

**Family management of overweight in
5-9 year old children:
results from a multi-site randomised controlled trial**

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A thesis submitted in the fulfilment of the requirements for the degree of
Doctor of Philosophy

February 2008

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Thesis summary

Childhood overweight is a leading global public health issue. **Chapter One** of this thesis is a three part literature review of the evidence concerning the issue of childhood overweight and its management. Section One of the literature review describes this issue in terms of Australian and international prevalence rates and trends, health outcomes and aetiology. Sections Two and Three of the literature review examine the evidence to guide effective management of childhood overweight and analyse the thoroughness by which this evidence has been determined and translated into practice recommendations.

The assumed cornerstones of child weight management are dietary change, increased physical activity, decreased sedentary behaviour, family support and behaviour modification. Recently, the role of parenting skills in the management of childhood overweight has been identified as a promising area of research. This thesis study examined the effect of the addition of parenting skills training to a parent-led, family-focussed healthy lifestyle intervention for the management of overweight in 5-9 year old children (The Parenting, Eating and Activity for Child Health (PEACH) Study). The methodology of the intervention is presented in **Chapter Two**.

Families of overweight 5-9 year old children across two sites (three cohorts per site) were randomized to either a healthy lifestyle group program (HL) or a healthy lifestyle plus parenting group program (HL+P). Parents in both groups received eight 1.5hour group education sessions covering topics on child/family nutrition, physical activity and positive body image. Parents in the HL+P group were offered a four week parenting skills training program prior to this. All information was directed to parents and they were responsible for initiating and maintaining healthy lifestyle changes with their families. The intervention was delivered over a six month period and group differences were examined at this time point (intervention effect) and six months following with no further program contact (maintenance effect). The sample size (n=169) was calculated to demonstrate an estimated reduction in BMI z-

score of 30% in the HL+P group and 10% in the HL group over 12 months, allowing for a drop out rate of one third (power=80%, significance=95%). Intention to treat analysis was conducted using ANCOVA.

The effectiveness of the intervention was measured against a comprehensive evaluation plan consisting of:

- primary outcome indicators (body mass index (BMI) z-score and waist circumference (WC) z-score) **(Chapter Three)**,
- secondary outcome indicators (health-related quality of life (HRQoL), body size dissatisfaction and height z-score) **(Chapter Three)**,
- impact evaluation indicators (children's lifestyle behaviours and parent's parenting practices) **(Chapter Four)**,
- process evaluation indicators (participant attendance and satisfaction and maintenance of program integrity across sites) **(Chapter Four)** and
- qualitative evaluation of the factors external to the intervention that supported or inhibited families to achieve their healthy lifestyle goals **(Chapter Five)**.

Analysis of the primary outcomes **(Chapter Three)** found a significant group difference at the six month time point for BMI z-score (HL: -8%, HL+P: -13%, $p=0.005$), but not WC z-score (HL: -9%, HL+P: -11%, $p=0.39$). There were no group differences at the 12 month time point (six months following intervention end and with no further program contact). Application of the IOTF definition for childhood overweight and obesity to the full study sample found that 39 (23%) and 130 (77%) children were classified as overweight and obese respectively at baseline. By the six month time point ($n=135$), six (4%) children fell within the healthy weight range and 38% were classified as overweight and 58% as obese. At 12 months ($n=123$), 4% of children remained in the healthy weight range, 35% as overweight and 61% as obese. Children's psychosocial health and linear growth were sustained during the intervention and maintenance periods.

There were no between-group difference observed for any of the children's lifestyle behaviours (dietary and activity behaviours) or parents' parenting practices. However, the group as a whole exhibited significant improvements from baseline for scores of diet quality at the six month time point that were maintained during the following six month non-contact period ($p < 0.001$ for 0-6mth and 0-12mth) (**Chapter Four**). Small screen usage significantly decreased for the full sample from 0-6 months and 0-12months ($p < 0.001$ for both), however time spent being physically active did not change. Parents in both groups reported improvements in aspects of parenting over both time periods.

