T2DM was occurring in children (Dean & Moffatt, 1988). The only risk factor that children with obesity had was hepatic steatosis. T2DM appeared as a disease alongside obesity in paediatric textbooks in the following decade (Dean & Sellers, 2015).

In Tokyo, annual screening was performed in schools to detect juvenile diabetes. Between 1984 and 1986, 124 children were newly diagnosed with NIDDM according to the criteria outlined in the WHO Global report on diabetes (Owada et al., 1990). The authors of the Japanese study state that there had been an increase in the incidence of NIDDM in children during the same period (Owada et al., 1990). Furthermore, in the period from 1987 to 1996 in Thailand, 5% of children aged 0–14 years had been diagnosed with T2DM (Likitmaskul et al., 2000). In India, data of at-risk people with T2DM (n = 545) aged below 30 years were evaluated in 1985 (Ramachandran et al., 1988). The results revealed that 58% (n = 314) of the population were diagnosed with T2DM and a small number of newly diagnosed patients under the age of 20 years, but the number was not specified (Ramachandran et al., 1988).

The research in the MENA region focused primarily on T2DM treatments, risk factors and associated complications in adults (Abdella et al., 1988; Ajabnoor & Laajam, 1987; al-Muhtaseb, al-Yuosuf, et al., 1991; Al-Shammari et al., 1994; Alwan & King, 1992; Musaiger, 1992; Rao, 1992). Likewise, the research focus in Kuwait was following similar trend (Abdella et al., 1987; Abdella et al., 1995; al-Muhtaseb, al-Yusef, et al., 1991; JOHNSTONE et al., 1990). However, no studies were found in the literature that address T2DM among children and adolescents between 1985 and 1995.

1.5.3 Between 1995 and 2005: Recognition of type 2 diabetes mellitus as a chronic disease

In the decade from 1995 to 2005, major national and international paediatric and diabetes conferences included full sessions and workshops on various clinical aspects of T2DM in children. Publications increased from two annually in the previous decade to over 200 annually. Small case series were also being reported from different countries globally (Dean & Sellers, 2015).

At three university diabetes hospitals in Florida (USA), the percentage of youth-onset T2DM increased from 9.4% to 20.0% between 1994 and 1998 (Deeb et al., 2000; Macaluso et al., 2002). ln 1998, Dr Frank Vinicor, a senior epidemiologist and seven paediatric endocrinologists developed the ‘gold standard’ criteria for the classification of T2DM in children as one of the aims of the Centers for Disease Control and Prevention (CDC), the national public health agency of the USA (Dean & Sellers, 2015). These clinicians reported that the majority of affected children were obese; of Mexican American, African American or indigenous heritage; had one or both parents affected by T2DM; and were from disadvantaged life circumstances (Dean & Sellers, 2015). There was no reliable biochemical test to differentiate type 2 from type 1 diabetes, as the serum immune markers for autoimmune T1DM remained undeveloped and unavailable in clinical settings (Dean & Sellers, 2015). Classification of diabetes in children was primarily based on clinical features, which remains a challenge to the present day, despite having increased availability of better examinations and tests for serum immune markers (Dean & Sellers, 2015).

In 2002, the long-term outcomes of T2DM in children showed a high rate of end-stage complications and pregnancy loss in early adulthood (Dean & Flett, 2002), which created a significant impact and spread fear related to the potential consequences of the epidemic of childhood obesity. It also accelerated the search for the history of T2DM due to its progressive nature, especially in microvascular complications in childhood-onset of T2DM in the absence of age-related cardiovascular factors (Dean & Sellers, 2015).

During the same period, high rates of psychosocial and psychiatric comorbidities affecting quality of life were found (Allan et al., 2008; Holt et al., 2014). Despite the increased focus on treatment, there was a lack of safety and efficacy data related to lifestyle interventions, insulin regimes and oral diabetes medications in children (Dean & Sellers, 2015). Other challenges interrupted clinical trials, including insufficient sample size, the cost of travel to study centres from remote communities, elevated liver enzymes due to steatosis, psychosocial comorbidities and the complex ethics of informed consent in children (Karres et al., 2014). Lifestyle modification as a diabetes treatment was found effective in the presence of a supportive environment, such as a summer camp (Dean & Sellers, 2015) or in developed communities (Wittmeier et al., 2012). Clinical trials that examined lifestyle change alongside metformin were inconclusive, and highlighted the challenges of medication non-adherence in children with T2DM (Jones et al., 2002). Metformin is considered to be the most popular oral glucose-lowering therapy in most countries among individuals with newly diagnosed T2DM (Sanchez-Rangel & Inzucchi, 2017).

There was also evidence of the effectiveness of short-term aggression (<3 months) when insulin was prescribed twice daily for youth presenting with symptomatic hyperglycaemia with or without diabetic ketoacidosis (Sellers & Dean, 2004). The largest multicentre randomised clinical trial of metformin alone or with intensive lifestyle change or a thiazolidinedione drug, pioglitazone, started in 2004. The children recruited to the Treatment Options for Type 2 Diabetes in Adolescents and Youth (TODAY) study remained under annual research surveillance a decade later because of the importance of understanding the unique natural history of this disease in children to inform future clinical research (Group, 2012). The results of the TODAY trial were not available until 2012 (Group, 2012).

The understanding about a genetic cause of T2DM was accelerated by new discoveries in molecular genetics, and the use of candidate genes involved in insulin secretion or binding. Multiple forms of MODY were defined, which were identified in the Oji-Cree people of central Canada (Hegele et al., 2000; Hegele et al., 1999), causing earlier expression of β-cell exhaustion. There was historical evidence that T2DM did not exist in this population prior to 1970, and it is speculated that the gene responsible for T2DM required the modern post-colonial obesogenic setting (Sellers et al., 2002). This gene was found in approximately 40% of the children with T2DM in Manitoba, Canada (Sellers et al., 2002).

T2DM in adolescents was initially recognised in the USA in the 1990s and accounted for approximately 3% of all newly diagnosed children and adolescents. However, in 2000, the number increased to 45% of all newly diagnosed cases of T2DM among adolescents (Association, 2000; Pinhas-Hamiel & Zeitler, 2005). A similar pattern has been observed in studies conducted in European, Asian and MENA region countries. Between 1995 and 2005, the number of reports of T2DM in children and adolescents increased across the globe (Pinhas-Hamiel & Zeitler, 2005). The European region reported an increase in T2DM incidence, with prevalence among this population in Germany (Kiess et al., 2003), Austria (Rami et al., 2003), England (Barrett et al., 2002; Ehtisham et al., 2000; Ehtisham et al., 2001; Feltbower et al., 2003), France (Ortega-Rodriguez et al., 2001), Sweden (Zachrisson et al., 2003), Russia, Belarus and Poland (Jones et al., 2002), Bulgaria (Konstantinova et al., 2000), Italy (Franzese et al., 1996) and the Netherlands (Roeleveld-Versteegh et al., 1998). Ehtisham et al. (2000) reported interesting results in 2000. Even though their study was conducted in the UK, all newly diagnosed adolescents (n = 8) were Indian, Pakistani or Arab (Ehtisham et al., 2000).

In the Asia-Pacific, a rise in the prevalence and incidence of T2DM was also observed in the region's countries. Furthermore, T2DM has become more prevalent among young people in recent years (Cockram, 2000). The prevalence of T2DM in children and adolescents is now four times higher than that of T1DM in certain parts of the region (Cockram, 2000), including in Japan (Kitagawa et al., 1998), Taiwan (Wei et al., 2003), Singapore (Lee et al., 2000; Lee, 2000), Hong Kong (Huen et al., 2000), Thailand (Likitmaskul et al., 2003; Likitmaskul et al., 2000), China (Zhi et al., 2003), India (Narayan et al., 2001; Ramachandran et al., 2003), New Zealand (Hotu et al., 2004; McGrath et al., 1999) and Australia (Craig et al., 2003; Harkin, 2002; McMahon et al., 2004).

Researchers from Saudi Arabia performed the first large-scale screening study for T2DM in children and young people in the MENA region in 1998 (El Hazmi, 1998). The Saudi study involved a total of 25,337 participants aged 2–77 years and used the WHO criteria for diabetes diagnosis (El Hazmi, 1998). Approximately 70% of participants (n = 17,397) were aged between two and 29 years. The prevalence of T2DM among those under the age of 14 years was 0.12%, and 0.79% among those who ranged in age from 14 to 29 years (El Hazmi, 1998). According to one study in Israel (occupied Palestine), there have been a few new cases of T2DM and impaired glucose tolerance among asymptomatic adolescents under the age of 18 years

(Pinhas-Hamiel et al., 2000). In the UAE, five adolescents were newly diagnosed with T2DM between 1990 and 1998, according to the patient records of a regional hospital (Punnose et al., 2002). There were only three studies conducted in the MENA region between 1995 and 2005. The lack of research in the MENA region during this period has led to an underestimation of T2DM in this specific population.

1.5.4 From 2005 to the present: Increase in international research on screening, prevention and treatment of youth with type 2 diabetes mellitus

Several international diabetes organisations have published clinical practice guidelines on T2DM in children. These preliminary guidelines were based on the mutual agreement of experts in the field (Dean & Sellers, 2015). Therefore, they varied between regions, and across countries. A global increase in paediatric obesity was associated with an increase in the use of surrogate markers of the risk of T2DM and cardio-vascular disease in obese children. This increase led to the growth of publications in this field. In 2012, results of the TODAY study showed glycaemic control deteriorated over time in approximately 50% of children diagnosed with T2DM regardless of management plan (TODAY Study Group, 2012). However, experts from the IDF and the International Society for Pediatric and Adolescent Diabetes state that since T2DM is difficult and challenging to diagnose in this population, children and adolescents with this disease could remain undiagnosed for a long period of time, which increases the risk of T2DM complications (Aschner et al., 2021; Mayer-Davis et al., 2018; Zeitler et al., 2018).

New knowledge has emerged concerning the mechanisms causing T2DM in children, as well as its complications. It has been proven that T2DM is both more aggressive in children and more detrimental in the long term. For instance, a study from the Manitoba, Canada, population, youth with T2DM had an increased risk of all complications compared to youth with T1DM (Dart et al., 2014). Renal and neurologic complications were seen within 5 years of diagnosis, and major complications, defined as dialysis, blindness or amputation, were manifest by 10 years post diagnosis (Dart et al., 2014).

A national Canadian Pediatric Surveillance Program Study conducted between 2006 and 2008 reported that the incidence of T2DM in Canadian youth was approximately 40% with at least one comorbidity at diagnosis, in which dyslipidaemia was the most common comorbidity found (Amed et al., 2010). Another large cohort study has verified the high prevalence of comorbidities at the time of diagnosis of this disease (Copeland et al., 2011).

In children with T2DM, albuminuria is challenging to diagnose clinically, with approximately 5% to 10% of adolescents having orthostatic proteinuria (Sellers et al., 2009). Therefore, confirming persistent albuminuria with repeated overnight urine samples or morning urine samples was necessary and unmet (Sellers et al., 2009). Indigenous children are more likely to have primary renal disease, which makes evaluating albuminuria more challenging (Sellers et al., 2009). A study in Manitoba, Canada, found that nine out of 10 children with persistent albuminuria had underlying primary renal disease (Sellers et al., 2009).

Youth T2DM has been increasing over the past few decades around the globe, and childhood obesity is considered the main risk factor (Buttermore et al., 2021). Although the knowledge about youth T2DM's pathophysiology, contributing factors and optimal prevention remain limited, there is an important fact for everyone; paediatric obesity is a preventable health condition that might reduce the spread of youth T2DM (Serbis et al., 2021). Moreover, youth T2DM remains a challenging disease to manage pharmacologically and therapeutically (Karavanaki et al., 2022). Therefore, lifestyle interventions, including healthier habits and increased physical activity, are recommended (Serbis et al., 2021). As an expert from the Lancet said:

> Surely children and adolescents cannot be held responsible for living in obesogenic environments and if the growing prevalence of obesity and type 2 diabetes in youth is accepted as the new normal, society will have grossly failed the next generation. (Kasmauski, 2018, p. 2325)

Early prevention and screening appear to be the only effective method to deal with youth T2DM so far (Peña et al., 2020; Serbis et al., 2021). However, Buttermore et al. (2021) highlight the need for further research regarding pathophysiology, therapies and prevention strategies for youth with T2DM.

From 2005, the number of reports regarding T2DM in children and adolescents started to increase in the MENA region. There were 16 cross-sectional studies performed in 10 countries, including the Kingdom of Saudi Arabia (Al-Agha et al., 2012; Al-Rubeaan, 2015; Alowfi et al., 2021), Turkey (Hatun et al., 2019; Önal et al., 2014), Kuwait (Al-Kandari et al., 2019; Moussa et al., 2008), Iran (Moadab et al., 2010; Zardast et al., 2015), Qatar (Ahmed et al., 2022; Alyafei et al., 2018), Israel (Occupied Palestine) (Levin et al., 2022), UAE (Al Amiri et al., 2015), Jordan (Al-Shudifat et al., 2017), Sudan (Osman et al., 2013) and Syria (Al-Bachir & Bakir, 2017). These studies focused on the incidence and prevalence of T2DM among children and adolescents in MENA countries. Moreover, some studies described the clinical characteristics of youth T2DM and the risk factors for this disease. A few studies attempted to estimate prediabetes in the same population. However, authors from the MENA region recommend future research focused on early screening, primary prevention and improving the management of youth T2DM in the MENA region (Al-Agha et al., 2012; Al-Kandari et al., 2019; Al-Shudifat et al., 2017; Alowfi et al., 2021; Moadab et al., 2010).

1.6 Health-Related Behaviours

A genealogical study by Armstrong (2009) reported on the origins of health-related behaviours and the use of the term ‘health behaviour’ during the last century. The term was first used in the late 1920s by Winslow (1929) when he was planning a public health education program for men, women and children. In 1940, the term was firmly established and commonly used for community health and school health educational programs (Hiscock, 1940). However, it was not until the 1960s that the use of this term began to rapidly increase (Armstrong, 2009) (see Figure 1.6 below).

Figure 1.6 below illustrates that there has been a steady increase in citations in the American Journal of Public Health pertaining to the 'health behaviour term' since 1912. Furthermore, the citations have increased considerably from 1991 until 2008.

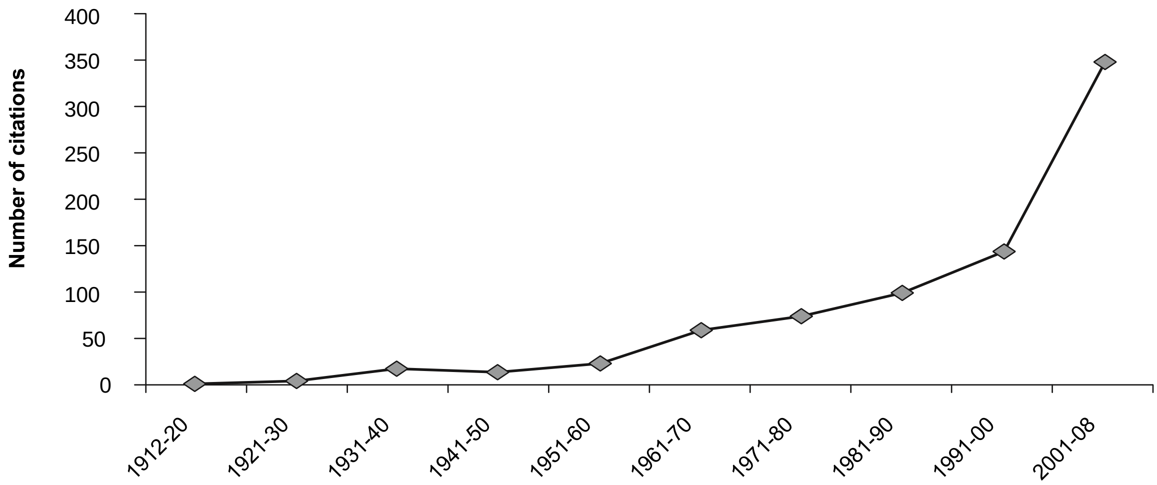


Figure 1.6: Growth of citations referring to 'health behaviour' in the American Journal of Public Health

Note. Source Armstrong (2009, p. 918)

In 1957, Derryberry (1957) claimed that health behaviours consisted of a number of complex and multifaceted components and stated that:

> Behaviour is now seen as the function of a great many variables – motivational, perceptual, social, and cultural. How an individual acts and thinks in specific situations seems to depend on inner drives arising from his personal goals and needs, his perception of the situation, and his past experiences, plus the influence of external

> factors of the situation, including the cultural patterns and social structures in the society to which he belongs. (Derryberry, 1957, p. 1361)

The concept of behaviour became increasingly prevalent in medicine and public health between the 1960s and 1980s, however, this time the use of this term was precise – to explain an individual's response to illness or maintain general health, that is, 'illness behaviour' or 'health behaviour' (Kasl & Cobb, 1966). The focus on individual behaviours as a medical and public health problem was recognised and began to emerge from 1975 (McKeown). In 1991, the authors of the Whitehall II study classified health behaviours such as cigarette smoking, alcohol consumption, eating habits and exercise as indicators of the general health status of individuals (Armstrong, 2009; Marmot et al., 1991).

A health behaviour can be defined as an action taken by an individual with the aim of maintaining or enhancing their health or preventing complications that may result over time (Cockerham et al., 2014). As a result of these actions, the factors that affect the development of T2DM are diet, physical activity, smoking, adherence to prescribed medical therapies and adherence to prescribed medication (Short & Mollborn, 2015).

Moreover, it is vital that people with T2DM and their health behaviours are managed according to the latest guidelines (Gale, 2004). According to Gale, the majority of evidence supports the view that behaviour is a dominant factor involved in the successful management of diabetes (Gale, 2004). McSharry et al. (2020) recommend that theories and theory-based approaches be used to change behaviours in healthcare professionals. Specific strategies have been designed to support those efforts (McSharry et al., 2020). Therefore, it is considered that the core aspect of diabetes prevention and teaching people how to manage the condition includes eating healthy food, taking regular exercise and modifying harmful daily habits (Bellou et al., 2018). These behaviours need to be integrated with education about diabetes and considered as core behaviours.

As mentioned earlier in this chapter, there was mounting evidence that confirmed the associations between health-related behaviours and NCDs, with NCD risk factors in both young people and adults. In addition, experts in the field of psychology and behaviour change underlined that even small changes in health-related behaviours could lead to clinically significant health improvements (Buckingham et al., 2019; Campbell-Danesh, 2021; Howlett et al., 2019; Kaner et al., 2018; Stead et al., 2017; Whatnall et al., 2021; Young et al., 2019; Zhou et al., 2018). The five key health-related behaviours for chronic disease prevention are never smoking, regular physical activity, consuming no alcohol or only moderate amounts, maintaining a normal weight and obtaining sufficient sleep daily (Liu et al., 2016).

1.7 Kuwait

This section provides general information about Kuwait, followed by a description of issues relating to religion, culture, the economy and the health system that is of relevance to the current research project.

Since the 18th century, the Al-Sabah family has ruled the State of Kuwait. It is a small country situated on the coastal side of the Arabian Gulf, between Iraq in the north, Saudi Arabia in the south and Iran in the east. Kuwait is located in the Arab world and MENA region. Geographically, Kuwait is covered by the hottest and driest desert in the world (Ochsenwald et al., 2018). The estimated area of Kuwait is about 17,820 square kilometres (for comparison, Australia is 7.688 million square kilometres; Kuwait is the 43rd smallest country in the world). Close to 100% of its population lives in urban areas (Worldometer, 2022). Kuwait's overall population in 2021 was estimated at 4.3 million, comprising approximately 1.5 million Kuwaitis, the rest being foreign nationals (Worldometer, 2022). Kuwait's official language is Arabic, although English is widely spoken as a result of the high percentage of immigrant employees in the country (Ochsenwald et al., 2018). This country is divided into six governorates: Al Asima Governorate (Kuwait City), the capital of the country; Al Ahmadi Governorate; Al Jahra Governorate; Al Farwaniyah Governorate; Hawalli Governorate; and Mubarak Al Kabeer Governorate (Kuwait Ministry of Health, 2015).

There is a large youth population in Kuwait, with 44% of the Kuwaiti population under the age of 20 years, and approximately 26% aged between 25 and 34 years (Worldometer, 2022). In accordance with these statistics, the Kuwaiti population is comprised of approximately 70% children, adolescents, young people and young adults. Therefore, it is important that health promotion strategies tackle the risk factors that have a bearing on the health status of this young population. These strategies should also focus on the prevention of NCDs in Kuwaiti communities (Behbehani, 2014).

1.7.1 Religion in Kuwait

Kuwait's official religion is Islam, but according to the National Assembly (the legislative authority of the State of Kuwait) foreigners of all faiths and beliefs are allowed to practice their own faiths. The majority of the population consists of Muslims. Kuwait has two main sects of Islam; Sunni Muslims make up 45% of the population, and Shi'a Muslims make up 40%, while Christianity, Hinduism and other religions are practised by the remaining 15%.

Islam focuses on purifying the soul through the five daily prayers of 'salat'. The purpose of salat is to strengthen one's devotion to Allah. It is imperative that one maintains good hygiene and cleanliness for performing ritual prayers in order to maintain good physical health, which is integral to good spiritual health in Islam. Kuwait is an Islamic nation that does not permit alcohol use, homosexual acts, pork products or the living together of heterosexual couples in an unmarried relationship. However, Kuwait is a country that is known for its cultural tolerance. Religious freedom is guaranteed for all faiths and religions.

During Ramadan, Kuwaiti Muslims must adhere to several cultural rules to keep Ramadan holy. Their working hours are limited to six hours per day, and they must fast for 16 hours. No eating, drinking, smoking or chewing gum is permitted before sunset. During Ramadan, people of different religions are also prohibited from practicing any of these things in public during the daytime. Ramadan is a month during which fasting begins at sunrise and lasts until sunset. Breaking the fast is usually done at sunset, with family and friends gathering to share food and celebrate. The working hours of many businesses, shops and restaurants are reduced during this month.

1.7.2 Culture in Kuwait

The State of Kuwait is based on Islamic beliefs and practices, which have shaped Arab culture and tradition. In the Kuwait National Museum, artefacts, archaeological pieces and historical documents from Kuwait's culture, heritage and background are well preserved. Moreover, Kuwaiti culture is renowned for its dialect poetry, films, theatre shows and television shows, which are thriving in Kuwait and being exported elsewhere.

The invasion of Kuwait by the Iraqis in 1990 led Kuwaiti young people to become aware of the importance of preserving and reviving old art and creating new art. A combination of modern style and old-style art can be seen in Kuwait City's new architectural buildings.

The Kuwait Opera House and the Sheikh Abdullah Al Salem Cultural Centre were opened in 2018 and are considered the largest cultural centres in the Middle East. There are many cultural centres throughout the country that offer a variety of events and workshops to the public. Examples include exhibition halls, theatres and cinemas. In both the *Diwaniya* and the Al Sadu, one can see that Kuwait has a wide range of customs and traditions that offer a colourful and extensive culture that reveals itself in an extensive range of customs and traditions. Kuwaitis have a great passion for literature, theatre, music, dance, films and contemporary art (The Center, 2021).

In Kuwaiti homes, there is usually one main hall, but rich families construct an extra hall or room on one side called a *Diwaniya*. A *Diwaniya* is a traditional Kuwaiti area or event named for the way one sits, with cushions placed around the room to decorate the walls. The floor is covered with woven, elegant Persian carpets (Kuwait Government Online, 2022). The *Diwaniya* receive guests daily or once a week, and they can be found on each street in the residential areas, where guests and visitors to Kuwait can enjoy Arabic coffee, tea and meals (Kuwait Government Online, 2022). The *Diwaniya* is similar to a social club or a cultural forum, with a political salon's general atmosphere (Kuwait Government Online, 2022).

Traditionally, Kuwaiti men hosted male guests and family members in their *Diwaniya* and met with their business colleagues in this area. The social halls have successfully preserved *Diwaniya's* significance in the social, economic and political life of Kuwait (Kuwait Government Online, 2022). Kuwaiti men's social life revolves around visiting or hosting *Diwaniyas*, which refer to reception halls as well as the gatherings held within them (Kuwait Government Online, 2022). As a result, it has become an integral part of Kuwaiti traditional and social life (Kuwait Government Online, 2022). Although this tradition is mostly reserved for men, some Kuwaiti female groups have begun a more feminine version of *Diwaniya*, which is called a teatime gathering that occurs during lunch (Kuwait Government Online, 2022). In Kuwaiti society, this ritual has been associated with excessive calorie consumption and low physical activity, which are associated with obesity and T2DM (Zaghloul et al., 2013).

As this section has shown, Ti culture is mostly non-active. This has likely led to the obesity that has been associated with an increase in T2DM.

1.7.3 Economic shift

Kuwaiti people were poor before the discovery of oil, and the harsh climate of the land made it difficult for them to earn a living. Kuwaiti men were involved in physical labour to make a living. Kuwaiti women were, in general, unemployed and were actively involved in household work. The lack of financial provisions and short schooling hours in the old days meant that young Kuwaitis had to work from an early age in order to support their families in this difficult life they had to lead. Work examples included fishing, pearl diving, and cutting and transporting stones to be used in construction (Online, 2022).

Oil was discovered in Kuwait in the 1960s, and as a result, Kuwaiti wealth grew, and the Kuwaiti population adopted a sedentary lifestyle, lived in luxury and relied on domestic help to carry out their daily household duties. They also used cars for transportation (Al-Baho et al., 2016; Al-Sejari, 2017). The increase of lifestyles that are not physical and the cultural practices of *Diwaniyas* have combined to increase the prevalence of T2DM. Leading a sedentary lifestyle and consuming a high-caloric diet contributed to their poor health and increased the prevalence of NCDs such as obesity, hypertension and diabetes (Al-Baho et al., 2016). Many Kuwaiti practices and beliefs are in conflict with the global health standards recommended by the WHO. Consequently, young people today are at an increased risk of developing chronic diseases as a result of their poor health status (Behbehani, 2014).

1.7.4 The healthcare system in Kuwait

The healthcare system in Kuwait is divided into the government and private sectors. Approximately 80% of medical services are provided by government sectors of the Ministry of Health, and the rest are private hospitals and clinics. The healthcare system consists of multifaceted primary healthcare clinics, general hospitals, specialised hospitals, rehabilitation hospitals and research centres.

The Ministry of Health's medical and healthcare services are free of charge for Kuwaiti citizens (Kuwait Ministry of Health, 2015). The Kuwaiti Government is committed to providing its own citizens with a comprehensive social welfare scheme to ensure a high quality of life. There is a very well-developed healthcare system in the country, as well as free medical care for those who are in need or who have disabilities of any kind (Ochsenwald et al., 2018).

1.7.5 Type 2 diabetes mellitus healthcare in Kuwait

The majority of T2DM care in Kuwait is provided by general practitioners in primary healthcare clinics (Al-Adsani et al., 2009). It is possible that in some hospitals, T2DM patients are provided with care under the supervision of a diabetologist and diabetes nurse. As part of Kuwait's national policy for managing T2DM, the Dasman Diabetes Institute offers training courses for healthcare professionals regarding the treatment of all types of diabetes (Al-Taweel et al., 2013). In general, the treatment of T2DM focuses on maintaining glycaemic control so as to reduce the risks of developing other medical conditions, such as coronary artery and cardiovascular diseases (Lu & Harris, 2013), According to Al-Taweel et al. (2013), these two diseases are the leading causes of death in Kuwait. In response, the IDF suggested developing a national diabetes program (Al-Taweel et al., 2013). As part of their T2DM care program in Kuwait, the Kuwait Diabetes Care Programme was established to improve the quality of care (Al-Adsani et al., 2008). Although the program resulted in improved T2DM care in adults, some areas still need attention, including the prevention and early detection of prediabetes and T2DM among adolescents and young people (Al-Kandari et al., 2019; Moussa et al., 2008).

1.7.6 Dasman Diabetes Institute

In 2006, the Dasman Diabetes Institute (DDI) was established with the goal of reducing the prevalence and high costs of diabetes in the State of Kuwait (Dasman Diabetes Institute, 2022a). The DDI's objectives and goals are geared towards preventing the diabetic epidemic and preventing it from spreading by conducting evidence-based diabetes research, implementing prevention policies, raising awareness via educational programs, training health care professionals and educating community members (DDI, 2022a). In the Arabian Gulf region, the MENA, and across the globe, the DDI is now recognised as the region's foremost diabetes organisation both regionally and globally (DDI, 2022a).

Diabetes mellitus care is available at the DDI through its therapeutic and action care department, which includes several medical clinics (Dasman Diabetes Institute, 2022b). In addition to diabetology, the DDI offers a variety of medical and health clinics including podiatry, ophthalmology, dentistry, neurology, nephrology, cardiology, dermatology, ear, nose and throat, and rehabilitation, which are operated by trained local and international health professionals (DDI, 2022b).

DDI has a specialised sports centre run by medically trained instructors for Kuwaiti citizens (DDI, 2022b). Through its scientifically designed fitness programs, DDI's sport centre offers a variety of programs that are tailored to fit the individual's specific needs while promoting a healthy lifestyle (Dasman Diabetes Institute, 2022b). There are several training options offered at the sports centre, including personal training, group studio classes, aqua classes and open gyms, as well as outdoor activities which are usually organised during the winter months (DDI, 2022b).

At the DDI, members receive a comprehensive medical and physical assessment by a diabetes nurse, as well as ongoing blood pressure monitoring (Dasman Diabetes Institute, 2022b). Fitness instructors adapt training programs for people with diabetes to help them control their blood glucose levels and avoid micro and macro complications caused by diabetes (DDI, 2022b). The institute also provides services to members who do not have diabetes but who want to improve their lifestyles (DDI, 2022b).

DDI (2022c) emphasises evidence-based practice and research as the cornerstones of modern and innovative medicine in its research department. In this department, knowledge and expertise are applied to understand diabetes in Kuwaiti populations (DDI, 2022c). Researchers are focusing on identifying clinically relevant biomarkers, gene variants, dietary components and other risk factors that could inform new treatment options for patients with diabetes. The DDI provides undergraduates, graduates, health professionals, patients and caregivers opportunities for learning and training (DDI, 2022d). The training programs are designed to provide participants with high-quality and up-to-date materials to improve their knowledge and attitude and to encourage their own development to benefit the community that they serve (DDI, 2022d).

Although DDI has an active research department, which includes different departments namely, biochemistry and molecular biology; genetics and bioinformatics; microbiology and immunology; bioenergetics; and population health. Most of the research in population health focused strongly on T1DM and monogenetic diabetes (MODY) (DDI, 2022e). Recent research on T2DM carried out at DDI’s population health department were on the adult population that examined the association of weight and health behaviours, and the link between T2DM and Alzheimer’s (Dasman Diabetes Institute, 2022f). No research was found on the prevention or the assessment and examination of T2DM in young people.

1.7.7 Kuwait Diabetes Society

Kuwait Diabetes Society (KDS) is an establishment of the Kuwait Medical Association. Over 31,000 healthcare professionals from different disciplines are registered with the Kuwait Medical Association (KDS, 2022). There is also an option to register for an annual fee for anyone living in Kuwait who is interested in joining. Members of the KDS may redeem benefits and attend workshops with a valid membership card (KDS, 2022). KDS is affiliated with the

IDF, which is responsible for organising more than 232 diabetes associations worldwide (KDS, 2022). KDS is a non-profit organization whose mission is to provide health education and workshops to its members in Kuwait (KDS, 2022).

KDS is an organisation that provides a variety of activities and services to individuals who are interested in diabetes, healthcare professionals and interested individuals (KDS, 2022). This involves the development of medical and nursing training courses, workshops, publications and teaching materials devoted to diabetes that provide updates in the field, the sponsorship and conduct of diabetes conferences at national and international levels, and the collaboration with other diabetes-related associations and organisations at local, regional, as well as global levels. The main purpose of the KDS is to encourage collaboration and cooperation among all healthcare professionals in order to boost knowledge and expertise among them; to coordinate an annual diabetes youth camp while using Instagram and Twitter to schedule and share news and announcements about the camp; to provide members with diabetes management software at a lower price than is available on the market; and to provide members with free HbA1c testing, retinal examinations, foot care and dietary consultations.

The KDS mainly focuses on T1DM and T2DM in adults. However, preventing T2DM in young people has not yet been considered. Despite the growing numbers of children with obesity and the development of T2DM in children and adolescents, efforts to prevent this rise are still underdeveloped. Raising awareness on T2DM in young people and providing community health services is needed to slow down the prevalence among the young population of Kuwait.

1.7.8 Kuwait Nursing Association

The Kuwait Nursing Association (KNA) was founded in the State of Kuwait in 1981, and was allocated a site in in Kuwait City, Salmiya (KNA, 2018a). A set of rules were considered for eligibility of membership of the KNA (KNA, 2018a). These are:

1. Holder of a nursing certificate recognised in the State of Kuwait and practicing the profession.
2. Final year students of nursing education programs in Kuwait.
3. The member is required to be of good conduct and behaviour and has never been convicted of a felony or misdemeanour involving moral turpitude unless he has been rehabilitated and that the association's statutes are approved and work to achieve its goals.
4. Five dinars admission fee for a member of the association. Ten dinars subscription fee for the member of the association All members must pay the annual subscription within six months before the end of the fiscal year at the latest.

The KNA's goals were listed as:

1. Strengthen the nursing profession and raise its level socially and scientifically.
2. Preserve the rights of the member in the field of nursing profession.
3. Liaising and coordinating with the Nursing Department at the Ministry of Health and the nursing education programs in Kuwait, to consult in them on the foundations of the profession, its laws and the new theories in the profession's world.
4. Working on organising and strengthening the ties between the members of the association, developing the spirit of cooperation, strengthening the ties between them socially, culturally and sportingly, expressing opinions on the differences that arise between them or the citizens, and seeking to settle them.
5. Working to strengthen links and strengthen scientific and professional cooperation between nurses in the State of Kuwait and their colleagues in Arab and foreign countries and the International Council of Nursing.
6. Consolidating the links between nurses in the government system and the private sector.

7. Organising scientific studies, lectures and cultural and social seminars and publishing them in a cultural magazine to familiarise citizens with the nursing profession.
8. Exchange visits with various Arab and foreign countries and participate in conferences related to nursing affairs to learn about and benefit from modern scientific methods of nursing (KNA, 2018b).

Despite these goals, the KNA lacked in providing training programs in community and public health such as diabetes education, awareness on diabetes and obesity-related issues that are major health concerns among the population of Kuwait. The KNA also fell short in providing accessible sources for non-Arabic speakers in their website, which is in Arabic. Most of the KNA's focus in the past years were on changing local policies and protocols in primary health care and hospital. Additionally, encouraging high school graduates into nursing programs by increasing nurses' pay as an attempt to increase the number of Kuwaiti population in this profession.

1.8 Interest in the Field

This section presents the rationale for my involvement in this area. It encompasses my experiences as a community nurse and researcher, as well as my personal interest.

As the principal researcher, I worked as a registered nurse, health educator and research assistant for more than 10 years in Kuwait's health sectors and hospitals before completing a master's degree in community nursing and nursing research at Flinders University in 2019 in Australia. Working in various health departments and studying in Australia helped me gain experience in the field as a community nurse and nursing researcher.

1.8.1 Interest in the field as a community nurse

Following a Diploma of Science in Nursing in Kuwait and a Bachelor of Science in Nursing in Jordan, I worked as a nurse in the surgical and medical ward of the military hospital of Kuwait for 8 years. I also worked at the diabetes clinic, and was involved as a diabetes educator and research assistant. The first research project at the diabetes clinic assessed the risk of T2DM and identified individuals in the prediabetes stage among the hospital's staff (AlRandi et al., 2014). Following this research, I became a member of the hospital's diabetes team and was regularly involved in the health teaching of people living with T2DM, as well as being involved in diabetes research.

1.8.2 Interest in the field as a researcher

Besides being a research assistant in the diabetes team, I completed a Master of Science in Nursing in Australia in 2019, where I conducted a cross-sectional study that evaluated the healthy lifestyle behaviours of nursing students in Kuwait. The master's thesis helped me find many gaps in the research regarding Kuwaiti students' general wellbeing and health-related behaviours.

Some recommendations from the master's thesis included:

- For the purpose of monitoring trends in health and wellbeing over a more extended period, cohort studies should be conducted. The results of these studies can be used to measure changes in health-related behaviours and health needs of different cohorts of students.
- In addition, there is a need to identify broader cultural barriers to the adoption of a healthy lifestyle and to identify the associations between cultural aspects and NCDs among Kuwaiti young people.

- It is recommended that further awareness-raising efforts be pursued and targeted at policymakers and stakeholders with regard to the needs of Kuwaiti young people in adopting healthy lifestyles.

My interest in quantitative methodologies encouraged me to pursue my PhD project and assess the health-related behaviours of young people in Kuwait.

1.9 Personal Justification for this Study

Since 2016, I have worked as an associate lecturer at the College of Nursing in the Public Authority of Applied Education and Training in Kuwait. I completed a nursing degree in general nursing in Kuwait, to become a registered nurse, and then further advanced my education and knowledge in the nursing field by studying in different countries, including Arabian and Western countries, between 2005 and 2019. These countries were Australia, the UK and Jordan, where I gained unique insight into the issue of health-related behaviours during my tertiary studies as a nursing student and registered nurse. I also have first-hand knowledge of how physical activity, diet and sleeping patterns can have an impact on academic outcomes. While I was in Arab countries, I had high calorie and fatty meals, and irregular sleeping patterns. In contrast, when in the UK and Australia I adopted healthier habits, resulting in a balanced nutritional diet and a better quality of sleep.

In order to explain the differences in my health-related behaviours, some factors can be considered. These include academic facilities (with gyms and outdoor sports facilities), the quality of food (fresh versus pre-made), psychological support networks (such as social workers and peer support) and weather (extreme cold and extreme heat). Also, I observed that physical activity, eating habits and sleeping patterns had a direct effect on my physical and psychological wellbeing.

Authors claim that despite the evidence supporting the role of physical activity in the prevention of NCDs and NCD risk factors, there is little likelihood that adolescents will change their behaviours in order to benefit their future health (Ding et al., 2020). There is, therefore, a need for further research on the immediate health benefits associated with physical activity in older adolescents and young adults (van Sluijs et al., 2021). This thesis reports on the investigation undertaken by the principal researcher into the association between physical inactivity and T2DM and prediabetes among Kuwaiti young people aged between 10 and 24 years.

The following section outlines the research hypotheses, the research objectives and the research aim. Additionally, the following section discusses the significance of the study.

1.10 Research Hypotheses

In Kuwaiti young people aged 10–24 years who are at risk of T2DM, the following hypotheses are posited:

- This population will have an elevated level of HbA1c.
- There is a significant relationship between health-related behaviours and HbA1c.

1.10.1 Research objectives

To address the dearth of research in Kuwait on effective nursing interventions to address the rise in T2DM in adolescents this research has the following objectives:

1. to determine, within the Kuwaiti context, the relationship between health-related behaviours and HbA1c
2. to validate the sleep, exercise and nutritional dimensions of the health-related behaviours scale in the Kuwaiti context
3. to identify prediabetes and T2DM among young people in Kuwait
4. to compare outcome measurements between sexes and different age groups

5. to predict the effects of health-related-behaviours on HbA1c levels
6. to predict the effects of demographic factors on HbA1c levels.

1.10.2 Research aim

This study aims to raise the awareness of policymakers and stakeholders of the burden of NCDs, and that this is no longer exclusively an adult problem, but has reached the younger population of Kuwait. In addition, identifying the associations between cultural aspects and NCDs among Kuwaiti young people could promote healthy living and increase awareness, which could eventually reduce the prevalence of T2DM and other comorbidities in Kuwait.

1.11 Importance of the Study

NCDs have been considered as a group of diseases of older adults and not as paediatric health issues. However, over the last 20 years, the incidence of NCDs in adolescents and young people has increased and become a public health problem worldwide (Akseer et al., 2020; Organization, 2020). Reducing the incidence of NCDs in adolescents and young people is a global priority in the Sustainable Development Goals (Alfvén et al., 2019). Developmentally, adolescents are more susceptible to adopting unhealthy lifestyle behaviours (Uddin et al., 2020). Young people share the same NCD risk factors as older adults, including overweight/obesity, sedentary lifestyle, physical inactivity and smoking (Alkatan et al., 2021; Nasser et al., 2020).

1.12 Chapter Summary

Kuwait ranks high in the prevalence of NCDs. With the growing burden of NCDs in the world, there is an even greater risk of younger generations in Kuwait developing T2DM. The sedentary lifestyle that young Kuwaitis are living only escalates their risk for developing comorbidities. Healthy behaviours have been studied in countries around the world, and it has been found that these behaviours have positive effects on their population’s overall health. Thus, with the help of community health nurses, there is a possibility that the risk of developing T2DM and other comorbidities might reduce. However, to address this problem, it is imperative to identify the age at which the risk of T2DM begins so that stakeholders and policymakers can develop and improve their guidelines and protocols when providing patient education and spreading awareness among this population.

1.13 Structure of the Thesis

The thesis is divided into five chapters. This first chapter introduced the burden of NCDs worldwide and in Kuwait. The chapter then described Kuwait as a study setting, in which the health contexts were presented. The principal researcher’s interest in the study, the research problem and the significance of the study were also explained. This chapter also identified the research hypotheses, objectives and aim.

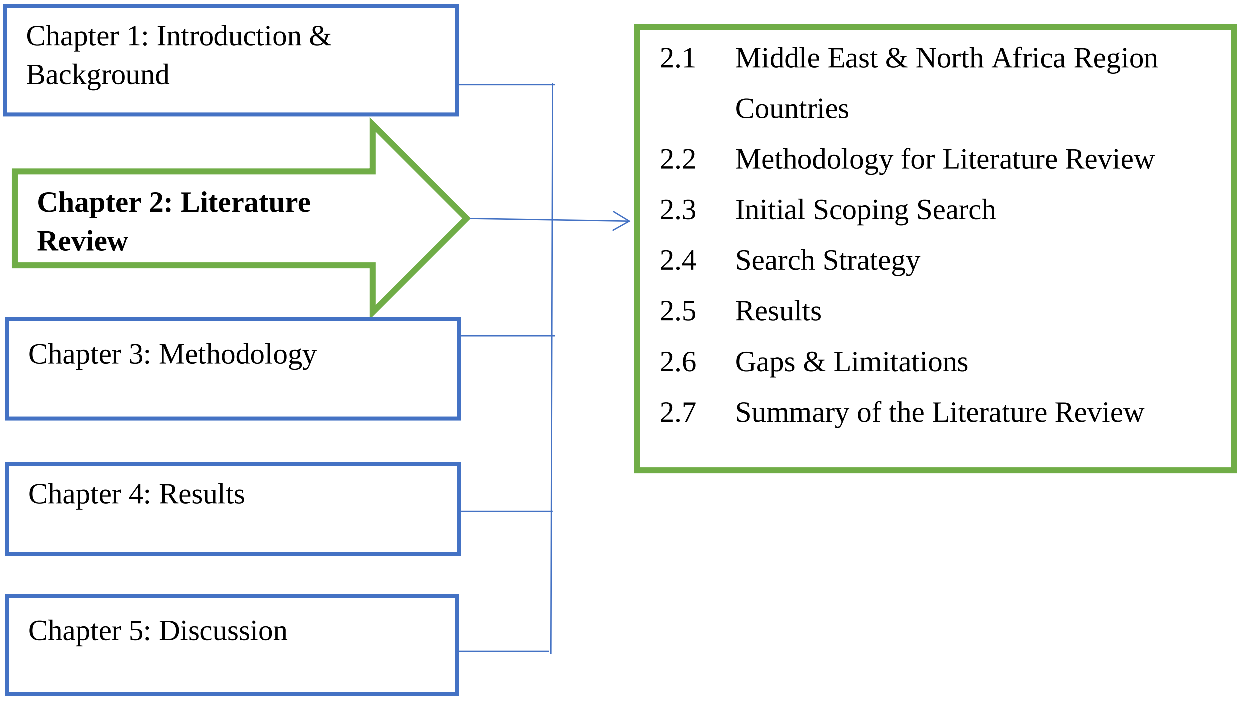
The second chapter presents the literature review, providing an overview of studies on health-related behaviours among young people in Kuwait. An integrative literature review identifies the gaps found in peer-reviewed journal articles.

The third chapter presents the methodology and methods utilised. The chapter describes why the quantitative research paradigm was selected to address the research hypotheses and objectives. This chapter also provides the theoretical and philosophical underpinnings of the chosen methodology, a repeated cross-sectional methodology. The methods used for this study are described and ethical considerations are presented.

The fourth chapter presents the results. This chapter outlines the demographic data of participants and their anthropometric data. This chapter also presents the analysis and interpretation of data collected from both the first and second phases of the study.

Finally, The fifth chapter discusses the findings, which are compared to the existing published literature, dissertations, case studies and reports, demonstrating the similarities and differences in the findings. This chapter also presents the strengths and limitations of this current study. It identifies future research implications and recommendations for patient education and clinical practice. In addition, it highlights new knowledge that was discovered in this study, future research and ends with the thesis conclusion.

Chapter 2: Literature Review



This chapter reviews the empirical research articles published in peer-reviewed journals on the relationship between health-related behaviours and T2DM among young people. The chapter presents the search strategy and methods that were conducted to answer research questions on the topic of prevention of T2DM in children, adolescents and young people in countries of the MENA region. These questions are:

- What are the methods used to screen and identify prediabetes and T2DM?
- What are the associations between health-related behaviours and HbA1c among young people at risk of T2DM in the MENA region?
- What is the incidence or the prevalence of T2DM among children and young people in the MENA region?

An integrative literature review was conducted to evaluate the eligibility of available research, including quantitative, qualitative and mixed-methods studies, that investigated T2DM among young people in the MENA region. The objective of this approach was to identify gaps in nursing practice, healthcare policy and strategies, as well as nursing research.

The chapter initially discusses the countries which constitute the MENA region. It then goes on to describe the methodologies used for literature reviews in the health professions, followed by the methodology selected for the literature review conducted for this research. Next, the initial scoping search, search strategy, study selection criteria and critical appraisal tools are described. The results of the included articles are then discussed in detail, including the limitations and gaps in the existing literature on the topic of this research. Finally, the significance of the current research project is discussed and a summary of the literature review is provided.

2.1 Middle East and North Africa Region Countries

The MENA region is a term is commonly used in academia, social sciences and international organisations. Some people refer to the Middle East as the Arab World or the Greater Middle East. According to the WHO (WHO, 2021), the MENA region consists of 22 countries, with a total population of around 679 million. These countries are Afghanistan, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Pakistan, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, UAE and Yemen. A further 14 countries are sometimes included depending on the purpose of the research or the way the data are used. These countries are Algeria, Armenia, Azerbaijan, Chad, Comoros, Cyprus, Eritrea, Ethiopia, Israel (Occupied Palestine), Georgia, Mali, Mauritania, Niger and Turkey.

Table 2.1 presents the full list of the 36 MENA region countries included in this integrative literature review.

Table 2.1: Middle East and North Africa countries

Number	WHO MENA region countries	Number	Countries sometimes included
1	Afghanistan	23	Algeria
2	Bahrain	24	Armenia
3	Djibouti	25	Azerbaijan
4	Egypt	26	Chad
5	Iran	27	Comoros
6	Iraq	28	Cyprus
7	Jordan	29	Eritrea
8	Kuwait	30	Ethiopia
9	Lebanon	31	Israel (Occupied Palestine)
10	Libya	32	Georgia
11	Morocco	33	Mali
12	Oman	34	Mauritania
13	Pakistan	35	Niger
14	Palestine	36	Turkey
15	Qatar		
16	Saudi Arabia		
17	Somalia		
18	Sudan		
19	Syria		
20	Tunisia		
21	United Arab Emirates		
22	Yemen		

Note. MENA = Middle East and Africa Countries; WHO = World Health Organization

2.2 Methodology for the Literature Review

Literature reviews are important by making substantive contributions to the field of knowledge (Torraco, 2005). Since the 1970s, the methods utilised for conducting literature reviews have been developing to enable synthesising findings from primary studies in the health professions (Jackson, 1980). Syntheses of existing literature can improve evidence-based decision-making (Tranfield et al., 2003; Whittemore & Knafl, 2005), identify gaps in knowledge (Booth et al., 2021), identify synergies within the existing literature (Booth et al., 2021) and narrow the gap between knowledge and lore in the field (Kennedy, 2007). By synthesising existing literature, healthcare professionals can gain a better understanding of a phenomenon of interest.