Evaluation of process indicators showed that the intervention was well attended and accepted by families (**Chapter Four**). Seventy three percent (123) of subjects were retained to the 12 month time point and 44% (75) attended at least 75% of scheduled program sessions. Of the 131 parents who responded to a program satisfaction questionnaire, ninety four percent reported receiving the help they desired and 99% would recommend the program to others. The integrity of intervention sessions was upheld across sites providing reassurance that the program protocol was adhered to and demonstrating a good degree of generalisability.

The thematic analysis of interviews conducted with parents at the 12month time point identified more references to barriers than facilitators of healthy lifestyle goal achievement (433 vs 375) (**Chapter Five**). This chapter highlights the contextual nature of family-based interventions and weight management strategies and the need to consider these during program planning and delivery.

Chapter Six concludes the thesis by summarising its results and highlighting how they have contributed to the evidence base. Study strengths and limitations are described and implications of the findings on practice and future research are presented.

Research output arising from this thesis

Peer-reviewed Journal Articles

Warren JM, Golley RK, Collins, CE, Okley AD, Jones RA, Morgan PJ, **Perry RA**, Baur LA, Steele JR, Magarey AM. Randomised controlled trials in overweight children: practicalities and realities. *International Journal of Paediatric Obesity*. 2007; 2: 73-85.

Golley RK, **Perry RA**, Magarey AM and Daniels LA. A family-focussed child weight management program incorporating parenting skills training with healthy lifestyle information to support behaviour modification. *Nutrition & Dietetics*. 2007; 64: 145-150.

Magarey A, Gehling R, **Haigh R** and Daniels L. 2004. Letters to the editor. Key elements for the nutrition component of child overweight management interventions in five- to nine-year-old children. *Nutrition & Dietetics*, 61,183-4.

Published Abstracts

Perry R, Man K, Wilson G, Daniels L, Magarey A. Nutrient intakes of 5-8 month old infants: different methods of calculating breast milk intake and comparison with intakes of formula fed infants (oral). Dietitians Association of Australia 25th National Conference, Hobart. *Nutrition and Dietetics* 2007; 64(S1): S32.

Daniels L, **Perry R**, Magarey A, Baur L, Steinbeck K, Hills A. PEACH RCT: a family-focused weight management program for 5-9 year olds – impact on maintenance of reduction in adiposity 6 months post intervention (poster). European Congress on Obesity, Budapest. *International Journal of Obesity* 2007; 31(S1): S145.

Perry R, Magarey A, Daniels L. Quality of life of 5-9 year olds enrolled in PEACH: a family focused child weight management program (poster). International Congress on Obesity, Sydney. *Obesity Reviews* 2006; 7(S2): 324.

Magarey A, **Perry R**, Baur LA, Daniels L, Steinbeck KS, Hills AP. Effectiveness of the PEACH RCT a Family Focussed Weight Management Program for 5 to 9-year-olds: 6 Month Outcomes (poster). International Congress on Obesity, Sydney. *Obesity Reviews* 2006; 7(S2): 114.

Magarey A, Wilson G, **Perry R**, Daniels L. Lifestyle Changes at 6 months of Subjects Enrolled in the PEACH RCT a Family Focussed Weight Management Program for 5 to 9-year olds (poster). International Congress on Obesity, Sydney. *Obesity Reviews* 2006; 7(S2): 325.

Perry R, Magarey A and Daniels L. Quality of life of 5-9 year olds enrolled in PEACH: a family focussed child weight management program (oral). European Childhood Obesity Group Workshop, Poland. *International Journal of Obesity* 2006; 30(S2): S41.

Perry R, Golley R, Magarey A and Daniels L. Application of parenting skills to a healthy family lifestyle program for overweight children: a case study of a novel approach for dietitians and parents (poster). Dietitians Association of Australia 24th National Conference, Sydney. *Nutrition and Dietetics* 2006; 63(S1): A37.

Other Conference Presentations

Haigh R and Magarey A. Parental perceptions of the health risk of childhood overweight and barriers to management (oral). *Australasian Society for the Study of Obesity Scientific Meeting*, Adelaide, October 2005.

Haigh R, Golley R, Magarey A and Daniels L. 2005. Program description and evaluation plan of PEACH: beyond kilograms and centimetres (oral). *National Health Outcomes Conference*, Canberra, August 2005.