The process of conducting an integrative literature review, however, can be challenging. It has been argued that traditional literature reviews lack precision and are prone to subjectivity and bias (Beck, 1999). Although statistical approaches have been applied to improve the findings of literature reviews, these approaches are only suitable for certain types of literature reviews (Beck, 1999). Over the last 10 years, literature review methods have continued to evolve to improve the quality and the rigour of nursing research (Whittemore, 2005b). In nursing research, literature reviews can be conducted using an integrative review, systematic review, meta-analysis review or qualitative review. Table 2.2 below illustrates the methods used in nursing research literature reviews, presenting the definition, purpose, scope, sampling frame and kind of data analysis used in each review.

Table 2.2: Methods of nursing research literature reviews

Type of review and exemplar	Definition	Purpose	Scope	Sampling frame	Analysis
Integrative review (Redeker, 2000)	A summary of the literature on a specific concept or content area whereby the research is summarised and analysed, and overall conclusions are drawn	To review methods, theories, and/or empirical studies around a particular topic	Narrow or broad	Quantitative or qualitative research; theoretical literature; methodological literature	Narrative
Meta-analysis (Clemmens, 2001)	A summary of past research using statistical techniques to transform findings of studies with related or identical hypotheses into a common metric and calculating the overall effect, the magnitude of effect, and subsample effects	To estimate the effect of interventions or relationships	Narrow	Quantitative research of similar methodology	Statistical
Systematic review (Forbes, 1998)	A summary of past research using an objective and rigorous approach on studies with related or identical hypotheses	To summarise evidence regarding a specific clinical problem	Narrow	Quantitative research of similar methodology	Narrative or statistical
Meta-summary Meta-synthesis Formal grounded theory Meta-study (Beck, 2002)	A summary of past research combining the findings from multiple qualitative studies	To inform research or practice by summarising processes or experiences	Narrow or broad	Qualitative methodology	Narrative

Note. Adapted from Whittemore (2005b)

Table 2.2 above is used here to help outline a potential method for this literature review. However prior to conducting a literature review, a justification of the methods, goals and purposes of the review should be provided by the authors (Torraco, 2016). Moreover, Torraco (2016) identifies five criteria that shape the boundaries around the topic of interest, showing the characteristics and variety of literature reviewed and the examination of the issues of the specific research area:

1. review, update and critique the literature
2. meta-analysis
3. review, critique and synthesise the literature

4. reconceptualisation of the topic
5. answer specific research questions about a topic.

The purpose of the literature review for this research is to answer specific questions around the topic of prevention of T2DM in children, adolescents and young people in the countries of the MENA region. In this study, the principal researcher used an integrative literature review method to answer the research questions outlined at the beginning of this chapter.

According to Broome (1993) there are three types of integrative review: methodological review, theoretical review and empirical review. Table 2.3 presents the definitions of each type of integrative review.

Table 2.3: Types of integrative reviews

Type of review	**Definition**
Methodological	Critical review and analysis of the designs, methods and analyses in a series of studies (i.e., methodological problems in the research of children with a chronic illness)
Theoretical	Critical review of theories around a particular topic examining supportive and non-supportive evidence
Empirical	Critical review of empirical studies (quantitative or qualitative, or both) around a particular topic examining outcomes and relationships between variables

Note. Adapted from Broome (1993)

An empirical integrative literature review method was used in this study to critically review the literature on the topic of prevention of T2DM among adolescents and young people in the MENA region. Broome (1993) in (Whittemore & Knafl, 2005, p. 546), defined the integrative literature review as ‘a specific review method that summarises past empirical or theoretical literature to provide a more comprehensive understanding of a particular phenomenon or healthcare problem’. Furthermore, Torraco (2005) argues that this approach of integrating multiple sources of information is a distinctive form of research that leads to novel knowledge regarding the topic being examined. As the broadest type of integrative literature review, it has the ability to capture the complexity of diverse perceptions, emergent phenomena and trends in health disorders (Hopia et al., 2016). This approach is believed to be the only method that combines different types of research, such as experimental, quasi-experimental and non-experimental research, and that properly has the ability to enhance the nursing evidence-based practice, policy initiatives and nursing research (Whittemore & Knafl, 2005). Moreover, an empirical integrative review summarises past studies, draws conclusions from current research and leads future research projects in a particular research area (Schneider & Whitehead, 2016). Authors of studies in the nursing field have commonly used an integrative literature review in their research (Baah et al., 2019; Blay et al., 2014; Coyle et al., 2010; Hurst et al., 2019; McAllister et al., 2019; Nicholls & Webb, 2006; Palominos et al., 2019; Shin et al., 2019; Stewart, 2019; Younas & Quennell, 2019). However, Schneider and Whitehead (2016) argue that integrative reviews are most likely to be incorrectly referred to as 'systematic reviews'. Torraco (2005) emphasises the benefits of following well established steps or a checklist, or methodological strategies when planning to conduct literature reviews.

Since literature reviews are considered research of existing research, frameworks should be developed and applied. Additionally, these frameworks should meet the same standards to enhance methodological rigour and reduce limitations (Cooper, 1998). Whittemore and Knafl (2005) updated the integrative literature review's methodological approaches that were originally based on Cooper's (1998) framework. Even though Cooper's original framework is aligned with the review methods of the systematic review and the meta-analysis, the updated framework was modified to address the challenges of combining different types of research. The modification was based on the concept of integration and allowing the use of data from a diverse range of evidence (Whittemore, 2005a, 2005b). The modified and updated methods involve five stages that guide the review process:

1. problem identification stage

2. literature search stage
3. data evaluation stage
4. data analysis stage
5. presentation of results stage.

Each of these stages is briefly discussed next.

2.2.1 Problem identification stage

Whittemore and Knafl (2005) in their article describing the methods of conducting a literature review, explain that problem identification is the most important stage. Having a clear problem to investigate, knowing the variables of interest, sampling the targeted population, identifying the health issues and selecting the type of studies at this stage will enable all other stages. Furthermore, this process facilitates accurate investigation of variables and extraction of relevant data from primary studies (Whittemore, 2005b). According to Callahan (2014), rigorous literature reviews should possess five outstanding characteristics: being concise, clear, critical, convincing and contributive.

Before conducting an integrative review, researchers should ask themselves many questions, such as: What will the integrative literature review address? Is the topic of the review clearly defined? Will the review article make a significant, value-added contribution to new thinking in the field? For further useful questions that can guide the researchers before and during literature reviews, refer to the checklist of Torraco (2016) for writing and conducting integrative literature reviews (Appendix 1). This checklist was used by the principal researcher in this study. By the end of this stage, the overall aim, objectives and research questions should be clearly stated and identified (Hopia et al., 2016).

2.2.2 Literature search stage

For any type of review, well-defined literature search strategies are essential to increase the accuracy and reduce the likelihood of a biased literature search, which can potentially lead to inadequate and inaccurate findings (Conn, Isaramalai, et al., 2003). An ideal literature review should include all of the relevant articles on the topic of interest; however, finding these articles can be tricky, costly and time-consuming (Jadad et al., 1998). An electronic database can be used to perform literature searches quickly and efficiently; however, an inconsistent use of keywords and search terminologies may lead to the return of only part of the relevant articles (Conn, Isaramalai, et al., 2003). Therefore, an expert librarian should be involved during planning and performing an electronic databases search (Lefebvre et al., 2019). In this study, the principal researcher sought support from a librarian who is expert in the nursing and health sciences fields to plan and perform a comprehensive electronic search on the literature currently available. Beside the electronic search, it is recommended other types of literature searches be performed, such as manual searching of relevant journals, searching research registries, networking and ancestry literature searching (Conn, Valentine, et al., 2003).

It is generally recommended that two to three different search strategies be used when conducting an integrative literature review to identify as many relevant sources as possible (Conn, Valentine, et al., 2003; Soares et al., 2014). Additionally, using inclusion criteria and limiters of the targeted population, such as health condition, date of publication, language of publication and outcomes of interest, to determine relevant studies can also be beneficial (Sanfilippo et al., 2020; Stern et al., 2014). The literature search stage seems to be complex, and many methodological matters should be considered. Therefore, the literature search strategies should be clearly documented to include the initial scope search, search terms and keywords, the electronic databases, search strategies and the inclusion and exclusion criteria

(Whittemore, 2005b). By the end of this stage, the principal researcher should be able to find the most relevant studies that could answer the research questions.

2.2.3 Data evaluation stage

As part of this stage, the quality of the included articles is examined in order to ensure that the search methods are rigorous, and limitations are minimised. Once the relevant studies have been attained, it is imperative to use reliable research evidence appraisal tools and valid coding methods in order to enhance methodological rigour and the quality of the available evidence (Brown et al., 2003; Haile, 2022; Newhouse et al., 2007). In the current integrative review, the principal researcher used The Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) appraisal tool to evaluate the quality of the available literature about the topic of prevention of T2DM among young people in the MENA region.

Experts in the field argue that there is no gold standard for assessing and evaluating the quality of the existing articles, as this process varies based on the methods and aims of conducting a literature review, as well as field-specific criteria (Furunes, 2019; Glenny, 2005; Lohr, 2004; Whittemore & Knafl, 2005). For example, the data evaluation process of relevant studies is altered in a systematic review, meta-analysis or in an integrative review. In addition, applying a systematic approach in evaluating and interpreting the relevant articles minimises the possible sources of selection bias (Conn & Rantz, 2003). Polit and Beck (2017) state that a successful research critique is able to identify strengths, weaknesses, and areas of adequacy and inadequacy of primary sources in an unbiased manner. It is clear that the process of evaluating the quality of primary sources is complex, particularly when conducting an integrative literature review. However, the quality and content of selected studies can be evaluated by two independent reviewers using specific assessment tools in order to ensure reliability and validity (Whittemore, 2005b). In this study, the principal researcher and one of the supervisory team members (who is expert in T2DM) used the research evidence appraisal tool to evaluate the current literature.

2.2.4 Data analysis stage

Researchers should organise and categorise data from relevant studies into unified and integrated conclusions about the research problems or research questions in the data analysis stage (Whittemore & Knafl, 2005). Moreover, The objective of this stage is to offer a thorough and unbiased interpretation of each study in order to produce clear conclusions (Fink, 2019). There is a potential for bias and subjectivity during this stage, which should be taken into account. Thus, detailed records of the data analysis process should be maintained to ensure rigour and transparency. Pan (2016) lists examples and guidelines about using tables, concept maps or diagrams whenever possible to summarise the selected studies. The use of these visual representations strengthen the researcher's findings and reinforce the reader's understanding (Pan, 2016).

To explain how relevant articles were included in this literature review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was employed. The PRISMA flow diagram is a graphical representation of the process of identifying and selecting studies for inclusion in the review (Page, McKenzie, et al., 2021). It shows the number of studies identified, screened and included in the review, as well as the reasons for excluding studies at each stage (Page, Moher, et al., 2021). Adherence to the PRISMA guidelines is recommended by many leading nursing and medical journals and is often required for publication (Page, McKenzie, et al., 2021). By following these guidelines, the principal researcher can ensure that this integrative literature review is conducted in a rigorous and transparent manner, which can increase the reliability and validity of the findings (Page, McKenzie, et al., 2021; Page, Moher, et al., 2021).

In addition, the principal researcher organised and recorded all relevant data from the included studies in a summary table (see Appendix 2).

Torraco (2005) states:

> Synthesizing the literature means that the review weaves the streams of research together to focus on core issues rather than merely reporting previous literature. Synthesis is not a data dump. It is a creative activity that produces a new model, conceptual framework, or other unique conception informed by the author's intimate knowledge of the topic. (Torraco, 2005, p. 362)

Integrative literature reviews generate new knowledge that can be synthesised into numerous forms and categories (Torraco, 2016; Younas et al., 2021). After reviewing the synthesis forms and categories, the principal researcher for this current research used the deductive method for the integrative literature review. This method was considered deductive because it was based on pre-existing criteria such as predetermined domains, predefined concepts, inclusion criteria and research questions (Younas et al., 2021). Authors of an integrative review who examined the usefulness of nursing theories practice used the deductive method where several themes and subthemes were developed, and the literature review findings were presented under each of their research questions (Younas & Quennell, 2019). In this current integrative literature review, themes and subthemes were generated under each of the research questions listed at the beginning of this chapter.

2.2.5 Presentation of results stage

Results of integrative literature reviews can be presented in tables, figures, graphs, construct maps, word clouds and conceptual models (Schneider & Whitehead, 2016; Whittemore, 2005b; Whittemore & Knafl, 2005; Younas et al., 2021). Presenting results in an integrative literature review is comparable to descriptive research because it describes and displays findings from primary sources in brief formats (Whittemore, 2005b). In general, summary tables report and document the results of primary studies by listing key details without extra information (Stetler et al., 1998). Schneider and Whitehead (2016) provide an example of summary table column headers that includes author, date, participants, methods, outcome variables and findings. The summary tables present an overview of the similarities and differences between the articles selected (Schneider & Whitehead, 2016). However, Hopia et al. (2016) highlight the need for adding limitations and strengths columns in the summary table, as that enabled the reporting of gaps in the literature, inform implications for current practice and guide future research.

Recent integrative literature reviews in the nursing field propose creative and innovative ways of presenting results using construct maps, word clouds and conceptual models (Baah et al., 2019; Booher, 2019; McAllister et al., 2019; Shin et al., 2019). Nursing research commonly uses tabular representations and summary tables for presenting the results (Hopia et al., 2016; Younas et al., 2021). The tabular presentation and summary of tables were used in the current review since the principal researcher has used this method several times in previous research projects (Alobaidly et al., 2018; Hasan, 2019), and has gained knowledge and skills in presenting results in tables.

To summarise the five stages of Whittemore and Knafl (2005) in conducting integrative literature reviews, employing the integration methods in gathering data from different types of primary sources has the potential to minimise bias, decrease errors and strengthen outcomes. Hopia et al. (2016) declare that this five-stage framework has been frequently used in nursing research. However, the methods of this framework have been rarely discussed and reported. Moreover, combining the use of guidelines, checklists and other appraisal tools alongside this framework ensures clarity and enhances the quality of the literature review methods (Hopia et al., 2016).

2.3 Initial Scoping Search

A search of the Elsevier Scopus database was conducted initially to assess the existing literature using the following search terms: ‘Health-related behaviours’, ‘type 2 diabetes mellitus’, ‘MENA countries’ to identify more keywords for the entire search. However, the results returned a large number of articles (*n* = 34,549), and the search needed to be narrowed down to studies focused on health-related behaviours among young people at risk of T2DM in the MENA region. This initial scoping guided the search strategy and ensured the inclusion of the most relevant articles for this integrative literature review.

With the guidance of the college librarian, comprehensive search strategies were planned to select the most appropriate databases, clarify inclusion and exclusion criteria, and establish methods of appraising the relevant articles.

2.4 Search Strategy

To investigate the current literature, an electronic comprehensive search was undertaken to obtain existing data. The search strategy was limited to English language articles published in the last 20 years, from 2002 to 2022. Different online databases such as the Cumulative Index to Nursing and Allied Health Literature, the MEDLINE (Medical Literature Analysis and Retrieval System Online), ProQuest and Scopus were employed in this search strategy. In addition, a few medical websites were accessed, such as the WHO, the ADA, the IDF, the International Society of Pediatric and Adolescent Diabetes, the National Association of School Nurses and the CDC. The purpose of using various search engines and medical websites was to ensure that the literature search strategy was comprehensive (Wu et al., 2012).

A search was performed employing various combinations of the following keywords, ‘adolescent’, ‘child’, ‘youth’, ‘young people’, ‘student’, ‘school’, ‘diabetes mellitus’, ‘T2DM’, ‘NIDDM’, ‘T2D’, ‘non insulin’, ‘prediabetes’, ‘prediabetic state’, ‘early stage diabetes’, 'borderline diabetes', 'health-related behaviours', 'health behaviours', 'life style changes', 'healthy lifestyle', 'smoking', 'drinking behaviour', 'physical activity', 'diet', 'eating habits', 'sleeping habits', 'MENA region', 'Arab countries', 'Afghanistan', 'Algeria', 'Armenia', 'Armenia', 'Azerbaijan', 'Bahrain', 'Chad', 'Comoros', 'Cyprus', 'Djibouti', 'Egypt', 'Eritrea', 'Ethiopia', 'Georgia', 'Iran', 'Iraq', 'Israel', 'Jordan', 'Kuwait', 'Lebanon', 'Libya', 'Mali', 'Mauritania', 'Morocco', 'Palestine', 'Oman', 'Pakistan', 'Qatar', 'Turkey', 'Saudi Arabia', 'Somalia', 'Sudan', 'Syria', 'Tunisia', 'United Arab Emirates', 'Yemen'. Advanced search options extended the search by using the keywords, MeSH terms and their Boolean logic. For full information about the search terms, key words and search results, see Appendix 3.

2.4.1 Selection criteria

Primary sources were included in this integrative literature review if found to be useful and helped to answer one or more of the research questions. The first search was performed to answer only the first two research questions (about the associations between health-related behaviours and HbA1c among young people at risk of T2DM in the MENA region and the methods used to screen and identify prediabetes and T2DM) and locate primary sources published within the last decade. However, only limited relevant studies were found after the screening of the generated literature. The principal researcher then decided to add the third research question (about the incidence or prevalence of T2DM among children and young people in the MENA region) and expand the second search to the past 20 years.

The exclusion criteria were studies with findings focused on T1DM or another form of diabetes like MODY, thereby studies focused on T2DM only were selected. Studies focused on the adult cohort were excluded unless the majority of their population were aged between 18 and 24 years. Studies were included if they focused on children, adolescents and young people aged between 0 and 24 years. Translated published studies and studies in a language other than

English were excluded because translating could lead to misinterpretation. In addition, this review was performed in English. Conference abstracts and case reports were excluded, since these kinds of reports are not considered as primary sources. Grey literature and student dissertations were excluded due to the lack of peer reviews. Published studies that provided an abstract only, where the full article could not be found, were also excluded. Table 2.4 lists the inclusion and exclusion criteria that were designed to select the relevant articles.

Table 2.4: Selection criteria

Inclusion criteria	**Exclusion criteria**
Articles published from 2002 to 2022	Articles published before 2001
Articles published in the English language	Articles published in other languages and translated articles
Peer-reviewed journal articles	Grey literature: dissertations & theses
Articles focusing on children, adolescents & young people	Articles focusing on adults only
T2DM	T1DM and MODY
Primary studies: systematic reviews, literature reviews and meta-analyses using qualitative studies, quantitative studies and mixed method studies	Studies that provide abstracts only and no ‘full-texts available’ papers, case articles, brief communications and conference papers

Note. T2DM = type 2 diabetes mellitus; T1DM = type 1 diabetes mellitus; MODY = maturity-onset diabetes of the young

2.4.2 Screening of relevant studies

All studies identified by the previous search were exported to Endnote. The principal researcher removed duplicates before commencing an initial title and abstract screening. This process looked for possible eligible studies that could answer the research questions. Then, the full text of these studies were retrieved and evaluated carefully before including them in this integrative review. Selected studies should meet all the selection criteria and be able to answer at least one research question.

2.4.3 Search result and selection of studies

The PRISMA framework and process was used to critique and analyse the articles to ensure the relevancy of the articles included in this literature review. The online search produced 308 studies, eight of which were duplicates. After reviewing the abstract of 300 papers, 262 were excluded because these studies will not be able to answer the literature review questions that mentioned earlier in this chapter. The full text of 38 studies were carefully reviewed for their eligibility. Hand-searching of the reference lists of the 38 studies was performed. An additional three studies were included and 22 studies were excluded after critical evaluation with the appraisal tool and screening the full text. Furthermore, the updated online search generated two relevant studies included in this literature review. Therefore, a total of 21 studies were found to be suitable for this integrative literature review. These 21 research article were then assessed using the Johns Hopkins Nursing Evidence-Base Practice (JHNEBP) appraisal tool described in detail in the section 2.4.4 below.

Figure 2.1 presents the PRISMA flow chart the articles included in this literature review.

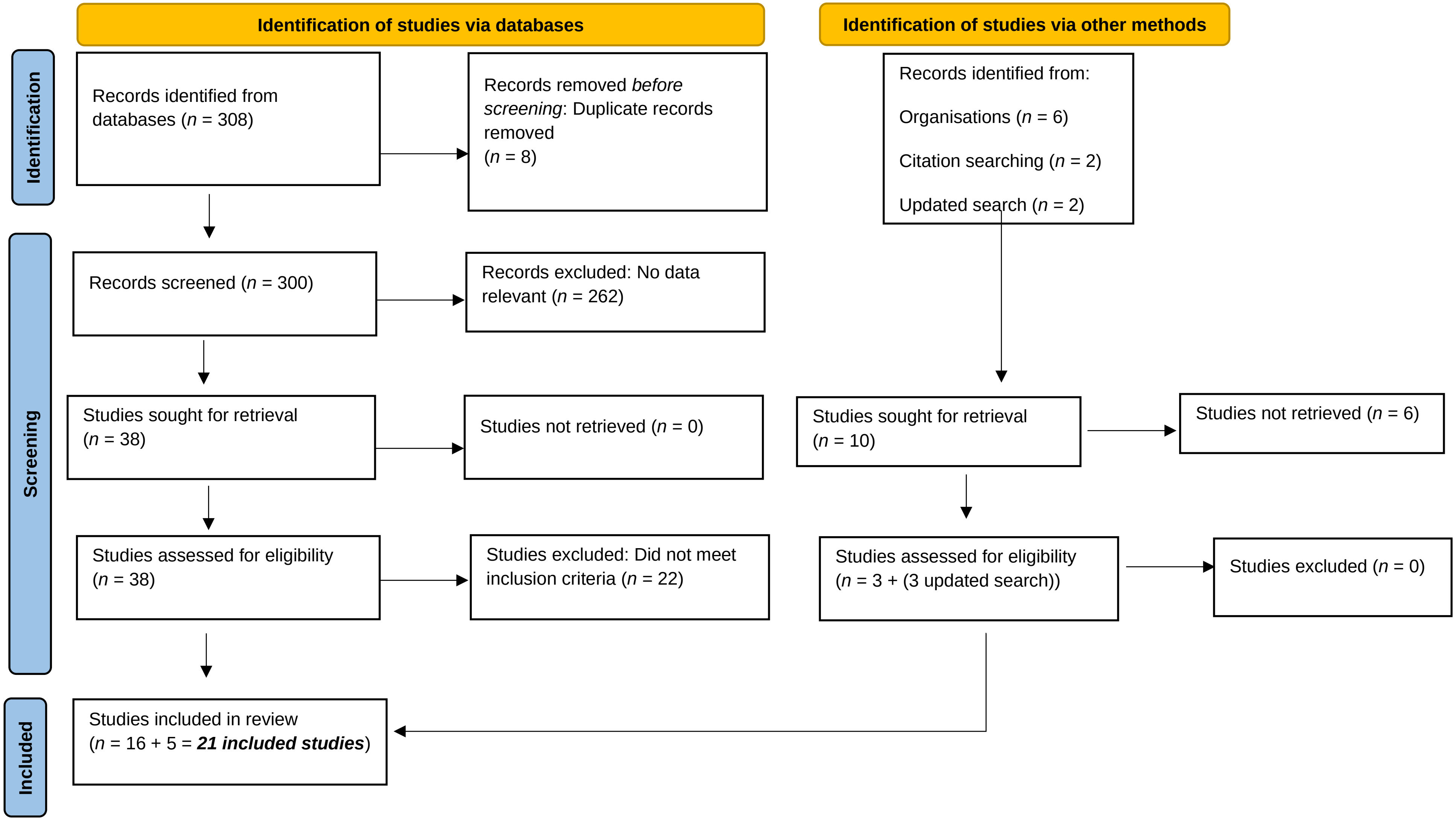


Figure 2.1: PRISMA 2020 flow diagram

2.4.4 Critical appraisal tool: Johns Hopkins Nursing Evidence-Based Practice appraisal tool

Following on from the PRISMA review of the literature search the JHNEBP appraisal tool was utilised to analyse and critique the selected articles (see Appendix 4). This validated tool identifies the type of research design that also evaluates the quality of evidence by critically appraising the research method conducted to assess for validity and reliability of the research approach and findings (Dang & Dearholt, 2017). The evaluation process of the quality and the relevance of available evidence requires the use of critical appraisal tools (Haile, 2022). Buccheri and Sharifi (2017) claim that nurses can use appraisal tools to move from subjective reporting towards objective reporting. Furthermore, they can use analytical methods to evaluate the current evidence.

2.4.5 Assessing the level of evidence

As part of evaluating published journal articles, it is essential to identify factors that could have an effect on the validity and reliability of the findings (Melnyk & Fineout-Overholt, 2011; Polit & Beck, 2017). Polit and Beck (2017) stress the importance of determining the level and the quality of evidence in evidence-based nursing practice and nursing research. In this integrative review, the JHNEBP tool provides a hierarchy of evidence that determines the level of evidence in evidence-based nursing practice. Accordingly, the evidence hierarchy of the JHNEBP tool was employed to verify the quality of the selected articles in this review.

The evidence hierarchy is divided into five levels: the highest is Level I, which includes experimental studies, randomised controlled trials (RCT) and systematic reviews of RCTs (with or without meta-analysis). The second highest level is Level II, which includes quasi-experimental studies, systematic reviews of a combination of RCTs and quasi-experimental studies and systematic reviews of quasi-experimental studies (with or without meta-analysis).

Level III includes non-experimental studies, systematic reviews of a combination of RCTs and non-experimental studies, systematic reviews of non-experimental studies (with or without meta-analysis), qualitative studies and systematic reviews of qualitative studies (with or without meta-synthesis). In Level IV, opinions of recognised authorities, committees and consensus panels based on scientific evidence, such as clinical practice guidelines and consensus panels, are included. The final level, Level V includes experiential and non-research evidence such as literature reviews, opinions of authorities on non-research evidence, case reports, program evaluation and quality improvements. The JHNEBP evidence level and quality guide is provided in Appendix 5.

In addition, there are three levels of quality for each of the levels of evidence in the JHNEBP tool. Evidence Levels I, II and III share the same quality guide, whereas Level IV and Level V each have their own quality guides. All quality guides have three levels of quality: A (high quality), B (good quality) and C (low quality or major flaws). These levels are explained in detail in Appendix 5.

Because of the importance of identifying the factors impacting validity and reliability, the level of evidence and quality guidelines of the JHNEBP tool were used to assess the level and quality of the selected papers in this study. Table 2.5 lists the articles included in this review and their level of evidence and quality according to the JHNEBP tool.

Table 2.5: Level of evidence and quality of the included articles

Article title and authors	Evidence level	Quality
Characteristics of Turkish children with Type 2 diabetes at onset: A multicentre, cross-sectional study (Hatun et al., 2019)	III	B
Association of glycosylated hemoglobin (HbA1c) levels with insulin resistance in obese children (Önal et al., 2014)	III	C
Prevalence of metabolic syndrome in elementary school children in East of Iran (Zardast et al., 2015)	III	B
Diabetes Risk Score in a young student population in Jordan: A cross-sectional study (Al-Shudifat et al., 2017)	III	B
Metabolic syndrome: prevalence and risk factors among adolescent female intermediate and secondary students in Saudi Arabia (Alowfi et al., 2021)	III	B
Youth-onset type 2 diabetes in Israel: A national cohort (Levin et al., 2022)	III	B
Predictive value of body mass index to metabolic syndrome risk factors in Syrian adolescents (Al-Bachir & Bakir, 2017)	III	C
Type 2 diabetes in Sudanese children and adolescents (Osman et al., 2013)	III	C
The prevalence of obesity and associated morbidity among 17-year-old Israeli conscripts (Dayan et al., 2005)	III	C
The prevalence of impaired fasting glucose and type 2 diabetes in a population-based sample of overweight/obese children in the Middle East (Moadab et al., 2010)	III	B
The prevalence, risk factors, and screening measure for prediabetes and diabetes among Emirati overweight/obese children and adolescents (Al Amiri et al., 2015)	III	A
Prevalence of hyperinsulinism, type 2 diabetes mellitus and metabolic syndrome among Saudi overweight and obese paediatric patients (Al-Agha et al., 2012)	III	B
National surveillance for type 1, type 2 diabetes and prediabetes among children and adolescents: a population-based study (SAUDI-DM) (Al-Rubeaan, 2015)	III	A
Childhood and adolescent diabetes mellitus in Arabs residing in the United Arab Emirates (Punnose et al., 2002)	III	C
Prevalence of type 2 diabetes mellitus among Kuwaiti children and adolescents (Moussa et al., 2008)	III	B
Incidence of type 2 diabetes in Kuwaiti children and adolescents: Results from the Childhood-Onset Diabetes Electronic Registry (CODeR) (Al-Kandari et al., 2019)	III	B
Incidence of type 1 and type 2 diabetes, between 2012-2016, among children and adolescents in Qatar (Alyafei et al., 2018)	III	C
The epidemiology, clinical, biochemical, immunological and radiological features of youth-onset type 2 diabetes mellitus in the state of Qatar (Ahmed et al., 2022)	III	B
Incidence and predictors of early adulthood pre-diabetes/type 2 diabetes, among Iranian adolescents: The Tehran lipid and glucose study (Mirbolouk et al., 2016)	III	A
Assessment of Overweight, Obesity, Central Obesity, and Type 2 Diabetes among Adolescents in Qatar: A Cross-Sectional Study (Cheema et al., 2022)	III	B

Article title and authors	Evidence level	Quality
Associations of adiposity and parental diabetes with prediabetes among adolescents in Kuwait: A cross-sectional study (Almari et al., 2018)	III	A

2.5 Results

The search strategy, selection criteria and quality assessments of the relevant studies yielded 20 studies (refer to Figure 2.1). All studies were quantitative studies; (*n* = 11) were cross-sectional studies and (*n* = 9) were retrospective cross-sectional studies. Most studies were conducted in the Kingdom of Saudia Arabia (KSA) (*n* = 3), followed by Turkey (*n* = 2), Kuwait (*n* = 3), Iran (*n* = 3), Qatar (*n* = 3), Israel (Occupied Palestine) (*n* = 2) and UAE (*n* = 2). Jordan, Sudan and Syria each contributed with (*n* = 1).

An update on the literature was conducted to include the most recent studies on T2DM in young people. The same keywords and inclusion and exclusion criteria were used to yield relevant results. The search strategy from January 2022 to March 2023 generated a total of 17 eligible articles. However, only three articles where relevant to address the hypothesis and objectives of this current research. These articles were conducted in Iran (*n* = 1), Kuwait (*n* = 1) and Qatar (*n* = 1). Thus, a total of 21 studies were included in this integrative literature review.

All the included articles belonged to Level III – non-experimental studies. The quality of these articles was found to be in A (*n* = 4), B (*n* = 11) and C (*n* = 6). Although most of the included articles in this literature review were found to be in Level III, and the quality was B or C, these studies were included due to the scarcity of literature around childhood and adolescent T2DM. Therefore, all the relevant articles on childhood and adolescent T2DM that were conducted in the MENA region were included in this literature review.

Four themes were generated to answer the three research questions. The first theme was the prevalence of T2DM among young people in MENA countries. The second theme was the association between health-related behaviours and T2DM among young people in MENA countries. The third theme was screening methods for T2DM and prediabetes among young people in MENA countries. The final theme was the clinical characteristics of T2DM, prediabetes and metabolic syndrome among young people.

2.5.1 Theme 1: The prevalence of type 2 diabetes mellitus, prediabetes and metabolic syndrome among young people in Middle East and North Africa countries

Theme 1 consists of studies that investigated the prevalence of T2DM, prediabetes and metabolic syndrome in young adults. This theme included 12 studies that were conducted in Iran (*n* = 3), KSA (*n* = 3), Sudan (*n* = 1), Israel (Occupied Palestine), (*n* = 1) UAE (*n* = 1), Kuwait (*n* = 2) and Qatar (*n* = 3) between 2002 and 2022. These studies are described in detail in the following paragraphs.

A descriptive cross-sectional study verified the prevalence of metabolic syndrome among school children in the east of Iran in 2013 (Zardast et al., 2015). Based on multiple cluster sampling, 1425 elementary school children were included in the study. The prevalence of metabolic syndrome was 0.9% among those with normal weight, 11.3% among those who were overweight and 36.2% among those who were obese (Zardast et al., 2015). The rate of metabolic syndrome was higher in girls compared to boys. In addition, around 43% of the participants had at least one component of metabolic syndrome, with a significantly higher risk for metabolic syndrome in those with a large waist circumference, high BMI and those aged older than 9 years (Zardast et al., 2015).

Another cross-sectional study was conducted in two female schools (one intermediate and one secondary) in the KSA between January 2018 and March 2018 (Alowfi et al., 2021). This study had a convenience sample of 172 female students aged between 12 and 19 years. The objectives of this study were to estimate the prevalence of metabolic syndrome and to determine the risk factors for metabolic syndrome among female adolescents. The results of the study revealed that 125 participants had a normal BMI, 24 were overweight, 20 were obese and three were underweight (Alowfi et al., 2021). In obese participants, high glucose levels were also often observed, but there was no statistical significance. In the study's population, metabolic syndrome was prevalent at 7%, and one participant had recently been diagnosed with T2DM. A family history of diabetes, hypertension, obesity and high cholesterol levels was associated with a higher prevalence of metabolic syndrome, although this was not statistically significant. Moreover, the most common risk factors in this population were high glucose levels and high waist circumference. The authors also claim that participants who ate fast food frequently and adopted a sedentary lifestyle had a higher prevalence of metabolic syndrome, but these factors were not statistically significant (Alowfi et al., 2021).

A hospital-based study in Khartoum, Sudan, used a retrospective, descriptive, cross-sectional design to measure the prevalence of T2DM among children and adolescents to identify the underlying causes, clinical characteristics and comorbidities of T2DM (Osman et al., 2013). The medical files of all children and adolescents (n = 985) who attended the hospital between 2006 and 2009 were reviewed, and those who met the diagnostic standards of T2DM (n = 38) were further investigated. The prevalence of T2DM among this population (Sudanese aged between eight and 18 years) was 4% (Osman et al., 2013). Out of those young people with diabetes (n = 38), around 92% (n = 35) had onset of T2DM when aged between 11 and 18 years and 8% (n = 3), who were extremely obese, had onset between 8 and 11 years. The study results indicated that approximately 55% (n = 21) of adolescents living with diabetes were of upper socioeconomic status, 34% (n = 13) were of middle socioeconomic status, 92% (n = 35) had a positive family history of diabetes, and 40% (n = 15) of patients' mothers had gestational diabetes (Osman et al., 2013) . Moreover, roughly 76% (n = 29) of the adolescents living with diabetes were obese and 21% (n = 8) were considered overweight, and 81% (n = 31) had clear signs of acanthosis nigricans. This condition is characterised by thickened, rough, and symmetrically distributed dark skin appearing on the neck, axillae, groin folds, popliteal, and sometimes on a person's face (Das et al., 2019). Also, Few health behaviours of this population were investigated, but the results revealed that 84% (*n* = 32) spent long hours in front of a computer or TV screen, around 89% (*n* = 34) were physically inactive and 84% (*n* = 32) chose fast food regularly (Osman et al., 2013).

Similarly, in 2005 Dayen et al. conducted a cross-sectional study in Israel (occupied Palestine) that aimed to represent the prevalence of obesity and accompanied morbidity, including hypertension and T2DM, and to compare findings between sexes among adolescents (Dayan et al., 2005). This study involved 76,732 conscripts, 42.2% (*n* = 32,402) were female and 57.8% (*n* = 44,330) were male. Under Israeli law, every 17-year-old is required to undergo a medical examination at an Israel Defence Forces recruitment office. Obesity was prevalent in 4.1% of males and 3.3% of females (Dayan et al., 2005). Furthermore, overweight prevalence among males and females was 12.4% and 11.4%, respectively. There was a significant increase in the prevalence of hypertension and T2DM among obese conscripts of both sexes. In addition, males were significantly more likely to suffer from hypertension and T2DM than females (Dayan et al., 2005).

In Iran, Moadab et al. (2010) attempted to estimate the prevalence of impaired fasting glucose and T2DM for the first time in a young population-based sample in Isfahan, Iran. Overall, 672 overweight and obese participants aged between 6 and 19 years were selected from 7554 school students. This random sample consisted of 55.1% (*n* = 370) male participants and 44.9% (*n* = 302) female participants (Moadab et al., 2010). The prevalence of impaired fasting glucose was 4.6% (*n* = 31) among the study's population. Moreover, the prevalence of T2DM was 0.14%. In those who demonstrated an impaired fasting glucose, the prevalence of high BMI was significantly higher. In addition, the presence of acanthosis nigricans and positive family history for diabetes were associated with T2DM (Moadab et al., 2010).

Another Iranian study by Mirbolouk et al. (2016) aimed to evaluate the incidence and predictors of prediabetes or T2DM in Iranian adolescents from 1999 to 2001, and then follow-ups with a 3-year interval until 2011. The study design was a combination of retrospective data and cohort for a median of 9.2 years. A total of 2563 adolescents aged 10–19 years without prediabetes or T2DM at baseline were included in this study (Mirbolouk et al., 2016). Using a multivariate cox-proportional analysis, the data in this study revealed that parental risk factors and T2DM history were significant to the development of T2DM in adolescents, and that approximately 1% of Iranian adolescents developed T2DM yearly (Mirbolouk et al., 2016). This study also reported that general adiposity and increased FPG are to be considered in the development of T2DM in adolescents. Mirbolouk et al. (2016) pointed out the lack of population studies on the incidents and predictors of T2DM and prediabetes in the young population despite the rising numbers of incidence (Mirbolouk et al., 2016).

During the period from 2006 to 2010, a retrospective cross-sectional study was conducted on paediatric patients with diabetes at a university hospital in Saudi Arabia (Al-Agha et al., 2012). The study had three objectives: the first objective was to identify the prevalence of hyperinsulinism among overweight/obese Saudi children and adolescents. The second objective was to estimate the prevalence of T2DM among those who were at risk. The third objective was to identify the prevalence of metabolic syndrome and its components among T2DM paediatric patients (Al-Agha et al., 2012). Medical records of 387 patients aged between 10 and 17 years were reviewed and analysed. It was found that 44% of the participants had hyperinsulinism and 9% had T2DM. The prevalence of overweight and obesity among paediatric patients with T2DM was 63% and 37%, respectively. Moreover, obesity was higher in around 71% of female patients living with diabetes. Approximately 29% of paediatric patients with T2DM had acanthosis nigricans, and 23% had an elevated waist circumference. The findings of this study show that obesity, metabolic syndrome and T2DM were emerging health problems among Saudi children and adolescents at that time. As a result, the authors recommended early screening, proper treatment and prevention programs be urgently implemented to reduce the impact of obesity-related health problems (Al-Agha et al., 2012).

The findings of Al-Rubeaan (2015) are in agreement with Al-Agha et al. (2012). Youth patients in Saudi society had a high prevalence of T2DM and impaired fasting glucose, with the majority of patients being ignorant of their health condition (Al-Rubeaan, 2015). The Saudi Abnormal Glucose Metabolism and Diabetes Impact Study was conducted from 2007 to 2009 to assess the prevalence of impaired fasting glucose, T1DM and T2DM (Al-Rubeaan, 2015). This national population-based cross-sectional study involved a large sample size of 53,370 Saudi children and adolescents aged from 6 to 18 years. The overall prevalence of T1DM, T2DM and impaired fasting glucose was 10.8% (n = 1883), of which 0.5% (n = 105) were known cases of T1DM or T2DM. In addition, 10.3% (n = 1788) were either newly identified cases of T2DM 4.2% (n = 735) or had impaired fasting glucose of 6.1% (n = 1,053) (Al-Agha et al., 2012) . Nearly 90% of adolescents who were newly diagnosed with T2DM were unaware of their condition, as mentioned earlier. Being aged more than 13 years was a significant risk factor for the onset of diabetes in this population. Age, being male, obesity, urban residency and high family income were found to be significant risk factors for impaired fasting glucose and T2DM in the study population (Al-Rubeaan, 2015).

Between 1990 and 1998, the pattern of diabetes mellitus, including type 1 and type 2, among childhood and adolescents in an Arab population of the UAE was studied (Punnose et al., 2002). This retrospective study included 40 Arab patients with diabetes aged between 0 and 18 years.

Five Arab adolescents had T2DM, four of whom were obese and had a positive family history of diabetes. However, data on the prevalence of T2DM were not available. This study focused mainly on T1DM patients but recommended future screening of T2DM among young people in the UAE (Punnose et al., 2002).

In Kuwait, Moussa et al. (2008) performed a retrospective study to determine the prevalence of T2DM among Kuwaiti children and adolescents aged between six and 18 years. Medical student records from 182 schools were examined to obtain data on 128,918 students. T2DM was identified in 45 of the students surveyed. This resulted in an overall prevalence of 34.9 cases per 100,000 students (Moussa et al., 2008). Of the 45 T2DM patients, 25 were male, and 20 were female; the male/female ratio was 1.25: 1. Moreover, the prevalence of T2DM increased significantly with age, and being a male was considered a risk factor among this population. The results of this study claimed that 51% (n = 23) had a positive family history of T2DM (Moussa et al., 2008).

Al-Kandari et al. (2019) reviewed and analysed the child-onset diabetes electronic registry between 2011 and 2013 in Kuwait to estimate the incidence rate of T2DM and to describe the clinical characteristics at the time of diagnosis. The results included 32 T2DM patients aged between six and 14 years, 50% (n = 16) were female patients. Overall, there was a 2.56 per 1000 incidence rate for T2DM patients aged between 0 and 14 years (Al-Kandari et al., 2019). The majority of T2DM patients, 94% (n = 30), were aged between 10 and 14 years. Only 6% of patients (n = 2) had T2DM at an age below 10 years. Among the youngest patients was a female aged 6 years with morbid obesity. BMI and HbA1c at diagnosis did not show a significance difference between sexes. However, Al-Kandari et al. (2019) strongly encourage that future research should focus on the screening of adolescents at risk of developing T2DM.

In Qatar, a retrospective cross-sectional study found the incidence and trend of T1DM and T2DM among Qatari children and adolescents aged 0–14 years between 2012 and 2016 (Alyafei et al., 2018). Alyafei et al. (2018) claim that there were no cases of T2DM among Qatari adolescents before 2008. After reviewing the medical records, 45 patients were identified as T2DM cases aged between 5 and 14 years. In this population a greater proportion of females than males were identified, with a ratio of 1.4:1. There was an increase in the incidence of T2DM in Qatari children and adolescents from 1.82 per 100,000 in 2012 to 2.7 per 100,000 in 2016. In addition, a positive family history of diabetes was present in all patients with T2DM. Moreover, all patients were obese or overweight when diagnosed with T2DM. The researchers suggested that further studies should be conducted to determine what is causing these increases in T2DM among the young Qatari population (Alyafei et al., 2018).

Another Qatari study was conducted between 2018 and 2020 to determine the clinical characteristics and incidence of T2DM in youth (Ahmed et al., 2022). This retrospective cross-sectional study examined the medical records of 1325 paediatric patients with diabetes aged between 0 and 18 years. However, only 104 patients aged 8–18 years were identified as having T2DM. The incidence of T2DM among Qatari adolescents in 2020 was 2.51 per 100,000 (Ahmed et al., 2022). The male to female ratio was 1.5:1, and there were more male patients than female patients. Almost all T2DM patients were obese or overweight, and 98% had acanthosis nigricans 90%. A positive family history of diabetes was found in 71% of the young patients. Moreover, maternal gestational diabetes was present in about 60% of T2DM patients. Ahmed et al. (2022) encouraged the implementation of programs for early screening and prevention of T2DM in Qatari young people.

A third Qatari study that aimed to determine the prevalence of obesity and T2DM in adolescents aged 13 to 17 years; and to evaluate the association of lifestyle, maternal breastfeeding, parental weight and familial history of T2DM in these adolescents (Cheema et al., 2022). This study used a cross-sectional design with a double clustered sampling strategy from 2018 to 2022 through self-administered parental and adolescent questionnaires. Resulting from the participation of 459 adolescents, 23.4% were overweight, 19.9% were obese, and 37.6% had central obesity. Random blood glucose (RBG) was used as a tool to determine prediabetes in 23 adolescents (Cheema et al., 2022). This study found that adolescents with obesity were not breastfed. It was also reported that central obesity and acanthosis nigricans in these adolescents was significantly associated with maternal obesity. Also, acanthosis nigricans was present with adolescents with increased RBGs (Cheema et al., 2022). According to Cheema et al. (2022), adolescents in Qatar will need extensive health programs that target lifestyle and health behaviours, stress management and self-care to tackle the burden of developing T2DM.

The findings from this theme reveal that young people with T2DM had a strong family history of T2DM, obesity and the presence of acanthosis nigricans. Studies included in this theme also showed that the place of residency (urban vs rural), family income, sex and sedentary lifestyle contributed to the development of T2DM in young adults of the MENA region. Despite the common characteristics found in the studies on young people, there were discrepancies in the sex and lifestyles of these young people.

2.5.2 Theme 2: The association between health-related behaviours and risk factors and type 2 diabetes mellitus among young people in Middle East and North Africa countries

Theme 2 consists of studies that identified associations between health-related behaviours, risk factors and T2DM in young adults in the MENA region. Four studies conducted between 2015 and 2022 conducted in Jordan, Israel (Occupied Palestine), Syria and UAE were included in this theme. These studies are presented in detail in the following paragraphs.

A study was conducted using the Finnish Diabetes Risk Score to determine the prevalence of T2DM and its risk factors among Jordanian young students aged between 18 and 25 years in 2014 (Al-Shudifat et al., 2017). This descriptive cross-sectional study consisted of 1821 university students who completed the diabetes risk score. Most participants reported that they had at least one first or second-degree relative with T2DM. Of note to the diabetes risk score, 1218 (66.9%) participants were at low risk of T2DM, 477 (26.2%) had a slightly elevated risk, 94 (5.2%) indicated a moderate risk, and 32 (1.8%) had a high risk of T2DM. Only 28 of the 32 participants who were at high risk were available and tested for T2DM using a fasting blood glucose test. Eight (29%) participants were diagnosed with T2DM and five (18%) were in the prediabetes state (Al-Shudifat et al., 2017). A large proportion of participants, 27%, had central obesity (above the recommended waist circumference) based on the risk score. The proportion of overweight and obese males was significantly higher than that of females. In the study population, there was a significant association between waist circumference, BMI and family history of diabetes, and the risk of having T2DM. Additionally, males had a higher risk of T2DM. However, low levels of physical activity and eating vegetables and fruits were not significant risk factors for T2DM among young people in Jordan (Al-Shudifat et al., 2017).

The authors of a retrospective cross-sectional observational study concerned youth onset of T2DM in Israel (Occupied Palestine) (Levin et al., 2022). Levin et al. (2022) assessed the incidence and clinical characteristics of newly diagnosed adolescents between 2008 and 2019. This study was a national collaboration between 14 paediatric diabetic hospitals. The authors claim that the cohort of this study represented the youth onset of T2DM in the country. Data from 379 (60% were females) newly diagnosed adolescents aged between 10 and 18 years were gathered and evaluated based on the study’s objectives. The incidence of T2DM in 2008 was 1.2 cases per 100,000 adolescents in both Arabs and Jews (Levin et al., 2022). The incidence was almost equal in both groups. However, the incidence in 2019 was three times greater among

Arab adolescents (6.4 cases per 100,000 Arabs and 2.3 cases per 100,000 Jews). The overall prevalence of T2DM in this cohort was 9.85 cases per 100,000 adolescents. Age was associated with the onset of diagnosis of all newly diagnosed adolescents (*n* = 379), around 47% (*n* = 179) were aged 15–18 years, 31% (*n* = 118) were aged 13–15 years and 22% (*n* = 82) were aged 10–13 years. Approximately 77% of adolescents were obese when diagnosed with T2DM, and the rest were overweight. Moreover, family history of T2DM was found in 73.1% of adolescents and was more prevalent in Arabs. The main three clinical characteristics of the study cohort were family history, obesity and elevated HbA1c levels (Levin et al., 2022).

Another cross-sectional study was conducted in Damascus, Syria (Al-Bachir & Bakir, 2017). A random sample of 2064 healthy adolescents aged between 18 and 19 years was selected. Participants were asked to fast overnight for 12 hours for biochemical and clinical tests. This study aimed to determine the relationship between participants' weight and major metabolic syndrome risk factors. The results of this study showed that fasting blood glucose, blood pressure, lipid profile and weight were significantly higher in overweight and obese participants compared to normal weight participants (Al-Bachir & Bakir, 2017). Participants' BMI was measured as weight divided by height squared (kg/m2). Furthermore, metabolic syndrome was defined according to the national criteria for each metabolic risk factor assessed. The abdominal fat of obese and overweight adolescents was high, which is associated with cardiovascular disease and T2DM (Al-Bachir & Bakir, 2017).

Another cross-sectional study was conducted in UAE to screen overweight/obese school children and adolescents for prediabetes and T2DM (Al Amiri et al., 2015). This study also aimed to determine the prevalence and risk factors for prediabetes and T2DM. Emirati students aged 11 and 17 years were recruited from 16 schools (*n* = 1034) for the first assessment. Of all the participants, 43% (*n* = 443) were at risk of T2DM and were eligible to do the second assessment. Only 348 participants completed the full assessment. On the basis of oral glucose tolerance test (OGTT) results, the prevalence of prediabetes was 5.4%, and the prevalence of T2DM was 0.87% (Al Amiri et al., 2015). There was a significant discrepancy in the results of HbA1c regarding the prevalence of prediabetes (21.9%) among the same population. Based on the BMI percentile charts for age and sex, 78% of the study population was obese and 22% were overweight. There was no significant relationship between glycaemic status, physical activity level and acanthosis nigricans. Moreover, family history of T2DM, adiposity and an elevated lipid profile were considered risk factors associated with prediabetes and T2DM among Emirati obese and overweight adolescents (Al Amiri et al., 2015).

This theme revealed that waist circumference, BMI and family history of diabetes were associated with the risk of having T2DM in young adults aged between 10 and 24 years living in the MENA region. This theme also found that there were discrepancies when it came to the presence of acanthosis nigricans, physical activity and sex in young people with T2DM.

2.5.3 Theme 3: The screening methods for type2 diabetes mellitus and prediabetes among young people in Middle east and North Africa countries

An overview of the screening methods used by the authors of the included articles in this integrative literature review is presented in this theme. Different screening criteria and guidelines were used to diagnose T2DM, prediabetes and metabolic syndrome in children and young people. Table 2.6 below presents the screening and assessment tools and criteria including the potential of the tools for diagnosing the symptoms of T2DM, such as insulin resistance.

Table 2.6: Screening and assessment tools/criteria for Theme 3

Assessment tool	**Used for**	**Studies**
The homeostasis model assessment estimated insulin resistance	Estimate insulin resistance	Önal et al. (2014), Moadab et al. (2010)
The Finnish Diabetes Risk Score	Identify individuals at high risk of developing T2DM	Al-Shudifat et al. (2017)
The American Diabetes Association criteria	Diagnosis of T2DM and identification of prediabetes	Hatun et al. (2019), Cohen et al. (2015), Al-Rubeaan (2015), Moussa et al. (2008), Al-Kandari et al. (2019), Ahmed et al. (2022)
The oral glucose tolerance test	Diagnosis of prediabetes and T2DM	Al Amiri et al. (2015), Al-Agha et al. (2012)
The International Diabetes Federation	Define of metabolic syndrome	Alowfi et al. (2021), Zardast et al. (2015)
No clear assessment or criteria	N/A	Osman et al. (2013), Dayan et al. (2005), Punnose et al. (2002), Alyafei et al. (2018), Al-Bachir and Bakir (2017)

Note. T2DM = type 2 diabetes mellitus

The Finnish Diabetes Risk Score was developed in 2003 by Lindström and Tuomilehto (2003) based on a random sample of healthy people aged between 35 and 64 years. Despite this non-invasive tool being considered fast, easy to use and cost-effective in determining the risk of T2DM among healthy people (Lindström & Tuomilehto, 2003), and being commonly used in the adult population (Agu et al., 2015; Bernabe-Ortiz et al., 2018; Janghorbani et al., 2013; Makrilakis et al., 2011), it was not used in adolescents or young people. One study included in this integrative review utilised the Finnish Diabetes Risk Score to identify the risk of developing T2DM among young people aged between 18 and 24 years (Al-Shudifat et al., 2017). The used of this tool by Al-Shudifat et al. (2017) was considered a limitation in their study methods.

The homeostasis model assessment estimated insulin resistance was developed in 1985 by Matthews et al. (1985). This assessment tool needs a fasting blood sample from the participants to calculate the insulin resistance score (Matthews et al., 1985). According to the results of Bonora et al. (2000), this test can be used to assess the insulin resistance of participants in epidemiological research and population-based studies. Moreover, this assessment method is valid and reliable in both healthy people and people with T2DM in any age group (Bonora et al., 2000). However, Kurtoğlu et al. (2010), in their evaluation of insulin resistance in children and adolescents, argue that cut-off values of this assessment score should be used, as BMI, sex and pubertal status all have an impact on insulin resistance levels. Önal et al. (2014) and Moadab et al. (2010) employed this tool to screen children and adolescents aged between 3 and 15 years in Turkey and between 6 and 19 years in Iran, respectively. However, neither author measured or evaluated pubertal status, and did not utilise cut-off levels in their studies, thereby imposing limitations in their methods.

The OGTT has been used for over a century to determine whether a person has prediabetes and T2DM (Jagannathan et al., 2020). Traditionally, the combined results of fasting plasma glucose levels and OGTTs have served as the gold standard for the diagnosis of T2DM ((Association, 2014). Testing individuals using these tests is a time-consuming and expensive process (Kim et al., 2019b). Furthermore, overnight fasting is required for these tests, which causes inconvenience in the research setting and may result in a lower rate of participation (Hosking et al., 2014; Kim et al., 2019b). Al Amiri et al. (2015) and Al-Agha et al. (2012) used the OGTT in two different studies that were conducted in UAE and Saudi Arabia, respectively. The first stage of the Al Amiri et al. (2015) study was a screening phase at a school where a physical examination was performed, and capillary blood sampling was collected from 1034 students. The second phase was the confirmation phase in the hospital to confirm the diagnosis of T2DM among those who were at high risk of T2DM during the first phase. The research team study used the OGTT and fasting plasma glucose via venous blood sampling to confirm the diagnosis. However, out of the 1034 students, only 348 students agreed to fast overnight and visit the hospital for the confirmation tests (Al Amiri et al., 2015). As mentioned earlier, the use of the test could reduce the participation rate, especially in research settings.

The IDF developed easy-to-use guidelines and simple criteria for the purpose of preventing conflict arising from the existing interpretations and definitions of metabolic syndrome in children and adolescents (Cameron et al., 2004; Cook et al., 2003; de Ferranti et al., 2004; Ford et al., 2005; Ford et al., 2002; Weiss et al., 2004). The recommended and revised IDF definition of metabolic syndrome in children and adolescents (Zimmet et al., 2007) was inspired by the IDF worldwide definition of metabolic syndrome in adults (Alberti et al., 2006). Table 2.7 below presents the IDF definition of the at-risk group and metabolic syndrome in children and adolescents. Two studies included in this integrative literature review utilised the IDF criteria to define the metabolic syndrome in their population (Alowfi et al., 2021; Zardast et al., 2015).

Table 2.7: The International Diabetes Foundation definition of the At-Risk Group and Metabolic Syndrome in Children and Adolescents

Age group (years)	**Obesity (WC)**	**Triglycerides**	**HDL-C**	**Blood pressure**	**Glucose**
6–<10	≥90th percentile				
10–<16	≥90th percentile or adult cut-off if lower	≥1.7 mmol/L (≥150 mg/dL)	<1.03 mmol/L (<40 mg/dL)	Systolic BP ≥ 130 or diastolic BP ≥ 85 mm Hg	FPG ≥ 5.6 mmol/L (100 mg/dL) or known T2DM
16+ (adult criteria)	WC ≥ 94cm for Europid males and ≥ 80cm for Europid females, with ethnic-specific values for other groups)	≥1.7 mmol/L (≥150 mg/dL) or specific treatment for high triglycerides	<1.03 mmol/L (<40 mg/dL) in males and <1.29 mmol/L (<50 mg/dL) in females, or specific treatment for low HDL	Systolic BP ≥ 130 or diastolic BP ≥ 85 mm Hg or treatment of previously diagnosed hypertension	FPG ≥ 5.6 mmol/L (100 mg/dL) or known T2DM

Note. WC = waist circumference; HDL-C = high-density lipoprotein cholesterol; BP = blood pressure; FPG = fasting plasma glucose; T2DM = type 2 diabetes mellitus; Hg = haemoglobin
Adopted from (Zimmet et al., 2007, p. 304)

Over the past 30 years, the ADA has actively participated in developing and disseminating standards of care, guidelines for treatment and criteria for diagnosis (Association, 2022). These standards and criteria apply to people who have diabetes or are at risk of diabetes. Moreover, healthcare professionals and researchers can use these criteria to assess the quality of diabetes care (Association, 2022). In response to emerging and changing evidence, these guidelines and criteria are reviewed and revised annually (Grant & Kirkman, 2015). Many studies in this integrative literature review used the ADA criteria to identify prediabetes and diagnose T2DM in children and adolescents (Ahmed et al., 2022; Al-Kandari et al., 2019; Al-Rubeaan, 2015; Cohen et al., 2015; Hatun et al., 2019; Moussa et al., 2008). The principal researcher of this research project used ADA criteria during data collection. The ADA criteria are explained in detail in Chapter 3, Section 3.5.3.

In this theme, the review identified that the majority of the studies (n = 15) used a criteria or guidelines when screening young people for T2DM in the MENA region. However, five studies did not identify a clear guideline for the assessment criteria when screening this population. This absence of a clear guideline or criteria is a gap and a limitation when screening a vulnerable and understudied population with a disease that has long been thought of as only being found in adults.

2.5.4 Theme 4: Clinical characteristics of type 2 diabetes mellitus among young people

This theme presents the clinical characteristics of young people with T2DM. Three studies were included in this theme. Both studies were conducted in Turkey in 2014 (Önal et al., 2014) and 2019 (Hatun et al., 2019), and Kuwait in 2018 (Almari et al., 2018) are presented in detail in the following paragraphs.

In the Turkish study by Hatun et al. (2019), the researchers describe the baseline clinical characteristics and treatment options of newly diagnosed children with T2DM in different paediatric hospitals. The study sample consisted of 367 children aged between 6 and 18 years. The ADA criteria for T2DM diagnosis in children and adolescents were applied (Hatun et al., 2019). A total of 227 participants (61%) were found to be at risk of T2DM. The majority of the

227 participants were female (68%), a positive family history of T2DM was seen in 86% of the participants and the presence of acanthosis nigricans was 81%. Furthermore, blood glucose and HbA1c levels were significantly higher in the female participants (Hatun et al., 2019).

The other study was also a cross-sectional study that was conducted between January and December of 2012 in Turkey. It included 130 children (n = 70 obese and n = 60 normal weight) aged between 3 and 15 years (Önal et al., 2014). The study investigated the relationship between insulin resistance and HbA1c levels in obese participants. The results showed a positive correlation between BMI, insulin resistance, HbA1c levels and insulin levels in the obese cohort. Moreover, the insulin resistance level and fasting glucose level were significantly higher in the obese group than in the non-obese group. However, there was no statistically significant difference in HbA1c level between the two groups. Also, the sex ratios between the two cohorts did not differ significantly (Önal et al., 2014).

The Kuwaiti study, also a cross-sectional study, included 1959 high school students across Kuwait (Almari et al., 2018). These students were aged between 14 and 19 years. The study aimed to evaluate the prevalence of prediabetes and the association of prediabetes with high BMI levels among adolescents in Kuwait. This study also aimed to examine the association between maternal/paternal history of diabetes and the offspring prediabetes in a sex-specific approach. The study resulted in explaining that adolescents with high adiposity showed strong association with prediabetes; and that students with prediabetes and no parental history had high BMI (Almari et al., 2018). This study also found that parental history affected the probability of their children's prediabetes according to their sex; where maternal history was associated with prediabetes in male students, and paternal history with the females (Almari et al., 2018).

Family history, the presence of acanthosis nigricans and obesity were the main characteristics found in this theme as being associated with T2DM in children and adolescents.

2.5.5 Summary of results

The included articles that were described previously revealed several findings regarding incidence, prevalence and risk of T2DM in young people of the MENA region. These findings included different settings and different populations. Four themes were generated; the prevalence of T2DM; the association between health-related behaviours and T2DM; screening methods for T2DM and prediabetes and clinical characteristics of T2DM, prediabetes and metabolic syndrome among young people in MENA countries. Kuwait contributed with three studies, while other countries from the MENA regions contributed a total of 18 studies, so a total of 21 studies were in this integrative literature review.

2.6 Gaps and Limitations in the Literature

Several gaps and limitations in the study designs were discovered when critically appraising the studies that hypothesised that young people have elevated levels of HbA1c, and that there is a significant relationship between healthy behaviours and HbA1c. These gaps and limitations are listed below with the response that this current study made to address them:

- Quantitative, cross-sectional study design

  Most of the studies (n = 16) were quantitative cross-sectional survey designs, which presented superficial knowledge by providing snapshots of situations and ideas.

  Although the current research study conducted a cross-sectional study, this study recruited a larger number of participants via conducting a repeated cross-sectional approach.

- Sample size

  The sample size in the studies were reported as small. This was due to the young age group (0–24 years) and the chronic disease (T2DM) being studied. Also, the studies reviewed either focused on sex, or examined T2DM in a very specific age group (17 years, 18 years and 19 years). Several studies also assessed young people with both T1DM and T2DM, but only focused on T1DM in their findings and discussion.

  These limitations are addressed in this current research study as a repeated cross-sectional study was conducted, which assisted in approaching and recruiting a larger number of participants from both sexes aged 10–24 years. Participants with T1DM were excluded from the current study; only eligible participants who fitted the study criteria were recruited.

- Biases

  Selection bias could have been present due to the specific age group and chronic disease that was intended when studying T2DM and obesity in young people. Another bias could have been reporting bias, which was due to the nature of questionnaire and the sensitivity of some of the questions. Recall bias could be another type of bias present due to the questions in the questionnaire that require participants to recall their daily routines and habits prior to their participation.

  The current study addressed these possible biases by allowing participants to answer their own questionnaires. Participants were also given the choice of having their parents or siblings present, depending on their preference.

- Criteria for T2DM in young people

  The studies reviewed used different criteria when diagnosing T2DM in young people. The studies often adapted the criteria to the participants despite the inappropriateness for the age group being studied, such as ADA criteria (age starts at 10 years, but used on 6-year-old children). Other criteria used were the Finnish Diabetes Risk Score and the homeostasis model assessment estimated insulin resistance.

For this current study, the principal researcher followed the ADA criteria when recruiting eligible participants. Two separate ADA criteria were followed: participants aged below 18 years, and participants aged 18–24 years.

- Duration of studies

  Short duration of the studies and lack of follow up were gaps found in the reviewed studies. These limitations could have impacted on the outcomes, such as an inability to assess physical activity, blood examinations, dietary habits and lifestyle.

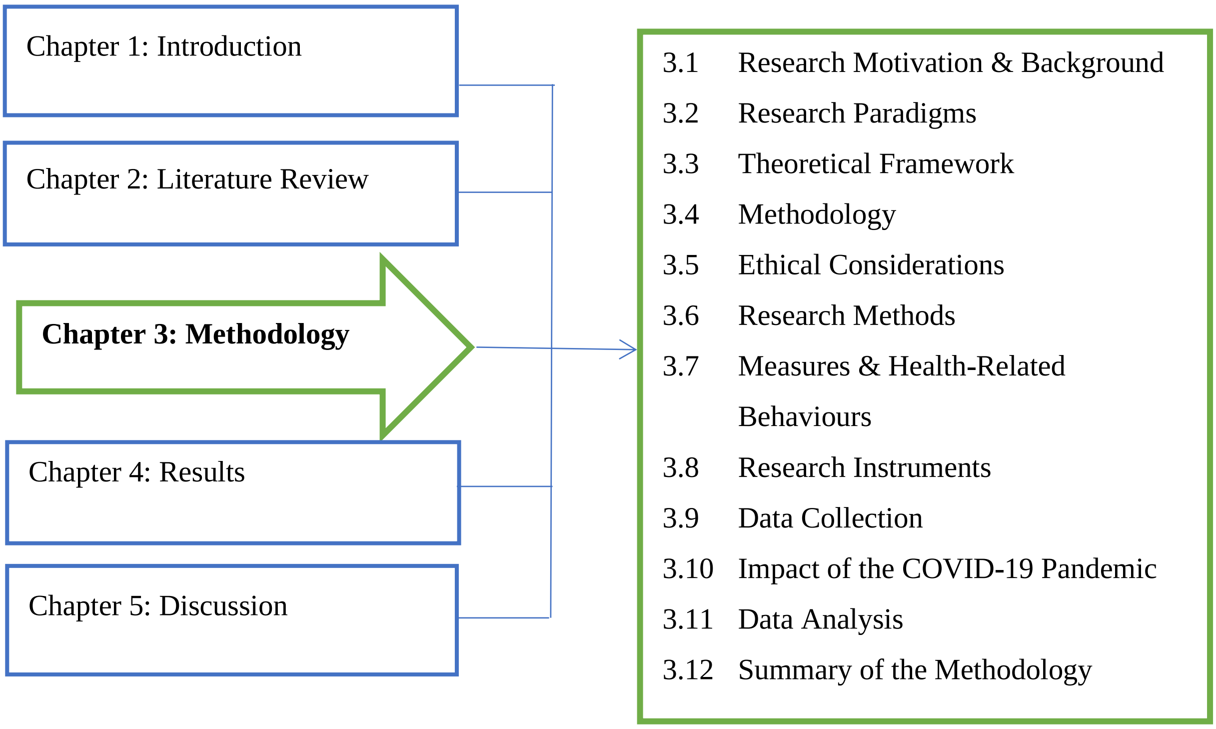
  The current research study considered the different health-related behaviours and included them in the questionnaire. This study used a criteria and tools which are presented in detail in Chapter 3 when studying young people. Family history was also added. The research study conducted the assessments on the participants at baseline and after six months.

2.7 Summary of the Literature Review

A cross-sectional research design was carried out by the researchers of all the articles included in this integrative literature review that examined the relationship between health-related behaviours and T2DM in a young population in the MENA region. Common findings such as family history, obesity and acanthosis nigricans were found to be associated with the development of T2DM in young people. Gaps and limitations in the literature were found due to the inability of generalising the findings because of the snapshot situations that come with a cross-sectional design, the low number of participants due to their vulnerability and specific age, and the lack of established criteria for this population. Although diabetes organisations provide several criteria, these criteria did not fit the characteristics of young people of the MENA region. Assessing the health-related behaviours that are associated with the development of T2DM in young people would provide a clearer picture of the NCDs that affect this young cohort and present possible solutions that could assist in the inability to adopt a healthier lifestyle among this population.

This chapter provided a thorough overview of youth T2DM in the MENA region. It also discussed different screening methods and diagnosis criteria, as well as identifying a number of limitations and research gaps. The integrative literature review informed the research aims and objectives of this research project. The following chapter is the methodology and methods chapter (Chapter 3), which explains the research methods, the data collection process and the ethical considerations of this research project.

Chapter 3: Methodology



This chapter provides an overview of the methodology and methods used to achieve the study aims and objectives. The chapter explains the research paradigm, research design and methods of selecting eligible participants. This chapter also describes the data collection process, data management, ethical considerations and data analysis of this study. This chapter concludes with a discussion of some of the challenges encountered during data collection and how these were overcome.

3.1 Philosophical Foundation

Philosophical assumptions about human knowledge and the nature of reality affect the research process, how research questions are understood, the choice of methods and how the findings are interpreted. This research was driven by the positivism approach. Traditionally, positivism has been considered a form of empiricism or a development of it (Ryan, 2018). Empiricism is a foundationalist philosophy and empiricists believe knowledge should be objective and free from any bias caused by the researcher's beliefs and values (Phillips & Burbules, 2000).

Positivism utilises scientific methods to create general laws that describe and predict patterns in the physical and real world (Suppe & Jacox, 1985).

The goal of positivists is to identify the factors influencing outcomes and results (Creswell, 2009). The purpose of their work is to formulate facts in a way that may serve as a basis for making predictions and generalisations. To further explain, positivism refers to the application of natural sciences to study social realities (Bryman, 2016). The purpose of positivism is to generate hypotheses that can be tested (Polit & Beck, 2017). Moreover, Bryman (2016) states that positivism can be described by four key characteristics: there is no such thing as genuine knowledge unless it is supported by the sciences (phenomenalism); an essential aspect of the theory is the generation of hypotheses that can be tested and proven (deductivism); values and beliefs should not be attached to science (objectivity); and in order to gain knowledge, it is necessary to gather facts that supply the basis for laws (inductivism). Therefore, clarity about the underpinning philosophy increases the quality and value of the research (Winit-Watjana, 2016).

A deductive approach was undertaken in this research. In a deductive approach, theory is established through formal statistical testing of hypotheses (Lincoln & Guba, 1985). Correlation and experimentation are used to reduce complex interactions with their constituent parts. Verifiable evidence is achieved through direct experience and observation, often involving empirical testing, random sampling, participant blinding, and group and variable controls (independent variables, dependent variables and a moderator) (Scotland, 2012). In social and behavioural research, researchers adopt the deductive method in quantitative studies, and the inductive method in qualitative studies or mixed-methods studies (Tashakkori & Teddlie, 2010).

3.2 Research Paradigm

Paradigms present the concept of ontology a worldview, as a general perspective on the complexity of the world. Often, identified by how philosophers, scientists and researchers address basic philosophical questions, such as what is the nature of reality? Moreover, paradigms present the idea of epistemology which explores the relationship between scientists/researchers and the subjects of the study (Polit & Beck, 2017).

Varpio and MacLeod (2020) explain the research paradigm as a set of shared beliefs and agreements among scientists relating to the understanding, approaching and solving of problems. According to Scotland (2012), a research paradigm is composed of four components: ontology, epistemology, methodology and methods. Therefore, in order to engage individuals in research, especially young people and adolescents, it is necessary for the researcher to understand the different perceptions of reality, knowledge and the approach to involving individuals in the research process. Each component is explained in the following sections.

3.2.1 Ontology

Ontology is concerned with the nature of reality and the researcher's assumptions about how the world operates (Crotty, 1998). Ontological questions in social sciences research are related to the nature of reality, namely, what is being investigated? The ontological position of positivism is one of realism. Realism is 'the view that objects have an existence independent of the knower' (Cohen et al., 2007, p. 7). Thus, a discoverable reality exists independently of the researcher (Pring, 2007). From an ontology perspective, positivists believe that facts could be proven, and reality could be reproduced in different ways by different investigators (Ryan, 2018). As an example, the weight of a child remains the same regardless of who measures it, and the investigators can determine what that reality is through observation and measurement. There is a tendency among positivists to assume that our senses do not mediate reality (Greener, 2011). It is important to consider the perspective taken in order to determine whether a quantitative approach is suitable for an objective and measurable study, a qualitative approach for an interpretive and subjective study, or whether a mixed-methods approach is appropriate (Greener, 2011).

3.2.2 Epistemology

Epistemology concerns the philosophical study of knowledge and is known as ‘the study of the grounds upon which we believe something to be true’ (Oliver, 2010, p. 35). Epistemologically, the positivist view of the world holds that the researcher and the world are separate and that the world exists regardless of the presence of the researcher (Howell, 2012). The investigator’s epistemological perspective is crucial to the selection of the methodology, and in terms of its purpose, aims and objectives (de Gialdino, 2009) since investigators are conducting research to seek new knowledge, that is, how will the reality be both observed and measured? As such, humans faced with the same reality construct meaning differently (Crotty, 1998). In many cases, researchers follow the deductive approach in purely quantitative studies or the inductive approach in qualitative studies. This study utilised a purely quantitative research design to explore the associations between health-related behaviours and HbA1c among Kuwaiti young people at risk of T2DM.

3.2.3 The relevance of positivism as a paradigm to nursing research

The paradigms that have been used for nursing research are positivist, postpositivist, interpretive and critical social theory (Weaver & Olson, 2006). The positivist paradigm arose from a philosophy known as logical positivism, which is based on rigid rules of logic and measurement, truth, absolute principles and prediction (Weaver & Olson, 2006). In positivism, short, clear, concise discussions are used rather than descriptive stories based on emotional reactions or subjective interpretations (McEwan & Wills, 2021). In nursing, the positivist research design includes experimental study, cross-sectional, cohort and case-control studies (Gerrish & Lacey, 2010; McEwan & Wills, 2021; Ryan, 2018). Positivism is essential in public health and nursing research, and epidemiological findings can inform local, national and global strategies related to health and social care (Ryan, 2018). Philosophical thinking, clinical observations and researchers' knowledge largely influenced the development of early nursing theories and nursing practice (Kirkevold, 1997) that were useful for articulating the nature of nursing profession and nursing practice but less useful for leading nursing research (Hinshaw, 1999). The evolution of evidence-based nursing practice and nursing research required the establishment of scientific methods and solid bases to increase the credibility of nursing research (Smith, 2019; Wuest, 1994). Therefore, the aims and objectives of this current research bring together scientific approaches as well as an integrative synthesis of the literature to explore the associations between health-related behaviours and HbA1c among Kuwaiti young people at risk of T2DM.

3.3 Theoretical Framework

Nursing and social science research often develop conceptual frameworks based on existing theories, concepts and empirical evidence (Durham et al., 2015; Kivunja, 2018). The conceptual framework helps establish the theoretical foundation and provides a logical structure for interpreting results. Moreover, it is a valuable tool for analysing the relationships among variables and develop hypotheses (Kivunja, 2018). As discussed in the previous chapters, there is a limited amount of empirical evidence to support the hypothesis of the significant relationship between health-related behaviours and elevated HbA1c levels among Kuwaiti young people. This study explores the relationship between these variables in a culturally different context, non-Western countries and, expands the international research on this topic.

The principal researcher of this study proposed a theoretical framework based on his philosophical thinking, clinical observations and researchers' knowledge, as recommended by Kirkevold (1997), as well as the limited amount of empirical evidence. furthermore, this study adopted a positivist research design to generate findings that based on rigid rules, absolute principles and prediction (Weaver & Olson, 2006). Figure 3.1 illustrates the proposed theoretical framework which shows the underlying mechanisms linking the variables of this study in the Kuwaiti context.

As illustrated in the theoretical framework (Figure 3.1), this study examined the extent to which the strength and/or direction of the correlation between HbA1c levels (dependent variable) and health-related behaviours (independent variables) is moderated by demographic and other factors, such as age, sex, nationality, family medical history, parents' educational level and family income (moderating variables). There was a need to define moderating variables in order to understand better when and for whom a relationship between independent and dependent variables is more or less strong. Because BMI is a known risk factor for T2DM and is prevalent among young Kuwaiti people. BMI was added as a mediating variable to help understand the process or etiology through which health-related behaviours affects HbA1c levels. It is important to note that moderating variables are not affected by the independent variable, even though it impacts the dependent variable. On the other hand, mediating variables are affected by the independent variable. Consequently, they also have an effect on the dependent variable.

The research statement of Troudi (2010) emphasises the importance of establishing a clear link between the paradigmatic nature and theoretical framework of the study. By doing so, researchers can select a suitable research methodology and method. It is imperative that researchers be more flexible in choosing a method in order to ensure that research outcomes are valid and reliable (Shah & Al-Bargi, 2013).

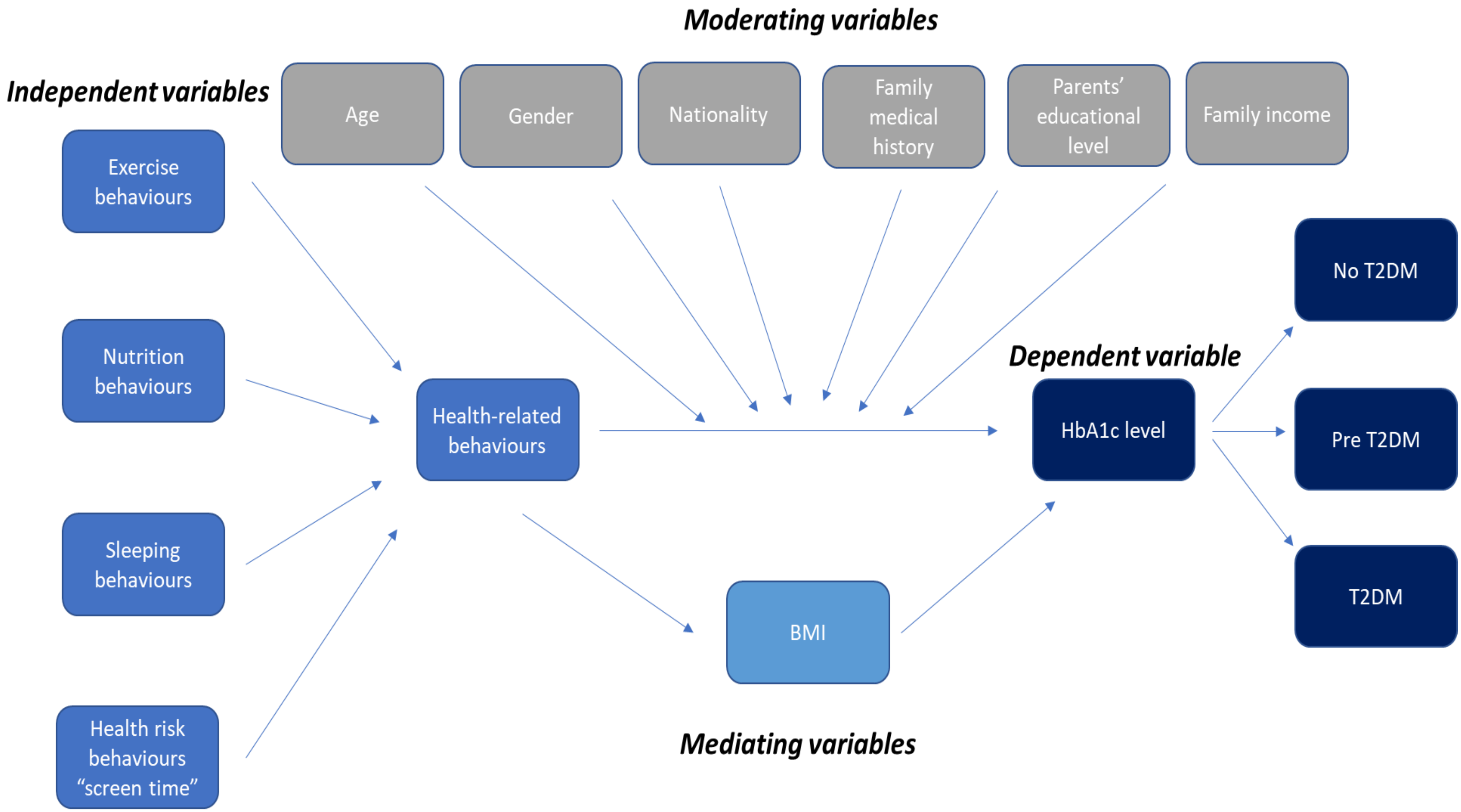


Figure 3.1: Theoretical framework

3.4 Methodology

The positivist approach of quantitative research involves objectively reporting on the collected data and analysing those data statistically (Polit & Beck, 2017). This research approach is a science that uses predictable approaches based on a framework, theories and hypotheses of human research inquiries (Creswell, 2014; Polit & Beck, 2017). It is also known to be a systematic investigation where a phenomenon is described with the help of mathematical formulas, statistics, tables and numbers (Maltby et al., 2014). Therefore, for the present study, quantitative research was deemed the most suitable method for answering the research questions, aims and objectives.

3.4.1 Research design

The purpose of a research design is to plan a study that will provide answers to a particular research question (Hallberg, 2008; Polit & Beck, 2017). The cross-sectional study design provides a framework and process that identifies the factors that present in the prevalence, incidence and proportion of a health disorder at one point in time (Hallberg, 2008). Therefore, this is useful here as the researchers explore the association between health-related behaviours and HbA1c among Kuwaiti young people at risk of T2DM. In addition, this study design allows researchers to explore and examine the associations between variables (Gerrish, 2015; Maltby et al., 2014; Schneider & Whitehead, 2016). Cross-sectional studies enable investigators to gather data from clusters of people sharing a health disorder, common condition or phenomenon (Polit & Beck, 2017). The main objective of descriptive studies is to describe, observe or document a natural phenomenon (Polit & Beck, 2017; Schneider & Whitehead, 2016).

3.4.2 Repeated cross-sectional study

There is a type of cross-sectional study called repeated cross-sectional study, also known as pseudo-longitudinal (Pan, 2021; Wang & Cheng, 2020). Bell et al. (2020) state that repeated cross-sectional studies are positioned between cross-sectional studies and longitudinal studies. Furthermore , in repeated cross-sectional studies, multiple cross-sectional data from individuals are analysed over a period of time (Bell et al., 2020). Therefore, repeated cross-sectional studies can be used to track changes in the population over time (also known as aggregate change over time) (Wang & Cheng, 2020). Repeated cross-sectional studies provide data that can be analysed at both the aggregate level and the individual level (Lebo & Weber, 2015). When comparing repeated cross-sectional designs to cohort designs, repeated cross-sectional designs tend to stress the importance of maintaining a good quality of sample representation and producing unbiased results for each data collection phase (Pan, 2021).

There are many ways in which repeated cross-sectional study designs can be constructed, and this has led to their increasing popularity (Lebo & Weber, 2015). Repeat cross-sectional designs allow for increased statistical power which can be important in studies that have limited sample sizes such as the present study, due to limited access to suitable subjects and limited resources for recruitment. Also, the repeated measures allow the establishment of the within and between-subject variability which is useful in assessing the reliability of each measure. In conclusion, repeat cross-sectional studies have several major advantages including increased statistical power, the ability to assess the association between changes in exposure and changes in outcomes, and the ability to assess within and between-subject variability which provides a measure of repeatability of each measure. Therefore, a repeated cross-sectional observational design was applied in the current research, where data collection was performed at baseline assessment and then a follow-up assessment was performed after six months.

3.4.3 Study design and justifications

The principal researcher used a quantitative observational approach in this study. The study was divided into two phases. In the first phase, a cross-sectional study was conducted to explore the association between HbA1c levels and health-related behaviours among Kuwaiti young people who were at risk of T2DM. In the second phase conducted six months after the first phase, the same participants were followed up and observed again to obtain a repeated cross-sectional analysis. This approach allowed the principal researcher to observe if there was any change in the associations between HbA1c levels and health-related behaviours among the study population. It also allowed the principal researcher to assess whether the observed associations were similar between baseline and follow-up. Moreover, it allowed the assessment of associations between changes in the exposure and changes in the outcome - which provides a higher level of evidence for exposure-outcome associations than those measured at a single point in time. This study design has the ability to increase statistical power for assessing the associations since within-subject variability is being measured and can be removed in the analysis of the associations between exposure and outcome (Pan, 2021). Therefore, outcomes and physical assessments were examined using the same methods of examination, for example, using the same health-related behaviours questionnaire, and measuring BMI and HbA1c levels on the same participants but at different time points. The study design was appropriate since the principal researcher wanted to determine whether the outcomes' trend changed over time. Additionally, by employing this repeated cross-sectional design, the principal researcher could obtain more accurate estimates since the effective sample size is larger (Hsieh et al., 2003).

3.5 Ethical Considerations

According to the Australian National Statement on Ethical Conduct in Human Research by the National Health and Medical Research Council (NHMRC, 2018), the researcher and participants' relationship is the basis for ethical conduct in human research. Additionally, the statement requires researchers to act honestly and respectfully towards participants (NHMRC, 2018). Ethics approval from the Women's and Children's Health Network (Human Research Ethics Committee) (Appendix 6) and the South Australian Government (through SA Health) in Australia (Appendix 7), and ethics committees from the Ministry of Health (Appendix 8) and Ministry of Education (Appendix 9) in Kuwait were obtained before the beginning of data collection. The principal researcher communicated any important modifications to the protocol to research ethics committees in Australia and Kuwait. Ethical standards guide human research by shaping the relationship between researchers and participants based on a number of values such as merit, integrity and justice; anonymity, confidentiality and privacy; vulnerability, power and control issues; and data storage and protection (NHMRC, 2018). Detailed explanations of how these values were addressed in this study can be found in the following sections.

3.5.1 Merit, integrity and justice

Ethical principles of merit and integrity were adhered to due to the potential advantages that this research study may add to the body of knowledge in the area of health promotion and chronic diseases prevention among adolescents and young people in Kuwait (NHMRC, 2018). The method for conducting the study was developed and designed with the help of supervisors who are experts in the field of community nursing and epidemiology. This research project was undertaken by strictly following the rules of recruitment and data collection as determined by the ethics application approved by the ethics committees. These ethics committees were two from Australia and two from Kuwait: the Women's and Children's Health Network (Human Research Ethics Committee) (Appendix 6) and the South Australian Government (through SA Health) in Australia (Appendix 7), and the Ministry of Health (Appendix 8) and Ministry of Education (Appendix 9) in Kuwait.

The principal researcher did not contact the participants directly during the recruitment process. Eligible participants who were interested in participating contacted the principal researcher or the clinic by telephone via details provided on the information sheet approved by the Women's and Children's Health Network Human Research Ethics Committee (Appendix 13 for English information sheet and Appendix 14 for Arabic information sheet). In accordance with the (NHMRC, 2018), the principal researcher was required to inform the participants if any improper conduct or behaviour has occurred during the research. This problem could arise because of the nature of human relationships and the effects of disclosing sensitive information related to the clinic that conducted the study (NHMRC, 2018). Primary researchers have the option of modifying the research or discontinuing it if their role is compromised (NHMRC, 2018). This research study did not require any modification as there were no issues identified and no need to contact the participants.

Findings resulting from conducting repeated cross-sectional research should also provide adequate information regarding the participants and the study setting in case the findings may lead to a larger study (NHMRC, 2018). The sampling strategy in this project was clearly described and the rigour of the study was considered through following the study protocol (NHMRC, 2018). Two elements in particular that are included under merit, integrity and justice − beneficence and respect − require ethical consideration and are explained below.

3.5.1.1 Beneficence

Beneficence is fundamental to healthcare. It refers to the moral imperative of acting for the benefit of participants (NHMRC, 2018). The benefit that participants might gain from this research is understanding that NCDs are no longer an adult disease, and that children have been shown to develop these diseases at an early age. This understanding might help in reducing the prevalence of T2DM in children through adopting a healthier lifestyle and paying attention to reducing their children's sedentary behaviours. Nevertheless, the benefits of a research study cannot outweigh any cost to the participants (NHMRC, 2018). Therefore, the information sheet used in the current study identified that participating in this study would not in any way affect the service provided to them or the treatment they receive. The principal researcher also assured participants that their identities were removed from all transcripts and written papers, and that the principal researcher was the only person who could link the transcripts to the participants.

In addition, participants could have felt burdened by donating their time to participate in the study, experiencing difficult emotions during or after answering the questionnaire or having their physical assessment (NHMRC, 2018). Furthermore, the adolescents and young people participating may gain a better understanding of their health and the potential risk of T2DM. Thus, gaining form the participating in the study. These burdens were managed through reminding the participants before the study that their involvement remained voluntary and that they could remove themselves from the study at any time without any repercussions. They were made aware of the time allocated for answering the questionnaire and having their physical assessment. Participants were given the choice to cancel or end their participation if the time allocated did not suit them.

3.5.1.2 Respect

During the study, participant confidentiality and privacy were respected by the principal researcher and assistant researchers. Consent forms in English and Arabic, and for participants and parents (Appendices 15, 16, 17 and 18) were attached to the information sheet and signed consent was obtained from the participants prior to their participation in the questionnaire and physical assessment. The questionnaires were in Arabic, the official language in Kuwait. However, some participants preferred the questionnaire in English (Appendix 19). All data obtained from the questionnaires and physical assessments were checked by the principal researcher before data entry occurred, as the first step in data cleaning for analysis . All variables were coded, and a codebook was created. Anonymisation of each participant's information was used to maintain their confidentiality. All participants were given a unique identification number (ID). Data were double-checked and cleaned manually before starting data analysis.

Simple language was used to explain the aims and objectives of this study to participants and their parents before asking for verbal and written consent. Consent forms were provided to all participants. All introduction letters, information sheets and consent forms were translated into Arabic (Appendices 14, 16, 18 and 21). All participants/participants' parents signed the consent form before participating in this study. Written and verbal consent was obtained during the study. Verbal assent was sought from participants before and throughout the data collection process. Research assistants ensured the child participants were fully willing to participate in this research by frequently asking for verbal assent before each physical assessment. Research assistants reminded children and their parents that participation was entirely voluntary. Any withdrawal from this study was respected and could occur at any time. The participants and participants' parents were free to discontinue their participation at any time or choose not to answer specific questions. Additionally, any removal of consent would not impact on any care the participant may receive at any time.

3.5.2 Anonymity, confidentiality and privacy

Prior to answering the questionnaire and having their physical assessment, participants were given an information sheet that clearly stated the anonymity of the participants and how confidentiality would be protected (see Appendix 13 and Appendix 14). Before data collection, the principal researcher created a coded ID to maintain the confidentiality of participants and their parents. Participants' names were replaced with codes and numbers. All participants' data were stored in a locked locker in an area with limited access at the study site.

Finger pricks were used during the physical assessment to check blood sugar. Research assistants followed strict steps to control any chance of infection and reduce discomfort. Finger pricks are usually not painful if appropriately and infrequently performed. During this study, blood sugar gwas checked twice, once at the baseline visit and again during the follow-up visit six months later. That meant each participant received only two finger pricks. Even though research assistants are well trained, they were reminded to follow the recommended guidelines when performing this test.

Most of the participants were overweight and obese because high BMI is considered the main risk factor among the selected population. To maintain the confidentiality and privacy of participants, all physical assessments were performed in a clinic outside the school. This was designed to reduce any embarrassment among participants. Also, parents were encouraged to stay with their children during the physical examination to manage any discomfort that might arise. During the physical assessment, participants were examined one by one in a private room. To maximise participants' comfort, the options of performing the data collection by a male researcher was available upon request; participants were free to choose between a female or a male researcher.

3.5.3 Vulnerability, power and control issues

As stated in the information sheet, participants were offered the choice to refrain from answering any interview questions they felt uncomfortable with. The participants could also refuse to participate in the questionnaire or have their physical assessments taken at any time during their participation. The information sheet also stated that if a participant wished to withdraw their participation, the principal researcher would withdraw their questionnaire and remove all the information that can be linked back to their participation. Due to the COVID-19 pandemic, many participants cancelled their appointments after showing interest in participating in the study without any repercussions or judgement.

3.5.4 Data storage and protection

The principal researcher and co-researchers planned data storage. All storage of data was in accordance with Flinders University and NHMRC protocols. The research team is responsible for retaining research data and maintaining confidentiality. The principal researcher and all co-researchers had access to datasets. The collected data were stored in two forms; hard copies in a protected locker at Flinders university and soft copies on a secured computer with a password. The data were accessible only to the research team. The collected data will be stored for at least 5 years following any publication from this thesis, and then can be destroyed, as recommended by the Women's and Children's Health Network, the National Statement on Ethical Conduct in Human Research, and the NHMRC (NHMRC, 2018).

3.6 Research Methods

This section outlines the study setting, sample size and participant eligibility criteria.

3.6.1 Study setting

Participants were recruited for this study from all intermediate schools, secondary schools, educational institutions and universities in Kuwait. There are about 820 middle and secondary schools in the government and private sectors (Education, 2020). Of these, 516 are public schools and 304 are private. Also, there are 16 post-secondary educational institutions and universities in Kuwait: The University of Kuwait, the Public Authority for Applied Education and Training and other 14 private universities (Education, 2020). During the recruitment process, the principal researcher targeted all schools and universities in each of the following six governorates: Al Asima Governorate (Kuwait City), the capital of Kuwait; Al Ahmadi

Governorate; Al Jahra Governorate; Al Farwaniyah Governorate; Hawalli Governorate and Mubarak Al Kabeer Governorate.

3.6.2 Sample size

In a quantitative study, a large sample size is essential for generalising findings (Schneider & Whitehead, 2016). Raosoft software was used to calculate the sample size (Raosoft, 2004). A sample size of 377 was recommended to represent young people in Kuwait. The Raosoft software calculates with a 5% margin of error, a confidence interval (CI) of 95% and a response distribution of 50%.

3.6.3 Participant eligibility criteria

This section addresses the inclusion and exclusion criteria, withdrawal criteria and the attrition rate.

3.6.3.1 Inclusion criteria

ADA criteria (used in Kuwait as the national standard) was used to identify eligible participants. Participants were included if:

1. they were at high risk of T2DM
2. they were aged between 10 and 24 years
3. participants and their parents provided consent forms.

ADA criteria states that all eligible participants should be at risk of T2DM (Tables 3.1 and 3.2).

Table 3.1: Risk-based screening for type 2 diabetes or prediabetes in asymptomatic children and adolescents in a clinical setting*

American Diabetes Association criteria
Overweight (BMI at 85th percentile for age and sex, weight for height at 85th percentile, or weight at120% of ideal for height) A
Plus one or more additional risk factors based on the strength of their association with diabetes as indicated by evidence grades:
• Maternal history of diabetes or GDM during the child's gestation A
• Family history of type 2 diabetes in first- or second-degree relative A
• Race/ethnicity (Native American, African American, Latino, Asian American, Pacific Islander) A
• Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, polycystic ovary syndrome, or small-for-gestational-age birth weight) B

Note. *Participants aged below 18 years BMI = body mass index; GDM = gestational diabetes mellitus
A and B refer to the evidence grades used by the American Diabetes Association, with A being clear evidence and B being supportive evidence. Adapted from American Diabetes Association (Association, 2018)

Table 3.1 above provides guidelines for screening for T2DM or prediabetes in asymptomatic children and adolescents in a clinical setting. Table 3.2 below illustrates the criteria for testing for T2DM or prediabetes in asymptomatic young adults.

Table 3.2: Criteria for testing for diabetes or prediabetes in asymptomatic young adults*

American Diabetes Association criteria
1. Testing should be considered in overweight or obese (BMI ≥ 25 kg/m2 or ≥ 23 kg/m2 in Asian Americans) adults who have one or more of the following risk factors:
• First-degree relative with diabetes
• High-risk race/ethnicity (e.g., African American, Latino, Native American, Asian American, Pacific Islander)
• History of CVD
• Hypertension (≥ 140/90 mmHg or on therapy for hypertension)
• HDL cholesterol level <35 mg/dL (0.90 mmol/L) and/or a triglyceride level >250 mg/dL (2.82 mmol/L)
• Women with polycystic ovary syndrome
• Physical inactivity
• Other clinical conditions associated with insulin resistance (e.g., severe obesity, acanthosis nigricans)
2. Patients with prediabetes (HbA1c ≥ 5.7% [39 mmol/mol], IGT, or IFG) should be tested yearly
3. Women who were diagnosed with GDM should have lifelong testing at least every three years
4. For all other patients, testing should begin at age 45 years

5. If results are normal, testing should be repeated at a minimum of 3-year intervals, with consideration of more frequent testing depending on initial results and risk status

Note. *Participants aged between 18 and 24 years
CVD = cardiovascual disease; HDL = high-density lipoprotein; HbA1c = glycated haemolgobin A1c; IGT = impaired glucose tolerance; IFG = impaired fasting glucose; GDM = gestational diabetes mellitus
Adapted from American Diabetes Association (Association, 2018)

Table 3.2 above informed the criteria for testing for prediabetes or T2DM in asymptomatic young adults.

3.6.3.2 Exclusion criteria

Participants were excluded if:

1. they were aged below 10 years or above 25 years
2. they were at low risk of T2DM
3. they had been diagnosed with T2DM according to the ADA criteria for the diagnosis of diabetes
4. they had blood disorders (e.g. sickle cell anaemia)
5. they did not provide a consent form
6. they were on steroid treatment.

Refer to Table 3.3 for the summary of inclusion and exclusion criteria.

Table 3.3: Inclusion and exclusion criteria

Inclusion criteria	**Exclusion criteria**
consent forms provided	no consent form
aged between 10 and 24 years	aged below 10 years or above 25 years
at high risk of T2DM	at low risk or diagnosed with T2DM
	Presence of blood disorders, for example sickle cell anaemia
	on steroid treatment

Note. T2DM = type 2 diabetes mellitus

3.6.3.3 Withdrawal criteria

There were no strict withdrawal criteria, as clearly explained in the consent form and information sheet prior to participating in this study. Participants and participants' parents had the option to withdraw from the current study at any time or stage.