Declaration

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

A funding proposal for the RCT had been developed prior to the commencement of my candidature. Following commencement, I developed protocols for implementation and modified intervention content and program materials used in the pilot study. Along with Gizelle Wilson (research assistant) I was jointly responsible for subject recruitment and retention, screening and baseline assessment at the Adelaide site. I delivered the parenting and healthy lifestyle components of the HL+P intervention arm at the Adelaide site. In order to provide blinded outcome assessment, research staff performed outcome measurements at the six- and 12-month time points.

I was responsible for the expansion of the original research protocol to include qualitative research methodology. I designed this component, secured additional grant funding to support this work and sought and gained ethics approvals for its implementation at both study sites. I trained staff in both sites to conduct the interviews.

I assisted with quantitative data entry and was responsible for all qualitative data entry. I performed all quantitative and qualitative data analysis.

The study was funded by a National Health and Medical Research Council Project Grant (275526) and I was supported by PhD Scholarships from National Health Foods (2004 and 2005) and the National Health and Medical Research Council (2006 and 2007).

Rebecca Anne Perry

4 February 2008

Acknowledgments

I would like to extend my appreciation to all those who have provided me with encouragement and support during my candidature.

Firstly to my primary supervisors Dr Anthea Magarey and Professor Lynne Daniels, whose guidance, wisdom and experience have been invaluable during this exciting and challenging time of my life. I have appreciated the trust and belief you have both placed in me and also the support and encouragement you supplied when required. Your supervision has fostered great working relationships and friendships which I truly value.

Special thanks must also go to Gizelle Wilson, whose commitment to the study ensured its successful delivery at the Adelaide site. Likewise, thanks to the Sydney site team, especially Anthea Lee, Professor Louise Baur and Associate Professor Kate Steinbeck.

At the Adelaide site I must also thank clinic staff at the Flinders Medical Centre for their cooperation and willingness to make time and space available for subject appointments, especially Kylie Bailey, Tina Owers and Sue Coppi. I am also grateful to paediatricians Dr Nicola Spurrier, Dr Brian Coppin and Dr David Everett for screening subjects.

I sincerely thank Kylie Lange for her advice regarding the statistical analysis of my data. I also thank Professor Elizabeth Farmer for her guidance regarding qualitative research methodology and techniques.

Finally, I would like to thank my husband, family and friends (and Meg) for their support and understanding whilst I undertook my PhD. Andrew, you especially have been my rock – thank you for helping me to never, never, never give up. Thanks also to my parents for their support, which knows no borders. You have all made sure I was able to achieve a fantastic balance between work and life during this time and I look forward to doing a lot more living with you all very soon.

Abbreviations

ADA	American Dietetic Association
AGHE	Australian Guide to Healthy Eating
ANCOVA	Analysis of Covariance
APQ	Alabama Parenting Questionnaire
BMI	Body Mass Index
CDC	Centres for Disease Control and Prevention
CDQ	Children's Dietary Questionnaire
CHQ-PF50	Child Health Questionnaire – Parent Form 50
CONSORT	Consolidated Standards of Reporting Trials
EE	Energy Expenditure
EI	Energy Intake
GP	General Practitioner
HL	Healthy Lifestyle (arm of the PEACH intervention)
HL+P	Healthy Lifestyle+Parenting (arm of the PEACH intervention)
HRQoL	Health-Related Quality of Life
HWR	Healthy Weight Range
IOTF	International Obesity TaskForce
ITT	Intention To Treat
NHMRC	National Health and Medical Research Council
NICE	National Institute of Clinical Excellence
NIDDM	Non-Insulin Dependent Diabetes
PAR	Planned Activity Routine
PEACH	Parenting, Eating and Activity for Child Health (the thesis study)
RCT	Randomised Controlled Trial
SEIFA	Socio-Economic Indices for Areas
SES	Socio-Economic Status
SPANS	Schools Physical Activity and Nutrition Survey
TV	Television
UK	United Kingdom
US	United States
VLCD	Very Low Calorie Diet
WC	Waist Circumference