3.6.3.4 Attrition rate

The dictionary of epidemiology defines attrition as a 'reduction in the number of participants in a study as it progresses' (Porta et al., 2014, p. 14). Losing participants is generally a result of participant withdrawal, dropouts or changes in the study protocol (Nunan et al., 2018). In RCTs, longitudinal studies and observational studies, failure to retain participants can pose a significant methodological challenge (Hindmarch et al., 2015). In observational studies and cohort studies, an attrition rate (dropout rate) of less than 20% is acceptable. However, the loss of more than 20% of participants can pose serious threats to the study's validity (Fewtrell et al., 2008; Isaman et al., 2018). Maintaining a follow-up rate of between 50 and 80% is considered acceptable in the context of epidemiological studies, despite the fact that most of these recommendations have not been evaluated for validity (Fewtrell et al., 2008; Kristman et al., 2004). Lower dropout rates have been associated with the parent's involvement in obesity prevention programs among children and adolescents (Park et al., 2020).

During this study, the aim was to reduce the likelihood of attrition of the participants in the first phase of data collection for the second phase of data collection. Hindmarch et al. (2015) recommend the use of multiple strategies for participant retention in clinical studies. The principal researcher and the research team followed a number of recruitment and retention strategies suggested by Hindmarch et al. (2015)to reduce the attrition rate during the data collection process. These strategies included:

- study publicity

- Short Message Service (SMS) reminders of the appointment and the follow-up
- good communication via mobile and SMS
- minimising the harm and burden on participants and their parents
- building trust between the research team and participants
- offering non-monetary incentives such as a bag of goodies, free BMI and HbA1c checks for parents, and complimentary coffee and drinks
- establishing a participant tracking sheet that has participants' contact details.

3.7 Measures and Health-Related Behaviours Questionnaire

The purpose of this study was to explore the association between health-related behaviours and HbA1c among Kuwaiti young people who were at risk of T2DM. Moreover, the principal researcher wanted to test the two following hypotheses: that this population will have an elevated level of HbA1c, and that there is a relationship between health-related behaviours and HbA1c.

The main variable in this study was HbA1c. This primary variable was compared with other variables that are listed in Table 3.5 in the following section. The health-related behaviours were assessed using a validated questionnaire. Each patient was interviewed in detail regarding their demographic information and medical history. In addition, the physical assessment was conducted for all eligible participants by well-trained research assistants. The HbA1c of participants was measured using the Afinion 2 Analyzer, clinical blood pressure and heart rate were monitored using the ADView 2 modular diagnostic station, height was measured manually using the Marsden HM-201M Manual Height Measure, weight was measured using the SC-31S Tanita scale, BMI was calculated based on the CDC's BMI calculator and waist circumference was measured using an MYO body measuring tape. The following sections explain the methods of measuring these variables and the validity of the diagnostic devices in detail.

3.7.1 Primary variable (glycated haemoglobin A1c)

The HbA1c test has been recommended by the ADA, the IDF and expert committees for the diagnosis of diabetes and prediabetes (Association, 2019; Committee, 2009; Gavin III et al., 1997; Group, 2014). The HbA1c test measures the person's average glycated haemoglobin level over the past few months (Vijayakumar et al., 2017). HbA1c is recognised as the gold standard for diabetic surveys (Gillery, 2013). Moreover, in the 1970s, this parameter was successfully introduced into clinical practice and has been standardised internationally since the 1990s (Gillery, 2013). It is possible to identify prediabetes in both adults and children by measuring HbA1c levels (Kim et al., 2019a; Vijayakumar et al., 2017). Jagannathan et al. (2020) illustrate the advantages and disadvantages of diabetes screening using the HbA1c test as shown in Table 3.4. Furthermore, the main factors that influence HbA1c measurements are stated in Table 3.5.

Table 3.4: Advantages and disadvantages of the glycated haemoglobin A1c test

Test	**Advantages**	**Disadvantages**
HbA1c	Reflects integrated glucose levels over preceding ~180 days Convenient, can be performed as a single blood draw Does not require fasting or patient preparation High reproducibility (precision) Less day-to-day perturbations during stress and illness Globally standardised and quality assurance in place	Less sensitive than the FPG and 2-h PG. The accuracy and interpretation can be affected by the presence of haemoglobin variants (i.e., sickle cell trait), chronic kidney failure, iron deficiency anaemia, differences in red blood cell lifespan, and differences with age and race Weakly associated with the diabetes pathophysiology (e.g., insulin sensitivity and ß-cell function) May be high or low relative to underlying average glucose levels (accuracy – HbA1c 'mismatches' as a reflection of average glucose levels).

Note. FPG = fasting plasma glucose; 2-h PG – 2-hour plasma glucose. Adopted from Jagannathan et al. (2020, p. 3791)

Table 3.5: Main non-glycaemic factors affecting glycated haemoglobin A1c measurement

Elevates HbA1c	**Reduces HbA1c**
Iron deficiency anaemia	Pregnancy
Chronic kidney disease	Hemolytic anaemia
Vitamin B12 deficiency	Erythropoietin therapy
Severe hypertriglyceridemia	Iron/vitamin B12 replacement
Aging	Chronic liver disease
Black race, Asian race, Hispanic ethnicity	Antiretrovirals
Genetic factors	Genetic factors

Note. Adopted from Jagannathan et al. (2020, p. 3792)

In this study, the research team used the Afinion 2 Analyzer to measure the HbA1c of the participants. It is a simple fingerstick test that only needs three steps and three minutes to provide the participant's HbA1c value during data collection. As shown in Figure 3.2, the first step is to collect the sample with the integrated sampling device, the second step is to place the sampling device back in the test cartridge, and the last step is to place the test cartridge in the analyser and close the lid. The analysing process then starts automatically.

Figure 3.2 shows the medical device and the 3-step procedure used to measure HbA1c during data collection.

Figure 3.2: 3-step procedure to measure the glycated haemogobin A1c of the participants

This test is low-cost, rapid, convenient, easy to use and accurate for use in research settings. Moreover, this test can reduce workload, enhance the participant–clinician relationship and improve client motivation and attitude towards blood sugar testing (Crocker et al., 2014;

Laurence et al., 2010). The HbA1c levels were categorised into three categories based on the ADA's criteria for diagnosing prediabetes and T2DM (Association, 2019), see Table 3.6.

Table 3.6: Glycated haemoglobin A1c categories

HbA1c level	**Category**
≤ 5.6% (38 mmol/mol)	Normal
5.7% – 6.4% (39–47 mmol/mol)	Prediabetes
≥ 6.5% (48 mmol/mol)	T2DM

Note. T2DM = type 2 diabetes mellitus

3.7.2 Secondary variables

BMI percentiles were measured and calculated based on the CDC growth chart. Waist circumference was measured and was based on cut-off points for obesity and metabolic complications. Digital blood pressure monitors were used to measure blood pressure. Participants were asked to sit for at least 10 minutes before performing this test. Height, weight and waist circumference were measured. Table 3.7 provides an overview of the questions asked about the medical and health history of the participant and their family.

Table 3.7: Data obtained from participants

Category	Participant data
History	Participant's medical history (acanthosis nigricans, HTN, high cholesterol levels, bronchial asthma, polycystic ovary syndrome and epilepsy) Participant's family medical history (T2DM, HTN, coronary heart diseases and high cholesterol levels) Demographic data (age, nationality, sex, monthly family income, enrolled education level, father's education level, mother's education level and the number of siblings)
Physical examinations and blood test	Weight Height BMI Waist circumference Heart rate Clinical BP (average of 2 readings) HbA1c
Questionnaires	Health-related behaviours questionnaire Exercise behaviours Nutrition behaviours Sleeping behaviours Sleeping duration Health risk behaviours Smoking Screen time

Note. HTN = hypertension; T2DM = type 2 diabetes mellitus; BMI – body mass index; BP = blood pressure; HbA1c = glycated haemoglobin A1c

The data collected on secondary variables included questions about the participant's health and health-related behaviour, and physical examinations were undertaken to measure their current overall health to map their health status at the time of testing.

3.7.2.1 Weight, height and body mass index

To obtain the BMI of the participants, height and weight were measured first. Height was measured manually using the Marsden HM-201M Manual Height Measure stadiometer. In order to obtain the best results (Casadei & Kiel, 2022), the participant was asked to stand up straight, with their buttocks, shoulder blades and feet touching the back of the stadiometer. The participant's feet should be turned outward at a 60-degree angle. Hands should be facing the thighs, and arms should be hung loosely at the sides. The horizontal bar of the stadiometer should touch the crown of the participant's head and should compress the hair. The measurements were rounded up to the nearest 0.1 cm (Casadei & Kiel, 2022). This procedure was repeated twice to obtain two readings, and the average of the measurements was recorded. Weight was measured using an SC-31S Tanita electronic floor scale. The participants were asked to wear light clothes only and stand still on the electronic scale until the measurement was completed (Casadei & Kiel, 2022). Their weight was measured to the nearest 0.1 kg (Casadei & Kiel, 2022).

BMI was calculated based on the CDC's BMI calculators. For participants aged between 10 and 19 years, the CDC BMI Percentile Calculator for Child and Teen was used (see Figure 3.3) (Prevention, 2022b). Additionally, the CDC Adult BMI Calculator (see Figure 3.3) (Prevention, 2022a) was used to calculate BMI for participants aged 20–24 years.

Figure 3.3 Illustrates the calculator measures BMI and the corresponding BMI-for-age percentile based on CDC growth charts for children and teens aged between 2 and 19 years (CDC, 2022b).

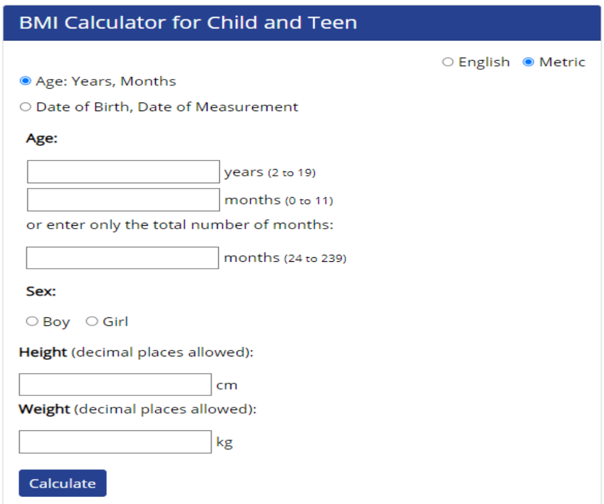


Figure 3.3: BMI calculator for Child and Teen aged between 2 and 19 years

Figure 3.4 illustrates the calculator that measure BMI and the corresponding BMI weight status category for young adults aged 20 years and older *(Prevention, 2022a)*

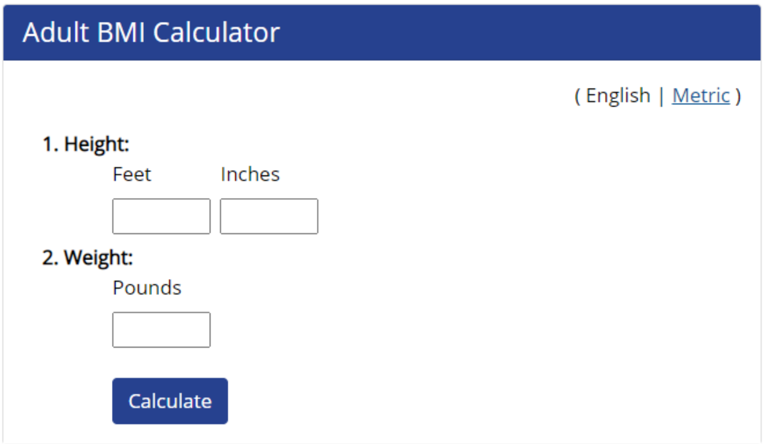


Figure 3.4: BMI Calculator for young adults aged 20 years and older

3.7.2.2 Waist circumference

During data collection, waist circumference was measured using MYO body measuring tape. In order to get the most accurate measurement, the WHO expert consultation recommendations on waist circumference were applied (Organization, 2011). Research assistants measured the waist circumference of participants at the midpoint between their lowest rib margin and the top of their iliac crest. It was necessary to hold the tape snugly, but not constrictively, and at a level parallel to the floor, when taking measurements. Participants were instructed to stand with their feet close together, their arms at their sides, and their body weight evenly distributed. They were also instructed to wear little clothing and remove extra clothing layers. Measurements were taken after a normal expiration, while the participants remained calm and relaxed. Waist circumference measurement was repeated twice for each participant and if the results were within 1 cm of one another, the average of both measures was calculated. But if the results exceeded a difference of 1 cm, the waist circumference measurement was repeated.

When selecting cut-off points for waist circumference, the experts generally agree that the basis for effective selection in clinical and public health should relate to health outcomes and risk protection for chronic diseases (WHO, 2011). The WHO cut-off points for obesity and metabolic complications were used for participants aged between 20 and 24 years due to the lack of Kuwaiti adult population-specific cut-off points (Table 3.8). On the other hand, there were age-specific and sex-specific smoothed waist circumference percentiles for Kuwaiti adolescents aged between 11 and 19 years, and these cut-off points were utilised during data collection (Table 3.9) (Jackson et al., 2010). Jackson et al. (2010) state that adolescents who have waist circumferences equal to or exceeding the 90th percentile were typically associated with an increased risk of metabolic complications and chronic diseases. Furthermore, many Chinese studies conducted on young adults emphasised that an increased waist circumference and abdominal adiposity tissues are more strongly associated with major chronic diseases such as hypertension, dyslipidaemia, heart diseases, cancer (Li et al., 2019; Lo et al., 2021) and T2DM (Fan et al., 2020).

Table 3.8: World Health Organization cut-off points and risk of metabolic complications

Indicator	**Cut-off points**	**Risk of metabolic complications**
Waist circumference	>94 cm (M); >80 cm (W)	Increased
Waist circumference	>102 cm (M); >88 cm (W)	Substantially increased

Note. M = men; W = women
Adopted from World Health Organization (2011, p. 27)

Table 3.9**:** Smoothed age- and sex-specific waist circumference percentiles (cm) for Kuwaiti adolescents aged between 11 and 19 years

Age (years)	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
Boys							
11	55.0	56.0	62.0	70.0	81.0	89.0	94.0
12	57.0	58.2	63.0	73.0	84.0	95.0	99.0
13	58.0	61.0	65.0	72.0	85.0	96.0	102.8
14	60.0	62.0	67.0	75.0	89.5	102.6	108.0
15	62.0	64.0	69.0	78.0	94.7	105.9	113.0
16	63.5	66.0	71.0	78.0	91.8	105.1	112.6
17	63.4	66.0	72.0	80.0	94.5	107.0	112.0
18	63.9	66.9	71.0	77.0	90.0	103.1	110.3
Girls							
11	54.6	56.0	61.7	69.0	76.1	85.5	93.6
12	56.9	59.5	63.0	69.0	79.0	87.1	92.1
13	58.5	60.0	64.6	70.0	80.2	86.6	94.0
14	59.9	62.7	66.7	73.0	81.0	93.8	98.7
15	58.0	60.0	65.0	72.5	80.0	90.4	97.0
16	59.0	61.0	65.1	71.0	80.0	89.0	94.7
17	58.0	61.0	64.7	70.4	77.9	91.2	98.9
18	59.8	61.2	65.2	71.0	79.5	89.6	100.8

Note. Adopted from Jackson et al. (2010, p. 272)

3.8 Research Instruments

Specific steps guided the adaptation process of the questionnaire design. First, based on the study’s aims and objectives, the developed and adapted questionnaire contained particular information about the health-related behaviours of young Kuwaiti people. Second, in order to represent the native language of the Kuwaiti young people, the survey was translated into Arabic. The final step was pre-testing the translated questionnaire using a small group of participants from the targeted population to evaluate, get feedback and enhance the language of the developed questionnaire.

3.8.1 Questionnaire adaptation process

This study was designed to assess the associations between health-related behaviours and HbA1c in the young Kuwaiti population. Besides the main two outcome variables, other variables that might influence the study's outcome were also measured. Demographic information, socioeconomic status, medical history and physical measurements were collected from participants. Parents of participants aged between 10 and 18 years completed the questionnaire. Participants aged between 19 and 24 years completed the questionnaire by themselves. An interviewer-administered questionnaire (Appendix 19) was used to assess participants' health-related behaviours. The health-related behaviours questionnaire of this study consisted of four sections: exercise behaviours (12 items), nutrition behaviours (14 items), sleeping behaviours (11 items) and health risk behaviours (8 Items).

The health-related behaviours questionnaire of this study was developed based on another three health-related questionnaires: The Arab Teens Lifestyle questionnaire (Al-Hazzaa et al., 2011), the Healthy Lifestyle Scale for University Students (Wang et al., 2012) and the Adolescent Sleep Habits questionnaire (Owens et al., 2000). The first questionnaire (the Arab Teens Lifestyle questionnaire) assesses lifestyle habits, including physical activity, sedentary behaviours and dietary habits, and contains 47 items (Al-Hazzaa et al., 2011). The second questionnaire was the Healthy Lifestyle Scale for University Students (Wang et al., 2013). This questionnaire was developed from Pender's Health Promotion Model, which was originally designed to evaluate influential factors for students' healthy lifestyles in China (Dong et al., 2013). This questionnaire contains 38 self-reported closed-ended questions divided into eight sections: exercise behaviour: regular behaviour, health risk behaviour: nutrition behaviour: health responsibility: social support, stress management and life appreciation. The last questionnaire was the Adolescent Sleep Habits questionnaire (Owens et al., 2000). This questionnaire includes 45 items relating to bedtime behaviour and sleep duration, and has been used in several studies to examine sleep behaviour in adolescents. Permission to use items from these questionnaires was obtained from the questionnaire authors (see Appendices 10, 11 and 12). Many researchers have used and/or specifically selected items from these questionnaires in their clinical studies (Al-Haifi et al., 2016; Al-Hazzaa et al., 2022; Aminisani et al., 2016; Hamrani et al., 2015; Kerkadi et al., 2019; Lara et al., 2019; Markovich et al., 2014; Wang et al., 2013).

3.8.2 Translation of questionnaires

Kuwait's official language is Arabic; however, the developed questionnaire was in English, which required translation. Questionnaire translation is common because most published questionnaires are in English (Harkness et al., 2004). By translating the questionnaire, the participants were able to better understand its content and provide more accurate responses. A variety of methods are used for translation, including back translation, forward translation and committee translation (Furukawa et al., 2014). The translation process in this study was based on the committee approach. The translation committee consisted of two translators who were fluent in both Arabic and English with expertise in developing and translating questionnaires, and one of the co-supervisors who is an expert in health research and quantitative methods. It is believed that this approach will reduce cultural bias by introducing a team of experts to translate the questionnaire collaboratively (Douglas & Craig, 2007). In compliance with the requirements of the ethics committee in Kuwait, two translators were assigned to translate the developed questionnaire. The first translator was a lecturer at the College of Education who had completed a Bachelor's Degree, a Master's Degree and a PhD from universities in the UK. The second translator was a PhD candidate at an Australian university. Two translated copies where obtained from the translators and then evaluated by the co-supervisor who approved the questionnaire and suggested minor changes to the final Arabic copy. Finally, the evaluation indicated that the questionnaire was written in a clear manner and the translation contained no vague words. After translation, a pilot study of the questionnaire was conducted.

3.8.3 Pilot test of the questionnaires

Pilot tests can be conducted for many reasons. These include determining whether the proposed study is feasible, identifying potential problems with the research design, and examining the reliability of data collection and questionnaire translation (Grove et al., 2012). The translated questionnaire was tested on 20 participants. Hertzog (2008) suggests that a sample size of 10 to 40 is adequate to test a questionnaire in quantitative research, thus testing the translated questionnaire on 20 participants was considered adequate. Participants in the pilot test reported that the questions were easy to understand, and the layout was easy to follow. Participants did not report any issues with readability and intelligibility. Furthermore, the questionnaires provided reasonable responses that would contribute to the achievement of the study's aims and objectives.

3.9 Data Collection

This section details participant identification methods and the recruitment process.

3.9.1 Methods of identifying the participants

The sample frame was all students between the ages of 10 and 24 years studying at intermediate and secondary schools and universities, both government and private. The principal researcher and research assistants targeted potential participants via social media and text messages. Participants who were interested in being involved in this study were asked to complete the risk assessment tool for T2DM or prediabetes in asymptomatic young people adopted from the ADA. After identifying potential participants, letters of introduction (Appendices 20 and 21), information sheets (Appendix 13 and 14), and consent forms for children (Appendix 15 and 18) and young adults (Appendix 17 and 18) in both Arabic and English were sent to eligible participants via text message or email. Eligible participants who agreed to participate in the current study were invited by phone to a private clinic to complete the entire assessment.

Because of COVID-19 restrictions, scheduled appointments were allocated to each eligible participant. A 45-minute appointment was made for each participant at the private clinic. A comprehensive explanation about the study and data collection process was provided to all parents and participants, including indications of risks, possibility of discomfort, and the time needed to complete the questionnaire and physical assessment. The principal researcher answered any enquiries raised by the participants.

The participants' rights were explained during the recruitment, and the principal researcher ensured that all participants and their parents were fully aware of their rights before being involved in this study. The participants' rights involved the following points:

1. The nature and purpose of the research project described in the attached information sheet have been explained to me. I understand it and agree with my child taking part.
2. I understand that my child may not directly benefit from taking part in this study.
3. I acknowledge that the possible risks and/or side effects, discomforts and inconveniences, as outlined in the information sheet, have been explained to me.
4. I understand that there will be no payment to me or my child for taking part in this study.
5. I have had the opportunity to discuss taking part in this research project with a family member or friend and/or have had a chance to have a family member or friend present while the research project was being explained by the researcher.
6. I am aware that I should retain a copy of the consent form and the information sheet when completed.

7. I consent to physical assessments that will be performed on my child and used in the above project.
8. I understand that my child's information will be kept confidential, as explained in the information sheet.
9. I understand that the alternate contacts I have provided may be used to contact me as explained in the information sheet for study-related purposes.

3.9.2 Recruitment process

In the first instance, a recruitment process is warranted to obtain the desired number of participants. The reason for this is that poor participant recruitment may result in an extended study period, waste of time and resources, and have a significant impact on the study results (Treweek et al., 2013). Moreover, the recruitment of vulnerable participants, especially those at a young age, can be extremely difficult (Treweek et al., 2013). These challenges have led researchers to look for effective recruitment strategies to identify potential participants (Frandsen et al., 2014; Lane et al., 2015). Using SMS and web-based strategies such as online massages broads, social media and emails can be effective in attracting specific populations (Frandsen et al., 2014; Lane et al., 2015).

Recruiting participants for this research study started on June 2021 through different social media platforms such as Twitter, Instagram and Flyers. Participants who were interested contacted the research team at the clinic, who were then provided with more information about the study. Participants who agreed to participate provided the clinic with their contact details (phone and email). Information sheets were sent to participants via WhatsApp or email according to their preferences.

On September 2021, 510 participants responded to the advertisement and were contacted to attend the clinic to assess their eligibility using the ADA criteria. These participants were allocated a timeslot to avoid overcrowding at the clinic. Of the 510 participants, 158 interested participants were excluded due to not meeting the inclusion criteria (n = 89), declining to participate (n = 19), and declining to participate due to COVID-19 (n = 50).

The remaining 231 participants who were booked for an appointment at the clinic after meeting the inclusion criteria and agreeing to participate in the study. A further 85 participants were excluded due to not showing up for their appointment (n = 85) and not completing the whole assessment (n = 3). Finally, Phase 1 (the baseline assessment) consisted of a total number of 146 participants who met the inclusion criteria and completed the assessment (see Figure 3.5).

On March 2022, phase two (the follow-up assessment) of the data collection process commenced. In this phase, the 146 participants from Phase 1 were assessed for further criteria. According to the ethics committee, participants who were found to have T2DM were immediately taken out of the study and referred for diabetes management (n = 3). A further nine participants were excluded due to their inability to attend/commit to appointments or their loss of interest in participating in the study.

One hundred and thirty-four participants still expressed their interest in participating in the second phase of data collection. However, 10 participants did not show up for their scheduled appointment, and one participant did not complete the full assessment. The total number of participants for this research study was 123 participants who were at risk of developing T2DM (see Figure 3.5).

3.9.3 The first phase (baseline assessment)

In the first phase, a cross-sectional study was conducted on at-risk young people of T2DM in Kuwait between September 2021 and November 2021. The ADA criteria for testing for diabetes or prediabetes in asymptomatic young people were utilised to determine the eligible participants (as explained in Section 3.6.3).

A Gantt chart was planned to facilitate the data collection and track the expected number of participants (Appendix 22). Twenty-five participants were expected to be seen by the principal researcher and the research assistant teams weekly. Scheduling more than five participants per day was not practical. The clinic was allowed to work at half capacity because of the COVID-19 restrictions; each data collection session took about 35 minutes for each participant, where family and participant history were attained, and physical examinations conducted. The first 10 minutes of the data collection session were allocated to answer the participant's enquiries, sign the consent forms and prepare the participant mentally for the physical examinations.

The research assistants followed the same following steps for all participants:

1. The first blood pressure reading was recorded.
2. Height and weight were recorded.
3. BMI was calculated.
4. Waist circumference was measured.
5. Heart rate was recorded.
6. Blood sample was collected via finger prick to measure HbA1c level.
7. Asking the participant to relax and rest for five minutes before the second blood pressure reading.
8. While resting, the participant was asked to complete the family medical history and some demographic data.
9. The second blood pressure reading was recorded.
10. The participant was asked to go back and see the principal researcher to complete the health-related behaviours questionnaire and discuss the results of the physical examination.

There were six months between the end of the first phase of data collection and the start of the second phase of data collection. Figure 3.5 illustrates the flow chart for the first data collection phase from September 2021 to November 2021.

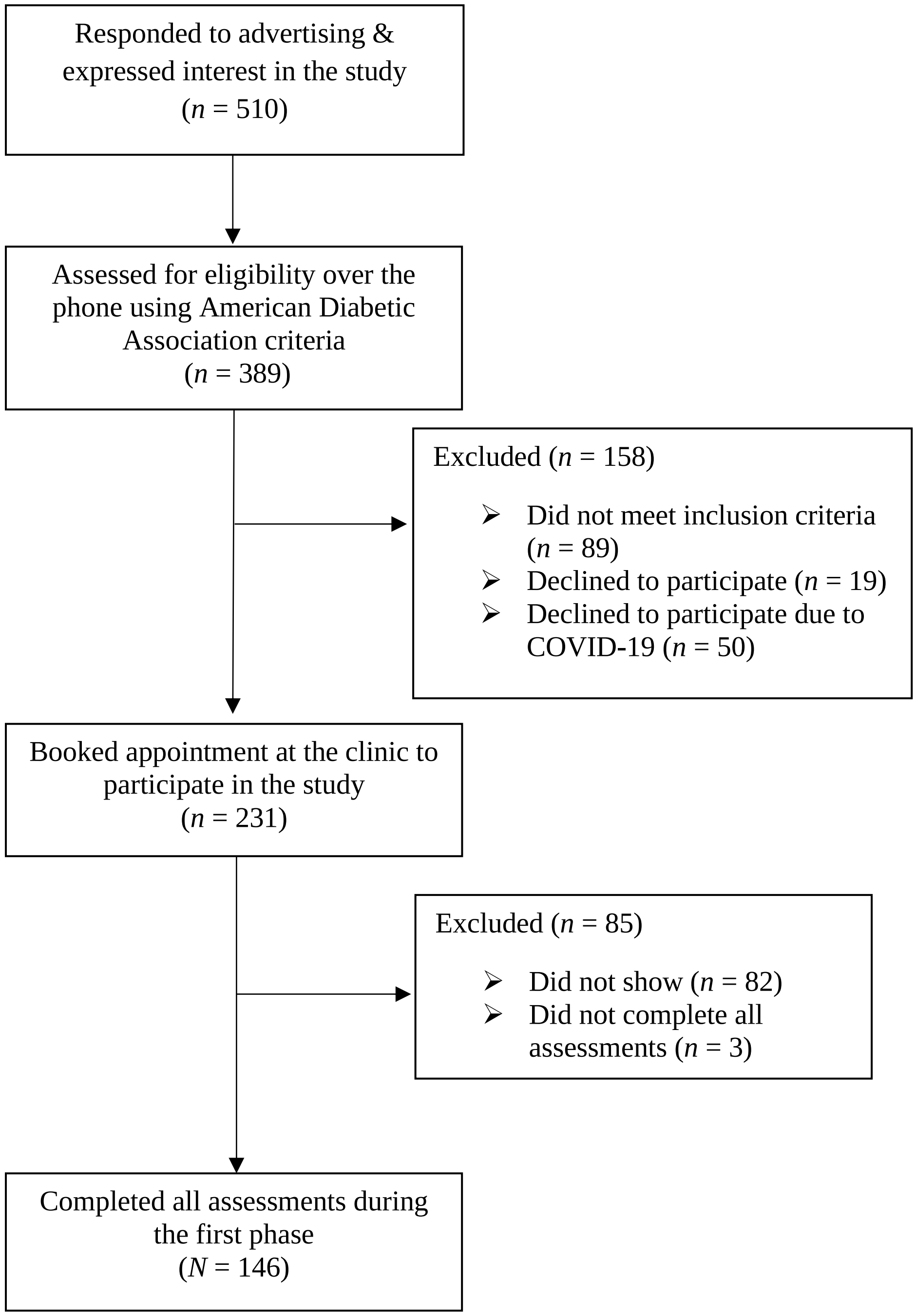


Figure 3.5: Flowchart for Phase 1 of data collection in this repeated cross-sectional study

Figure 3.5 above illustrates the participant commitment required for involvement in the study. This commitment ensured the participation rate was maintained and that the number of participant dropouts was reduced.

3.9.4 The second phase (follow-up assessment)

Six months after the first phase of the research study another data collection phase was carried out, thereby providing a repeated cross-sectional design. The second phase started in March 2022. A Gantt chart tracked and planned data collection and participant tracking (Appendix 22). The flow chart below (Figure 3.6) illustrates the process during the second data collection phase from March 2022 to May 2022.

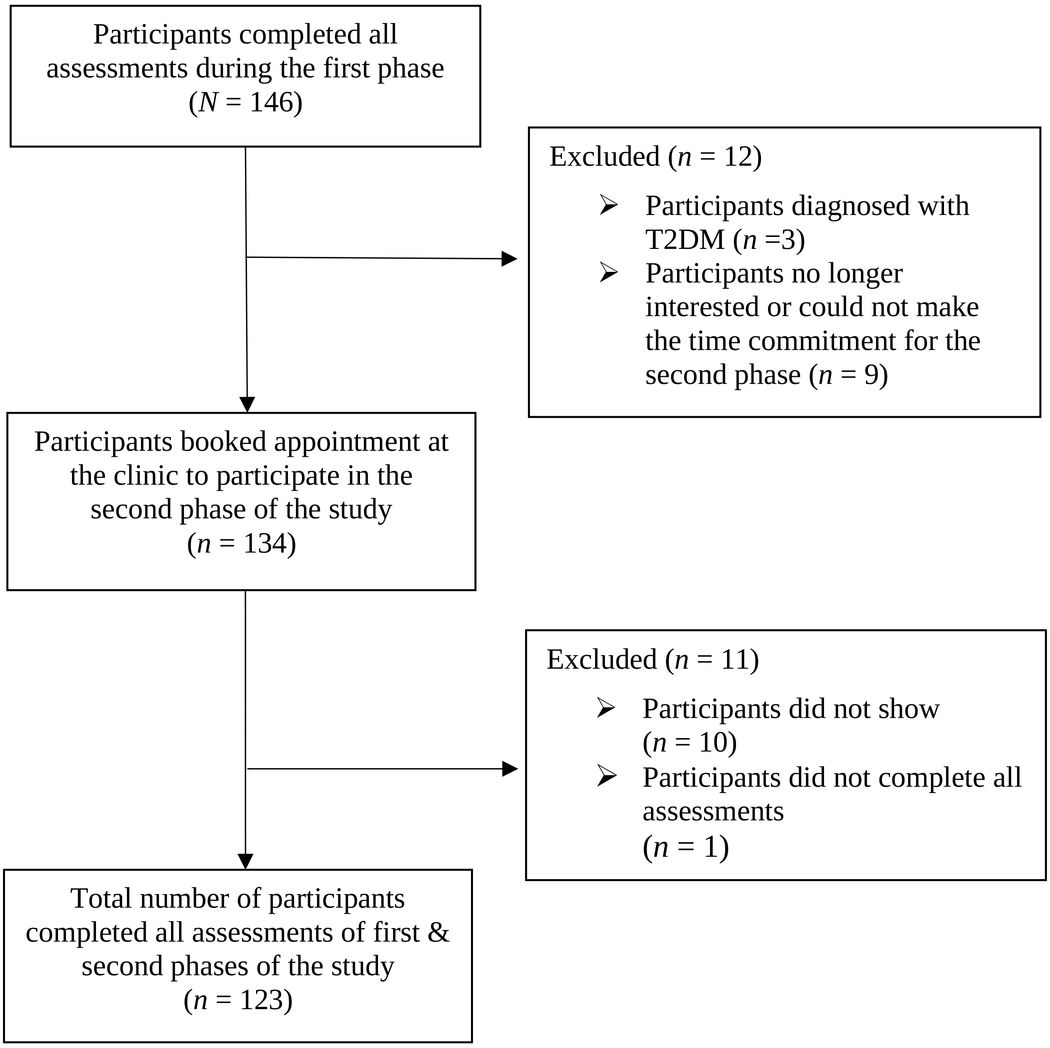


Figure 3.6: Flowchart for Phase 2 of data collection in this repeated cross-sectional study

Phase 2 of this study involved the re-measurement of the participants and Figure 3.6 above illustrates the retention and attrition rates for the study. Usually, it is expected that the dropout rate will be high, especially when the observational study involves children and young people (Fewtrell et al., 2008; Kristman et al., 2004). However, the principal researcher was able to maintain a follow-up rate of 84.2%, losing only 15.8% of the total participants who completed the baseline assessment.

3.10 Impact of the COVID-19 Pandemic

A coronavirus identified in 2019, SARS-CoV-2, caused a pandemic of respiratory illness, called COVID-19 (Southwick, 2021). Older people and young people with chronic diseases such as cardiovascular disease, diabetes, chronic respiratory disease and cancer were at increased risk of developing severe symptoms that could lead to respiratory failure, irreversible heart damage, kidney failure and death (Bhaskaran et al., 2021). The pandemic resulted in widespread lockdowns across the globe, and younger people with chronic illness were also at risk due to limited access to healthcare services and reduced daily physical activities during these lockdowns. The pandemic also increased mental stress.

3.10.1 Impact on the original study design

As a full-time international student, I had a limit of 3 years for the completion of the research with an additional year allocated to the writing up of the dissertation. The impact of COVID-19 and health system pressures impacted and shaped data collection and the progress of the study. The pandemic made it challenging for me to conduct the research. I had to re-think the research approach and make use of all work undertaking to this point for a study that was no longer feasible to carry out. These challenges are explained in more detail below.

3.10.1.1 Randomised control trial

This study first intended to conduct a clinical trial to test whether the Let's Go! 5-2-1-0 childhood obesity prevention program as an intervention for the prevention of T2DM among adolescents would lower levels of HbA1c and other measurable outcomes such as waist circumference, BMI, fasting blood glucose and blood pressure lipid profile in participants more than the control group. This clinical trial aimed to evaluate the effectiveness of the school nurse-led educational program in preventing T2DM among adolescents, and to compare outcome measurements.

However, the pandemic caused the cancellation of this research project when Kuwait went into complete lockdown for two months, followed by an imposed curfew for four months. This impact determined a necessary change, which I addressed.

The current study was redirected to a repeated cross-sectional study design as described in Section (3.4.2).

The title was changed from: A school-nurse-led, assessor-blinded, randomised, 6-month clinical trial to evaluate the effectiveness of an educational program in the prevention of type 2 diabetes among children and adolescents with elevated HbA1c in Kuwait to: Studies to explore the association between health-related behaviours and HbA1c among Kuwaiti young people at risk of T2DM – A repeated cross-sectional study.

This change shows that I modified my study from a randomised control study design to a repeated cross-sectional design while bearing in mind the amount of time remaining in the candidature.

3.10.2 Ethics approval

Ethics approval was obtained from the Women's and Children's Health Network Human Research Ethics Committee in Australia (see Appendix 6). The process for approval took six months (26 February 2020 to 26 August 2020), with final approval granted on 27 August 2020.

Ethics applications in Kuwait were applied for at the same time as the application in Australia was commenced. Also, I obtained approval from both the Ministry of Health (see Appendix 8) and the Ministry of Education (see Appendix 9) ethics committees in Kuwait, which were granted on 1 September 2020 and 11 October 2020, respectively. The time and work spent on the preparation for data collection for the first project was almost 1 year. However, due to COVID-19 restrictions, people working in both the government and private sectors were all required to work from home, and students had to study online. With the unseen crisis of the pandemic, I instigated changes to my research hypothesis and study design. Although the main aims, objectives and foundation concepts of this current study remained the same, the focus and study design had changed; this entailed modifying the ethics application and waiting again for their approval from Australia and Kuwait ethics committees before the commencement of data collection.

The current study hypothesis and design was feasible to conduct with the eased COVID-19 restrictions. However, another challenge arose; the inability to find a proper facility to accommodate the participants when answering the study questionnaire while providing these participants with privacy when conducting the physical assessment. An approval was not given to access to government organisations such as the KNA (see Appendix 23), Kuwait Diabetes Association and the Public Authority for Applied Education and Training – College of Nursing (see Appendix 24) to use their facility to conduct the current research. Following the recommendations of the ethics committee in Kuwait, I was able to obtain permission to conduct this research study at a private clinic on condition that the principal researcher and other parties involved would exercise proper COVID-19 precautions and safety regulations during data collection.

The College of Nursing in Kuwait was also provided research assistants who were nursing students in their final year. These research assistants were briefed about their roles and responsibilities prior to commencing data collection; they were also compensated for their time; and their efforts acknowledged by the dean of the college and head of the bachelor degree program.

3.10.3 Impact on data collection

Due to the COVID-19 pandemic, several restrictions were imposed and were considered while recruiting participants and accommodating them during their participation. These restrictions included:

1. Limited number of participants: Appointments were allocated to participants who showed interest. These appointments were easily forgotten despite the text reminders and calls that were made to the interested participants at five days and one day before their appointment. Most of the participants chose similar times, which were in the evenings, and avoided weekends. The limited timeslots available to accommodate participants caused them to reschedule multiple times or cancel. Participants willingly completed the questionnaire, but were reluctant to have their weight and HbA1c checked.
2. Social distancing and face masks: A mandatory two-metre gap was to be maintained in the clinic. Face masks were to be worn the whole time. This was inconvenient for participants as they would prefer to stay at home than to volunteer for a study where they had to go out and be possibly exposed to the virus.

3.10.4 Data entry

All data obtained from the questionnaires and physical assessments were checked by the principal researcher before being entered into the computer. All variables were coded, and a codebook was created. Anonymisation of each participant's information was used to maintain their confidentiality. All participants were given a unique ID. Data were double-checked and cleaned manually before starting data analysis.

3.11 Data Analysis

Stata® software version 17 was used to carry out the data analysis (StataCorp, 2021). Descriptive profiles of the participants were tabulated, including frequency distributions, means and standard deviations, depending on the type of the variable. Means and standard deviations were calculated for continuous variables. Frequencies and percentages were calculated for categorical variables. Age was classified into two categories: 10–19 years and 20–24 years. Demographic variables and medical history were examined for all study participants and classified by sex and age category. The ADA cut-off points were used to classify the participants into three categories of diabetes: no diabetes, prediabetes and with diabetes. Those with an HbA1c less than 5.7 were classified as "no diabetes", those with an HbA1c between 5.7 and 6.4 were classified as "prediabetes", and those with a HbA1c greater than 6.4 were classified as "with diabetes".

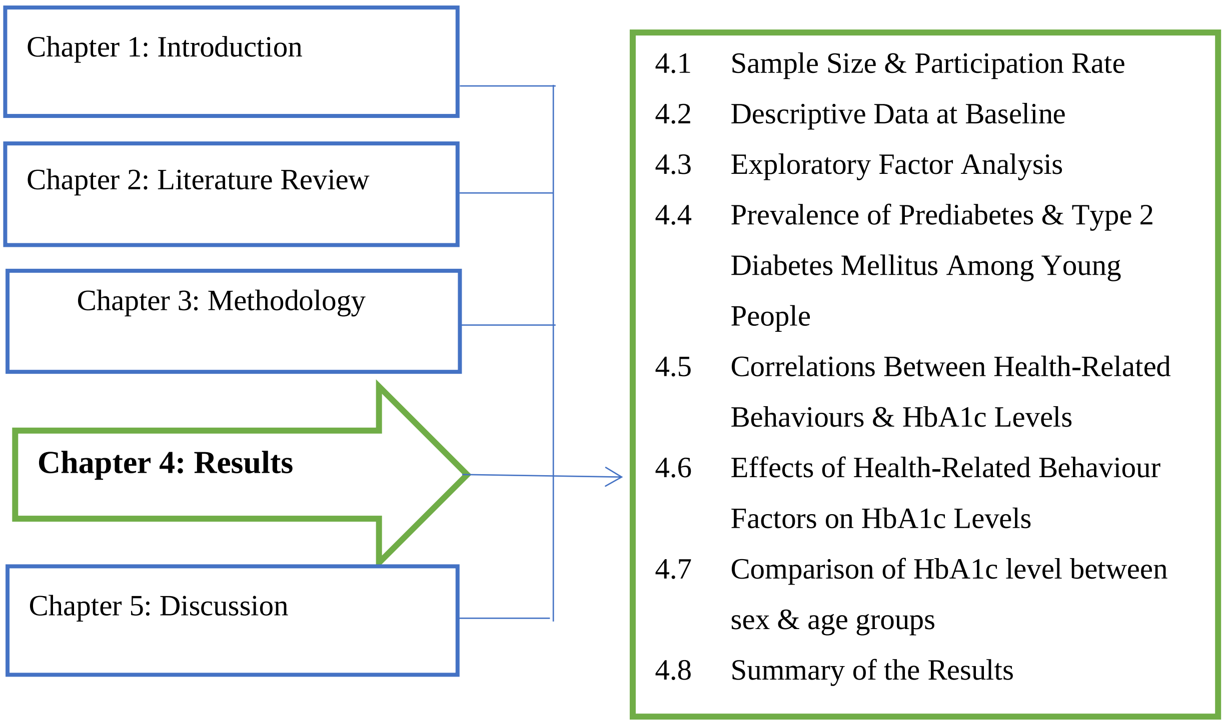
Exploratory factor analysis (EFA) and reliability analysis was conducted to validate the sleep, exercise and nutritional dimensions of the health-related behaviours scale. A Chi-square test was conducted to determine the association between the prevalence of prediabetes and diabetes and the age group. A one-sample *t*-test was used to compare the mean HbA1c level in the sample with the HbA1c level the general population. Bivariate correlation coefficients were used to examine the correlations between health-related behaviours, HbA1c levels and BMI of the participants. Linear mixed-effects models were constructed to evaluate the effects of demographic and health-related behaviour scale factors on the repeated measures of HbA1c. Statistical significance for all inferential tests was indicated if $p < 0.05$.

3.12 Summary of the Methodology

This chapter presented the philosophical foundation of the research study, repeated cross-sectional design. The research paradigm, ontology and epistemology were then described, followed by the research methodology. The ethical considerations were then discussed prior to discussing the study setting, sample size and participants' criteria. The measures and health-related behaviours questionnaire, as well as the primary variable (HbA1c) and secondary variables, were explained thoroughly. Due to the COVID-19 lockdown and restrictions, the data collection period was interrupted, which led to a change in the study hypothesis and protocol. Finally, an explanation of the data analysis was provided before ending with the summary of the chapter.

The next chapter, Chapter 4, presents the statistical analysis of the data collected from the study participants.

Chapter 4: Results



This chapter presents the results of the statistical analyses of the completed physical assessments and health-related behaviour questionnaires that were collected from Kuwaiti young people aged 10–24 years. The data were analysed using Stata® software version 17 (StataCorp, 2021). The recruitment process is briefly described, and an explanation of the methods used for data analysis is also provided in this chapter.

Participants' descriptive profiles were tabulated according to the variable types. Means and standard deviations were calculated for continuous variables. Frequencies and percentages were calculated for categorical variables. For all participants in the study, demographic variables and medical history were examined and classified by sex and age. There were two categories of age: those between the ages of 10 and 19 years and those between the ages of 20 and 24 years. Participants were classified into three categories according to the cut-off points of the ADA (2019); no diabetes, prediabetes and with diabetes. EFA and reliability analysis were conducted in order to validate the health-related behaviour scale's sleep, exercise and nutritional dimensions. It was determined whether or not there was an association between the prevalence of prediabetes and T2DM and the age group by performing a Chi-square test. A one-sample *t*-test was used to compare the mean HbA1c level between the sample and the general population. Bivariate correlation coefficients were used to examine the correlations between health-related behaviours, HbA1c levels, and the age, weight and BMI of the participants. An analysis of the repeated measures of HbA1c levels was conducted by using linear mixed-effects models that evaluated the effects of demographic factors and health-related behaviour scale factors. Statistical significance was indicated for all inferential tests when $p < 0.05$.

4.1 Sample Size and Participation Rate

A private clinic was used to recruit participants and collect data due to the closure of schools and COVID-19 restrictions in Kuwait at the time of the study. COVID-19 also extended the initiation of the follow-up assessment (Phase 2) of this project. All participants recruited for the baseline assessment (Phase 1) were invited to attend a follow-up visit six months after the initial visit. Initially, the period between Phase 1 and Phase 2 was six months. Recruiting participants and collecting data for this research study started in June 2021 and was completed in May 2022.

Figure 4.1 illustrates the flow of participants in each phase over the course of this repeated cross-sectional study. A total of 510 young people responded to advertising and expressed interest in this study. Following assessment of the volunteer participants for eligibility over the phone using ADA criteria (Association, 2018), see Section 3.5.3 for a description of the participants' availability for the two rounds of physical assessment) only 231 of the respondents agreed to arrange an appointment at the clinic to participate in this study. However, of these, 85 respondents either did not attend the clinic or did not complete all physical assessments.

Therefore, only 146 people attended the baseline assessment data collection session (Phase 1). This resulted in a sample of 146 participants being included in Phase 1.

In Phase 2, 123 participants completed the follow-up assessment, resulting in a follow-up rate of 84.2% and an attrition rate of 15.8%. Refer to Section 3.7 for complete details regarding the recruitment process and data collection for this study.

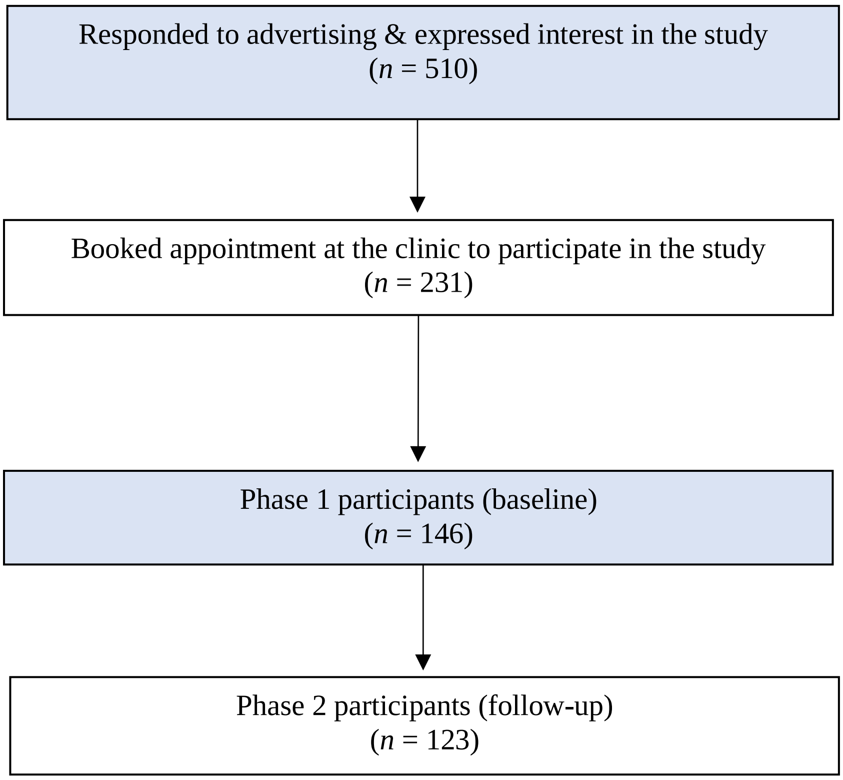


Figure 4.1: *Flowchart of participants through the repeated cross-sectional study*

The flowchart above assisted in tracking the participants across the two studies. This was necessary to ensure the number of participants met the statical requirements of the inferential analysis.

The baseline demographic data collection included details of participants' age, sex, nationality, governate (area in Kuwait), monthly family income, education level and education level of their parents, along with a health-related questionnaire that included 45 items, such as exercise behaviours (12 items), nutrition behaviours (14 items), sleeping behaviours (11 items) and health risk behaviours (8 items) (see Appendix 19). Moreover, participants consented to physical examinations including height, weight, BMI, waist circumference, blood pressure and HbA1c blood tests (sample).

4.2 Descriptive Data at Baseline

The section presents the demographic and clinical characteristics of participants at baseline assessment. Furthermore, these characteristics are classified by sex and age group. Participants' descriptive profiles are tabulated according to demographic and clinical characteristics. There are two categories of age: those aged between 10 and 19 years and those aged between 20 and 24 years.

4.2.1 Demographic characteristics of the participants by sex

Table 4.1 presents a demographic profile of the participants classified by sex. In the study sample, there were more males than females. Eighty-five participants (58.22%) were male, and 61 participants (41.78%) were female. Most participants were Kuwaiti, (*n* = 109, 74.66%), and the rest were from different nationalities (non-Kuwaiti), (*n* = 37, 25.34%). Participants from all six governorates of Kuwait were involved; Al Ahmadi, Al Asima, Al Farwaniya, Al Jahra, Mubarak Al Kabir and Hawalli. More than half of the participants came from two governorates, Al Asima (*n* = 37, 25.3%) and Hawalli (*n* = 40, 27.3%), while only nine participants (6.17%) were from Al Jahra. When comparing participation according to governorates among females, the biggest proportion of participants were from Al Asima (*n* = 22, 36.10%), with a few participants from Al Ahmadi and Hawalli (*n* = 3, 4.90% each). Meanwhile, among males, the biggest proportion of participants came from Hawalli (*n* = 22, 25.90%). In addition, participants were asked about their monthly family income in the demographic section of the health-related questionnaire. Almost all participants had a high monthly income (*n* = 59, 40.4%) or a medium monthly income (*n* = 66, 45.2%). More than half of the female participants (*n* = 35, 57.30%) reported a medium monthly income. For male participants, approximately half (*n* = 44, 51.80%) reported a high monthly income, while six participants (4.11%) did not specify or did not want to share their monthly family income.

Participants were asked about their education level (intermediate school, high school or undergraduate) and their parents' education level (less than high school, high school, college or more than college). The participants' answers to those questions indicate that a large proportion of participants were enrolled in high school (*n* = 59, 40.41%), nearly half of the mothers (*n* = 60, 41.09%) had a college degree and nearly a quarter of mothers had a high school certificate. The fathers of the participants had an education level that was divided almost equally within three levels – less than high school, high school and college (*n* = 43, 29.46%), (*n* = 42, 28.76%) and (*n* = 42, 28.76%), respectively.

Table 4.1: Demographic profile of Phase 1 participants classified by sex[1]

Demographics	**Female (*n* = 61)**	**Male (*n* = 85)**	**Total (*N* = 146)**
Nationality			
Kuwaiti	36 (59.00%)	73 (85.90%)	109 (74.70%)
Non-Kuwait	25 (41.00%)	12 (14.10%)	37 (25.30%)
Governorate			
Al Ahmadi	3 (4.90%)	20 (23.50%)	23 (15.76%)
Al Asima	22 (36.10%)	15 (17.60%)	37 (25.34%)
Al Farwaniya	10 (16.40%)	11 (12.90%)	21 (14.38%)
Hawalli	18 (29.50%)	22 (25.90%)	40 (27.39%)
Al Jahra	5 (8.20%)	4 (4.70%)	9 (6.17%)
Mubarak Al Kabir	3 (4.90%)	13 (15.30%)	16 (10.96%)
Monthly family income			
Did not specify or did not share	4 (6.60%)	2 (2.40%)	6 (4.11%)
Low income < KD1500	7 (11.50%)	8 (9.40%)	15 (10.27%)
Medium income KD1500–KD2500	35 (57.30%)	31 (36.40%)	66 (45.21%)
High income > KD2500	15 (24.60%)	44 (51.80%)	59 (40.41%)
Participant’s education			
Intermediate school	18 (29.50%)	22 (25.90%)	40 (27.41%)
High school	23 (37.70%)	36 (42.40%)	59 (40.41%)
Undergraduate	20 (32.80%)	27 (31.80%)	47 (32.18%)
Father’s education			
Less than high school	20 (32.70%)	23 (27.10%)	43 (29.46%)
High school	16 (26.30%)	26 (30.60%)	42 (28.76%)
College	20 (32.70%)	22 (25.80%)	42 (28.76%)
More than college	5 (8.30%)	14 (16.50%)	19 (13.02%)
Mother’s education			
Less than high school	14 (22.90%)	17 (20.00%)	31 (21.23%)
High school	17 (27.90%)	19 (22.40%)	36 (24.65%)
College	23 (37.70%)	37 (43.50%)	60 (41.09%)
More than college	7 (11.50%)	12 (14.10%)	19 (13.03%)

Note. [1]Data presented as number of observations and frequencies (*n* (%))

Table 4.1 above shows that the number of male participants outnumbered the number of female participants. The physical assessment required participants to expose part of their body and have a finger prick to check their HbA1c levels. It is possible that these assessments can cause discomfort to female participants, leading to a higher number of males in the study. However, this was not verified. The majority of participants were Kuwaiti. It was expected that this would be the case since the study was conducted in Kuwait. Furthermore, the majority of the participants were from two governorates (Al Asima and Hawalli). This can be explained by the location of the clinic where data collection took place. These two governorates are the closest to the clinic.

More than 85% of participants (*n* = 125) fell into the two highest income groups, with a net monthly family income between 1500KD and 2500KD, or with a family income >KD2500. In this regard, this can be clarified by the number of Kuwaiti participants in this study. This could be because the biggest proportion of participants were Kuwaiti, who generally have a higher family income than other nationalities. This information could be useful in the discussion chapter when the results of this study are compared with other regional and global findings. Also, there is a link between family income and T2DM (Al-Rubeaan, 2015; Osman et al., 2013).

4.2.2 Clinical characteristics of participants by sex

As shown in Table 4.2, participants completed a physical assessment that included their BMI category, diabetes status, waist circumference category, family history of T2DM and smoking status. The observations and frequencies of these T2DM risk factors were classified by sex.

The main blood tests examined were HbA1c. HbA1c tests measure a person's average glycated haemoglobin level over the previous few months. Based on the ADA's criteria for diagnosing prediabetes and T2DM (Association, 2018), HbA1c levels were divided into three categories: normal or no diabetes is ≤ 5.6% (38 mmol/mol), prediabetes is 5.7%–6.4% (39–47 mmol/mol) and T2DM is ≥ 6.5% (48 mmol/mol). See Section 3.6.1 for comprehensive details about the HbA1c test. Out of the 146 participants, 60 (41.10%) were in the prediabetes stage, and three participants (2.05%) were newly diagnosed with T2DM. When comparing the primary variable of this study between females and males, almost half of the male participants (*n* = 40, 47.06%)

were in the prediabetes stage, while two male participants (2.35%) were diagnosed with T2DM; however, only one-third of female participants, (*n* = 20, 32.79%), were in the prediabetes stage and only one participant (1.64%) was newly diagnosed with T2DM.

Based on the BMI calculators provided by the CDC, the BMI of the participants was calculated. For participants aged between 10 and 19 years, the CDC BMI Percentile Calculator for adolescents was used (Casadei & Kiel, 2022; Prevention, 2022b), while the CDC Adult BMI Calculator was used to calculate BMI for participants aged 20–24 years. See Section 3.6.2.1 for full details about weight, height and BMI measurements (Casadei & Kiel, 2022; Prevention, 2022a). At baseline assessment, most participants were obese (*n* = 129, 88.36%), and the rest were overweight (*n* = 17, 11.64%). The percentages of obesity and overweight for female and male participants were relatively similar. There were no significant differences in the BMI variable.

The cut-off points for age-specific and sex-specific smoothed waist circumference percentiles for Kuwaiti adolescents aged between 11 and 19 years were determined during data collection (Jackson et al., 2010). In addition, the WHO's cut-off points for obesity and metabolic complications were used for participants aged between 20 and 24 years due to the lack of Kuwaiti adult population-specific cut-off points (WHO, 2001). This variable was classified into low risk and high risk of developing metabolic complications and chronic diseases, refer to Section 3.6.2.2.

Of the total participants at baseline, Table 4.2 below shows 120 participants (82.19%) were at high risk, and 26 (17.81%) were at low risk of chronic diseases and T2DM. There were more male participants (*n* = 73, 85.88%) at high risk of chronic diseases and T2DM than female participants (*n* = 47, 77.05%). Several studies have found that abdominal adiposity tissues and waist circumference are more closely related to major chronic diseases, including hypertension, dyslipidaemia, heart disease, cancer (Li et al., 2019; Lo et al., 2021) and T2DM (Fan et al., 2020).

Approximately 40% of the total participants were smokers, with a greater rate among male participants (*n* = 38, 44.7%) compared to female participants (*n* = 21, 34.42%). Moreover, almost all participants had a family history of diabetes (*n* = 143, 97.95%).

Table 4.2: Clinical characteristics of participants classified by sex[1]

Parameters / Variables	**Female (*n* = 61)**	**Male (*n* = 85)**	**Total (*N* = 146)**
BMI category			
Overweight	8 (13.11%)	9 (10.59%)	17 (11.64%)
Obese	53 (86.89%)	76 (89.41%)	129 (88.36%)
Diabetes status			
No diabetes	40 (65.57%)	43 (50.59%)	83 (56.85%)
Prediabetes	20 (32.79%)	40 (47.06%)	60 (41.10%)
Diagnosed with T2DM	1 (1.64%)	2 (2.35%)	3 (2.05%)
Waist circumference category			
Low risk	14 (22.95%)	12 (14.12%)	26 (17.81%)
High risk	47 (77.05%)	73 (85.88%)	120 (82.19%)
Participants' smoking status			
Yes	21 (34.42%)	38 (44.71%)	59 (40.41%)
No	40 (65.58%)	47 (55.29%)	87 (55.29%)
Family history diabetes			
Yes	61 (100%)	82 (96.47%)	143 (97.95%)
No	0 (0%)	3 (3.53%)	3 (2.05%)

Note: [1]Data presented as number of observations and frequencies (n (%))
BMI = body mass index; T2DM = type 2 diabetes mellitus

Table 4.2 above illustrates that a large number of males are at risk of health-related issues from elevated BMI, high waist circumference and smoking at the time of screening and assessment. This highlights a potential for longer term detrimental health outcomes for these participants. Therefore, these initial results are useful in providing results that can be used as identifiers of future health risks.

4.2.3 Demographic characteristics of participants by age group

Table 4.3 below summarises the demographic profile of the participants by age group, nationality, governate, family income and parental education level. There are two categories of age: those between 10 and 19 years and those between 20 and 24 years. This table quantifies the demographic details that can impact on the presence of T2DM in the participant cohort. For example, parental education level may impact on the prevalence of T2DM in children and young adults. This information is useful in the interferential analysis performed later in this chapter.

When classifying the study sample by age group, there were 110 participants aged 10–19 years and 36 participants aged 20–24 years. Of the 110 participants aged 10–19 years, there were slightly more male participants than female participants (*n* = 63, 57.27% and *n* = 47, 42.73%), respectively. In the older age group (20–24 years), male participants made up the larger proportion, with about 61.11% (22 out of 36 participants), whereas female participants accounted for 38.89% (14 out of 36 participants).

There were more Kuwaiti participants in both groups, (76 out of 110, 69.09%) in the 10–19-years age group, and 33 (91.67%) out of 36 participants in the 20–24-years age group. Among the younger age group, participants came mostly from Al Asima Governorate (*n* = 28, 25.46%). In the older age group, the majority of participants came from Hawalli (*n* = 15, 41.67%). In both groups, participants reported similar monthly family income, with the majority either having a medium monthly family income that ranged between 1500 and 2500 KD, or a high monthly family income of more than KD2500.

The distribution of the participants' mothers' education in the 10–19-years age group revealed that the majority of the mothers held college degrees (*n* = 41, 37.27%), likewise among the 20–24-years age group, college degrees made up the largest proportion (*n* = 19, 52.78%). The number of participants' fathers holding high school certificates and college degrees was exactly the same (*n* = 34, 30.91%) in both educational levels among the 10–19-years age group, while other qualification categories were numbered at 27 (24.55%) and 15 (13.64%) for less than high school and more than high school qualification holders respectively. In the 20–24-years age group, the majority of participants' fathers had less than a high school certificate (16 out of 36 participants, 44.44%), and only four participants' fathers (11.11%) had more than a college degree.

Table 4.3: Demographic profile of participants classified by age group

Demographics	**10–19 years (*n* = 110)**	**20–24 years (*n* = 36)**	**Total (*N* = 146)**
Sex			
Male	63 (57.27%)	22 (61.11%)	85 (58.22%)
Female	47 (42.73%)	14 (38.89%)	61 (41.72%)
Nationality			
Kuwaiti	76 (69.09%)	33 (91.67%)	109 (74.66%)
Non-Kuwait	34 (30.91%)	3 (8.33%)	37 (25.34%)
Governate			
Al Ahmadi	18 (16.36%)	5 (13.88%)	23 (15.66%)
Al Asima	28 (25.46%)	9 (25.00%)	37 (25.34%)
Al Farwaniya	20 (18.18%)	1 (2.77%)	21 (14.40%)
Hawalli	25 (22.73%)	15 (41.67%)	40 (27.40%)
Al Jahra	7 (6.36%)	2 (5.56%)	9 (6.20%)
Mubarak Al Kabir	12 (10.91%)	4 (11.12%)	16 (11.00%)
Monthly family income			
Did not specify	3 (2.73%)	3 (8.33%)	6 (4.11%)
Low income < KD1500	12 (10.91%)	3 (8.33%)	15 (10.27%)
Medium income KD1500 –KD2500	49 (44.54%)	17 (47.23%)	66 (45.21%)
High income > KD2500	46 (41.82%)	13 (36.11%)	59 (40.41%)
Participant's education			
Intermediate school	57 (51.82%)	0 (0.00%)	40 (27.41%)
Secondary school	42 (38.18%)	0 (0.00%)	59 (40.41%)
Undergraduate	11 (1.00%)	36 (100%)	47 (32.18%)
Father's education			
Less than high school	27 (24.55%)	16 (44.44%)	43 (29.48%)
High school	34 (30.91%)	8 (22.22%)	42 (28.76%)
College	34 (30.91%)	8 (22.22%)	42 (28.76%)
More than college	15 (13.64%)	4 (11.11%)	19 (13.01%)
Mother's education			
Less than high school	20 (18.18%)	11 (30.55%)	31 (21.23%)
High school	32 (29.09%)	4 (11.11%)	36 (24.66%)
College	41 (37.27%)	19 (52.78%)	60 (41.10%)
More than college	17 (15.45%)	2 (5.56%)	19 (13.01%)

Note. [1]Data presented as number of observations and frequencies (*n* (%))

Table 4.3 above identifies that the majority of participants were Kuwaiti males in both age groups. Most of the participants had a medium to high monthly family income. In the comparison of parental education levels, the education level of the participants' mothers in both groups was higher. Chapter 5 interprets and discusses these data results.

4.2.4 Clinical characteristics of participants by age group

The results presented in Table 4.4 shows the impact of known variables on the potential development of T2DM in the participants in both age groups. This table also shows the T2DM status based on the ADA's criteria for diagnosing prediabetes and T2DM (Association, 2018).

As described earlier in Chapter 1, Section 1.3.3 the risk of T2DM can be attributed to a number of risk factors. These factors include obesity and overweight (Elkum et al., 2016; McSharry et al., 2020), family history (Cole & Florez, 2020; Lascar et al., 2018), waist circumference (Terencio et al., 2017) and smoking (Bertoni et al., 2018; Lown et al., 2019).

Out of the 110 participants in the 10–19-years age group, 46 participants (41.82%) were in the prediabetes stage, and 61 participants had no diabetes (55.45%). Only three participants (2.73%) had recently been diagnosed with T2DM. In the older age group, no new cases of T2DM were found. However, 14 out of the 36 participants (38.88%) were in the prediabetes stage, and the rest had normal HbA1c levels (n = 22, 61.22%).

As expected, the vast majority of participants were obese in both age groups, with a proportion of 88.18% in the 10–19-years age group and 88.89% in the 20–24-years age group. The results of the waist circumference categories revealed that 101 participants (92.82%) were at high risk of developing T2DM in the 10–1-years age group. The waist circumference data, however, differ from that of the older age group. The participants in the 20–24-years age group were divided almost equally between the two risk categories. Of the total participants (n = 36) in this group, 17 (47.78%) were at low risk of T2DM, and 19 (52.78%) were at high risk of T2DM.

Further, a family history of diabetes was found in all participants (*n* = 110, 100%) in the 10–19-years age group and among most participants (33 out of 36, 91.67%) in the 20–24-years age group.

The distribution of the participants' smoking status in the younger age group included 28 smokers (25.45%) and 82 non-smokers (74.55%) out of 110 participants. With respect to the older participants, there were 31 smokers (86.11%) out of 36 participants, and only five participants (13.89%) were non-smokers.

Table 4.4: Clinical characteristics of participants classified by age group[1]

Parameters/Variables	**10–19 years (*n* = 110)**	**20–24 years (*n* = 36)**	**Total (*N* = 146)**
BMI category			
Overweight	13 (11.82%)	4 (11.11%)	17 (11.64%)
Obese	97 (88.18%)	32 (88.89%)	129 (88.36%)
Diabetes status			
No diabetes	61 (55.45%)	22 (61.22%)	86 (56.85%)
Prediabetes	46 (41.82%)	14 (38.88%)	60 (41.10%)
Diagnosed with T2DM	3 (2.73%)	0 (0.00%)	3 (2.05%)
Waist circumference category			
Low risk	9 (8.18%)	17 (47.78%)	26 (17.81%)
High risk	101 (92.82%)	19 (52.78%)	120 (82.19%)
Participants' smoking status			
Yes	28 (25.45%)	31 (86.11%)	59 (40.41%)
No	82 (74.55%)	5 (13.89%)	87 (59.59%)
Family history diabetes			
Yes	110 (100.00%)	33 (91.67%)	143 (97.95%)
No	0 (0.00%)	3 (8.33%)	3 (2.05%)

Note: [1]Data presented as number of observations and frequencies (n (%))
BMI = body mass index; T2DM = type 2 diabetes mellitus

Table 4.4 above illustrates that the proportion of prediabetes was nearly the same in both groups. The three newly diagnosed cases of T2DM in this study belonged to the 10–19-years age group. The elevated percentages of T2DM risk factors such as high BMI, increased waist circumference and family history of T2DM were observed in both age groups. The proportion of smokers was higher among the 20–24-years age group compared to the 10–19-years age group.

4.3 Exploratory Factor Analysis

EFA is a statistical technique used to identify underlying dimensions, or factors, that explain the correlations among a set of observed variables, such as questionnaire items (Kline, 2014) . This statistical technique can be used to identify the latent constructs or underlying dimensions that are being measured by the individual items or questions (Kline, 2014). EFA works by analysing the correlations among the questionnaire items, and then grouping together those that are most strongly correlated. These groups of questionnaire items are then considered as a single factor or underlying dimension (DeVellis & Thorpe, 2021). The goal is to identify the minimum number of factors that account for the maximum amount of variation in the questionnaire items (DeVellis & Thorpe, 2021). Once the factors have been identified, they can be named based on the content of the items that are most strongly associated with each factor (DeVellis & Thorpe, 2021; Hair et al., 2013; Kline, 2014).

In regard to this statistical method, Lorenzo-Seva (2013) states that:

> EFA accounts for the common variance (i.e., the shared variance among observed variables). The common variance is partitioned from its unique variance and error variance, so that only the common variance is present in the factor structure: this means that the percentage of explained variance should be reported in terms of common variance (i.e., the percentage of explained common variance should be reported). (Lorenzo-Seva, 2013, p. 3)

When analysing multivariate data, the percentage of explained variance is a popular and intuitive method of evaluating the goodness of fit (Lorenzo-Seva, 2013). As a general rule, the higher the percentage of variance explained by a proposed model, the more valid it appears to be (Lorenzo-Seva, 2013).

4.3.1 Sleeping behaviour scale of the health-related behaviour questionnaire

The sleeping behaviour scale of the health-related behaviour questionnaire consisted of 11 questions. The first question asked the participants about their average sleeping time per day (*On average, how many hours do you sleep per day?*), and this question was not included in the EFA. All other questions evaluate sleep quality and sleep pattern (see Appendix 19). Table 4.5 presents the summary of the results of the EFA for the sleep behaviour scale including factor loadings of the factor solutions.

Table 4.5: Exploratory factor analysis of sleep behaviour scale

Question		Factor loadings	Uniqueness
Q2)	Do you have a lot of difficulties getting out of bed in the morning?	0.484	0.765
Q3)	Do you wake up irritable or in a negative mood?	0.471	0.778
Q4)	Do you sweat during sleep?	0.343	0.883
Q5)	Do you snore during sleep?	0.399	0.841
Q6)	Do you grind your teeth during sleep?	0.148	0.978
Q7)	Do you complain of being tired during the day?	0.602	0.638
Q8)	Do you nap during the day?	0.481	0.769
Q9)	Do you feel rested after a night’s sleep?	0.511	0.739
Q10)	Do you have regular sleep time?	0.347	0.880
Q11)	Do you use TV, iPad, laptop, smartphone, or music to fall asleep?	0.101	0.990

The EFA was found to be appropriate (likelihood ratio test for independent versus saturated factors: $\chi 2$ (45) = 217.26, $p < 0.001$). The eigenvalue, which is a measure of the variance explained by the factor compared to that explained by one item, was more than 1.0 for the first factor. Therefore, a single-factor solution was revealed. This factor reported an eigenvalue of 1.74, Akaike information criterion of 413.169, Bayesian information criterion of 449.94, and accounted for 72.47% of the variance in the data. Five items in the scale showed high factor loadings (> 0.40) (in bold in the table). To determine the strength of the relationship between the items, Shrestha (2021) indicates that the factor-loading matrix must show factor loadings greater than 0.30. A factor-loading matrix consists of a matrix of correlations between factors and variables (Tabachnick & Fidell, 2001) Researchers use factor loadings to assess how much the variable has contributed to the factor; the higher the factor loading, the greater the contribution to the factor (Yong & Pearce, 2013).

Based on the general literature in the social and behavioural sciences, Merenda (1997) argues that a threshold factor loading of 0.30 is considered to be the minimum number at which an item or variable can be accepted as a factor or component. Moreover, Hair et al. (2006, p. 111) states that:

> factor loadings greater than ± 0.30 are considered to meet the minimal level; loadings of ± 0.40 are considered more important; and if the loadings are ± 0.50 or greater, they are considered practically significant.

4.3.2 Exercise behaviour scale of the health-related behaviour questionnaire

The exercise behaviour scale of the health-related behaviours questionnaire, like the sleeping behaviour scale, also consisted of 11 questions (see Appendix 19). These questions evaluated the frequency and intensity of the weekly physical activity of the participants. Moreover, these questions ask the participants about the reasons for participating in sport or physical activities. Table 4.6 presents a summary of the results of the EFA for exercise behaviour including factor loadings of the extracted factor solution.

Table 4.6: Exploratory factor analysis of exercise behaviour scale

Question		Factor 1	Uniqueness
Q1)	How often do you regularly walk per week?	0.073	0.995
Q2)	How often do you regularly jog or run per week?	0.033	0.999
Q3)	**How often do you take part in moderate physical activity (bicycling, aerobic dancing, stair climbing, hiking) for 30–60 min?**	**0.400**	**0.840**
Q4)	How often do you exercise vigorously for 30 min?	0.225	0.950
Q5)	**How often do you warm-up before vigorous exercise?**	**0.617**	**0.620**
Q6)	**How often do you exercise vigorously within 30 min after meals?**	**0.687**	**0.528**
Q7)	How many times per week do you engage in household work (e.g., gardening, vacuuming, washing, car cleaning)?	0.034	0.999
Q8)	Where do you usually do your physical activities or sports?	−0.291	0.915
Q9)	**With whom do you usually do your physical activities or sports?**	**−0.425**	**0.819**
Q10)	**When do you usually do your physical activities or sports?**	**−0.414**	**0.829**
Q11)	Why do you participate in physical activities? What are the main reasons?	−0.184	0.966

The EFA was found to be appropriate (likelihood ratio test for independent versus saturated factors: $\chi 2$ (55) = 184.61, $p < 0.001$). The eigenvalue, which is a measure of the variance explained by the factor compared to that explained by one item, was more than 1.0 for the first factor. Therefore, a single-factor solution was revealed. This factor had an eigenvalue of 1.54, Akaike information criterion of 359.08, Bayesian information criterion of 398.67 and accounted for 73.10% of the variance in the data. Five items in the scale indicated high factor loadings (>0.40) (in bold in the table).

4.3.3 Nutritional behaviour scale of the health-related behaviour questionnaire

The nutritional behaviour scale of the health-related behaviour questionnaire included 14 items (see Appendix 19). These questions evaluated the eating habits of participants by asking them how often they have breakfast per week, and about the food types they consume on a weekly basis. All the items were included in the EFA. Table 4.7 presents the summary of the results of the EFA for the nutritional behaviour scale including factor loadings of the extracted factor solution.

Table 4.7: Exploratory factor analysis of nutritional behaviour scale

Questions		Factor 1	Factor 2	Uniqueness
Q1)	How often do you have breakfast per week?	0.170	0.348	0.850
Q2)	How often do you drink sugary drinks /soft drinks (e.g., Coke, canned juice) per week?	0.312	0.202	0.862
Q3)	**How often do you eat vegetables (fresh or cooked) per week?**	0.026	**0.672**	0.547
Q4)	**How often do you eat fresh fruit per week?**	−0.057	**0.599**	0.638
Q5)	How often do you have dairy products (e.g., milk, yoghurt, cheese) per week?	−0.027	0.180	0.967
Q6)	**How often do you eat fast food (e.g., burgers, sausage, pizza, or Arabic shawarma, inside or outside your home) per week?**	**0.730**	0.023	0.466
Q7)	**How often do you eat French fries and potato chips per week?**	**0.733**	−0.050	0.460
Q8)	How often do you eat cakes, biscuits, doughnuts, or similar food per week?	0.227	0.232	0.895
Q9)	How often do you eat sweets and chocolates per week?	0.078	0.181	0.961
Q10)	How often do you drink energy drinks (e.g., Red Bull, Power Horse) per week?	−0.039	0.188	0.963
Q11)	**How often do you pay attention to replenishing fluids during exercise per week?**	**−0.428**	0.164	0.790
Q12)	**How often do you drink at least 800ml (~5 disposable paper cups) of water per day?**	**−0.457**	0.155	0.767
Q13)	**How often do you eat foods rich in dietary fibre (e.g., fruit, vegetables) per day?**	−0.167	**0.585**	0.629
Q14)	How often do you consciously choose a diet low in fat, saturated fat, salt, and cholesterol per day?	−0.169	−0.008	0.971

The EFA was found to be appropriate (likelihood ratio test for independent versus saturated factors: $\chi2$ (91) = 410.46, $p < 0.001$). A two-factor solution was found. The eigenvalue, which is a measure of the variance explained by the factor compared to that explained by one item, was more than 1.0 for the first two factors. Therefore, a two-factor solution was revealed. The two factors reported an eigenvalue of 1.75 and 1.48, Akaike information criterion of 551.65, Bayesian information criterion of 650.92 and accounted for 39.87% and 33.74% of the variance in the data, respectively (Shrestha, 2021). The two factors together accounted for 73.61% of the total variance. Four items in the scale indicated high factor loadings (> 0.40) with the first factor (nutrition 1). Of these, two items reflected eating fast food and the other two indicated a lack of fluid intake. This factor was labelled “healthy eating.” Three items indicated high factor loadings with the second factor (nutrition 2). These three items indicated eating habits related to fruits, vegetables and foods rich in dietary fibre. This factor was labelled “fruit and vegetable consumption”. The high factor loading items are indicated in bold in Table 4.7.

4.3.4 *Correlation between factors*

Spearman’s rank correlation analysis was performed to examine the correlation between the factors extracted from the health-related behaviour scale. Computed factor scores from the EFA for each scale were used in the correlation analysis. Table 4.8 shows that the exercise and nutrition one behaviour scale (fruit and vegetable consumption) were not correlated (Spearman’s *rho* = 0.069, $p = 0.255$). All the other pairs of factors showed a positive and statistically significant correlation (Spearman’s *rho* = 0.212 to 0.498, $p < 0.01$).

Table 4.8: Correlations between factors of health-related behaviour scale

	Sleep	**Exercise**	**Nutrition 1 (healthy eating)**	**Nutrition 2 (fruit & vegetable consumption)**
Sleep	1.000			
Exercise	0.498***	1.000		
Nutrition 1 (healthy eating)	0.212***	0.548***	1.000	
Nutrition 2 (fruit & vegetable consumption)	0.416***	0.069	0.461***	1.000

Note. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Values given are Spearman’s rank correlation coefficient

4.3.5 *Internal consistency reliability of factors*

Cronbach’s alpha is a measure of internal consistency reliability, which assesses the extent to which the items in a test or scale are measuring the same construct. Cronbach’s alpha values range between 0.0 and 0.1, with higher values suggesting greater reliability. In general, a Cronbach’s alpha of 0.7 or higher is recommended (Streiner, 2003); however, a Cronbach’s alpha of 0.6 can be considered as acceptable for some purposes (Tavakol & Dennick, 2011). Therefore, whether a Cronbach’s alpha of 0.6 is acceptable depends on the context and the purpose of the test (Tavakol & Dennick, 2011). It is important to consider the specific requirements and standards in the field, as well as the intended use of the developed scale. DeVellis and Thorpe (2021); Streiner et al. (2015) state that the value of Cronbach's alpha can be influenced by several factors, including:

- Number of items: Cronbach's alpha tends to increase with the number of items in a scale. Generally, scales with more items are expected to have higher alpha values.
- Item difficulty: If the items in a scale are too easy or too difficult, it can affect the reliability of the scale. If the items are too easy, the scale may not be able to discriminate well between respondents who score high and those who score low. Conversely, if the items are too difficult, respondents may not be able to understand them or may not have the ability to respond appropriately.
- Homogeneity of items: The more similar the items are in terms of content, format and response options, the more likely they are to be measuring the same construct consistently. If the items are heterogeneous, it can reduce the reliability of the scale.
- Variability of responses: If respondents tend to respond in a narrow range of the scale, this can also affect the reliability of the scale. A wider range of responses can increase the reliability of the scale.
- Sample size: A larger sample size generally increases the reliability of the scale, as it provides more information about the consistency of responses.

It is important to consider these factors when interpreting Cronbach's alpha, and when designing and administering a questionnaire or developing a scale (DeVellis & Thorpe, 2021; Streiner et al., 2015).

Table 4.9 presents the results of the scale reliability analysis. Specifically, Cronbach's alpha measure was used to assess the internal consistency reliability of the developed health-related behaviour scale. The sleep subscale consisted of five items (Cronbach's alpha = 0.63), the exercise subscale consisted of five items (Cronbach's alpha = 0.58), the first nutritional subscale (healthy eating) consisted of four items (Cronbach's alpha = 0.66) and the second nutritional (fruit and vegetable consumption) consisted of three items (Cronbach's alpha = 0.70).

Sleep and nutritional behaviour factors indicated satisfactory reliability (Cronbach's alpha > 0.60) (Streiner, 2003; Tavakol & Dennick, 2011). The Cronbach's alpha score for the exercise factor was 0.58. Being close to the suggested cut-off value of 0.60 for Cronbach's alpha, the exercise factor was included, as it was for the subsequent analysis (Streiner, 2003; Tavakol & Dennick, 2011). In summary, the subscales of the health-related behaviour questionnaire were valid for the intended use in this study.

Table 4.9: Scale reliability of factors extracted from health-related behaviour scale

	Sleep	**Exercise**	**Nutrition 1 (healthy eating)**	**Nutrition 2 (fruit & vegetable consumption)**
Average interitem covariance	0.449	0.275	0.649	0.791
Number of items in the scale	5	5	4	3
Cronbach's alpha	0.630	0.586	0.667	0.706

4.4 Prevalence of Prediabetes and Type 2 Diabetes Mellitus Among Young People

Table 4.10 presents the frequency distribution of participants in the sample classified by HbA1c levels (normal, prediabetes and diabetes). Studies that calculate the prevalence of a medical condition or disease need to use the normal approximation to the binomial distribution to obtain CIs for estimated prevalence values (Lang & Reiczigel, 2014). Authors normally calculate the sample prevalence with a 95% CI for the population prevalence for the purpose of giving an indication of the accuracy of the estimate (Reiczigel et al., 2010).

More than half of the sample (56.85%, 83 out of 146) were classified as normal. The prevalence was slightly higher (61.11%, 22 out of 36) among the 20–24-years age group when compared to the prevalence of the 10–19-years age group, which was 55.45% (61 out of 110).

The prevalence of prediabetes in the sample was 41.10%; 95% CI: 33.03%, 49.53% (60 out of 146 participants). The prevalence rate of prediabetes among the 10–19-years age group was 41.82%; 95% CI: 32.48%, 51.61% (46 out of 110 participants), and among the 20–24-years age group, the prevalence of prediabetes was 38.89%; 95% CI: 23.14%, 56.53% (14 out of 36 participants).

The prevalence of diabetes in the sample was 2.05%; 95% CI: 0.4%–5.8 9% (three out of 146 participants). The prevalence of diabetes among the 10–19-years age group was 2.73%; 95% CI: 0.567–7.76% (three out of 110 participants) but was 0% (0 out of 36 participants) among the 20–24-years age group. A Chi-square test indicated no significant association ($p = 0.551$) between the two diabetes groups and the two age groups; however, two of the cells in the cross-tabulation contained frequencies < 5, therefore the calculation of $\chi 2$ was biased.

Table 4.10: Prevalence of prediabetes and diabetes by age-group[1]

Category	**10–19 years (*n* = 110)**	**20–24 years (*n* = 36)**	**Total (*N* = 146)**	**Chi-square test**
Normal (HbA1c < 5.7%)	61 (55.45%)	22 (61.11%)	83 (56.85%)	$X^2(2) = 1.19$, $p = 0.551$
Prediabetes (HbA1c 5.7%−6.4%)	46 (41.82%)	14 (38.89%)	60 (41.10%)	
Diabetes (HbA1c ≥ 6.5%)	3 (2.73%)	0 (0.00%)	3 (2.05%)	

Note: [1]Data presented as number of observations and frequencies (*n* (%))

HBA1c levels of the study group participants were compared with the general population. Table 4.11 presents results of the comparison of the mean HbA1c levels of the 10–18-years and 19–24-years age groups in the study population with that of the general population. In the 10–19-years age group, the mean HbA1c level was 5.60 (*SD* = 0.37). The results of the one-sample *t*-

test indicated that there was a significant difference between the mean HbA1c level of the 10–19-years age group of the study group compared to the same age group in the general population (mean difference = 0.60, t = 16.725, p < 0.001).

In the 20–24-years age group, the mean HbA1c level was 5.56 (*SD* = 0.32). The results of the one-sample *t*-test indicated that there was a significant difference between the mean HbA1c levels of the 20–24-years age group of the study participants compared with the same age group in the general population (mean difference = 0.59, t = 10.855, p < 0.001). This means that the participants who were aged 20–24 years had higher HbA1c levels compared to other participants.

Table 4.11: Comparison of glycated haemoglobin A1c level of the study population with general population by age[1]

Age group (years)	**Study population**		**General population**	***t*-test**	
	n	**Mean (*SD*)**	**Mean**	***t***	***p***
10–19	110	5.60 (0.37)	5.00	15.179	< 0.001
20–24	36	5.56 (0.32)	4.97	13.510	< 0.001

Note.[1] Using a one-sample *t*-test
SD = standard deviation

4.5 Correlations Between Health-Related Behaviour and Glycated Haemoglobin A1c Levels

Bivariate correlation coefficients were used to examine the correlations between health-related behaviours and HbA1c levels of the participants. Bivariate correlation coefficients, also known as Pearson correlation coefficients, measure the strength and direction of the linear relationship between two variables (Field et al., 2012; Warner, 2012). It can range from (−1 to +1); values close to +1 or −1 indicate a strong linear relationship and values close to 0 indicate a weak or no linear relationship. A positive value indicates a positive correlation, meaning that as one variable increases, the other variable tends to increase as well. Conversely, a negative value indicates a negative correlation, implying that as one variable increases, the other variable tends to decrease (Field et al., 2012; Warner, 2012). A value of zero indicates no linear correlation between the variables (Field et al., 2012; Warner, 2012). It is important to note that correlation does not imply causation. A strong correlation between two variables does not necessarily mean that one variable causes the other to change (Osborne, 2013).

Figure 4.2 below presents a scatter plot of the factor score of the sleep factor and HbA1c levels. The scatter plot of sleep and Spearman's rank correlation analysis indicated a weak positive correlation (N = 146, *rho* = 0.276, p = 0.001). This identifies that HbA1c levels appeared to increase when the participants had higher sleep disturbance.

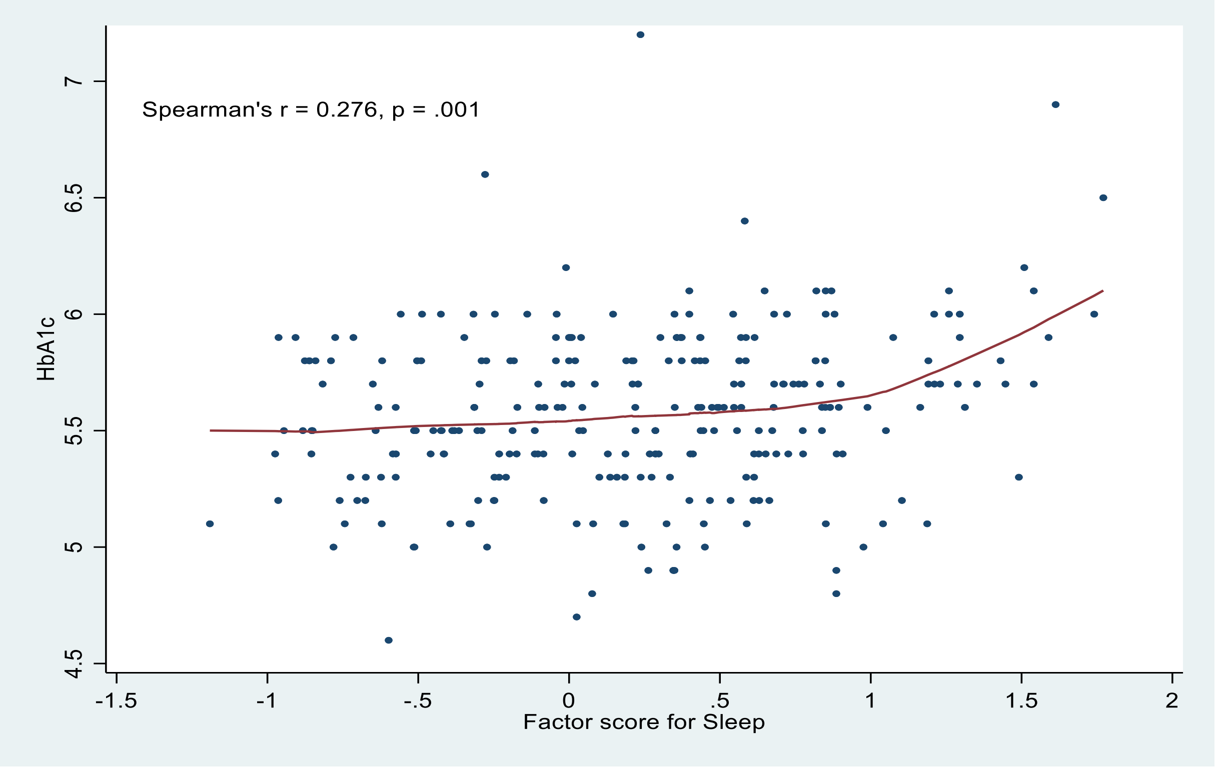


Figure 4.2: Scatter plot of the sleep factor score and glycated haemogobin A1c

Figure 4.3 below shows a scatter plot of the factor score of the exercise factor and HbA1c level. The scatter plot of exercise and Spearman's rank correlation analysis indicates a weak negative correlation (N = 146, *rho* = −0.242, p = 0.003). This indicates that higher exercise levels were associated with lower HbA1c levels.

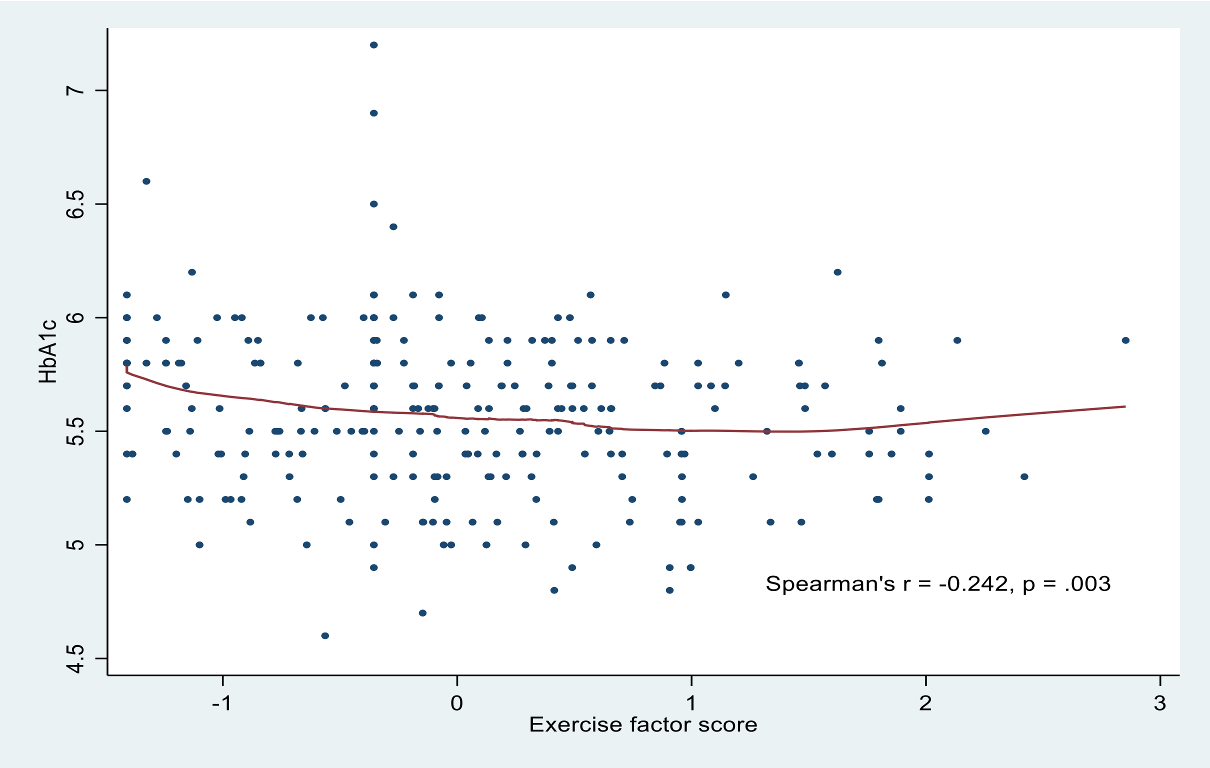


Figure 4.3: *Scatter plot of the exercise factor score and glycated haemogobin A1c*

Figure 4.4 below presents a scatter plot of the first nutrition factor score and HbA1c levels. The scatter plot of the first nutrition factor (healthy eating) and Spearman's rank correlation analysis indicates a weak negative correlation (N = 146, rho = −0.224, p = 0.007). In other words, a reduction in HbA1c levels was observed when participants consumed more healthy foods.

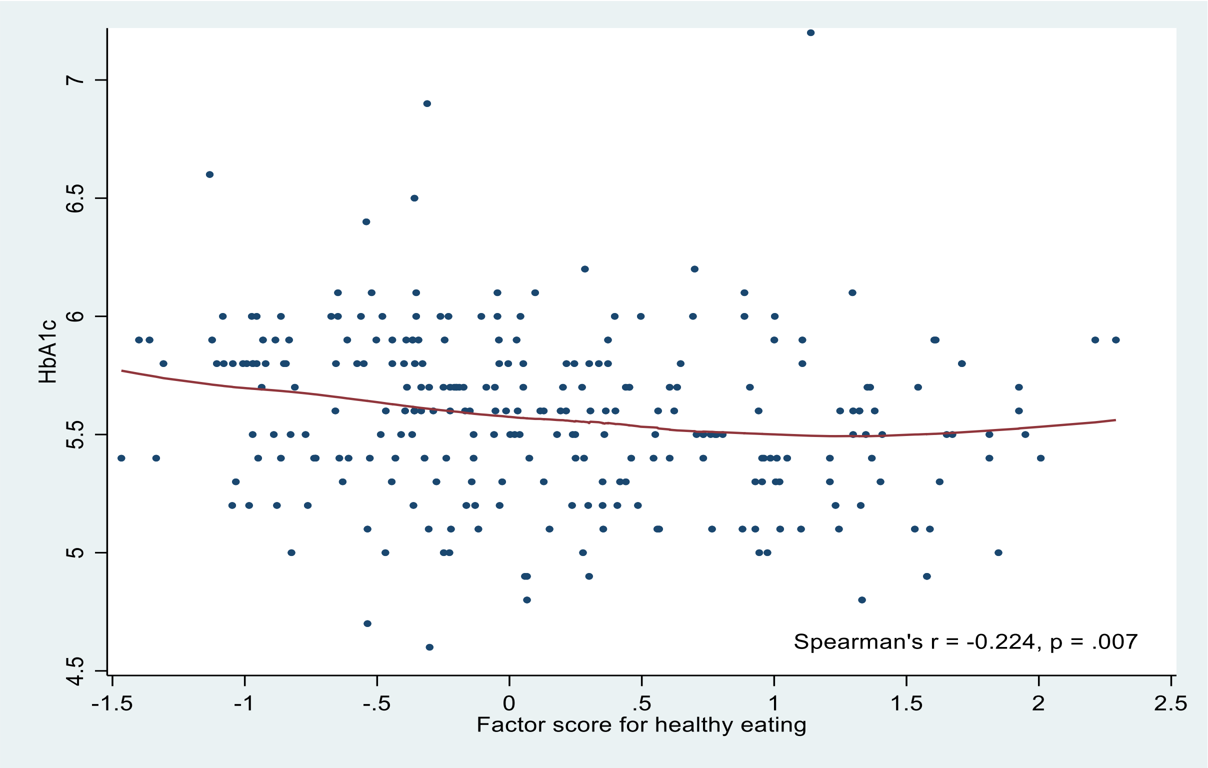


Figure 4.4: Scatter plot of the first nutrition factor (healthy eating) and glycated haemogobin A1c

Figure 4.5 below describes a scatter plot of the second nutrition factor (fruit and vegetable consumption) and Spearman's rank correlation analysis, indicating a weak positive correlation with HbA1c level (N = 146, rho = 0.306, p < 0.001). This means that higher fruit and vegetable consumption is associated with higher HbA1c levels, which is considered an correlation unless this association simply reflects a higher consumption of sugary fruits or dried fruits such as dates or raisins. In summary, the association between fruits and vegetables and HbA1c levels needs more investigation. This association is further discussed and explored in Chapter 5 in the context of Kuwaiti culture and Kuwaiti people's eating habits.