Unless otherwise stated, the term “overweight” refers to “overweight and obesity”

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Chapter One: Literature Review

The first chapter of this thesis is compiled in three sections. The first describes “the issue” of childhood overweight with respect to prevalence rates, health outcomes and aetiology. The second section examines the evidence informing best practice and critically reviews four reviews that are regularly relied upon to guide management. In addition, this section examines the accuracy by which evidence is translated into practice via a review of the clinical practice guidelines for the management of overweight in childhood from Australia, the United Kingdom and the United States. The final section of this chapter examines the rigour by which child weight management interventions have been evaluated according to the assessment of outcome, impact and process evaluation indicators. This chapter culminates in the formulation of the research question which this thesis aims to address.

1.1 Section One: The Issue of Childhood Overweight

Childhood overweight is one of the greatest public health concerns of this generation and has implications for the health of children now and in the future (1). The development of childhood overweight results from the interaction of a complex set of factors from multiple settings, acting in differing ways throughout a child’s growth (2).

The first section of this literature review will provide an explanation of the definition of childhood overweight and obesity, present national and international prevalence rates, discuss the health outcomes of the condition and examine its causes.

1.1.1 Defining overweight in children

Overweight results from the accumulation of excess body fat, so ideally measures to determine body fatness should be used to diagnose and monitor overweight.

In adults, the body mass index (BMI) is closely correlated with body fat as determined by densitometry (3) and positively associated with an increased risk of chronic disease and mortality (4). Although it does not differentiate between muscle and fat, BMI correlates with more direct measures of fatness (5) and provides the best estimate of adiposity of all the calculated indices (6). A BMI of 25 or 30 is used to define overweight or obesity respectively in adults as these cut points accurately indicate adverse risk to health (4).

Body mass index is also closely correlated with body fat in childhood and long term health risks such as high blood pressure and elevated serum concentrations of lipids and insulin (7) (8) (3). During childhood, BMI changes with age and differs between the sexes and thus a set cut point to define overweight and obesity during this time is not appropriate (9) (7). Childhood overweight has been defined in various ways in the literature (eg. percentage overweight, BMI centile, BMI z-score) leading to confusion and an inability to directly compare the effectiveness of studies across sites, the prevalence between countries and to conduct meta-analyses (discussed further in Section 1.3.3.2). Therefore the need for a consistent definition of childhood overweight is urgent, especially during a time of increased global prevalence rates requiring standardised monitoring.

In 1997, the International Obesity Task Force (IOTF) Childhood Obesity Working Group accepted BMI as an index of excess adiposity in children (10). Subsequently, cut points based on adult definitions that reflect age and gender differences during childhood were established (11). These internationally recognised standards allow determination of prevalence and permit comparison of study findings across different populations. They are recommended for use in epidemiological studies and research by the Australian National Health and Medical Research Council Clinical Practice Guidelines for the Management of Overweight and Obesity in Children and Adolescents (12). This definition provides a categorical system for classify childhood overweight and obesity, thus decreasing sensitivity and increasing sample size required to detect change.

To address these issues, the use of a continuous variable to express age, height and gender-specific BMI (eg. BMI z-score/centile or percent overweight) may be advantageous, however there is not consensus on which is most suitable (10) (11) (13). All methods have been found to be highly correlated in 3-6 year olds (all $r > 0.9$), however there may be some advantage in using BMI z-score to assess adiposity change in children (13).

Therefore, for the purposes of this thesis, change in degree of overweight is defined using BMI z-score calculated by comparing subjects against a UK reference population (14) and the IOTF definition (11).

In recognition of the possibility of waist circumference being a better predictor of obesity-related health risk in children than BMI, waist circumference z-scores are also reported as a measure of abdominal adiposity, also calculated by comparison to a UK reference population (15).

Results from this thesis study will refer to these outcome indicators as “change in degree of overweight/abdominal adiposity” however when referring to previously published literature, the terminology used by those authors is often quoted, which may be “weight loss”. Except where otherwise indicated, the term “overweight” is used in this thesis to refer to “overweight and obesity”.