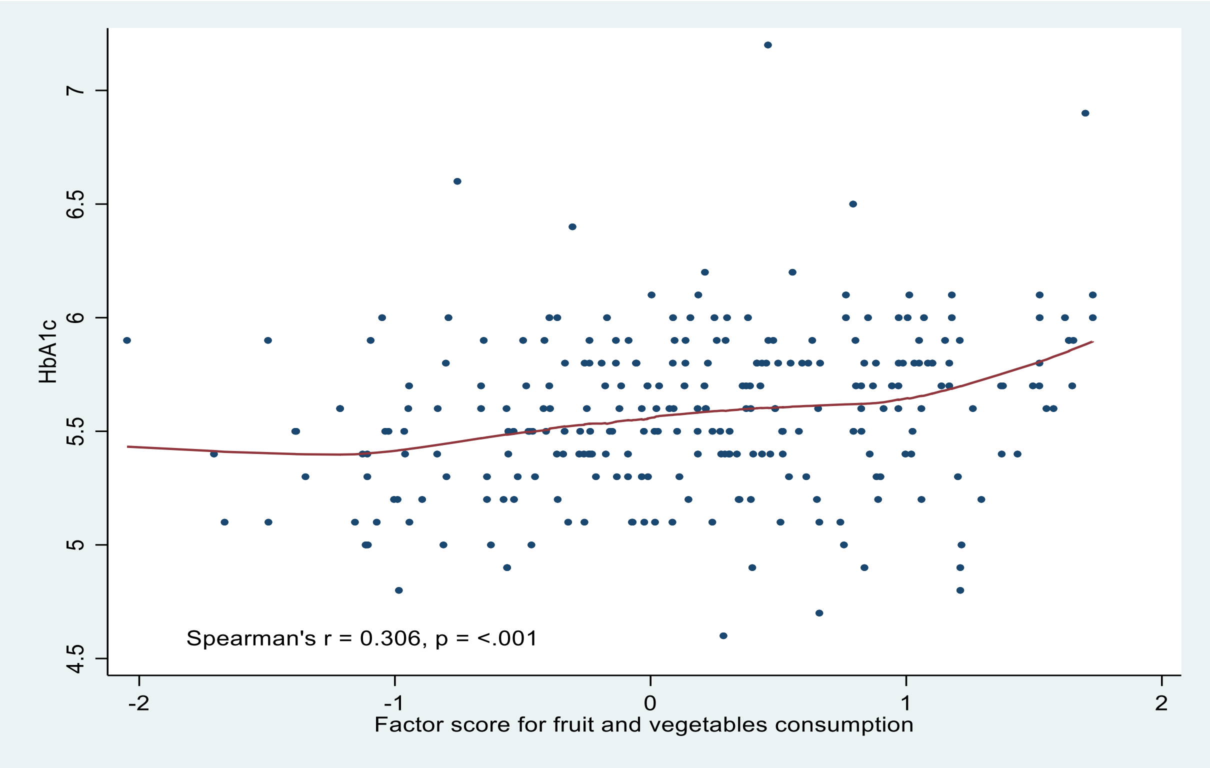


Figure 4.5: Scatter plot of the second nutrition factor (fruit and vegetable consumption) and glycated haemogobin A1c

4.6 Effects of Health-Related-Behaviour Factors on Glycated Haemoglobin A1c Levels

A linear mixed-effect model was constructed using the scores for the sleep, exercise and two nutrition factors as predictors, along with the visit number (Baseline assessment and follow-up assessment), while considering HbA1c as the dependent variable. A linear mixed-effects model is a statistical model that combines fixed effects (population-level effects) and random effects (subject-specific effects) to analyse data with hierarchical or nested structures (Gelman & Hill, 2006; Singer & Willett, 2003). It is used when there is a dependence among observations due to clustering or repeated measurements within subjects. In a linear mixed-effects model, the response variable is assumed to be linearly related to a set of fixed effects and random effects. The fixed effects represent the average effects across all subjects or groups, while the random effects capture the individual variation within subjects or groups (Gelman & Hill, 2006; Singer & Willett, 2003). The estimation of the parameters in a linear mixed-effects model can be done using maximum likelihood estimation or restricted maximum likelihood estimation (Bates et al., 2014). The model parameters provide information about the fixed effects and the variance components associated with the random effects (Bates et al., 2014). Linear mixed-effects models are commonly used in various fields, including psychology, biology, medicine, economics and social sciences, to analyse repeated measures, longitudinal data, clustered data and multilevel data (Bates et al., 2014; Gelman & Hill, 2006; Singer & Willett, 2003).

In this study, a random intercept model was applied to estimate the model effects. Table 4.12 below presents the results of the linear mixed-effect model assessing the effect of health-related behaviour factors on HbA1c. The ß coefficients with $p < 0.05$ and 95% CI not capturing zero indicates the significant effects of sleep, exercise and one of the nutrition factors. The results indicate significant and independent associations between sleep behaviour and HbA1c levels, with higher sleep disturbance predicting higher HbA1c (ß = 0.147, 95% CI: 0.029, 0.264, p = 0.015). There was an inverse and negative association with exercise, with higher exercise predicting lower HbA1c (ß = −0.099, 95% CI: −0.167, −0.031, p = 0.005). Moreover, there was a positive association between fruit and vegetable consumption on HbA1c levels. Higher fruit and vegetable consumption predicted higher HbA1c levels (ß = 0.104, 95% CI: 0.014, 0.193, p = 0.023).

Table 4.12: Effects of health-related behaviour factors on glycated haemogobin A1c level

Fixed effect	**Specified category**	**Reference category** [a]	**ß**	***p***
Sleep			0.147	0.015*
Exercise			−0.099	0.005*
Nutrition 1 (healthy eating)			−0.033	0.150
Nutrition 2 (fruit & vegetable consumption)			0.104	0.023*
Visit number	2	1	0.054	0.065

Note. [a] Effect of the specified category is estimated relative to the reference category
ß = regression coefficient for fixed effect
* $p < 0.05$

4.7 Comparison of Glycated Haemoglobin A1c Level Between Sex and Age Groups

A linear mixed-effect model was carried out and tested to assess the possible significant effect of BMI on HbA1c levels, adjusting for all the confounding variables. Three models were specified and tested. Model 1 included age and sex, Model 2 added education, family income, family history of diabetes, hypertension, sleep duration and daily screen time, and finally Model 3 added BMI, which is a well-known predictor of HbA1c levels.

Table 4.13 presents the results of the linear mixed-effect analysis for all three models. There was no statistically significant difference in mean HbA1c level between male participants and female participants ($p > 0.05$) or between the two age groups ($p > 0.05$) in any of the three models in this study. However, significant difference in mean HbA1c level was reported between people with daily screen time of one to two hours and more than four hours. Specifically, the mean HbA1c level for participants with more than four hours of daily screen time was 0.433 (95% CI: 0.196–0.670) units higher ($p < 0.001$) compared with those spending one to two hours of daily screen time.

When adjusting for all the confounding variables, BMI was found to exhibit a statistically significant association with HbA1c level ($p < 0.001$). Specifically, an increase of one point in the BMI measure was associated with a corresponding average increase of 0.03 units in the HbA1c level (b = 0.03, 95% CI: 0.019–0.041, z = 5.43, p < 0.001).

Table 4.13: Effect of age and sex on glycated haemoglobin A1c level based on linear mixed-effect model

Fixed effect	**Specified category**	**Reference category**	**Model 1 (Sex and age)**		**Model 2 (+ Income, sleep duration and screen time)**		**Model 3 (+ BMI)**	
			ß	***p***	**ß**	***p***	**ß**	***p***
Sex	Female	Male	0.033	0.061	−0.171	0.100	−0.098	0.087
Age (years)	20–24	10–19	0.087	0.061	0.300	0.124	0.162	0.109
Nationality	Non-Kuwaiti	Kuwaiti			−0.158	0.109	−0.049	0.095
FHx DM					0.267	0.288	0.146	0.247
FHx HTN					0.059	0.098	−0.012	0.085
FHx Other					−0.016	0.113	0.272	0.100
Education	Secondary	Intermediate			0.394	0.113	0.272	0.100
Family income (KD)	1500–2000	1000−1500			0.058	0.147	−0.046	0.127
	2000−2500	1000−1500			−0.234	0.116	−0.188	0.099
Sleep duration (hours)	6–7	4–5			−0.709	0.413	−0.614	0.353
	7–8	4–5			−0.642	0.418	−0.579	0.360
	8–9	4–5			−0.444	0.411	−0.500	0.351
	>9	4–5			−0.447	0.411	−0.445	0.351
Daily screen time (hours)	2–3	1–2			0.270	0.188	0.220	0.171
	3–4	1–2			0.147	0.152	0.122	0.142
	>4	1–2			0.433	<0.001*	0.291	<0.001*
	<1	1–2			0.218	0.141	0.131	0.135
BMI (kg/m^2)							0.030	0.006*

Note. [a] Effect of the specified category is estimated relative to the reference category
ß = regression coefficient for fixed effect; BMI = body mass index; DM = diabetes mellitus; HTN = hypertension
* p < 0.05

4.8 Summary of the Results

A total of 123 young people aged between 10 and 24 years responded to the health-related behaviours questionnaire and completed the baseline and follow-up assessments (Phases 1 and 2). Even though this study was based on a convenience sample and not a non-randomised sample, it provides the first evidence of an association between health-related behaviours and HbA1c levels among young people at risk of T2DM in Kuwait.

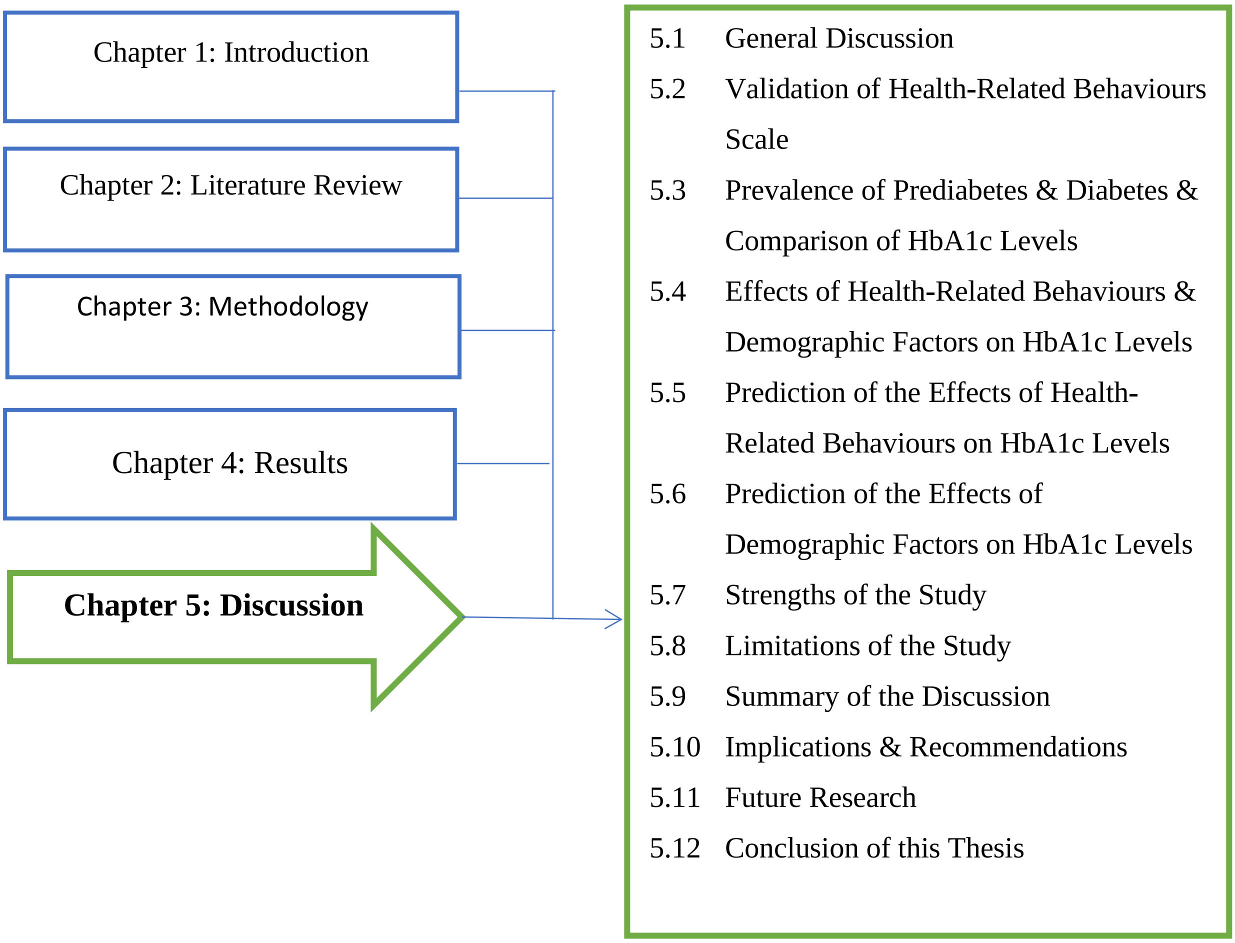
The descriptive results of the demographic data showed that about 60% of the participants were male, and more than 70% were Kuwaiti. Most of the participants came from Al Asima and Hawalli governorates. In addition, almost all participants had a high or medium monthly income. The clinical characteristics of the participants showed that a large proportion of participants, approximately 40%, were in the prediabetes stage, and three participants (2.05%) were newly diagnosed with T2DM, according to the ADA's criteria for diagnosing prediabetes and T2DM. In addition, almost all participants had a family history of diabetes. All participants were obese or overweight. Truncal obesity (abdominal obesity) and smoking were observed more among male participants.

In accordance with the results of the EFA of the questionnaire developed for the study, four subscales were defined and named as follows: sleep, exercise, healthy eating and fruit and vegetable consumption. The internal consistency and reliability of these scales were measured. The Cronbach's alpha scores of these subscales were acceptable for the purpose of their use in this study.

The results of the bivariate correlation coefficients between health-related behaviour subscales and HbA1c levels indicated that HbA1c levels increased if sleep disturbances increased and if participants consumed more fruit and vegetables. As mentioned, the association between increased HbA1c levels and consumption of more fruit and vegetables is explored in Chapter 5. On the other hand, the results indicated that HbA1c levels decreased with higher exercise levels. Also, it was found that healthy food consumption reduced HbA1c levels. The results of the multiple regression models showed that there was no statistically significant difference in mean HbA1c level between male and female participants and between the two age groups;

however, the BMI of the participants exhibited a statistically significant relationship with the HbA1c level.

Chapter 5: Discussion



This chapter discusses the findings in relation to each of the research hypotheses and research questions. The present study's findings are synthesised, compared and discussed in light of the conclusions found in existing peer-reviewed literature. In addition, this chapter provides an overview of how the findings address the research questions and empirically contribute to the current literature. Moreover, the present study adds new knowledge to the association between health-related behaviours and T2DM among adolescents and young people in Kuwait.

This chapter covers the implications and recommendations for healthcare practice, nurse education, policymakers and stakeholders, and possible future research. The strengths and limitations then follow. This chapter ends by presenting the new knowledge discovered from conducting this research and the conclusion to this thesis.

5.1 General Discussion

The overarching aim of this quantitative study was to test the following hypotheses:

1. The population of Kuwaiti young people have an elevated level of HbA1c.
2. There is a significant relationship between health-related behaviours, demographic factors and HbA1c levels.

The hypotheses were tested using an observational repeated cross-sectional study with a longitudinal survey to collect data from 146 young people in Kuwait (aged 10–24 years) in Phase 1 (baseline assessment) of which 123 attended the second phase (follow-up assessment). Most participants were Kuwaiti and 58.2% were male. All the participants exhibited overweight or obesity as risk factors for T2DM. More than half of the participants were smokers. Almost all participants had a family history of diabetes.

Evidence was also provided to support the second hypothesis. Statistically significant relationships were found between health-related behaviours, demographic factors and HbA1c levels. The following sections present a summary and interpretation of the data collected in this study to achieve the following six objectives:

1. to validate the sleep, exercise and nutritional dimensions of the health-related behaviours scale in the Kuwaiti context
2. to compare the prevalence of prediabetes and diabetes by age group
3. to compare the HbA1c levels in the sample vs. the general population
4. to examine the correlations between health-related behaviours and HbA1c levels
5. to predict the effects of health-related-behaviours on HbA1c levels
6. to predict the effects of demographic factors on HbA1c levels.

The following sections present the implications of the results obtained to achieve these objectives, and an interpretation of the results in the context of the literature. These sections are followed by a consideration of the implications and limitations of the findings, and recommendations for future research are presented. The chapter ends with an overall conclusion.

5.2 Validation of Health-Related Behaviours Scale

The first objective was to validate the health-related behaviours scale in the Kuwaiti context. In the context of research in health, and social and behavioural research, a questionnaire that does not collect valid and reliable data is meaningless (Boateng et al., 2018). Consequently, validation of the health-related behaviours scale was essential to ensure that the findings of this study have applications in the context of biomedicine, evidence-based nursing and public health (Heale & Twycross, 2015). Evidence was required to confirm that the questionnaire items (see Appendix 19) measured the health-related behaviours (sleep, exercise and nutritional) that they were designed to measure. EFA provided objective statistical evidence to identify and validate the sleep, exercise and two nutritional dimensions of the health-related behaviours scale in the Kuwaiti context. Some of the questionnaire items had weak factor loadings (<0.5) implying that they contributed little to the total variance of the factors (Shrestha, 2021). However, Merenda (1997) argues that a threshold factor loading of 0.30 is considered to be the minimum number at which an item or variable can be accepted as a factor or component.

The internal consistency of the developed health-related behaviours scale was measured using Cronbach's alpha. Cronbach's alpha value of ≥ 0.7 is the commonly used benchmark to indicate that the scores for multiple items are sufficiently consistent to indicate that a factor is reliably measured (Tavakol & Dennick, 2011). The values of Cronbach's alpha between 0.6 and 0.7 found in this study were minimally acceptable and could be reasonable indicators of internal consistency reliability (Tavakol & Dennick, 2011). Streiner (2003) argues that if the developed scale is being used for observational studies, exploratory research, or initial data gathering for future studies, a Cronbach's alpha value between 0.6 and 0.7 would be considered acceptable. Furthermore, Streiner (2003) claims that there are several factors that determine whether a Cronbach's alpha value is acceptable. These factors include the purpose of the scale, the number of items and the intended use of the measure.

5.3 Prevalence of Prediabetes and Diabetes, and Comparison of Glycated Haemoglobin A1c Levels

The mean HbA1c level of participants was 5.6% (*SD* = 0.36) compared to the normal HbA1c level of less than 5.7% according to the ADA. Although the mean HbA1c level is assumed to be at normal HbA1c levels, it is borderline to prediabetes when HbA1c levels are between 5.7% and 6.4%. This evidence supports the study hypothesis that the study sample has elevated HbA1c levels. Please refer to Table 3.6 for HbA1c levels and categories.

The prevalence of prediabetes and T2DM has been reported previously in Kuwait (Al-Kandari et al., 2019; Almari et al., 2018; Moussa et al., 2008). The prevalence of T2DM in this study was estimated to be 2.1%, indicated by even higher HbA1c levels ($\geq$ 6.5%). Fifteen years ago, the prevalence of T2DM among children and adolescents aged between 6 and 18 years in Kuwait was reported to be 34.9 per 100,000 or 0.035% by MoussaMoussa et al. (2008). In 2019 a study was conducted to estimate T2DM incidence among Kuwaiti children and adolescents between 2011 and 2013 (Al-Kandari et al., 2019). The authors reported that Kuwait's overall incidence rate for children and adolescents was 2.56 per 100,000 (Al-Kandari et al., 2019). In relation to Kuwait's neighbouring countries in the MENA region with similar cultures and lifestyles, studies in Qatar reported an incidence rate of 2.72 per 100,000 in 2016 and an incident rate of 2.83 per 100,000 in 2020 among children and adolescents (Ahmed et al., 2022; Alyafei et al., 2018). A Saudi Arabian study found that approximately 10% of the study sample of

T2DM among 387 overweight and obese patients aged between 10 and 17 years was diagnosed with T2DM (Al-Agha et al., 2012).

A prevalence of T2DM has also been reported in developed countries, including the USA, Canada, China, New Zealand and Denmark. The Danish Government reported the diagnosis of T2DM in seven young individuals in 2014, with an overall prevalence rate of 0.6 per 100,000 (Oester et al., 2016). Furthermore, authors from China, Canada and New Zealand reported incidence rates of 1.96 per 100,000 in Chinese young people aged 5–19 years (Wu et al., 2017); 1.54 per 100,000 in Canadian young people aged less than 18 years (Amed et al., 2018); and 1.3 per 100,000 in New Zealander adolescents aged less than 15 years (Jefferies et al., 2012). In addition, data from the USA between 2011 and 2012 indicated a higher incidence of 12.5 per 100,000 among children and adolescents aged 10–19 years (Mayer-Davis et al., 2017). A recent study estimated that there were 41,600 newly diagnosed cases of T2DM among children and adolescents in 2021 worldwide (Wu et al., 2022). The authors of the same study determined that the incident rate of T2DM in Kuwaiti young people under 20 years would be more than four per 100,000 in 2021, which is higher than previously reported incidents (Wu et al., 2022).

After comparing the findings of this study with recent and previous studies conducted in Kuwait and the MENA region, it appears that the rate of T2DM is increasing and is getting worse, without any signs of improvement (IDF, 2022). Three countries have reported the highest comparative diabetes prevalence rates in 2021: Pakistan 30.8%, French Polynesia 25.2% and Kuwait 24.9%. In 2045, Pakistan, with 33.6% of the comparative diabetes prevalence rate, is expected to have the highest overall prevalence of diabetes, followed by Kuwait and French Polynesia with 29.8% and 28.2%, respectively (IDF, 2022). This prediction was based on the current health-related behaviours and genetic factors of young people and young adults in

Kuwait and MENA region countries (IDF, 2022). Consequently, urgent action should be taken by the health authorities in Kuwait to tackle this health issue.

Worldwide, epidemiological trends demonstrate increases in the prevalence of prediabetes in the general population (Andes et al., 2020; Li et al., 2015; Mainous et al., 2014); young people and adolescents seem to follow these trends regardless of their ethnicity and background. The prevalence of pre-diabetes in this study was estimated to be 41.1% in high-risk cohort, indicated by greater than normal HbA1c levels (5.7% to 6.4%), which means two in five young people had prediabetes. This prevalence was reported among Kuwaiti young people at risk of T2DM. Elsewhere in the MENA region, studies examined the same population. For example in the UAE, Jordan and Iran, reports of lower prevalence rates have been published; 22% in those aged 11–17 years (Al Amiri et al., 2015), 18% in those aged 18–25 years (Al-Shudifat et al., 2017) and around 5% in those aged 6–19 years (Moadab et al., 2010), respectively. In Brazil and Italy, the prevalence of prediabetes among adolescents was 22% (aged 12–17 years) and 21% (aged 5–17 years), respectively (Nobili et al., 2019; Telo et al., 2019). In general, prediabetes prevalence varies according to the criteria that are used (Esquivel Zuniga & DeBoer, 2021). Consider the following example: recent analyses of data from USA adolescents estimate prediabetes to be present in 4–23% of adolescents based on criteria being used during data collection (Esquivel Zuniga & DeBoer, 2021). As mentioned earlier in Chapter 1, prediabetes is characterised by impaired insulin incretin, insulin resistance and hypersecretion (Khetan & Rajagopalan, 2018). Several studies estimate that approximately 70% of patients in the prediabetes stage eventually develop T2DM (Buysschaert & Bergman, 2011; Nathan et al., 2007). There is little doubt that the transition from prediabetes to T2DM may take many years, but it may also be rapid. For example, in one study of 526 adolescents in the prediabetes stage with obesity followed over an average of 3 years, 8% of the participants progressed to T2DM within less than 3 years (Galderisi et al., 2018). Young people with prediabetes also present an unfavourable cardiometabolic risk profile, increasing their risk of T2DM complications and cardiovascular diseases (Andes et al., 2020). Therefore, an annual assessment and evaluation should be carried out by healthcare professionals for young people with prediabetes in Kuwait. This will prevent the transition from prediabetes to T2DM. In addition, standardised and unified local and regional assessment criteria should be considered in future studies to produce consistent comparable data.

The difference between the previously reported prevalence estimates and the current estimates of the prevalence of T2DM in Kuwait may indicate (a) a highly elevated prevalence of T2DM among young people in Kuwait or (b) the prevalence of T2DM among young people in Kuwait was overestimated in the current study, because this study examined young people who are at risk of T2DM. The latter explanation is more likely, because estimates of the prevalence of a disease in a population require random sampling to ensure that the characteristics of the sample are representative of the population. Moreover, sample size estimates to measure the prevalence of a disease in a population are a function of the expected prevalence and not the total population size (Arya et al., 2012). The small non-random sample of 146 young Kuwaitis who were selected for the current study was probably not representative of the general targeted population, and therefore the estimated prevalence of T2DM of 2.1% and prediabetes of 41.1% may be overestimated, or may be due to the sampling process where this study examined a population that at risk of T2DM based on the ADA and HbA1c levels.

Vijayakumar et al. (2017) state that HbA1c level is a useful predictor of prediabetes and diabetes risk in children and young people. The mean HbA1c levels of both the 10–19-year age group and the 20–24-year age group were significantly higher ($p < 0.05$) than those in the same age groups in the general population. There was consistency between these finding and previous findings where participants’ age is positively associated with higher HbA1c levels (Al-Kandari et al., 2019; Al-Rubeaan, 2015; Kim et al., 2019a; Vijayakumar et al., 2017). Al-Rubeaan (2015) argues that the age of 13 years and over was a significant risk factor for T2DM among Saudi children and adolescents. Data from the Ministry of Health registry in Kuwait indicate that the youngest patient diagnosed with T2DM was a female aged 6 years (Al-Kandari et al., 2019). Furthermore, a German study found that higher HbA1c levels were associated with age and puberty in a large sample of healthy children and adolescents (Hovestadt et al., 2022). For example, compared to the prepuberty stage, the pubertal and post-pubertal stages were associated with higher HbA1c levels (Hovestadt et al., 2022). Evidence was provided to support the research hypothesis that the sample of Kuwaiti young people who are at risk of T2DM appeared to have an elevated level of HbA1c.

In light of what has been discussed in the previous paragraphs, there were few studies that attempted to estimate and determine the prevalence of prediabetes and T2DM among children and young people in Kuwait (Al-Kandari et al., 2019; Almari et al., 2018; Moussa et al., 2008). However, no studies were published investigating the association between health-related behaviours and prediabetes and T2DM among Kuwaiti children and young people. As far as we are aware, this is the first study of its kind, where the researchers investigated the association between health-related behaviours and T2DM among Kuwaiti young people at risk of T2DM. The following sections discuss the results of these associations.

5.4 Effects of Health-Related Behaviours and Demographic Factors on Glycated Haemoglobin A1c Levels

Correlation analysis and visual examination of scatterplots derived from the baseline data indicated a positive correlation coefficient (0.276) between HbA1c levels and sleep; a negative correlation coefficient (−0.242) between HbA1c levels and exercise; a negative correlation coefficient (−0.224) between the first nutrition factor (healthy eating) and HbA1c level; and a positive correlation coefficient (0.306) between the second nutrition factor (fruit and vegetables). The conclusion is that the HbA1c levels appeared to increase when the participants had more sleep and ate more fruit and vegetables, but the HbA1c levels decreased when the participants had more exercise and consumed healthy foods.

The correlation between HbA1c levels and the consumption of fruit could be explained by the Kuwaiti culture where dried fruits are frequently eaten as part of the diet. In Kuwait, people eat dates and dried apricots as healthy snacks. However, these dried fruits have a high glycaemic index and are considered sugary snacks. Therefore, further research is required to clarify this correlation within the Kuwaiti context.

Although the three correlation coefficients were statistically significant ($p < 0.001$); the small magnitudes of the correlation coefficients (between 0.2 and 0.3) reflected weak relationships in the context of clinical research (Hung et al., 2017). The squares of the correlation coefficients (0.05–0.09) indicate that these correlations may have little practical significance or clinical relevance (Ferguson, 2016); where practical significance and clinical relevance refer to respectively to research impressiveness and real-world usefulness (Mohajeri et al., 2020). Although the magnitudes of the bivariate correlation coefficients were small, the directions of the correlations (i.e., positive or negative) were generally consistent with the relationships reported in previous studies on the effects of sleep (Brouwer et al., 2020; Lee et al., 2017), exercise (Benham et al., 2020; Wu et al., 2019) and nutrition (Mackey et al., 2018; Maffeis et al., 2020; Mottalib et al., 2018) on HbA1c levels among adults and young people.

Bivariate correlation coefficients are often misleading because they are confounded by the effects of extraneous variables that are partially correlated with both variables, and may affect the strength and/or direction of a bivariate correlation (Jose, 2013). Multivariate models, which incorporated the interrelationships between the repeated measures of HbA1c were more appropriate to test the hypothesis that there is a significant relationship between health-related behaviours, demographic factors and HbA1c levels (Twisk, 2019). These models included both random effects (i.e., the variance within the participants between the baseline and follow-up studies) and fixed effects (i.e., health-related behaviours and demographic factors) to predict the variance in the HbA1c levels among the young Kuwait participants (Twisk, 2019).

5.5 Prediction of the Effects of Health-Related Behaviours on Glycated Haemoglobin A1c Levels

The first linear mixed-effect model was constructed using the scores for the sleep, exercise and the two nutrition factors as predictors along with the visit number, with HbA1c as the dependent variable. The regression coefficients with $p < 0.05$ indicated that higher sleep disturbance predicted higher HbA1c; higher exercise predicted lower HbA1c, and higher fruit and vegetables consumption predicted higher HbA1c levels. The directions and magnitudes of the regression coefficients were equivalent to the bivariate correlation coefficients and provided information that was generally consistent with the relationships reported in previous studies on the effects of sleep (Brouwer et al., 2020; Lee et al., 2017), exercise (Benham et al., 2020; Wu et al., 2019) and nutrition (Mackey et al., 2018; Maffeis et al., 2020; Mottalib et al., 2018) on HbA1c levels in among adults, adolescents and young people. The findings are consistent with the conclusion that low levels of physical activity and a high-calorie diet contributes to the poor health of the Kuwaiti population with increased prevalence of NCDs, such as diabetes, hypertension and obesity (Al-Baho et al., 2016; Al-Kandari et al., 2019; Allafi et al., 2014). Similar findings were published in the MENA countries region (Aljulifi, 2021; Alowfi et al., 2021; Osman et al., 2013). However, Al-Shudifat et al. (2017) report that physical activity and eating vegetables and fruits were not a significant risk factor for T2DM in their study sample.

5.6 Prediction of the Effects of Demographic Factors on Glycated Haemoglobin A1c Levels

The second linear mixed-effect model was constructed to examine the effects of demographic factors on the repeated measures of HbA1c. No statistically significant difference in mean HbA1c levels were found with respect to the sex, age, educational levels or family income of the participants. The results of this study were not consistent with previous studies in Kuwait suggesting that older age and being male was considered a risk factor for diabetes among this population (Moussa et al., 2008). The results of this survey were also not consistent with previous surveys conducted outside Kuwait concluding that HbA1c levels were correlated with the age, sex and socioeconomic status of the participants (Guo et al., 2014; Hovestadt et al., 2022; Ma et al., 2016). The results were also not consistent with the survey conducted by Saaddine et al. (2002) on the distribution of HbA1c levels for children and young adults in the USA that a low level of education was associated with high HbA1c levels.

BMI was found to exhibit a statistically significant association with HbA1c level ($p < 0.001$). Specifically, an increase of one point in the BMI measure was associated with a corresponding average increase of 0.03 units in the HbA1c level. As previously reported in Chapter 1, elevated BMI is considered the dominant risk factor for T2DM and other NCDs in both young and older adults. It was found that the results of this study were in agreement with those of previous studies in Kuwait (Al-Baho et al., 2016; Al-Kandari et al., 2019; Allafi et al., 2014; Almari et al., 2018). Moreover, similar findings were also observed in the MENA countries, confirming that elevated BMI was associated with high HbA1c levels among young people in the region (Al-Rubeaan, 2015; Al-Shudifat et al., 2017; Levin et al., 2022; Moadab et al., 2010; Önal et al., 2014; Zardast et al., 2015).

A significant difference in mean HbA1c level was reported in the current study with respect to differences in daily screen times. The mean HbA1c level for participants with more than four hours of daily screen time was significantly ($p < 0.001$) higher than the reference category (i.e., participants spending one to two hours of screen time daily). When adjusted for the significant effects of BMI ($p = 0.006$) the effects of the screen time remained statistically significant ($p < 0.001$) but was reduced in magnitude. However, little is known about the effects of screen time on HbA1c levels. There is no published data about the association between HbA1c levels and screen time among young people in Kuwait. In the MENA region, only one study has been published that explored the etiological factors and clinical presentations of 38 T2DM adolescent patients (Osman et al., 2013). Osman et al. (2013) report that about 85% (32 out of 38 T2DM adolescent patients) spend four hours or more watching TV daily. The finding of Osman et al. (2013) was consistent with the results of the current study. Roy and Bhattacharjee (2020) studied the effects of screen time spent on social media per day on glycaemic parameters in T2DM adult patients during COVID-19 outbreak. An increased risk of uncontrolled glycaemic indices was observed among T2DM adult patients when the screen time increased (Roy & Bhattacharjee, 2020). In response to the COVID-19 pandemic and public health restrictions, the use of digital screen devices and the reliance on remote learning methods has increased significantly. Viner et al. (2022) state that due to school closures, lockdowns, social isolation and online learning classes, screen time became more prevalent during the pandemic.

Sedentary behaviour based on screen use was associated with physical inactivity and increased calorie consumption among adolescents (Musa et al., 2022). These behaviours contributed significantly to obesity and T2DM among adolescents and young people (Musa et al., 2022). There is no doubt that increased screen time negatively affects adolescents and young people’s general health (Musa et al., 2022; Viner et al., 2022). Therefore, public health policies and health promotion strategies targeting this population and their parents are needed to raise awareness of the adverse health effects associated with increased screen time. Parental or family-focused interventions might effectively reduce young people’s screen time.

5.7 Strengths of the Study

To our best of knowledge, this is the first study that explored the association between health-related behaviours and HbA1c among young people at risk of T2DM in Kuwait. In addition, this study targeted all governorates in Kuwait to ensure the sample represented young Kuwaiti people. However, what is most significant is that the findings build on the existing literature on the prevalence of T2DM and risk factors among young people in Kuwait and the MENA region. Prior studies on T2DM children and adolescents in Kuwait focused on prevalence and incidence rates. In contrast, this study investigated the associations between health-related behaviours and HbA1c levels. Previous research in Kuwait used data from medical students recorded with the Ministry of Health diabetes registry. However, this study collected data at baseline and, after six months, using repeated observational measures. This repeated cross-sectional study tracked changes in Kuwait's young people over time. This approach observed the aggregate change at the individual level over time (Wang & Cheng, 2020). Most longitudinal studies in biomedicine and healthcare are plagued by attrition, and dropout rates of between 30% to 70% between the baseline and the end of the follow-up period are common (Gustavson et al., 2012). Therefore, it was expected that the dropout rate would be high, especially when the observational study involved children and young people (Fewtrell et al., 2008; Kristman et al., 2004). However, the principal researcher was able to maintain a follow-up rate of 84.2%, losing only 15.8% of the total participants who completed the baseline assessment (23 out of 146 participants dropped out of the study).

5.8 Limitations of the Study

A random sample of 384 participants out of a target population of about 750,000 was originally estimated as the minimum sample size to represent the population of young people in Kuwait; however, this number of participants was not achieved in practice. Although 510 young people responded to advertising and expressed interest in this study, only 146 participants attended the clinic for the baseline assessment, and only 123 participants completed the re-assessment, giving an attrition rate of 15.8%. The participants' selection criteria at the beginning of this study, and the fact that this study was conducted during the pandemic, resulted in this reduced number of eligible participants. See Section Section 3.6.3 for full details regarding participants' inclusion criteria and recruitment process. A sample size calculation using Raosoft software indicated that 123 participants did not precisely represent the target population because the margin of error was slightly wider than an acceptable level of 5% (7.41%) and the confidence level (90%) was slightly smaller than an acceptable level of 95%. This limitation should be addressed in future research by allowing more time during the recruitment of eligible participants.

The results of the inferential statistical analysis would be biased if the attrition was systematic, meaning that certain groups of participants, who differed from those who remained in the study, were underrepresented in the sample, because they selectively dropped out for a specific reason (Deng et al., 2013; Nunan et al., 2018). Selective attrition bias would distort the relationship between the independent and dependent variables, and threaten internal validity, because the statistical analysis may indicate that the variables are significantly correlated, even though they are significantly correlated in the target population from which the sample was drawn (Hill et al., 2020). Because the sample used in this study was biased due to attrition and non-random sampling, the external validity of the results and conclusions may be compromised, implying that generalising the findings of from the sample to the target population is difficult (Andrade, 2018). The small sample size, which did not represent the Kuwaiti population in all of its essential details, might explain why the results of this study were not consistent with previous cross-sectional surveys concluding that HbA1c levels are correlated with the demographic characteristics of the participants, including their age, sex, socioeconomic status, educational level and history of diabetes (Guo et al., 2014; Hovestadt et al., 2022; Ma et al., 2016; Moussa et al., 2008; Saaddine et al., 2002).

To reduce threats to validity, some statisticians recommend multiple imputation, which involves using a set of simulated data to replace the missing data with predicted values (Lin & Tsai, 2020; Rombach et al., 2018); however, missing values were not replaced in this study. Lewin et al. (2018, p. 87) report that, 'for missing outcome data, multiple imputation does not do better than complete case analysis'. It is necessary to understand the risk of attrition bias by collecting information on the reasons for dropout before conducting multiple imputation; however, there is a high level of inconsistency in the methods commonly used by researchers to appraise the risk of attrition bias (Babic et al., 2019).

A further limitation associated with the small sample size of 146 participants was that to obtain an accurate solution using EFA, a sample size of 50 is considered to be very poor, 100 is poor, 200 is fair, 300 is good, and 500 is very good. A sample size of 200 to 500 is generally recommended to validate the variables collected in a cross-sectional survey using EFA (Shrestha, 2021). Sample sizes in excess of 200 are also recommended to provide adequate statistical power to obtain accurate results using linear mixed models (Twisk, 2019).

The second limitation was that the *p* values generated by inferential statistics did not directly measure the effects of health-related behaviours and demographic factors on HbA1c levels for two reasons. First, non-random sampling was used to collect the data; however, despite contrary information in textbooks, *p* values cannot be meaningfully interpreted when the data are not collected by random sampling (Figueiredo Filho et al., 2013; Hirschauer et al., 2020, 2021; Trafimow, 2019; Trafimow et al., 2022). Second, over 100 articles (too many to cite here) have been published in peer-reviewed journals in the last 10 years demanding that statistical inferences based on the interpretation of *p* values should be banned, abandoned, or at least reduced in importance, as *p* value does reflect the practical significance, clinical relevance or importance of inferential test statistics derived from quantitative data collected in a clinical setting. A *p* value only indicates the theoretical probability of obtaining an extreme test result, assuming the null hypothesis is true, and that other conditional assumptions of the test (e.g., random sampling, statistical power, normality, homoskedacity and multicollinearity) are satisfied (Wasserstein & Lazar, 2016; Wasserstein et al., 2019). The main reason why 'statistical significance expires' (Hurlbert et al., 2019, p. 352) is that:

> P-values – cannot do what researchers ask of them. Despite the impression created by countless research papers, lecture courses and textbooks, *p*-values below 0.05 do not 'prove' the reality of anything. Nor, come to that, do *p*-values above 0.05 disprove anything. (Matthews, 2021, p. 16)

In the context of studies conducted by nurses in clinical settings, Hayat et al. (2019) assert that it is time to stop using the term 'statistically significant' entirely. Nor should variants such as 'significantly different,' '$p < 0.05$,' and 'nonsignificant' survive, whether expressed in words, by asterisks in a table, or in some other way. Regardless of whether it was ever useful, a declaration of statistical significance has today become meaningless (Hayat et al., 2019). In addition, In the context of research on nutrition, the editorial board of the American Journal of Clinical Nutrition advised that:

> P = 0.05, a cut-point frequently used to denote statistical significance, is an arbitrary value that is not evidence based. The distinction of statistically nonsignificant vs. significant is a convenience. It does not indicate that a finding should be completely ignored or conversely endorsed. A statistically significant finding is not necessarily clinically important; a nonsignificant finding from an adequately powered study is not necessarily of no importance. (Sorkin et al., 2021, p. 1284)

Similarly, the editorial board of the International Journal of Exercise Science, is 'embracing an era beyond P < .05' (Johnson et al., 2020, p. 1). The editorial board of the New England Medical

Journal provided statistical guidelines for authors to cover both clinical trials and observational studies, including a requirement to replace *p* values with more meaningful statistics (Harrington et al., 2019). The implications are that the reporting of *p* values to interpret the results of Chi-square tests, *t*-tests, correlation analysis, and linear mixed models may not be acceptable for publication by the editors and peer reviewers of some nursing and medical journals.

5.9 Summary of the Discussion

This chapter provided a discussion of the findings. These findings reveal that a high level of prediabetes and T2DM is prevalent among Kuwaiti young people. The findings of this study are consistent with those of previous studies conducted in Kuwait and MENA region countries as well as in Western countries. With respect to variations in prediabetes and T2DM prevalence rates worldwide, empirical studies show that Kuwait has higher rates than other countries in the MENA region. This could be explained by the rapid economic growth in Kuwait, especially after the discovery of oil. Kuwaiti citizens have adopted a modernised lifestyle that negatively impacts their health-related behaviours. They have adopted a sedentary lifestyle and consume processed food, increasing the risk of NCDs, especially T2DM. As well as Kuwaitis, this phenomenon has been observed in Arabs and Westerners across the globe. Interestingly, data from the Ministry of Health registry in Kuwait reveal that the youngest patient diagnosed with T2DM was a female aged 6 years. This is an alarming sign that T2DM is not a disease for the elderly only. Authors report that the transition from prediabetes to T2DM might be rapid. Therefore, healthcare professionals should conduct an annual assessment and evaluation of adolescents in the prediabetes stage in Kuwait. This will prevent the transition from prediabetes to T2DM.

After repeated measures of health-related behaviours, this study also found that higher sleep disturbance predicts higher HbA1c levels, and more physical activity predicts lower HbA1c levels. In addition, it was found that healthy food consumption reduced HbA1c levels. These findings are consistent with the literature in the MENA region of the Western world. However, a unique prediction emerged from the participants' data. Higher fruit and vegetable consumption predicted higher HbA1c levels, which is not consistent with the existing literature. The unique prediction between fruit and vegetable consumption and HbA1c levels could be explained by Kuwaiti citizens' excessive consumption of sugary fruits or dried fruits such as dates. In Kuwait, people eat dates and dried apricots as healthy snacks. However, these dried fruits have a high glycaemic index. Therefore, further research is required to clarify this prediction. In this study, there was no statistically significant difference in mean HbA1c levels based on sex, age, education level or family income. However, a significant difference in mean HbA1c level was reported with respect to differences in BMI and daily screen.

This chapter also discussed the strengths and limitations of this study. The findings of this study build upon existing literature on the prevalence and risk factors of T2DM among young people in Kuwait. Moreover, the repeated measures used during data collection increase the statistical power of the results even with a relatively small sample size. The dropout rate was only about 15%, with the majority of the participants completing both assessments (baseline and follow up). During the course of this study, a few limitations were identified. This study used a convenience sample, which might threaten the internal validity and statistical analysis of participants' data. Also, reporting of *p* values to interpret Chi-square tests, *t*-tests, correlation analysis and linear mixed models was used during this study. This may not be acceptable for publication by some nursing and medical journal editors. This study was also limited by the fact that recruitment and data collection were conducted during the time of the pandemic and lockdown. This could have significantly reduced the number of interested participants. Further, participants were stressed and had no access to parks or playgrounds where they could exercise, which might have increased their HbA1c levels.

5.10 Implications and Recommendations

The purpose of this study was to formulate implications and recommendations for the Kuwaiti community. This study showed that health-related behaviours are associated with HbA1c levels in young people. The results were discussed earlier in this chapter, and their implications could positively impact young Kuwaiti health-related behaviours. These recommendations should be considered when developing strategies to help fight T2DM among young people. Several recommendations are made to ensure that the Kuwaiti Government and society is aware of this health issue. These implications and recommendations are presented in detail in the following section.

5.10.1 Implications and recommendations for healthcare systems and health professionals

The practical clinical implications of this baseline information are that healthcare professionals are informed of the necessity to improve their patients' role in the self-management of diabetes, which, in turn, should reduce the frequency and cost of future hospital and emergency visits (Begum et al., 2011). Moreover, the findings of this study may lay the foundation for future interventional research that may help to reduce the prevalence of prediabetes and diabetes among the young Kuwaiti population.

The factors associated with health-related behaviour (sleep disturbance, lack of exercise and poor nutrition) were found to be correlated with elevated levels of HbA1c. The practical clinical implications are that primary care clinicians and school nurses in Kuwait are informed of the necessity to improve their patients' role in the self-management and prevention of T2DM among young people. The 5 As model (ask, advise, assess, assist, arrange) is recommended for this purpose. The modern approach to interventions designed for the management of obesity and comorbidities including diabetes is rooted in the assumption that many health benefits can be derived from behavioural changes in lifestyle, diet and physical activity (Semlitsch et al., 2019). One of these approaches is the 5 As model as illustrated in Figure 5.1.

Figure 5.1: The 5 As model

The 5 As model is a patient-centred process of care that the primary care provider can tailor for each individual patient and their personal situation (Sturgiss & Van Weel, 2017). The healthcare professionals, such as primary healthcare nurses or school nurses, can provide individual counselling to each patient based on scientific evidence to promote and sustain a healthy pattern of behaviours. The five components of the 5 As model do not prescribe exactly how healthcare professionals treat every patient, rather the model outlines the development of a therapeutic relationship between the healthcare professional and their patient. The 5 As model has been proven to promote the development of therapeutic relationships between patients and healthcare providers in primary care (Tucker et al., 2021) and in schools (Tucker & Lanningham-Foster, 2015); therefore, it is recommended that this model should be implemented by primary care providers (primary health care nurses or school nurses) in Kuwait to treat young Kuwaitis diagnosed with obesity, prediabetes and/or T2DM. For example, selected patients should initially be 'Asked' (first A) by their primary care providers if they want to participate in the 5 As intervention, because motivation to succeed is an important factor (Sturgiss & Van Weel, 2017). The participants are then 'Advised' (second A) to follow a healthy diet and increase their level of exercise, and they are provided with appropriate resources to support these activities (Sturgiss & Van Weel, 2017). The primary care provider subsequently 'Assesses' (third A) to monitor the changes in body weight, HbA1c and blood pressure at regular intervals of time (Sturgiss & Van Weel, 2017). For example, the entire assessment may comprise the pre-test at the baseline, followed by multiple follow-up measures, at yearly intervals as recommended by ADA guidelines for adolescents and young people who have prediabetes and every 3 years for those who are at risk of T2DM. At each follow-up visit the healthcare provider ‘Assists’ (fourth A) the patient to sustain a healthy diet and exercise regime and makes an appointment to ‘Arrange’ (fifth A) the next visit (Sturgiss & Van Weel, 2017).

The COM-B model of behaviour change can also be considered to prevent NCDs and T2DM among at-risk young people in Kuwait. This framework is used in the field of health psychology and behavioural science to understand the factors that influence human behaviour. It acts as a guide to the development of effective behaviour change interventions. COM-B stands for Capability, Opportunity, and Motivation, and it was introduced by Michie et al. (2011). See figure 5.1 for the COM-B framework for understanding behaviour.