1.1.2 Prevalence and trends of childhood overweight

Prevalence and trends of childhood overweight - Australia

The most recent nationally representative data on the prevalence of childhood overweight and obesity in Australia is provided by the National Nutrition Survey conducted in 1995 (16). Application of the IOTF cut points classifies 20% and 21% respectively of Australian boys and girls aged 2-18 years of age as overweight or obese (17). When compared to the 1985 Australian Health and Fitness Survey (18), this represents an almost doubling of the rate of overweight and a more than trebling of the rate of obesity amongst Australian children in one decade (17). More recent data on

the rates of overweight and obesity in a sample of four year old South Australian children suggest that the 1995 rates have continued to increase (19).

Table 1.1 highlights the dramatic increase in prevalence of childhood overweight experienced by boys and girls in Australia between 1985 and 2002. These figures indicate a greater increase in the prevalence of obesity than overweight between 1985 and 1995, suggesting that the number of children in the upper end of the distribution is rapidly increasing. Furthermore, girls appear to have a higher prevalence of overweight and obesity than boys for both age groups presented. The data from Child and Youth Health in South Australia indicate that overweight affects children as young as four years old, emphasising the need to prevent and manage the condition in early life.

Table 1.1: Prevalence* (%) of Overweight (including obesity) and [Obesity] in Australian Children of Various Ages Between 1985 and 2002

	Time 1	Time 2	Fold increase over time
National Data: 1985-1995 ^a			
7-15y			
Males	11 [1]	20 [5]	X1.8 [x5]
Females	12 [1]	22 [6]	X2 [x6]
South Australian Data: 1995-2002 ^b			
4y			
Males	10.2 [3.2]	17.3 [4.1]	x1.7 [x1.3]
Females	12.8 [3.5]	21.4 [5.8]	x1.7 [x1.7]

* Prevalence calculated using the IOTF cut points (11)

^a Australian Health and Fitness Survey 1985: males n=4302, females n=4190 and National Nutrition Survey 1995: males n=817, females n=769 (17)

^b South Australian Child and Youth Health data 1995: males n=8275, females n=7931 and 2002: males n=5308, females n=5037 (19)

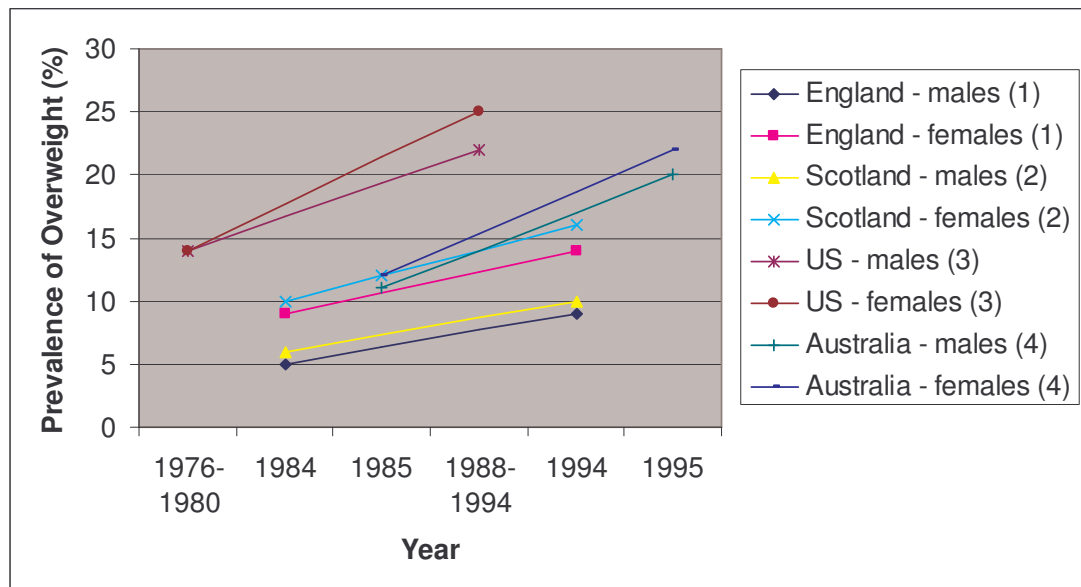
Prevalence and trends of childhood overweight –Worldwide

The average global prevalence of childhood overweight and obesity is 10% and 2-3% respectively for children aged 5-17 years (1). This global average reflects a wide international range, varying between less than 10% for African countries and over 20% for the Americas and Europe (1). There is a trend for the prevalence of overweight to be higher amongst the poor in rich countries and the rich in poor countries, and greater in urban than rural communities (1) (20) (21).

These prevalence rates are increasing, with Australia, Canada and the UK experiencing increases of 1.0% per annum over the last 20 years (1). Furthermore, the distribution of BMI across the ages has shifted in a skewed fashion to the right, indicating that children at the upper end of the distribution are getting even heavier (20).

Figure 1.1 presents childhood overweight prevalence rates from a number of countries over recent decades. Rates have increased by between 150% and 180% over the years reported and show no signs of slowing.

Figure 1.1: Global prevalence* (%) of overweight (including obesity) for children of various ages between 1976-1980 and 1995



* Prevalence calculated using the IOTF cut points (11)

¹National Study of Health and Growth (England), 4-11 years old: 1984 n=6267, 1994 n=5874 (22)

²National Study of Health and Growth (Scotland), 4-11 years old: 1984 n=4246, 1994 n=4108 (22)

³National Health and Nutrition Examination Surveys, 6-11 years old: 1976-1980 n=not stated, 1988-1994 n=not stated (23) in (1)

⁴Australian Health and Fitness Survey, 1985: 7-15 years old: n=8492 and National Nutrition Survey, 1995: 2-18 years old: n=2962 (17)

Summary - Prevalence and trends of childhood overweight

Australian childhood overweight prevalence rates are generally higher than in Britain and lower than in the US, although some age groups are inconsistent with this overall trend (17) (24). Global childhood overweight rates continue to increase, representing a public health issue requiring urgent action. Most

importantly, action is required to prevent its continued development into adulthood and to reduce or eliminate its associated health outcomes.

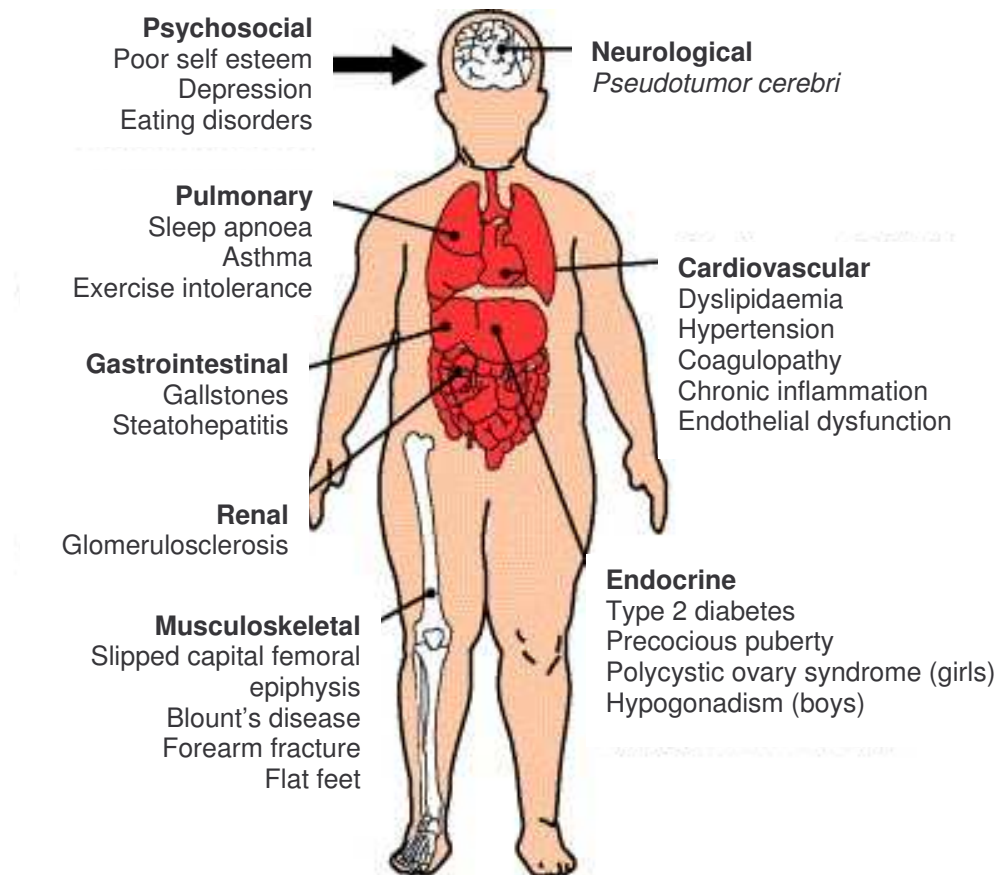
1.1.3 The health outcomes of childhood overweight