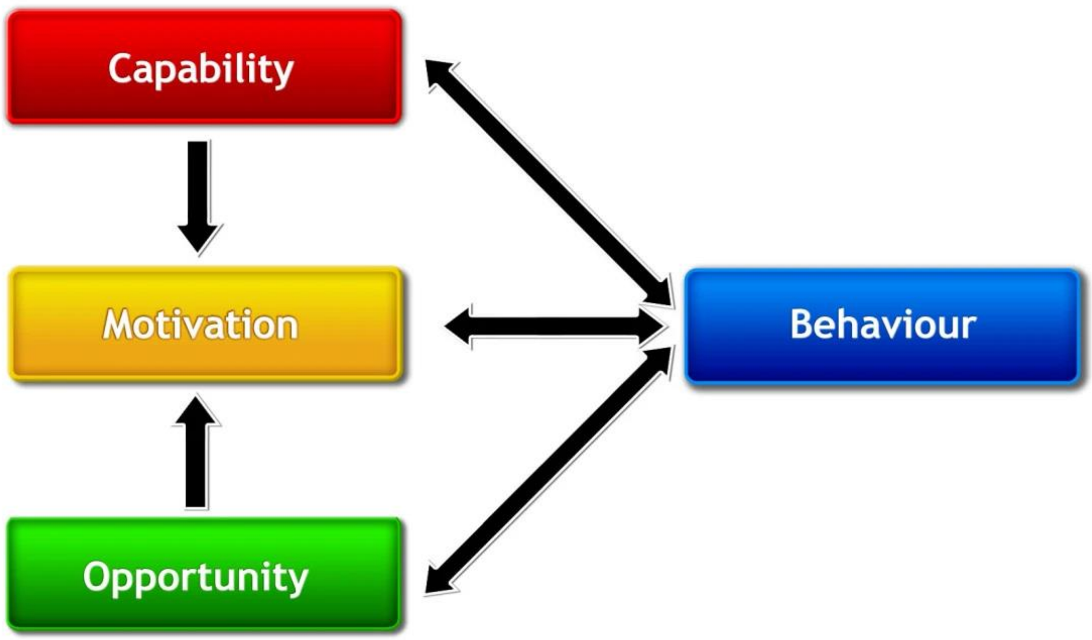


Figure 5.2: the COM-B framework for understanding behaviour

Note: resource Michie et al. (2011). Reproduced under the CC-BY licence.

The model can help identify the key elements related to Capabilities, Opportunities, and Motivations and guide the development of effective interventions. The table below is a suggested example of how to this model in the prevention of NCDs and T2DM in Kuwait.

	Capabilities	**Opportunities**	**Motivations**
Assessment	- Identify the knowledge and skills needed to prevent T2DM. - Assess whether individuals have the necessary understanding of risk factors, healthy behaviours, and how to make positive choices. - Consider individuals' physical capabilities, such as the ability to engage in regular physical activity, maintain a healthy diet and have regular sleep pattern.	- Assess the physical environment for opportunities or barriers. - Are there accessible places for physical activity? - Is healthy food readily available? - Evaluate social and cultural factors that may affect opportunities, including family, community, and workplace support for healthy behaviours	- Understand the individual's motivation to prevent T2DDM. - What are their beliefs and attitudes regarding their health? - Are they aware of the risks? - Explore emotional factors that may influence motivation, such as fear of complications or a desire for better health
Intervention Development	- Develop interventions to enhance knowledge and skills. This can include educational programs, workshops, or online resources on T2DM prevention. - Provide training in meal planning, physical activity, and stress management	- Create environments that facilitate healthy choices. Promote the availability of fresh and healthy foods in local stores. - Develop community programs that encourage physical activity, such as walking groups or fitness classes.	- Use motivational techniques like goal setting and feedback to boost individuals' motivation to prevent T2DM. - Employ social support mechanisms, such as peer mentoring or support groups, to maintain motivation over time.
Implementation	- Deliver educational sessions or workshops to increase knowledge and skills related to T2DM prevention. - Monitor participants' progress and provide additional support or resources as needed	- Ensure that the physical environment supports healthy behaviours. - Advocate for policies that improve access to healthy foods and safe places for physical activity. - Promote social opportunities for engagement, such as organizing community events or creating workplace wellness programs.	- Use behaviour change techniques, such as self-monitoring or rewards, to maintain and boost motivation. - Encourage participants to set specific, achievable goals and provide positive reinforcement for their efforts.
Evaluation	- Continuously assess the effectiveness of interventions by measuring changes in knowledge, behaviours, and health outcomes related to T2DM prevention. - Adjust interventions based on feedback and data to optimize their impact.		

The COM-B model can be applied to the prevention of T2DM, resulting in tailored interventions that are tailored to the specific capabilities, opportunities, and motivations of individuals and communities, thereby enhancing the likelihood that prevention efforts will be successful.

5.10.2 Implications and recommendations for school nurses

In light of existing literature, school nurses can play a crucial role in designing and implementing intervention strategies to prevent NCDs like T2DM, and promote health-related behaviours (Gonzaga et al., 2014; Longobucco et al., 2023; March et al., 2020; Willgerodt & Yonkaitis, 2021). Thus, it is necessary to make specific recommendations for school nurses in Kuwait. Collaboration should be established between the College of Nursing, the Ministry of Health and the Ministry of Education. This will empower school nurses and help them overcome barriers that hinder them from working to their full potential. Currently, there is a lack of resources and support. Stakeholders should ensure that clinics in schools are equipped with medical devices and materials. These materials assist school nurses in effectively participating in health promotion for young people. In addition, school nurses can use the Afinion 2 Analyzer to measure students' HbA1c. This test is low-cost, rapid, convenient, easy to use and accurate for early detection of prediabetes and T2DM in school clinics. Refer to Section 3.7.1 for full details.

There is a need to build effective communication between healthcare professionals, families and school nurses to identify adolescents and young people who are at risk of T2DM and obesity. Communication between school nurses and students' families is critical before, during and after implementing a school-based screening program highlighting childhood obesity consequences (Schantz & Bobo, 2009). After the school nurse completes the initial screening and follow-up phone assessment, children determined to be at risk are strongly encouraged to be referred to their healthcare providers. This is a crucial step in seeking family support and cooperation in reducing students' NCDs risk. See Figure 5.2 for a suggested referral letter that can be used by school nurses in Kuwait.

[SCHOOL ADDRESS & PHONE NUMBER HERE]

Results of Body Mass Index (BMI) and T2DM Risk Screening

Dear Parent/Guardian,

Your child, ________________________, was measured at school for height and weight. This was done as part of the school's ___________ program. I sent a letter about that program on (_______date). The height and weight help us get a body mass index (BMI).

BMI is used by doctors and nurses to help identify underweight, normal weight, overweight, and obese in children. These are the percents used:

Underweight	BMI less than 5%
Within normal range	BMI 5% to 84%
Overweight	BMI 85% to 94%
Obese	BMI greater than or equal to 95%

Your child's results showed:

Height __________
Weight __________
BMI-for-age% (percent) ____________

Things like amount of activity in a day or family history can affect height and weight in children and adolescents and their BMI. Increased muscle from sports or physical activities can increase BMI.

Your child's health care provider is the best person to say whether his or her measurements are within a healthy range.

If your child is in the overweight/obese area by BMI result, I will be contacting you soon. I will ask questions that help us to know if your child is at risk for type 2 diabetes. I will ask you to share the results with your child's health care provider. The health care provider may recommend changes in eating, physical activity, or other areas.

Please call me if you have any questions or concerns about the results of this BMI measurement.

Sincerely,

[SCHOOL NURSE NAME HERE]

Phone______________

Figure 5.2: Suggested referral letter

Note. Adopted from Schantz and Bobo (2009) and modified by Abdullah Hasan

School nurses and teachers should be involved in developing a program to prevent the development of T2DM in school children and reduce obesity and overweight (e.g., physical education classes, home economics classes, school trips, summer camps). Furthermore, it is important to encourage healthcare professionals such as dieticians, pharmacists and health educators to visit schools and provide health-related advice and activities. School nurses should ensure that young people with diabetes and those at high risk of developing it receive routine follow up.

5.10.3 Implications for government and policymakers in Kuwait

Creating a healthy environment for children and adolescents can be achieved through the implementation of laws and regulations by the Kuwaiti Government. No action can be taken without government support; therefore, all Kuwaiti Government ministries can play a vital role in reducing young people's NCDs. Each ministry has different responsibilities towards Kuwaiti young people's general health. For this reason, each ministry receives its own recommendations.

5.10.3.1 Ministry of Health

Kuwait's health system has been negatively affected by the prevalence of T2DM and its complications, with Kuwait being ranked among the highest rates of T2DM and obesity, regionally and globally. In order to raise community awareness of the consequences of T2DM and obesity, workshops and lectures on these health issues should be provided by healthcare professionals in each governorate. Additionally, posters concerning T2DM and childhood obesity should be displayed in prominent locations. Community nurses may distribute leaflets concerning T2DM and obesity during home visits. More importantly, the Ministry of Health should improve healthcare professionals' knowledge and skills to help them in their role as health educators. This will raise health awareness among the Kuwaiti community.

5.10.3.2 Ministry of Youth and Sports

There are a lot of vacant squares in all Kuwaiti governorates that could be turned into parks or playgrounds. These recreational areas can be used by young people and their parents to exercise and get exposed to sunlight. A playground or a park in the neighbourhood may help children and adolescents become more active and reduce the risk of obesity (Fan & Jin, 2014). In addition, Blanck et al. (2012) point out that children are more likely to be physically active when they have access to recreational facilities. Further, the environment in which children live, study and play has a significant influence on their health and wellbeing (Blanck et al., 2012). Another recommendation is to initiate 5 km walk/run family-friendly events to encourage family and community involvement and increase physical activity among Kuwaiti citizens.

5.10.3.3 Ministry of Commerce and Industry

The Ministry of Commerce and Industry is responsible for all imported food into Kuwait. As a result, introducing rules and regulations requiring food manufacturers to include nutritional information on their packaging would increase consumers' awareness of what they eat. The nutritional information on food labels can assist consumers in making healthier choices (Jones et al., 2019). According to Jones et al. (2019), nutrition labelling regulations could encourage food manufacturers to produce healthier products. Aside from that, imposing rules and regulations on the fast-food industry to use nutrition labelling would warn consumers about the number of calories they consume and the nutritional value of their meals. Furthermore, this ministry should regulate food delivery services. In addition, food delivery companies work 24/7. It might be beneficial if these companies worked within a daily timeframe, for example, no food delivery between 10 pm and 6 am.

5.10.3.4 Ministry of Information

There is no doubt that the media, in general, has a tremendous impact on society. The Ministry of Information can use all mass media and social media to raise health awareness among young people in Kuwait. Mass media and social media have transformed the way health information is delivered to T2DM patients. Social media can be used to provide health and education interventions to a targeted population (Alfian et al., 2021). To improve Kuwaiti young people's eating habits, unhealthy food advertisements should be banned. Children are significantly more likely to consume unhealthy food after viewing screen advertisements for unhealthy foods (Russell et al., 2019). It is also crucial to create a safe platform where young people are able to access valid and reliable information.

5.11 Future Research

According to the JHNEBP tool, the quality of the evidence provided in this observational study was low down in the hierarchy (i.e., Level III) because of the high risk of bias associated with the results of non-experimental studies such as cross-sectional surveys with non-random sampling. A cross-sectional survey using a convenience sample of only 146 participants did not prove the existence of causal relationships between the demographic characteristics, health-related behaviours, prevalence of T2DM and HbA1c levels of the population of young people in Kuwait. However, this observational study without an intervention provided a foundation for future experimental research involving healthy lifestyle interventions that may help to reduce the prevalence of T2DM in the Kuwaiti population. To ensure the internal and external validity of the results, the recommended research should use a research design that is higher in the hierarchy of evidence than a cross-sectional survey. The principal researcher has identified a gap in the literature concerning the degree to which the 5 As model may provide an effective treatment to promote a clinically significant reduction in BMI and HbA1c levels, providing a direction and rationale for future research in Kuwaiti and other populations. Therefore, this model of care can be used and evaluated by healthcare professionals in Kuwait.

A ‘gold standard’ research design, such as an RCT classified in Level I of the hierarchy of evidence (Hariton & Locascio, 2018) would be beneficial. The randomisation in RCTs eliminates much of the bias inherent in other study designs, which makes them the preferred method for studying causal relationships between interventions and outcomes (Hariton & Locascio, 2018). An RCT must be designed and conducted in a robust manner in order to provide a truly reliable assessment of effectiveness. This includes concealing the allocation, blinding, intention to treat analysis, as well as a sufficient number of participants (Hariton & Locascio, 2018). An RCT should ideally be conducted to compare the HbA1c levels of an experimental or treatment group of young Kuwaiti people (randomly assigned to implement changes in their sleep, exercise, nutritional and/or other healthy lifestyle behaviours, underpinned by the 5 As model) and a control group (who do not implement healthy behaviours) at regular time intervals over a long period of time (at least 1 year). An alternative approach is to compare repeated measures of HbA1c in a randomly assigned cohort (the treatment group) of participants before and after exposure to a healthy lifestyle intervention program. Repeated measures of HbA1c levels in the treatment group should be compared with those in a randomly control group who are not exposed to the lifestyle intervention (e.g., (Coughlin et al., 2017; MohammadniaMotlagh et al., 2022; Taheri et al., 2020).

The Let’s Go! 5-2-1-0 program can be used as an intervention in a school-based RCT in Kuwait (Rogers et al., 2013). Let’s Go! 5-2-1-0 is an obesity prevention initiative working with communities to create environments that support healthy choices, bringing evidence-based strategies for healthy living into schools, childcare and workplaces. This educational program reaches children and young people where they live, learn and play (Rogers et al., 2013). Rogers et al. (2013, p. 1011) state that, ‘the mnemonic 5-2-1-0, represents four recommendations for healthy eating and physical activity each day: eat five or more servings of fruits and vegetables, limit of two hours or less of recreational screen time, engage in one hour or more of physical activity, and limit sugary drinks; drink more water and low fat milk’. Through the use of the Let’s Go! 5-2-1-0 strategies listed below, schools can address policies, practices, and environments that influence positive lifestyle behaviours. In addition to a toolkit, this program provides guidance and assistance to support schools in the adoption of the 10 strategies:

1. Provide healthy choices for snacks and celebrations; limit unhealthy choices.
2. Provide water and low-fat milk; limit or eliminate sugary beverages.
3. Provide non-food rewards.
4. Provide opportunities for children to exercise every day.
5. Limit recreational screen time.
6. Participate in local, state and national initiatives that promote healthy eating and active living.
7. Engage community partners to support and promote healthy eating and active living at your site.
8. Partner with and educate families in adopting and maintaining a lifestyle that supports healthy eating and active living.
9. Implement a staff wellness program that includes healthy eating and active living.
10. Collaborate with food and nutrition programs to offer healthy food and beverage options.

The intervention is based on social cognitive theory, employing cognitive-behavioural techniques to enable self-behavioural changes through health knowledge and the development of positive daily habits (Bandura, 1986). School nurses use the Let’s Go! 5-2-1-0 educational materials to deliver this intervention. These materials cover health aspects such as eating fruits and vegetables, limiting screen time, participating in physical activity, restricting soft drinks and improving sleeping patterns. Participants and their parents receive educational materials before the educational sessions. Participants are asked to keep logbooks to record their weekly diet, exercise and sleep data. The intervention is considered a low-intensity educational program (six group discussions, one hour per session over six weeks). Each educational session covers a few aspects of the Let’s Go! 5-2-1-0 program. Table 5.1 provides information about the topics.

Table 5.1: Topics in the Lets Go! 5-2-1-0 program

Session no	Topic covered
1	Discuss and explain Let’s Go! 5-2-1-0 strategies and goals Explain how to use the log-book
2	Physical activity (participate in at least 1 hour of moderate physical activity per day) Sleep (at least 9 hours per day)
3	TV and video game time (less than 2 hours per day) Eating out (limit number of time & reduce portion size)
4	Fruit and vegetables (at least 5 servings per day) Eating a healthy breakfast
5	Soda and sugar-sweetened drinks (0 per day) Limit unhealthy snacks and deserts (replace with healthy alternatives), eating when not hungry (bored, stressed, or sad)
6	Recap of the educational program strategies and goals Share stories and challenges

RCTs could also be designed to measure repeated measures in the changes in HbA1c levels in experimental vs. control groups classified by demographic and other factors (e.g., sex, age, BMI, socioeconomic status, educational level, smoking, sleep disturbance, screen time). More RCTs should be implemented using representative samples to identify the barriers (e.g., lack of motivation) and enablers (e.g., motivation) that explain why some people adhere to healthy lifestyle behaviours and others do not (Gadowski et al., 2021; Kebbe et al., 2017; Lakerveld et al., 2020).

The results of future research should not be interpreted using *p* values to determine if the differences between the treatment and control groups are statistically significant. Lakens (2021, p. 639) comments that, 'because of the strong overreliance on *p* values in the scientific literature, some researchers have argued that we need to move beyond p values and embrace practical alternatives'. Accordingly, in the last 5 years, many statisticians have suggested practical alternatives to using *p* values specifically for interpreting the results of research in biomedicine and healthcare (Amaral & Line, 2021; Davis et al., 2021; Fleischmann & Vaughan, 2019; Harris et al., 2023; Kinney et al., 2020; Mellis, 2018; Mohajeri et al., 2020; Morgan, 2018; Schober et al., 2018; Schober & Vetter, 2020; Solla et al., 2018). These alternatives include measures of practical significance, clinical relevance, or clinically important differences, which are more useful and easier to interpret than *p* values, because they estimate the size of an observed effect in a clinical setting in the same units that were used to measure the outcomes. The effect sizes recommended by statisticians to interpret the data collected in clinical research, depending on the research design and measurement levels of the variables, include Cohen's *d*, Hedge's *g*, Glass's Δ, Steiger's ψ, 1.5 Cramer's V, r^2, Cohen's f^2, η^2, ω^2, and odds ratio (Ialongo, 2016). Statisticians also recommend reporting CIs as well as the point estimates of the effect sizes because 'the combination of the point estimate and CI therefore give more information than an effect estimate and its *p* value and certainly more than a *p* value alone' (Sorkin et al., 2021, p. 1284).

An alternative approach to avoid the statistical limitations and threats to validity of quantitative approach is to conduct qualitative research. Qualitative research is required to explore young people's perceptions about implementing healthy behaviours that reduce the risk of T2DM and to explain the enablers and barriers, and may help to provide deeper insight into why there is so much variability in healthy behaviours among young people. An interpretive phenomenological analysis can be employed in future research to study Kuwaiti young people's health-related behaviours. An interpretive phenomenological analysis is a qualitative research approach used to explore and understand the lived experiences of individuals (Eatough & Smith, 2017). It underlines the subjective interpretation of experiences and focuses on how individuals make sense of their world (Smith & Nizza, 2022). This qualitative approach would involve interviewing a purposive sample of young people, to explore the many non-quantitative factors that the interviewees perceive may influence their patterns of healthy or unhealthy behaviours. An interpretive phenomenological analysis to extract themes from qualitative data may reveal richer and more detailed personal insights into the reasons for the healthy or unhealthy behaviours of young people than the statistical analysis of quantitative data collected with a questionnaire (Eatough & Smith, 2017; Pringle et al., 2011; Smith & Nizza, 2022; Tuffour, 2017). This analysis might provide more meaningful data to address research questions beginning ‘Why’ that cannot easily be answered by quantitative data, such as: Why do some young people exhibit healthy sleep, nutrition and exercise behaviours to protect themselves against obesity and T2DM, while others do not?

A Delphi study is an alternative methodological approach that can be considered. The Delphi technique is a systematic and iterative process that aims to achieve a consensus or convergence of opinions among a group of experts on a particular topic or issue (Hsu & Sandford, 2007). A Delphi study is valuable in situations where there is limited empirical data or when expert judgement is essential, such as in policy development, or exploring complex and uncertain topics (Turoff & Linstone, 2002). By aggregating and synthesising expert opinions, the Delphi method can provide valuable insights, identify emerging trends, or inform decision-making processes (Powell, 2003). The Delphi technique has been widely used in the field of health promotion, including studies focusing on young people, identifying health priorities (Pouresmaeil et al., 2019), developing evidence-based interventions (Cuijpers, 2003), assessing school-based program effectiveness (Bailey et al., 2021) and policy development (Lines et al., 2023). These examples illustrate the application of a Delphi study in health promotion for adolescents and young people, highlighting its potential to gather expert insights and drive evidence-informed decision-making in this field.

5.12 Conclusion of this Thesis

NCDs in children and adolescents are a global issue, and it appears that no country has successfully addressed this issue to date. With the growing burden of NCDs in the world, there is an even greater risk of younger generations in Kuwait developing T2DM. Therefore, investigating the current situation regarding prediabetes and T2DM among the at-risk population is an important step in order to better understand this phenomenon in Kuwait. Assessing the health-related behaviours that are associated with the development of T2DM in young people would provide a clearer picture of the NCDs that affect this young cohort and present possible solutions that could assist in overcoming cultural barriers and the inability to adopt a healthier lifestyle among this population. The principal researcher employed a positivist approach to quantitative research and a repeated cross-sectional observational design in the current study. The aims and objectives of this current research brought together scientific approaches as well as an integrative synthesis of the literature to explore the associations between health-related behaviours and HbA1c among Kuwaiti young people at risk of T2DM.

A total of 123 young people aged between 10 and 24 years responded to the health-related behaviours questionnaire and completed the baseline and follow-up assessments. Young Kuwaitis have a high prevalence of prediabetes and T2DM compared to regional and international countries. BMI and daily screen time both significantly influenced the mean HbA1c levels among the participants of this study. Furthermore, higher sleep disturbance predicted higher HbA1c, whereas higher physical activity and healthier eating predicted lower HbA1c. This repeated cross-sectional study design lays out the foundation of the association between health-related behaviours and HbA1c among young people at risk of T2DM in Kuwait. However, future research should consider different research methods, such as qualitative research, RCTs and Delphi studies. These methods can enrich the existing literature, and assist stakeholders and decision-makers to update health policies in Kuwait.

School nurses can play an important role in implementing intervention strategies to prevent NCDs like T2DM and promote health-related behaviours. Therefore, this thesis outlined the implications of the current situation and proposed recommendations, such as the appropriate implementation of the 5 As model of care and the adoption of a referral letter for young people who are at risk of T2DM. It is important that stakeholders ensure that school clinics are equipped with medical devices and materials. These materials help school nurses promote health and detect prediabetes and T2DM in school clinics.

Young people and their parents are responsible for developing their own healthy habits. Yet, young people are more likely to be encouraged by their surroundings. Thus, the Kuwaiti Government has a responsibility to promote healthy environments to adopt healthy lifestyles. As a matter of priority, the T2DM prevention program should start early, as young people’s behaviours could be shaped at a very early age, and it is possible for unhealthy behaviours to persist into adulthood. Additionally, studies have shown that prediabetes in children and adolescents is more likely to develop into T2DM in later life. Therefore, the Ministry of Health should prioritise the prevention of T2DM among Kuwaiti citizens. Without the Kuwaiti Government’s support, no T2DM prevention interventions, public health awareness campaigns, or health policies can be implemented successfully. The stakeholders and decision-makers are identified as significant players who can lead the fight against T2DM. Therefore the implications and recommendations highlighted in this study can be noted and utilised by the

Kuwaiti Government: it is imperative that the Kuwaiti Government takes further steps to combat T2DM among young people.

Although the knowledge about youth T2DM's pathophysiology, contributing factors and optimal prevention remain limited, there is an important fact for everyone: paediatric obesity is a preventable health condition that might reduce the spread of youth T2DM. Moreover, youth T2DM remains a challenging disease to manage pharmacologically and therapeutically. Therefore, lifestyle interventions, including healthier habits and increased physical activity, are recommended. Finally, I would like to conclude this thesis with a statement by an expert published in the Lancet who said:

> Surely children and adolescents cannot be held responsible for living in obesogenic environments and if the growing prevalence of obesity and type 2 diabetes in youth is accepted as the new normal, society will have grossly failed the next generation. (Kasmauski, 2018, p. 2325)

This quote identifies the role and responsibilities of those such as policy makers, leaders, educators, and health professionals in stepping up to support children and young people in addressing the global issue of T2DM. The results from this study provide further evidence that will be used to improve the health outcomes for young people in Kuwait.

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Appendices

Appendix 1: Checklist for writing an integrative literature review (Torraco, 2016)

A. Before Writing an Integrative Literature Review

1. What will the integrative literature review address (i.e., review of a new topic? a mature topic?). Is the topic of the review clearly defined? Are the scope and boundaries of the review demarcated to show the bodies of literature that will and will not be reviewed?
2. Is there a *need* for the integrative literature review? Is an integrative literature review the most appropriate form of research to address the problem? Will the review article make a significant, value-added contribution to new thinking in the field?
3. Is the perspective taken by the author on the literature review explained to readers (e.g., neutral representation vs. taking a position or point of view)? Are the assumptions of the author regarding the literature review stated?

B. Organizing an Integrative Literature Review

4. Is the integrative literature review organized effectively?
   - (a) Is the literature review organized for logical flow of ideas, organization, and readability?
   - (b) Is the literature review organized around a coherent structure for clarity about what is being reviewed and how the main concepts or themes of the topic come together as a unified idea (e.g., temporal, methodological, or conceptual structure)?
   - (c) Should diagrams or other visual representations be used to show how the literature review is structured and to enhance the reader's understanding of how the topic is addressed in the literature?
5. Are the methods for conducting the integrative literature review sufficiently described?

(a) How was the literature for the review selected? What key subject terms (or keywords) were used to search the literature? What databases were used to search the literature?

(b) Is a table or matrix used to track which keywords and databases led to relevant literature and which did not? If so, is the use of the table mentioned in the review for readers?

(c) Are the criteria stated for retaining or discarding the literature retrieved?

(d) Is there a discussion of how each piece of literature was reviewed (e.g., complete reading of each literature source, reading of abstracts only, a staged review)?

(e) Is there a discussion of how the main ideas and themes from the literature were identified and analyzed?

(f) Is the description of the methods for searching, analyzing, and interpreting the literature as transparent as possible for the reader? Is the description of the literature review methodology written so that if other researchers attempted to replicate the integrative literature review, sufficient information would be available to do so?

C. Writing an Integrative Literature Review

6. Does the review critically analyze existing literature on the topic (i.e., is a critique provided)?

(a) Does the critical analysis describe both the strengths and weaknesses of the literature?

(b) Does the critical analysis identify literature deficiencies, omissions, inaccuracies, conflicting perspectives and inconsistencies, and aspects of the topic or phenomenon that are missing, incomplete, or poorly represented in the literature?

(c) Would it be beneficial for the review to include a concept map, analysis matrix, or other visual representation of the main ideas and conceptual relationships of a topic to enhance the reader's understanding of the critical analysis of the literature?

7. Does the integrative literature review synthesize knowledge from the literature into a significant, value-added contribution to new knowledge on the topic?
8. Does the integrative literature review lay the foundation for future research by formulating questions for further research on the topic?
9. Does the integrative literature review describe the logic and conceptual reasoning used by the author to synthesize the model or framework from the review and critique of the literature?
10. Does the integrative literature review explore the future of the topic or field? Does the review identify factors that are shaping the future of the topic, discuss pending developments in the field, and assess the direction for future events and trends?
11. Has the integrative literature review been examined and revised for clear, concise, understandable writing?

Appendix 2: Summary table of the included articles

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
1	Hatun et al. (2019) Turkey	To describe the baseline clinical and laboratory findings and treatment modalities of 367 children and adolescents diagnosed with T2DM	Cross-sectional study	367 children aged 6–18 years diagnosed with T2DM	BMI Acanthosis nigricans FPG FI level HbA1c	Being female and having a positive family history were strongly associated with T2DM in Turkish children (*n* = 130, 57%) were identified by diabetes testing, which was conducted because they were at high risk of T2DM due to a positive family history of T2DM in a first or second-degree relative (86%), and/or presence of acanthosis nigricans (81%)	The frequency of testing was low, OGTT results were missing, and follow-up data were not available ADA criteria limitation (testing start at 10 years) Large sample size for this population and multicentre stud
2	Önal et al. (2014) Turkey	To investigate the relationship between insulin resistance reflected by HOMA-IR index and HbA1c levels of obese children	Cross-sectional study	130 children 70 obese and 60 non-obese Aged 3–15 years	BMI FPG FI level HbA1c Insulin resistance using HOMA-IR assessment	There was no significant difference between the sex ratios in the obese and non-obese group Insulin resistance percentage is higher in obese compared to non-obese FPG level of the obese group was significantly higher than non-obese group There was no statistically significant difference in HbA1c There was a positive correlation between BMI and HOMA-IR, HbA1c, and insulin levels. - It is important to identify insulin resistance at an early stage.	Small sample HbA1c screening is cheap and simple, no need for fasting

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
3	Zardast et al. (2015) Iran	To verify the rate of MS in elementary school students of Birjand, Iran	Cross-sectional study	1296 subjects aged 6–11 years	BMI WC FPG Lipid profile BP	WC significant difference based on sex 43.5% had at least one abnormal component of MS Significantly higher risk for MS with a large waist circumference, a BMI above the 85th percentile and those older than 9 years of age MS was seen in girls compared to boys among those with a waist circumference Based on BMI, MS prevalence is 11.3% in overweight, and 36.2% in obese	Large sample size Cross-sectional only Did not evaluate the lifestyle, physical activity level or family history A longitudinal design is required
4	Al-Shudifat et al. (2017) Jordan	To determine the prevalence of diabetes risk factors among young students	Cross-sectional study	1821 students aged 18–25 years	BMI WC FPG Physical activity Fruit/veg Family history	Significantly higher proportion of men were overweight and obese Large proportion of study subjects had central obesity; 27.3% had a high WC Physical activity and eating vegetables and fruits were not a significant risk factor for T2DM Men had higher risk of T2DM Significant association between BMI, WC, family history with T2DM 28 students at high-risk group and tested for T2DM, 8 (29%) diagnosed while 5 (18%) had prediabetes	Large sample Report bias The Finnish Diabetes Risk Score can be used as a self-administered test to screen subjects at high risk for T2DM More research needed in the middle east countries

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
5	Alowfi et al. (2021) Saudi Arabia	To estimate the prevalence of MS among adolescents To determine the most common MS risk factors	Cross-sectional study	172 female students aged 12–19 years	BMI WC FPG Physical activity Eating habits Family history	High glucose levels and high WC were the most common among participants High glucose also is commonly observed among obese adolescents but not statistically significant The overall prevalence of MS among female Saudi adolescents (aged 12–19 years) was 7% and one was diagnosed with T2DM Adolescents with parental history of T2DM, HTN, obesity & high cholesterol level have a higher prevalence of MS, but not statistically significant Eat fast-food & no weekly exercise have a higher prevalence of MS, but this is not statistically significant	Small sample size Females only Primary prevention of NCDs, particularly in Gulf Country communities facing the burden of nutritional disorders & lifestyle disorders

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
6	Cohen et al. (2022) Israel (Occupied Palestine)	To assess the incidence, clinical manifestations of youth-onset T2DM	Retrospective observational study 2008 - 2019	379 individuals aged 10–18 years	BMI FPG Lipid profile BP HbA1c	179 (47%) aged 15–18 years at diagnosis, 118 (31%) aged 13–15 years & 82 (22%) aged 10–13 years Girls were significantly younger than boys at diagnosis 60% were females at diagnosis Screening for diabetes in obese adolescents led to the diagnosis of T2DM in 11.5% of the cohort Mean BMI at the mean age of 14.7 ± 1.9 years was 32.7 ± 7.8 kg/m2 Mean HbA1c level at diagnosis was 8.8 ± 2.5% (73 ± 4 mmol/mol) 278 (77%) had a BMI percentile > $95^{th.}$ Family history of T2DM found in 73.1% of patients, more in Arabs Gestational diabetes was found in 7% of participants The main clinical characteristics were obesity, HbA1c high rates & earlier presentation among females due to puberty & presence of T2DM complications	Retrospective data were not collected systematically from all patients in real time Missing is the socioeconomic profile; thus, could not conclude if socioeconomic status contributed to T2DM

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
7	Al-Bachir et al. (2017) Syria	To determine the relationship between obesity & major metabolic risk factors among Syrian adolescents	Cross-sectional study	- 2064 health Syrian adolescents aged 18–19 years	BMI WC FPG Lipid profile BP	- FPG, BP, Lipid profile & BMI were significantly higher in overweight and obese groups in comparison with the normal group - Obese adolescents had higher abdominal fat, which is associated with CVD & T2DM	Focused only on 18–19-year-old adolescents Early screening for MS, CVD & T2DM is recommended Interventions aimed at increasing physical activity and improving diet to reduce the risk of T2DM & CVD associated with obesity
8	Osman et al. (2013) Sudan	To determine the prevalence of T2DM among children and adolescents attending a paediatric and adolescent diabetic clinic in Khartoum - To explore etiological factors, clinical presentation & associated comorbidities	Retrospective observational study 2006 – 2009	38 with diabetes aged 8–18 years	BMI WC FPG Lipid profile BP Acanthosis nigricans HRB	35 (92.1%) had onset of T2DM between 11 and 18 years & were pubertal, 3 (3%) very obese children had onset between 8 and 11 years 21(55.3%) from high social class, 13 (34.2%) from medium social class 35 (92%) family history of T2DM 29 (76.3%) were obese, 8 (21.1%) were overweight 31 (81.6%) had acanthosis nigricans 15 (39.5%) mothers had gestational diabetes 32 (84.3%) long hours of TV watching 31 (87.6%) lack of physical activities 32 (84.3%) consume fast food regularly	Retrospective data were not collected systematically from all patients in real time

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
9	Dayan et al. (2005) Israel (Occupied Palestine)	To define the prevalence of obesity & associated morbidity, including T2DM & HTN among adolescents To compare results between males & females	Cross-sectional study	76,732 Israeli conscripts All conscripts aged 17 years	BMI FPG BP OGTT Urine analysis	32,402 (42.2%) females and 44,330 (57.8%) males The prevalence of obesity was 4.1% in males & was 3.3% in females The prevalence of overweight was 12.4% in males & 11.4% in females The prevalence of T2DM & HTN was significantly higher among obese in both sexes, significantly higher in males compared with females A significantly higher prevalence of T2DM & HTN among conscripts without high school education	Participants were only 17-years-old. Used adult BMI standards for adolescents
10	Moadab et al. (2010) Iran	To determine the prevalence of IFG & T2DM for the first time in a population-based sample of Iranian obese children	Cross-sectional, population-based study	672 obese & overweight students, selected from 7554 students, aged 6–19 years, were screened for IFG and T2DM	BMI FPG Lipid profile OGTT Acanthosis nigricans	- The prevalence of IFG was 4.6% (n = 31). IFG In the 6 - 10 years age group (n = 165), 2% (n = 4) & 10.1 - 19 years (n = 507) was 5% (n = 27) in the 10.1 - 19 years (n = 507) was 5% (n = 27). - BMI was significantly higher in those with IFG - Acanthosis nigricans & family history associated with T2DM - Prevalence of T2DM was 0.14% i.e., 1 in 1000 among obese and overweight youths - In many studies, the prevalence of IFG is reported to be higher in boys, but in this study, there was no difference in terms of sex - Prevalence of T2DM is low in Iranian obese adolescents (0.1%), IFG, prediabetes is common (4.61%)	This study did not measure dietary habits, physical activities and other HRB -revention including lifestyle modifications, dietary changes & improve physical activity should be considered Regular screening of prediabetes & T2DM should be considered in obese children who are prone toT2DM

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
11	Al Amiriet al. (2015) UAE	To estimate the prevalence of T2DM & prediabetes among overweight/obese adolescents	Cross-sectional	1034 at risk of T2DM 1st stage 348 students complete full assessment 2nd stage aged 11–17 years	BMI WC FPG OGTT HbA1c Lipid profile BP Acanthosis nigricans HRB	78% were obesity & 22% overweight according to the BMI percentile charts for age & sex No significant correlation between glycemic status, level of physical activity & acanthosis nigricans No significant correlation was shown related to age, sex, WC, BP, parents' employment & lipid profile Prevalence of prediabetes & T2DM among overweight/obese adolescents is high based on OGTT & HbA1c -More than 40% of all students diagnosed with prediabetes & T2DM had first-degree relative with T2DM	Difficulties achieving a good response rate with the risk of sampling bias. Possibility of selection bias, main reason assumed to be unwillingness to be exposed to finger pricking
12	Al-Agha et al. (2012) Saudi Arabia	Prevalence of hyperinsulinism among overweight & obese patients Prevalence of T2DM among those with hyperinsulinism Prevalence of MS & its components	Retrospective cross-sectional	387 patients aged 10–17 years	BMI WC FPG OGTT HbA1c Lipid profile BP Acanthosis nigricans	The prevalence of hyperinsulinism & T2DM were 44.7% & 9.04% Acanthosis nigricans was present in 28.75% of T2DM paediatric patients 31.43% had elevated FPG & 23% had a WC > 95th percentile Among T2DM paediatric patients, 62.86% were overweight & 37.14% were obese Obesity was higher in females, 71.43% were female & the rest male	Recommendations: Addressing dietary habits of adolescents Promotion of indoor exercises for at least 30 minutes per day To limit TV usage hours to 2hrs / day

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
13	Al-Rubeaan (2015) Saudi Arabia	To assess the prevalence of type 1 & T2DM & IFG among children & adolescents	Cross-sectional study, population-based, multistage stratified cluster sampling	53,370 participants aged 6–18 years	- BMI - FPG - Lipid profile - BP	The overall prevalence of diabetes was 10.84%, of which 0.45% were known cases of type 1 diabetes or T2DM, and 10.29% were either newly identified cases of T2DM (4.27%) or IFG (6.12%) About 90% of those newly diagnosed with diabetes were unaware of their disease Age, being male, obesity, urban residency & high family income were found to be significant risk factors for diabetes and IFG Age ≥ 13 years was a significant risk factor for diabetes BMI ≥ 95th centile was found to be a significant risk factor	Large random sample of children & adolescents Possibility that the enrolled participants might have not overnight fasted There is an urgent need for screening & prevention for adolescents in this society & similar other societies in the Middle East
14	Punnose et al. (2002) UAE	To define the pattern of diabetes mellitus in childhood and adolescence in an Arab population in Al-Ain, UAE	Retrospective cross-sectional 1990–1998	0 Arab patients aged 0–18 years	BMI FPG Lipid profile BP Acanthosis nigricans	5 Arab adolescents had T2DM, 4 of them were obese with a positive family history of T2DM. There is no clear data on T2DM prevalence	The study focused mostly on type 1 diabetes Further screening for T2DM is recommended

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
15	Moussa et al. (2008) Kuwait	To determine the prevalence of T2DM among Kuwaiti children aged 6–18 years	Retrospective cross-sectional 2000–2002	128,918 Kuwaiti children aged 6–18 years	Data from medical students' records from 182 schools	T2DM identified in 45 of the 128,918 children surveyed, giving an overall prevalence of 34.9 per 100,000 25 were male and 20 were female; the male/female ratio was 1.25:1 There was a significant increase in prevalence of T2DM with age overall and in males (51.1%) had a positive family history of diabetes	Efforts need to be initiated to address prevention strategies of T2DM in youth
16	Al-Kandari et al. (2019) Kuwait	To estimate the incidence rate of T2D Kuwaiti adolescents aged 14 years & younger To describe clinical characteristics at the time of diagnosis	Retrospective cross-sectional 2011–2013	32 had T2DM children aged 0–14	Data from MoH diabetes registry	The overall incidence rate for ages 0–14 years was 2.56/1000. Most of the patients (*n* = 30; 93.8%) presented with T2DM between ages 10 and 14 years, only 2 below 10 years The male to female ratio was 1.0, 16 cases were male & 16 female The youngest patient was female aged 6 years with BMI 36.1 kg/m2 There was no statistically significant difference between sexes with regards to BMI or HbA1c at diagnosis	Study duration of the registry was relatively short Future research should focus on screening adolescents at risk of T2DM Improve management & prevent complications at early age to enjoy good quality of life

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
17	Alyafei et al. (2018) Qatar	To determine the incidence & trend of type 1 diabetes & T2DM, among children aged 0–14 years, in Qatar	Retrospective cross-sectional 2012–2016	45 had T2DM children aged 0–14	Data were obtained from the Pediatric Diabetes Center of Hamad Medical Center	No cases of T2DM were registered before 2008 The incidence of T2DM was equal to 28.39 per 100,000 The male to female ratio for T2DM was 1:1.4, more females All T2DM adolescents were obese or overweight & had a positive family history of T2DM A significant trend increase was registered in the 2012 - 2016 period compared to previous years	Study duration of the registry was relatively short Future research is required to determine the causes of these increases in T2DM cases
18	Ahmed et al. (2022) Qatar	To describe the epidemiology, clinical, biochemical, immunological and radiological aspects of T2DM in youth	Retrospective cross-sectional 2018–2020	104 T2DM children aged 0–18 years	Data were obtained from the AlSidra Pediatric Diabetes Hospital	The incidence of T2DM in 2020 was 2.51 per 100,000 Males were more affected than females (1.5/1) Overweight/obesity was present in 98% of all the patients Positive family history of T2DMn 71% Maternal gestational diabetes found in 60% of patients. More than 90% had acanthosis nigricans	Study duration of the registry was relatively short Programs for early detection & prevention of T2DM & its complications

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
19	Cheema et al. (2022) Qatar	To determine the prevalence of overweight, obesity and T2DM in adolescents To evaluate associations with adolescents' lifestyle and breastfeeding history, parental weight, and familial T2DM history	Cross-sectional (double-stage cluster sampling) 2018–2020 using self-administered questionnaires	459 adolescents aged 13–17 years	Family history of diabetes BMI Pre-diabetes WC Acanthosis nigricans RBS	Obesity was significant with no breastfed adolescents. Central obesity was significant with maternal obesity and acanthosis nigricans. Acanthosis nigricans was associated with increased RBG	The strength is the sampling strategy (double- clustered), which is appropriate to conduct future studies requiring a large sample population for generalisability Limitations was the use of RBG instead more reliable glucose tests; and self-reporting bias by the participants The need for extensive health and wellbeing programs that focus on healthy lifestyle and behaviours in addition to stress management and self-care

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
20	Mirbolouk et al. (2016) Iran	To evaluate the incidence and predictors of early adulthood prediabetes / T2DM among Iranian adolescents	Retrospective Multivariate Cox-proportional analysis (1999–2001) and follow-ups with 3-year intervals until 2011	2563 aged 10–19 years without prediabetes / T2DM at baseline	BMI WC FPG Lipid profile BP -Family istory for obesity, T2DM, lipid profile, HTN, & smoking	Approximately 1% of Iranian adolescents develop prediabetes / T2DM yearly The presence of general adiposity and higher FPG are indicators that should be considered for adolescents at risk of developing T2DM. Parental risk factors were associated with the development of prediabetes / T2DM in adolescents	The strengths were using the standard definitions of T2DM and pre-diabetes; and the measuring parental risk factors instead of self-reported factors Limitations include not reporting physical activity and nutrition patterns which have been factors for T2DM. Puberty stages were also not considered when analysing the results The need for more population studies regarding the incidence and predictors of prediabetes / T2DM in young population

N	Author, date & country	Aim	Method	Sample	Outcomes & variables	Findings	Strengths, limitations & recommendations
21	Almari, Alsaedi, Mohammad & Ziyab (2018) Kuwait	To estimate the prevalence of prediabetes and assess its association with adiposity among adolescents in Kuwait	Cross-sectional study The study was approved by the Health Sciences Center Ethical Committee at Kuwait UniversityAnalysed via SAS 9.4	-High school students (*n* = 1959) aged 14–19 across Kuwaiti high schools	BMI Waist-to-hip ratio HbA1c	Adolescents with high adiposity showed strong association with prediabetes. Students with prediabetes and no parental history had high BMI Parental history affected the probability of their children's prediabetes according to their gender Maternal history was associated with prediabetes in male students, and paternal history with the females	Strength included the large and representative sample of adolescents, and objective measurements of weight, height, waist and hip circumferences, and HbA1c A limitation would be limitation of our study is the use of point-of-care system to measure HbA1c instead of a more accurate lab-based analysis

Note. T2DM = type 2 diabetes mellitus; BMI = body mass index; FBG = fasting blood glucose; HbA1c = glycated haemoglobin A1c; OGTT = oral glucose tolerance test; ADA = American Diabetes Association; HOMA-IR = homeostasis model assessment estimated insulin resistance; MS = metabolic syndrome; WC = waist circumference; BP = blood pressure; HTN = hypertension; NCD = non-communicable disease; CVD = cardiovascular disease; HRB = health-related behaviour ; IFG = impaired fasting glucose; MoH = Ministry of Health; RBS = Random Blood Sugar:

Appendix 3: Search strategy

	Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions <1946 to May 27, 2022>	
1	exp Diabetes Mellitus, Type 2 /	157977
2	(MODY or NIDDM or T2DM or T2D). tw,kw.	49425
3	(non insulin* depend* or noninsulin* depend* or noninsulin?depend* or non insulin?depend*). tw,kw.	12419
4	((typ? 2 or typ? II or typ?2 or typ?II) adj3 diabet*). tw,kw.	170689
5	(((late or adult* or matur* or slow or stabl*) adj3 onset) and diabet*). tw,kw.	5111
6	Or /1-5	225893
7	exp life style /	106553
8	(life adj2 (style$ or change$ or event$)). tw,kw.	38565
9	(lifestyle* or life style*). tw,kw.	133052
10	exp Health Behavior /	351923
11	(health and (behaviour* or behavior*)). tw,kw.	224388
12	Smoking Cessation /	31558
13	smoking cessation/ or smoking reduction/ or "tobacco use cessation"/	32734
14	exp Smoking /	157726
15	(smoking or smoker* or vaping or vape or nicotine or tobacco or cigarette*). tw,kw.	379445
16	drinking behavior/ or alcohol abstinence/ or exp alcohol drinking /	82400
17	((alcohol* or drinking) adj3 (use* or misuse* or drink* or stop* or quit*)). tw,kf.	173953
18	exp Exercise /	231900
19	exp Exercise Therapy /	59716
20	Walking/ or sports/ or bicycling/ or running/ or swimming/ or Physical Fitness /	143515
21	(sport* or exercis* or walk* or swim* or cycling or cyclist* or run* or jog*). tw,kw.	816983
22	(physical* adj (fit* or activ*)). tw,kw.	147446
23	Diet /	177780
24	exp Dietary Supplements /	93502
25	exp food habits/ or meals /	190093
26	exp Diet Therapy /	60266
27	exp Nutrition Therapy /	110581
28	Caloric Restriction /	6973
29	(diet* or nutrit*). tw,kw.	886416

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions <1946 to May 27, 2022>		
30	Weight Reduction Programs /	2725
31	Weight Loss /	41263
32	((weight or fat) adj2 (loss or lost or reduc* or eliminat* or gain* or high* or low* or increas*)). tw,kw.	417372
33	((body mass index or bmi) adj3 (loss or lost or reduc* or eliminat* or gain* or high* or low* or increas*)). tw,kf.	62928
34	body mass index /	143523
35	exp Health Behavior /	351923
36	(health* adj4 (behaviour* or behavior* or habit*)). tw,kw.	86454
37	exp Sleep /	91808
38	exp Sleep Wake Disorders /	102838
39	(sleep or insomnia* or parasomnia* or dysomnia*). tw,kw.	204921
40	Or /7-39	3531831
41	Arabs /	5216
42	africa, northern/ or algeria/ or egypt/ or libya/ or morocco/ or tunisia/ or liberia/ or mali/ or mauritania/ or niger/ or nigeria/ or senegal/ or middle east/ or afghanistan/ or bahrain/ or iran/ or iraq/ or jordan/ or kuwait/ or lebanon/ or oman/ or qatar/ or saudi arabia/ or syria/ or turkey/ or united arab emirates/ or yemen /	206245
43	(middle east* or arab* or Saudi Arabia or Jordan* or Libya* or Sahrawi Republic or Yemen* or United Arab Emirates or UAE or Oman* or Kuwait* or Qatar* or Bahrain or Iran or Israel* or Iraq* or kurd* or Tunisia* or Afghanistan* or Western Sahara or Yemen* or Algeria* or Leban* or Morocco* or Palestine or Jordan* or Djibouti* or Libya* or sundan*). tw,kw.	1041403
44	Or /41-43	1126053
45	adolescent/ or child /	3049840
46	(child* or (school adj child*) or schoolchild* or (school adj age*) or schoolage*). tw,kw.	1566967
47	(kid or kids or adoles* or teen* or boy* or girl*). tw,kw.	581213
48	(minors* or (under adj ag*) or underage* or juvenil* or youth* or young adult*). tw,kw.	298265
49	(puber* or pubescen* or prepubescen* or prepubert*).tw,kw.	55279
50	((high adj school*) or highschool* or (primary adj school*) or (elementary adj school) or (secondary adj school*)). tw,kw.	69257
51	Or /45-50	3892019
52	6 and 40 and 44 and 51	308

Appendix 4: Johns Hopkins research evidence appraisal tool

Appendix 5: Johns Hopkins evidence level and quality guide

Removed due to copyright restriction.

Appendix 6: Ethics Approval from Women's and Children's Health Network Human Research Ethics Committee in Australia

27th August 2020

Women's & Children's Hospital

Research Secretariat
Level 2, Samuel Way Building
72 King William Rd
North Adelaide SA 5006
Tel 08 8161 6390
Fax 08 8161 6521
www.wch.sa.gov.au

Mr A Hasan
College of Nursing and Health Sciences
Flinders University

Dear Mr Hasan

Re: A school nurse-led, assessor-blinded, randomised, 6-Month clinical trial to evaluate the effectiveness of an educational program in the prevention of type 2 diabetes among children and adolescents in Kuwait. HREC/20/WCHN/11. Expiry date: 31/08/2023.

Lead HREC for the above study for the following institutions/sites:

Flinders University

I refer to your letter dated 24th July 2020 in which you responded to matters raised by the WCHN Human Research Ethics Committee at its 26th February 2020 meeting. I am pleased to advise that, at its meeting on 26th August 2020 your protocol was granted full ethics approval and meets the requirements of the *National Statement on Ethical Conduct in Human Research*.

Specifically, the following documents have been noted/approved:

Document	*Version*	*Date*
Protocol: Study protocol	1	22 July 2020
HREA Application: AU/1/123B311		11 February 2020
Consent Form (English)	1	24 July 2020
Consent Form (Arabic)	1	24 July 2020
Participant Information Sheet (English)	1	24 July 2020
Participant Information Sheet (Arabic)	1	24 July 2020
Letter of Introduction (English)	1	24 July 2020
Letter of Introduction (Arabic)	1	24 July 2020

This letter constitutes advice on ethical consideration only. You must not commence this research project at a site until you have obtained separate research governance approval from the site concerned. A copy of this letter should be forwarded to all site investigators for submission to the relevant Research Governance Officer.

The Committee has approved the study on the understanding that it does not involve any WCHN patients or staff and that the research is not carried out at any SA Health site. This letter therefore constitutes advice on ethical consideration only. All research governance matters, including indemnification, are the responsibility of Flinders University and it is recommended that you obtain appropriate governance approval from Flinders University before proceeding. If the study is amended to include the WCHN or any SA Health site, separate authorisation from the Chief Executive or delegate of that site must be obtained through a Site Specific Assessment (SSA) request. For information on this process at the WCHN, please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

I remind you approval is given subject to:
•immediate notification of any serious or unexpected adverse events to participants;

Government of South Australia

SA Health

•immediate notification of any unforeseen events that might affect continued ethical acceptability of the project;
•submission of any proposed changes to the original protocol. Changes must be approved by the Committee before they are implemented;
•immediate advice, giving reasons, if the protocol is discontinued before its completion;
•submission of an annual report on the progress of the study, and a final report when it is completed to the WCHN Research Governance Officer. It is your responsibility to provide these reports, without reminder. The proforma for the report may be found on the WCHN Research Governance and Ethics website.

Approval is given for three years only. If the study is more prolonged than this, an extension request should be submitted unless there are significant modifications, in which case a new submission may be required. Please note the expiry date in the title above and include it in any future communications.

The WCHN HREC wishes you every success with your research.

Yours sincerely

TAMARA ZUTLEVICS (DR)
CHAIR
WCHN HUMAN RESEARCH ETHICS COMMITTEE

Appendix 7: Ethics Approval SA Health

2021/HRE00145: Application HREA - Approved

no_reply@gems.sahealth.sa.gov.au <no_reply@gems.sahealth.sa.gov.au>
Thu 12/08/2021 2:57 PM
To: yvonne.parry@flinders.edu.au <yvonne.parry@flinders.edu.au>
Cc: Abdullah Hasan <hasa0049@flinders.edu.au>

Date of Decision Notification: **12 Aug 2021**
Dear Abdullah Hasan,

Thank you for submitting the following Human Research Ethics Application (HREA) for HREC review;

2021/HRE00145: "Studies to explore the association between health-related behaviours and HbA1c and BP among Kuwaiti young people at risk of type 2 diabetes mellitus" A repeated cross-sectional study

Your response has been reviewed by the Chair of the WCHN Human Research Ethics Committee. I am pleased to advise that your protocol has been granted full ethics approval and meets the requirements of the *National Statement on Ethical Conduct in Human Research*.

This project has been approved to be conducted at the following sites:

- Women's and Children's Hospital

The following documentation was reviewed and is included in this approval:

- Abdullah Hasan-ATLS questionnaire-0-03-Apr-2021
- Abdullah Hasan-Demographic data-0-03-Apr-2021
- Abdullah Hasan-HLSUS questionnaire-0-03-Apr-2021
- Arabic consent form (children)-1-15-Jun-2021
- Arabic consent form (young adults)-1-15-Jun-2021
- English consent form (children)-1-15-Jun-2021
- English consent form (young adults)-1-15-Jun-2021
- HREA
- New Study Protocol_Edited_Final.docx
- PhD's Information sheet (arb).docx
- PhD's Information sheet (eng) (1).docx
- ProjectRegistration
- Researcher's responds to HERA's feedback -0-15-Jun-2021

Application Documents - (**Please note : Due to security reasons, this link will only be active for 14 days**.)

The Human Research Ethics Application reviewed by the HREC was:
Version: 1.02
Date: 12 Aug 2021

The approval is for a period of **3 years from the date of this e-mail (12 Aug 2021)** , on condition of the submission of annual reports for both ethics and governance applications.

This HREC is constituted and operates in accordance with the National Statement on Ethical Conduct in Human Research (2007) (Updated 2018). The processes used by this HREC to review multi-centre research proposals have been certified by the National Health and Medical Research

Council. Confidentiality of the research subjects must be maintained at all times as required by law.

This letter constitutes advice on ethical consideration only. You must not commence this research project at a site until you have obtained separate research governance approval from the site concerned.

At the WCHN, or any other SA Health site, separate authorisation from the Chief Executive or delegate of that site must be obtained through a Site Specific Assessment (SSA) request. For information on this process at the WCHN, please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

I remind you approval is given subject to:

- immediate notification of any serious or unexpected adverse events to participants;
- immediate notification of any unforeseen events that might affect continued ethical acceptability of the project;
- submission of any proposed changes to the original protocol. Changes must be approved by the Committee before they are implemented;
- immediate advice, giving reasons, if the protocol is discontinued before its completion;
- submission of an annual report on the progress of the study, and a final report when it is completed to the WCHN Research Governance Officer. It is your responsibility to provide these reports, without reminder. The proforma for the report may be found on the WCHN Research Governance and Ethics website.

Please contact us if you would like to discuss any aspects of this process further.

The WCHN HREC wishes you every success with your research.

Yours sincerely

Dr Tamara Zutlevics
Chair, WCHN Human Research Ethics Committee

GEMS

Appendix 8: Ethics Approval from Ministry of Health in Kuwait

State of Kuwait
Ministry of Health
Asst. Undersecretary
for Planning & Quality

دولـة الكـويـت
وزارة الـصـحـــة
وكيل الوزارة المساعد لشئون
التخطيط والجودة

كويت جديدة
NEWKUWAIT

المرجع : 1018

التاريخ : 1-9-2020

To Whom it May Concern

***From**: Ministry of Health – Kuwait*

The Standing Committee for Coordination of Medical Research

To: Mr Abdullah Hasan
UNIVERSITY OF FLINDERS - ADELAIDE - AUSTRALLA

A school nurse-led clinical trial to evaluate the effectiveness of an educational program in the prevention of type 2 Diabetes Mellitus among children and adolescents in Kuwait"

(#1318/2020)
The above mentioned Proposal was given an ethical approval by the Committee on August 31, 2020.

The research will be conducted in Kuwait MOH Kuwait Institutions

Asst. Undersecretary for
Planning & Quality

Head, Standing Committee for Coordination of Medical Research

Ministry of Health – State Of Kuwait

Dr. Mohammad Jassem Al Khashti
Asst. Undersecretary for Private
Medical Services Affairs

31 | 4 | 2020

د/ محمد جاسم الخشتي
وكيل الوزارة المساعد لشئون
التخطيط والجودة

P.O. Box : (5) 13001 Safat, State Of Kuwait
Tel.: 24622230/24622228 - Fax : 24866514

ص. ب. (٥) الرمز البريدي ١٣٠٠١ الصفاة، الكويت
تلفون: ٢٤٦٢٢٢٣٠/٢٤٦٢٢٢٢٨ - فاكس: ٢٤٨٦٦٥١٤

Appendix 9: Ethics Approval from Ministry of Education in Kuwait

MINISTRY OF EDUCATION
CAPITAL EDUCATIONAL AREA
DIRECTOR MANAGER OFFICE

وزارة التربية
الإدارة العامة لمنطقة العاصمة التعليمية
مكتب المدير العام

Date: ٢٠٢٠/١٠/١١

المرجع: ٤٨٣٥٣

قسم السكرتارية والسجل
الصادر
15 OCT 2020
الجهة ٥١٤٦
الرقم

نشرة خاصة
لمدارس المرحلة المتوسطة ،الثانوية
(بنين بنات)

السادة المحترمون / مديرو ومديرات المدارس

تحية طيبة وبعد،،،

الموضوع: تسهيل مهمة الباحث عبدالله يعقوب حسين

بالإشارة إلى كتاب إدارة البحوث التربوية رقم ٢٧٥ والمؤرخ في ٢٠٢٠/٩/١٦ م والخاص بالموضوع أعلاه.

يرجى التكرم بتسهيل مهمة الباحث / عبدالله يعقوب حسين المقيد بكلية التمريض والعلوم الصحية بجامعة فلندرز – أستراليا بتطبيق استبانة بعنوان :

(تجربة سريرية بقيادة التمريض المدرسي لتقييم فعالية البرامج التثقيفية في الوقائية من دواء السكر من النوع الثاني بين الاطفال والمراهقين في الكويت).

ويتطلب هذا البحث تطبيق المقاييس المختومة صفحاتها على المرحلة التابعة وفق اللوائح والنظم المعمول بها في وزارة التربية ومراعاة القرارات الصحية الخاصة بالتباعد الاجتماعي والشروط المتعلقة بهذا الشأن.

ملاحظة: لا يتضمن البحث إجراء اي تجارب طبية أو إعطاء أدوية او أخذ عينات حيوية..

مع خالص التحية،،،

مدير عام
الإدارة العامة لمنطقة العاصمة التعليمية
منطقة العاصمة التعليمية بالإنابة

نسخة لكل من:
- مدير عام المنطقة
- قسم التخطيط والمعلومات

وزارة التربية

تليفون: 22412334 – فاكس: 22412355 ص.ب: 2396 الصفاة – الرمز البريدي 13024 الكويت
www.moe.edu.kw - www.capital-edu-kw

75/30EA 0098386/13/10000

وزارة التربية
الإدارة العامة لمنطقة الأحمدي التعليمية
مكتب المدير العام

التاريخ: ....
الموافق: ....
رقم الإشارة: ....

نشرة خاصة لمدارس المرحلتين الثانوية و المتوسطة (بنين)

السادة / مديرو المدارس .. المحترمون
تحية طيبة وبعد ،،،

الموضوع: تسهيل مهمة

بالإشارة إلى الموضوع أعلاه، وإلى كتاب مدير إدارة البحوث التربوية رقم ٢٧٦ المؤرخ في ٢٠٢٠/٩/١٦م ، بشأن قيام الباحث / **عبد الله يعقوب حسين** بكلية التمريض والعلوم الصحية بجامعة فلندرز بتطبيق استبانة بعنوان ((تجربة سريرية بقيادة التمريض المدرسي لتقييم فعالية البرامج التثقيفية في الوقاية من داء السكر من النوع الثاني بين الأطفال والمراهقين بدولة الكويت))

يرجى تسهيل مهمة المذكور من خلال تطبيق الاستبانة المختومة صفحاتها من إدارة البحوث التربوية على مدارس المرحلتين الثانوية و المتوسطة وذلك خلال العام الدراسي الحالي ٢٠٢١/٢٠٢٠م دون التأثير على انتظام سير العملية التعليمية، وكذلك مراعاة الإجراءات الاحترازية الوقائية التي تتبعها الإدارات المدرسية في مثل هذه الحالات .

مع خالص التحية؛؛؛

مدير عام
الإدارة العامة لمنطقة الأحمدي التعليمية

منصور عبدالله الديحاني
مدير عام منطقة الأحمدي التعليمية

نسخة إلى:
- مدير الشؤون التعليمية.
- الملف

م . رمضين ٢٠٢٠/٠٩/٢٧

ص.ب: 51247 الرمز البريدي 53453 - الفحيحيل - تلفون: 23923523 - 23923525 - 23923521 - فاكس: 23923524
البريد الالكتروني: (Email: m.k.sahmad@hotmail.com)

Appendix 10: Permission to use Arab Teens Lifestyle Study questionnaire

Abdullah Hasan
To: Hazzaa Al-H
Tue 21/03/2023 2:14 PM

Dear Professor Al Hazzaa

Thank you for your kind permission to use the questionnaire. I really appreciate it.

kind regards

Abdullah Hasan *MN, GDipANP, BSN, AssocDegN.*
PhD Candidate
+61 431 779 438
hasa0049@flinders.edu.au

Reply Forward

HA Hazzaa Al-Hazzaa <halhazzaa@hotmail.com>
To: Abdullah H
Thu 16/03/2023 11:15 PM

تبانة أطلس عربي- منقح 2018...
176 KB

Show all 5 attachments (2 MB) Save all to OneDrive - Flinders Download all

Dear Abdullah,
Kindly, find attached the updated ATLS questionnaire along with the instructions.

BR.

Hazzaa

Hazzaa M. Al-Hazzaa, PhD, FACSM, FECSS
Professor Emeritus, Founder, and Former Head, Lifestyle and Health Research Center,
Health Sciences Research Center, Princess Nourah Bint Abdulrahman University.
Former Director, Pediatric Exercise Physiology Research Laboratory &
Former Board member, Obesity Research Chair, King Saud University
P. O. Box 93216
Riyadh 11673, Saudi Arabia
halhazzaa@hotmail.com
https://lh-hsrc.pnu.edu.sa/
https://scholar.google.com/citations?user=DJpXW6wAAAAJ&hl=en&oi=sra

Appendix 11: Permission to use Healthy Lifestyle Scale for University Students questionnaire

Brietta.Pike@csiro.au

To: Abdullah H

Wed 4/10/2017 10:08 AM

Dear Abdullah

This scale was developed by the authors and is a published finding. It is fine for you to use their scale for your own research, as long as you refer to the paper with the correct citation upon publication.

Best wishes
Brietta

Reply Forward

AH Abdullah Hasan

Dear Briette, thanks for your reply, yes I want to reuse Healthy Lifestyle Scale. could you...

Thu 28/09/2017 3:57 PM

See 2 more messages

AH Abdullah Hasan

To: publishing@

Sun 24/09/2017 4:57 PM

Hi,

I am a postgraduate student at Flinders University in South Australia. I was not able to contact the main author of the Healthy Lifestyle Scale for University Students. Could you please grant me the permission to use this tool in my research.

Article title: The Healthy Lifestyle of University Students: development and psychometric testing
Author: Dong Wang
Published: 2012

Thank you

Abdullah Hasan

Appendix 12: Permission to use the sleep questionnaire

Abdullah Hasan

To: owensleep

Wed 22/03/2023 9:08 PM

Dear Professor Owens

Thank you for your kind permission to use the questionnaire. I really appreciate it.

Kind regards

Abdullah Hasan MN, *GDipANP, BSN, AssocDegN.*
PhD Candidate
+61 431 779 438
hasa0049@flinders.edu.au

Reply Forward

JO Judith
Owens <owensleep@gmail.com
>

To: Abdullah

Wed 22/03/2023 10:03 AM

CSHQ with coding-rev 3-31-...
28 KB

4 attachments (129 KB) Save all to OneDrive - Flinders Download all

Thank you for your inquiry regarding the CSHQ and please see the attached materials. Good luck with your project! Best, Judy Owens

--

Judith Owens MD MPH
Boston Children's Hospital
Professor of Neurology
Harvard Medical School
Judith.owens@childrens.harvard.edu

Appendix 13: Information sheet (English)

Mr Abdullah Hasan
College of Nursing and Health Sciences
Flinders Drive, Bedford Park SA 5042
GPO Box 2100
Adelaide SA 5001
Tel: +61 8 82013149
Email: hasa0049@flinders.edu.au

INFORMATION SHEET

(for 'Participants')

Title: *"Studies to explore the relationship between health-related behaviours and HbA1c and BP among Kuwaiti young people at risk of type 2 diabetes mellitus"*

Researcher:
Mr Abdullah Hasan
Flinders University
Email: hasa0049@flinders.edu.au

Supervisor(s):
Dr Yvonne Parry
Flinders University
Email: yvonne.parry@flinders.edu.au

Prof Richard Woodman
Flinders University
Email: richard.woodman@flinders.edu.au

Dr Didy Button
Flinders University
Email: didy.button@flinders.edu.au

Dr Meshari Al-Koot
Meshari Clinic
Email: dr_m@q8i.org

Description of the study:
This study will be an experimental study which aims to explore the relationship between health-related behaviours and HbA1c and BP among Kuwaiti young people at risk of type 2 diabetes mellitus. It is a 6-month study where participants will be involved in two examinations and physical assessments. The Flinders University College of Nursing and Health Sciences, Flinders Centre for Epidemiology and Biostatistics, and Meshari clinic support this project.

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

Purpose of the study:
This project aims to:

1. To determine, within the Kuwaiti context, the relationship between health-related behaviours and HbA1c and BP
2. To identify pre-diabetes and prehypertension among young people in Kuwait
3. To compare outcomes measurements between different age groups

What will I be asked to do?
You/your child are invited to participate in this six-month study. You/your child will be asked about their age, gender, height, weight, and parents' medical history. In addition, you/your child will be asked about their medical history whether they have one or more of the following medical conditions: hypertension, high cholesterol levels, asthma, acanthosis nigricans, polycystic ovary syndrome or epilepsy. These data will help the researcher to assess your/your child's eligibility to participate in this study. If you/your child is eligible, an appointment will be given to perform the physical assessments. There will be two physical assessments in a private clinic. During the physical assessment, the research assistants will measure your height, weight, waist circumference and calculate your BMI. Your accumulated blood sugar and blood pressure will be checked. Demographic data, your medical history and your parents'/grandparents' will be collected. You/your child will be asked also to complete a lifestyle questionnaire that covers different aspects of your health-related habits like eating habits, food choices, sleeping patterns and daily physical activities.

What benefit will I gain from being involved in this study?
You/your child will be familiar with some habits that may affect your general health and wellbeing. The results might lead to possible improvements in the school's health services, schools' and universities' buildings and amenities.

Will I be identifiable by being involved in this study?
You/your child will not be identifiable by anyone except the researcher. Your name and your child's name will not be used during data collection. Please 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. However, if you/your child will be diagnosed with type 2 diabetes during the physical assessment, you will be referred to health professionals in the Ministry of Health. In this case you/you child might be identifiable and your/your child information will be shared with another health professional. Please be assured that the health professionals in the Ministry of Health with maintain your/your child confidentiality and this service is free of charge.

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

Are there any risks or discomforts if I am involved?

Your child will receive 2 finger pricks during this study. Finger pricks will be used during the physical assessment to check blood sugar. Nurses/research assistants will follow strict steps to control any chance of infection and reduce discomfort.

You/your child have the option to choose between a female or a male nurse to perform the physical assessment to reduce the embarrassment and discomfort.

How do I agree to participate?

If you/your child show interest to participate in this study, a consent form will be given to you and you have to read and sign it. In addition to your formal consent, the nurse/research assistant will listen to your child opinions and always ask for his/her verbal consent regarding actions that will be next taken, like physical assessments.

"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 Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

Appendix 14: Information sheet (Arabic)

Flinders UNIVERSITY ADELAIDE • AUSTRALIA

ورقة المعلومات للمشاركين في البحث

العنوان: " دراسات لاستكشاف العلاقة بين السلوكيات المتعلقة بالصحة العامة وسكر الدم التراكمي وضغط الدم بين الشباب الكويتيين المعرضين لخطر الإصابة بداء السكري من النوع الثاني "

وصف الدراسة:

هذه الدراسة تهدف إلى استكشاف العلاقة بين السلوكيات المتعلقة بالصحة العامة وسكر الدم التراكمي وضغط الدم بين الشباب الكويتيين المعرضين لخطر الإصابة بمرض السكري من النوع الثاني. مدة الدراسة ستة أشهر حيث سيشارك المشاركون في فحصين وتقييمين جسديين. يدعم هذا المشروع كلية التمريض والعلوم الصحية بجامعة فلندرز-أستراليا ، ومركز فلندرز لعلم الأوبئة والإحصاء الحيوي-أستراليا ، وعيادة مشاري- الكويت.

الغرض من الدراسة:

1. لتحديد العلاقة بين السلوكيات المتعلقة بالصحة العامة وسكر الدم التراكمي وضغط الدم في السياق الكويتي
2. التعرف على حالات ما قبل السكري وارتفاع ضغط الدم لدى الشباب في الكويت
3. لمقارنة قياسات النتائج بين الفئات العمرية المختلفة

ماذا سيطلب مني أن أفعل؟

أنت / طفلك مدعو للمشاركة في هذه الدراسة لمدة ستة أشهر. سيتم سؤالك أنت/ طفلك عن عمره وجنسه وطوله ووزنه والتاريخ الطبي للأم و الأب. بالإضافة إلى ذلك، سيتم السؤال عن التاريخ الطبي للمشاركين عما إذا كان لديهم حالة أو أكثر من الحالات الطبية التالية: ارتفاع ضغط الدم، وارتفاع مستويات الكوليسترول في الدم، والربو، والشواك الأسود، ومتلازمة المبيض المتعدد الكيسات أو الصرع. ستساعد هذه البيانات الباحث على تقييم أهلية طفلك للمشاركة في هذه الدراسة. إذا كنت أنت / طفلك مؤهلاً ، فسيتم تحديد موعد لإجراء التقييمات الجسدية. سيكون هناك تقييمان جسديان في عيادة خاصة. أثناء التقييم البدني ، سيقيس مساعدو البحث طولك ووزنك ومحيط الخصر وحساب مؤشر كتلة الجسم. سيتم فحص سكر الدم المتراكم وضغط الدم. سيتم جمع البيانات الديموغرافية وتاريخك الطبي وتاريخ والديك / أجدادك. سيُطلب منك / طفلك أيضًا إكمال استبيان نمط الحياة الذي يغطي جوانب مختلفة من عاداتك المتعلقة بالصحة مثل عادات الأكل وخيارات الطعام وأنماط النوم والأنشطة البدنية اليومية.

ما الفائدة التي سأحصل عليها من مشاركتي في هذه الدراسة؟

ستكون أنت / طفلك على دراية بنتائج الفحوصات الطبية وبعض العادات الصحية التي قد تؤثر على صحتك وصحة طفلك. قد تؤدي نتائج هذه الدراسة إلى تحسينات محتملة في الخدمات التمريضية والصحية في المدارس بشكل خاص والمجتمع بشكل عام.

هل سيتم التعرف علي من خلال مشاركتي في هذه الدراسة؟

لن يتم التعرف عليك أنت أو طفلك من قبل أي شخص باستثناء الباحث. لن يتم استخدام اسمك واسم طفلك أثناء جمع البيانات. يرجى التأكد من أن أي معلومات يتم تقديمها سيتم التعامل معها بسرية تامة ولن

وقد تمت الموافقة على هذا المشروع البحثي من قبل لجنة أخلاقيات البحث العلمي والبشري بشبكة صحة المرأة والطفل في جنوب أستراليا (رقم المشروع *HRE00145*)

يتم التعرف على أي من المشاركين بشكل فردي في الأطروحة الناتجة. ومع ذلك ، إذا تم تشخيصك أنت أو طفلك بمرض السكري من النوع 2 أثناء التقييم البدني ، فسيتم تحويلك إلى المهنيين الصحيين في وزارة الصحة. في هذه الحالة ، قد يتم تحديد هويتك أنت / طفلك وسيتم مشاركة معلوماتك / معلومات طفلك مع أخصائي صحي آخر. يرجى التأكد من أن المهنيين الصحيين في وزارة الصحة يحافظون على سرية معلوماتك / سرية طفلك وهذه الخدمة مجانية.

هل هناك أي مخاطر أو مضايقات خلال مشاركتي في هذه الدراسة؟

سيتم استخدام وخز الإصبع أثناء التقييم البدني. ستتبع بروتوكولات منع العدوى من قبل فريق البحث للسيطرة على أي فرصة العدوى.

لديك / طفلك الخيار في الاختيار بين ممرض أو ممرضة لإجراء التقييم البدني للحد من الإحراج وعدم الراحة.

كيف أوافق على المشاركة؟

إذا أبديت أنت / طفلك اهتمامًا بالمشاركة، سيتم تقديم نموذج الموافقة لك وعليك قراءتها بتمعن والتوقيع عليها. بالإضافة إلى موافقتك الرسمية، سوف يقوم فريق البحث العلمي بالانصات وملاحظة آراء طفلك وتطلب موافقته الشفوية دائماً بشأن الإجراءات التي سيتم اتخاذها.

الباحث:

السيد عبدالله يعقوب حسن
كلية التمريض والعلوم الصحية
جامعة فليندرز
الهاتف: 98890665
الواتساب: 0061431779438
البريد الإلكتروني: hasa0049@flinders.edu.au

المشرفين:

الدكتورة ايفون باري
جامعة فليندرز
البريد الإلكتروني: yvonne.parry@flinders.edu.au

البروفيسور ريتشارد وودمان
جامعة فليندرز
البريد الالكتروني: richard.woodman@flinders.edu.au

الدكتورة دايدي بوتون
جامعة فلندرز
البريد الالكتروني: didy.button@flinders.edu.au

"نشكرك على تخصيص بعض الوقت لقراءة ورقة المعلومات هذه ونأمل أن تقبل دعوتنا للمشاركة"

وقد تمت الموافقة على هذا المشروع البحثي من قبل لجنة أخلاقيات البحث العلمي والبشري بشبكة صحة المرأة والطفل في جنوب أستراليا (رقم المشروع *HRE00145*)

Appendix 15: Consent form for children (English)

Flinders UNIVERSITY ADELAIDE • AUSTRALIA

Mr Abdullah Hasan
College of Nursing and Health Sciences
Flinders Drive, Bedford Park SA 5042
GPO Box 2100
Adelaide SA 5001
Tel: +61 8 82013149
Email: hasa0049@flinders.edu.au

CONSENT FORM (participants aged 10-18years)

Title: *"Studies to explore the association between health-related behaviours and HbA1c and BP among Kuwaiti young people at risk of type 2 diabetes mellitus"*

I ____________ (parent's name) ________________

hereby consent to my child involvement in this research project.

1. The nature and purpose of the research project described on the attached Information Sheet has been explained to me. I understand it and agree to my child taking part.
2. I understand that my child may not directly benefit by taking part in this study.
3. I acknowledge that the possible risks and/or side effects, discomforts and inconveniences, as outlined in the Information Sheet, have been explained to me.
4. I understand that there will be no payment to me or my child for taking part in this study.
5. I have had the opportunity to discuss taking part in this research project with a family member or friend, and/or have had the opportunity to have a family member or friend present whilst the research project was being explained by the researcher.
6. I am aware that I should retain a copy of the Consent Form when completed, and the Information Sheet.
7. I consent to physical assessments that will be performed to my child and will be used in the above project.
8. I understand that my child's information will be kept confidential as explained in the information sheet.

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

Flinders UNIVERSITY ADELAIDE • AUSTRALIA

9. I understand that the alternate contacts I have provided may be used to contact me as explained in the information sheet for study-related purposes.

Signed: ....

Relationship to child: ....

Full name of child: ....

Dated: ....

I certify that I have explained the study to the parent the child, and consider that he/she understands what is involved.

Signed: .... Title: ....

Dated: ....

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HREC00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

Appendix 16: Consent form for children (Arabic)

السيد عبدالله يعقوب حسن
كلية التمريض والعلوم الصحية
جامعة فلندرز - أستراليا
أديليد 5001
هاتف: 82015433 (08) 61+
البريد الإلكتروني: hasa0049@flinders.edu.au

رقم التسلسل ....

اقرار موافقة مستنير/نموذج الموافقة

العنوان: " دراسات لاستكشاف العلاقة بين السلوكيات المتعلقة بالصحة العامة وسكر الدم التراكمي وضغط الدم بين الشباب الكويتيين المعرضين لخطر الإصابة بداء السكري من النوع الثاني "

أنا ____________ أوافق بموجبه على مشاركة طفلي ____________ في هذا المشروع البحثي.

1. تم شرح طبيعة وغرض المشروع البحثي الموضح في ورقة المعلومات المرفقة. وأوافق على مشاركة طفلي.
2. أتفهم أن طفلي قد لا يستفيد بشكل مباشر من خلال مشاركته في هذه الدراسة.
3. لقد تم شرح لي الآثار الجانبية البسيطة لهذه الدراسة، كما هو موضح في ورقة المعلومات.
4. يمكنني الانسحاب انا و طفلي من الدراسة في أي مرحلة وذلك لن يؤثر على التحصيل الدراسية أو الرعاية الطبية أو أي جوانب أخرى لطفلي.
5. لن يتم دفع أي مبلغ مالي لي أو لطفلي للمشاركة في هذه الدراسة.
6. أدرك أنه يجب علي الاحتفاظ بنسخة من نموذج الموافقة عند استكمالها ونسخة من ورقة المعلومات.
7. أوافق على الفحوصات والاجراءات الطبية التي سيتم إجراؤها لطفلي وسيتم استخدامها في المشروع أعلاه، كما هو موضح في ورقة المعلومات.
8. أتفهم أن معلومات طفلي ستظل سرية كما هو موضح في ورقة المعلومات.
9. سيتم الاتصال بي من قبل الباحث وفريق البحث لأغراض تتعلق بالدراسة كما هو موضح في ورقة المعلومات.

وقعت: .... بتاريخ: ....

العلاقة بالطفل: .... الاسم الكامل للطفل: ....

أقرّ بأنني قد شرحت الدراسة بشكل تفصيلي لوالد/لوالدة الطفل، وهو الآن مُلم بكامل أغراض هذه الدراسة.

وقعت: .... بتاريخ: ....

اسم الباحث: ....

وقد تمت الموافقة على هذا المشروع البحثي من قبل لجنة أخلاقيات البحث العلمي والبشري بشبكة صحة المرأة والطفل في جنوب أستراليا (رقم المشروع *HRE00145*)

Appendix 17: Consent form for young adults (English)

Flinders UNIVERSITY ADELAIDE • AUSTRALIA

Mr Abdullah Hasan
College of Nursing and Health Sciences
Flinders Drive, Bedford Park SA 5042
GPO Box 2100
Adelaide SA 5001
Tel: +61 8 82013149
Email: hasa0049@flinders.edu.au

CONSENT FORM (participants aged 18-24years)

Title: *"Studies to explore the association between health-related behaviours and HbA1c and BP among Kuwaiti young people at risk of type 2 diabetes mellitus"*

I ____________ (participant's name) ________________

hereby consent to be involved in this research project.

1. The nature and purpose of the research project described on the attached Information Sheet has been explained to me. I understand it and agree to taking part.
2. I understand that I may not directly benefit by taking part in this study.
3. I acknowledge that the possible risks and/or side effects, discomforts and inconveniences, as outlined in the Information Sheet, have been explained to me.
4. I understand that there will be no payment to me for taking part in this study.
5. I have had the opportunity to discuss taking part in this research project with a family member or friend, and/or have had the opportunity to have a family member or friend present whilst the research project was being explained by the researcher.
6. I am aware that I should retain a copy of the Consent Form when completed, and the Information Sheet.
7. I consent to physical assessments that will be performed and will be used in the above project.
8. I understand that my information will be kept confidential as explained in the information sheet.

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

9. I understand that the alternate contacts I have provided may be used to contact me as explained in the information sheet for study-related purposes.

Signed: ....

Full name: ....

Dated: ....

I certify that I have explained the study to the participants and consider that he/she understands what is involved.

Signed: .... Title: ....

Dated: ....

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

Appendix 18: Consent form for young adults (Arabic)

السيد عبدالله يعقوب حسن
كلية التمريض والعلوم الصحية
جامعة فلندرز - أستراليا
أديليد 5001
هاتف: 82015433 (08) 61+
البريد الإلكتروني: hasa0049@flinders.edu.au

رقم التسلسل ....

اقرار موافقة مستنير/نموذج الموافقة

العنوان: " دراسات لاستكشاف العلاقة بين السلوكيات المتعلقة بالصحة العامة وسكر الدم التراكمي وضغط الدم بين الشباب الكويتيين المعرضين لخطر الإصابة بداء السكري من النوع الثاني "

أنا ____________ أوافق بموجبه على المشاركة في هذا المشروع البحثي.

1. تم شرح طبيعة وغرض المشروع البحثي الموضح في ورقة المعلومات المرفقة. وأوافق على المشاركة.
2. أتفهم أنني قد لا يستفيد بشكل مباشر من خلال مشاركتي في هذه الدراسة.
3. لقد تم شرح لي الآثار الجانبية البسيطة لهذه الدراسة، كما هو موضح في ورقة المعلومات.
4. يمكنني الانسحاب من الدراسة في أي مرحلة وذلك لن يؤثر على التحصيل الدراسية أو الرعاية الطبية أو أي جوانب أخرى.
5. لن يتم دفع أي مبلغ مالي لي للمشاركة في هذه الدراسة.
6. أدرك أنه يجب علي الاحتفاظ بنسخة من نموذج الموافقة عند استكمالها ونسخة من ورقة المعلومات.
7. أوافق على الفحوصات والاجراءات الطبية التي سيتم إجراؤها لي وسيتم استخدامها في المشروع أعلاه، كما هو موضح في ورقة المعلومات.
8. أتفهم أن معلوماتي ستظل سرية كما هو موضح في ورقة المعلومات.
9. سيتم الاتصال بي من قبل الباحث وفريق البحث لأغراض تتعلق بالدراسة كما هو موضح في ورقة المعلومات.

وقعت: .... بتاريخ: ....

أقرّ بأنني قد شرحت الدراسة بشكل تفصيلي للمشارك، وهو الآن مُلم بكامل أغراض هذه الدراسة.

وقعت: .... بتاريخ: ....

اسم الباحث: ....

وقد تمت الموافقة على هذا المشروع البحثي من قبل لجنة أخلاقيات البحث العلمي والبشري بشبكة صحة المرأة والطفل في جنوب أستراليا (رقم المشروع *HRE00145*)

Appendix 19: Questionnaire

Flinders UNIVERSITY ADELAIDE • AUSTRALIA

Demographic Data **ID ....**

Age: Hight: Weight:
BMI: Waist circumference:
HbA1c: BP:

Gender: □ male □ female

Nationality: □kuwaiti □non-kuwaiti

Medical history of participants:

□hypertension □high cholesterol levels □asthma
□acanthosis nigricans □polycystic ovary syndrome □epilepsy
□others

Family medical history:

□father □mother
□grandfather □grandmother

Number of siblings:

□0 □1 □2 □3
□4 □5 □6 □more than 6

Skin type according to Fitzpatrick scale:

□ I □ II □ III □ IV □ V □ VI

Enrolled education level:

□ intermediate school □ secondary school □college/university

Father's educational level:

□less than secondary school □secondary school □diploma
□bachelor's degree □master □PhD

Mother's educational level:

□less than secondary school □secondary school □diploma
□bachelor's degree □master □PhD

Monthly family income:

□below 500KD □500-1000KD □1000-1500KD
□1500-2000KD □2000-2500KD □above 2500KD

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

Flinders UNIVERSITY ADELAIDE • AUSTRALIA

The Health-Related Behaviours Questionnaire ID ………..

- Exercise Behaviours

1) How often do you regularly walk per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

2) How often do you regularly jog or run per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

3) How often do you take part in moderate physical activity (bicycling, aerobic dancing, stair climbing, hiking) for 30–60 min (excluding warm-up)?
□ Never □ Rarely □ Sometimes □ Usually □ Always

4) how often do you exercise vigorously for 30 min (excluding warm-up)?
□ Never □ Rarely □ Sometimes □ Usually □ Always

5) Warm-up before vigorous exercise.
□ Never □ Rarely □ Sometimes □ Usually □ Always

6) Exercise vigorously within 30 min after meals.
□ Never □ Rarely □ Sometimes □ Usually □ Always

7) How many times per week do you engage in household work (e.g., gardening, vacuuming, washing, car cleaning)?
□ Never □ Rarely □ Sometimes □ Usually □ Always

8) Where do you usually do your physical activities or sports?
□ Home □ Public park □ Health club □ School □ Other ……………………

9) With whom do you usually do your physical activities or sports?
□ Alone □ Friends □ Relatives □ School peers □ Other ……………………

10) When do you usually do your physical activities or sports?
□ Morning □ Afternoon □ Noon time □ Evening □ Other ……………………

11) Why do you participate in physical activities? What are the main reasons for that?
□ Health □ Social □ lose weight □Recreation □ Other ……………………

12) Why don't you participate in physical activities? What are the main reasons for that?
□ No time □ Not important □ Health reasons □ Afraid of criticism
□ Other ……………………

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

Flinders UNIVERSITY ADELAIDE • AUSTRALIA

-Nutrition Behaviours

13) How often do you have your breakfast per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

14) How often do you drink sugary drinks /soft drinks (e.g. Coke, canned juice) per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

15) How often do you eat vegetables (fresh or cooked) per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

16) How often do you eat fresh fruit per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

17) How often do you have dairy products (e.g. milk, yogurt, cheese)?
□ Never □ Rarely □ Sometimes □ Usually □ Always

18) How often do you eat fast food (e.g. burgers, sausage, pizza, or Arabic shawarma, inside or outside your home) per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

19) How often do you eat French fries and potato chips per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

20) How often do you eat cakes, biscuits, doughnuts, or similar food per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

21) How often do you eat sweets and chocolates per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

22) How often do you drink energy drinks (e.g. Red Bull, Power Horse) per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

23) How often do you pay attention to replenishing fluids during exercise per week?
□ Never □ Rarely □ Sometimes □ Usually □ Always

24) How often do you drink at least 800mL (~5 disposable paper cups) of water per day?
□ Never □ Rarely □ Sometimes □ Usually □ Always

25) How often do you eat foods rich in dietary fibre (e.g. fruit, vegetables) per day?
□ Never □ Rarely □ Sometimes □ Usually □ Always

26) How often do you consciously choose a diet low in fat, saturated fat, salt and cholesterol per day?
□ Never □ Rarely □ Sometimes □ Usually □ Always

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

-Sleeping Behaviours

27) On average, how many hours do you sleep per day?
□ less than 4hrs □ 4-5hrs □ 6-7hrs □ 8-9hrs □ more than 9hrs

28) Do you have a lot of difficulties getting out of bed in the morning?
□ Never □ Rarely □ Sometimes □ Usually □ Always

29) Do you wake up irritable or in a negative mood?
□ Never □ Rarely □ Sometimes □ Usually □ Always

30) Do you sweat during sleep?
□ Never □ Rarely □ Sometimes □ Usually □ Always

31) Do you snore during sleep?
□ Never □ Rarely □ Sometimes □ Usually □ Always

32) Do you grind your teeth during sleep?
□ Never □ Rarely □ Sometimes □ Usually □ Always

33) Do you complain of being tired during the day?
□ Never □ Rarely □ Sometimes □ Usually □ Always

34) Do you nap during the day?
□ Never □ Rarely □ Sometimes □ Usually □ Always

35) Do you feel rested after a night's sleep?
□ Never □ Rarely □ Sometimes □ Usually □ Always

36) Do you have regular sleep time?
□ Never □ Rarely □ Sometimes □ Usually □ Always

37) Do you use TV, iPad, laptop, smartphone or music to fall asleep?
□ Never □ Rarely □ Sometimes □ Usually □ Always

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

-Health risk behaviour:

38) On average, how long do you watch TV and/or DVD/Video per day?
□ less than 1hrs □ 1-2hrs □ 2-3hrs □ 3-4hrs □ more than 4hrs

39) On average, how long do you spend on the computer and/or the internet per day?
□ less than 1hrs □ 1-2hrs □ 2-3hrs □ 3-4hrs □ more than 4hrs

40) Smoke or consume tobacco, cigarettes, e-cigarettes, shisha or other forms of tobacco?
□ Yes □ No

42) Do you use or listen continuously to headphones for more than 30 mins?
□ Never □ Rarely □ Sometimes □ Usually □ Always

43) Do you go to a doctor promptly when any unusual sign or symptom appears?
□ Never □ Rarely □ Sometimes □ Usually □ Always

44) Do you comply with the doctor's advice and treatment?
□ Never □ Rarely □ Sometimes □ Usually □ Always

45) Do you brush your teeth or use dental floss after meals?
□ Never □ Rarely □ Sometimes □ Usually □ Always

46) do you wash your hands before meals?
□ Never □ Rarely □ Sometimes □ Usually □ Always

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

Appendix 20: Introduction letter (English)

Dr Yvonne Parry
College of Nursing and Health Sciences
Flinders Drive, Bedford Park SA 5042
GPO Box 2100 Adelaide SA 5001
Tel: +61 8 82013354
Email: yvonne.parry@flinders.edu.au

LETTER OF INTRODUCTION

(Ministry of Health/Education – Kuwait)

To whom it may concern,

This letter is to introduce Abdullah Hasan who is a PhD candidate in the College of Nursing and Health Sciences, at Flinders University in South Australia. He is undertaking research leading to the production of a PhD thesis or other publications on the subject of prevention of Type 2 Diabetes Mellitus among children and adolescents in Kuwait. His thesis is titled:

"Studies to explore the association between health-related behaviours and HbA1c and BP among Kuwaiti young people at risk of type 2 diabetes mellitus"

He would like to invite you to assist with this project by your voluntary participation in a study that will be conducted during this academic year 2020/2021. Participants of this study will be involved in physical assessments and one follow-up.

If you are interested in being part of this study, please contact the principal researcher or Meshari Clinic to book your appointment.

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, reports or other publications. You are, of course, entirely free to discontinue your participation at any time or to decline to answer particular questions.

Any enquiries you may have concerning this project should be directed to me at the address given above or by telephone on (+61 8 82013354) e-mail (yvonne.parry@flinders.edu.au).

Thank you for your attention and assistance.
Yours Sincerely,

This research project has been approved by the Women's and Children's Health Network Human Research Ethics Committee in South Australia (Project number HRE00145). For queries regarding the ethics approval of this project please contact the WCHN Research Governance Officer, Dr Carmel Murone (telephone 8161 6688, email carmel.murone@sa.gov.au).

Appendix 21: Introduction letter (Arabic)

الدكتورة ايفون باري
كلية التمريض والعلوم الصحية
جامعة فلندرز - أستراليا
أديليد 5001
هاتف: 82013354 (08) 61+
البريد الإلكتروني:yvonne.parry@flinders.edu.au

رسالة تعريفية

إلى من يهمه الامر،

هذه الرسالة لتقديم الباحث عبدالله يعقوب حسن وهو طلب في مرحلة الدكتوراة في كلية التمريض والعلوم الصحية - جامعة فليندرز- جنوب أستراليا. هو في الوقت الحالي يجري أبحاثًا تؤدي إلى إنتاج أطروحة أو منشورات أخرى حول موضوع الوقاية من داء السكر من النوع الثاني بين الأطفال والمراهقين في دولة الكويت. أطروحته بعنوان:

"دراسات لاستكشاف العلاقة بين السلوكيات المتعلقة بالصحة العامة وسكر الدم التراكمي وضغط الدم بين الشباب الكويتيين المعرضين لخطر الإصابة بداء السكري من النوع الثاني "

الباحث يود دعوتك للمساعدة في هذا المشروع من خلال مشاركتك التطوعية في دراسة ستُجرى خلال العام الدراسي 2021/2020. اللآباء والطلاب المشاركون في هذه الدراسة سيخضعون لبعض الفحوصات البدنية.

تأكد من أن كل المعلومات المقدمة سيتم التعامل معها بسرية تامة ولن يتم التعرف على أي من المشاركين بشكل فردي في الأطروحة أو المنشورات الأخرى. أنت بالطبع حر تمامًا في إيقاف مشاركتك في أي وقت أو رفض الإجابة عن أسئلة معينة.

يجب توجيه أي استفسارات قد تكون لديك بشأن هذا المشروع إلى على العنوان المذكور أعلاه أو عبر الهاتف أو على البريد الإلكتروني (yvonne.parry@flinders.edu.au).

شكرا لكم على اهتمامكم ومساعدتكم.

تفضلوا بقبول فائق الاحترام والتقدير،

الدكتورة ايفون باري

وقد تمت الموافقة على هذا المشروع البحثي من قبل لجنة أخلاقيات البحث العلمي والبشري بشبكة صحة المرأة والطفل في جنوب أستراليا (رقم المشروع HRE00145)

Appendix 22: Data collection Gantt chart

WEEKLY DATA COLLECTION TRACKER ***The 1st phase***	Sep-2021				October 2021				November 2021			
	WK 1	WK 2	WK 3	WK 4	WK 5	WK 6	WK 7	WK 8	WK 9	WK 10	WK 11	WK 12
WEEKLY PLAN FOR DATA COLLECTION												
Numbers of expected participants	25	25	25	25	25	25	25	25	25	25	25	25
Total numbers of expected participants	25	50	75	100	125	150	175	200	225	250	275	300
Research assistant team	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
DATA COLLECTION PROCESS												
Number of participants per week	17	21	16	20	9	13	18	17	11	2	1	1
Total number of participants	17	38	54	74	83	96	114	131	142	144	145	146

WEEKLY DATA COLLECTIONTRACKER

The 2nd phase

	Mar-22				Apr-22				May-22			
	WK 1	WK 2	WK 3	WK 4	WK 5	WK 6	WK 7	WK 8	WK 9	WK 10	WK 11	WK 12
WEEKLY PLAN FOR DATA COLLECTION												
Numbers of expected participants	25	25	25	25	25	25	25	25	25	25	25	25
Total numbers of expected participants	25	50	75	100	125	150	175	200	225	250	275	300
Research assistant team	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
DATA COLLECTION PROCESS												
Number of participants per week	23	15	19	11	16	9	11	12	5	1	1	0
Total number of participants	23	38	57	68	84	93	104	116	121	122	123	123

Appendix 23: Letter from Kuwait Nursing Association

State of Kuwait
Kuwait Nursing Association

دولة الكويت
جمعية التمريض الكويتية

Date:15/11/2020

Dear Dr. Parry

Abdullah Hasan approached the Kuwait Nursing Association and asked to support his PhD clinical trial entitled " A school nurse-led clinical to evaluate the effectiveness of an educational program in the prevention of type 2 Diabetes Mellitus among children and adolescents in Kuwait".

I regret to inform you that the KNA is not able to provide any help for the following reasons:

1. COVID-19 restrictions

2. The rules and regulations of the associations of public benefits in Kuwait do not allow us to set a research clinic in the premises

Please do not hesitate to contact me for more information.

Yours sincerely,

Name: Bandar Nashmi Al-Enezy

Contact number:0096525735008

President of Kuwait Nursing Association

Bandar N. Al-Enezy
Chairman

Kuwait Nursing Association

P.O.Box: 22533 - Code: 13086 - Al-Safat, Kuwait
Tel.: 25735008 - 25749555 - Fax: 25735007
www.kuwaitnursing.com q8nursing q8_nursing
E-mail: kna@ kuwaitnursing.com

Appendix 24: Letter from Public Authority for Applied Education and Training – College of Nursing

Student: Mr. Abdullah Hasan

Contact: +61431779438

Email: hasa0049@flinders.edu.au

November 15th, 2020

To whom it may concern

I am writing to confirm that the PhD researcher Abdullah Hasan requested assistance from the College of Nursing for his fieldwork to his clinical trial entitled "A school nurse-led, assessor-blinded, randomised, 6-Month clinical trial to evaluate the effectiveness of an educational program in the prevention of type 2 diabetes among children and adolescents with elevated HbA1c in Kuwait". Mr. Abdullah asked for a lab at the college to be set as a clinic where he would initiate his fieldwork and collect his data. He therefore requested for research assistants from our School Health Nursing program students'.

We regret to inform you that the College of Nursing will not be able to provide the researcher with a lab at the college due to the current situation resulted from COVID-19 pandemic restrictions. However, we are pleased to inform you that we are willing to support Mr. Abdullah by nominating four students from the School Health Nursing program at the college to be his research assistants.

Please do not hesitate to contact us for more details.

Yours sincerely

Head, BSN Program

Muna Abdulmohsen Alshammari, PhD

د. منى عبد المحسن الشمري
Dr. Muna A. Al-Shammari
رئيس قسم البكالوريوس
كلية التمريض