1.1.3.1 Introduction

A systematic review of the health outcomes of childhood overweight concluded that one of the most significant *immediate* adverse effects of the condition is psychological morbidity (25). Persistence into adulthood is considered to be the most significant *long term* health outcome of childhood overweight, increasing adult morbidity and mortality rates. Other health outcomes of childhood obesity have also been reported, often only seen in clinic settings amongst children with severe obesity and these are represented in Figure 1.2.

Health outcome data collected for the purposes of this thesis include the psychological consequences of childhood overweight and the tracking of weight with age - the most significant immediate and long term consequences of childhood overweight. Therefore, this literature review will focus primarily on these outcomes and provide a brief overview only of the biological and other health outcomes of childhood overweight.

Figure 1.2: Potential multisystem health consequences of childhood obesity



(Taken from (20))

1.1.3.2 Psychosocial health outcomes of childhood overweight

Overweight in childhood is strongly associated with psychosocial morbidity (4), which may impact upon quality of life, body image and self esteem. Negative influences on these aspects of health are experienced immediately and acutely by children meaning they may be the most profound consequence of childhood overweight.

The study described in this thesis collected measures of children's quality of life and perceived body image. The limited evidence reporting on these psychosocial outcomes, particularly for pre-adolescent children, is reviewed. For completeness, reviews reporting on self esteem, a psychosocial health outcome which was not specifically monitored in this study but often included as a domain in measures of quality of life, are also included.

1.1.3.2a Health Related Quality of Life

Health related quality of life (HRQoL) is a multidimensional measure that provides a patient centred perspective of the experience of a condition (26). There is strong evidence of the negative effect of obesity on adult HRQoL (27) but there has been relatively little attention directed to this relationship in children. A number of condition-specific tools are available to measure HRQoL in obese adults (27) and for children with various chronic illnesses (28), however no obesity specific tool exists for children. Obesity-related HRQoL in children is assessed using generic instruments to measure global HRQoL such as the PedsQL™4.0 (29) and the Child Health Questionnaire – Parent Form 50 (CHQ-PF50) (30).

In the last three years, four studies have reported on the HRQoL of overweight children aged 5-18 years from various settings (Table 1.2). One study used the parent-report CHQ-PF50 as the measurement tool (31) and three used the parent- and child-reported PedsQL™4.0 (32-34). The PedsQL™4.0 is the tool used to measure HRQoL by this thesis study.

The paper by Friedlander and colleagues may not provide an accurate perception of child quality of life as data were limited to parent report of child HRQoL which may not be consistent with that of the child (28, 35). The discrepancies in findings between the three studies using the PedsQL™ to measure HRQoL may be explained by cultural differences in perceptions of quality of life (36) or inconsistencies between definitions of weight status.

Overall however, it can be concluded that aspects of HRQOL decrease with increasing weight. All four studies found a significant negative correlation between BMI and HRQOL for *physical functioning summary* (p values varied between 0.02 and <0.01), which is consistent with the adult literature (27). *Psychosocial functioning summary* scores were also negatively correlated with BMI for child- and/or parent-reports (p values varied from <0.01 to <0.001), indicating that even at a young age children may be experiencing negative self perception. These findings provide evidence for the importance of early intervention to prevent the negative consequences of childhood overweight on children's quality of life.

Table 1.2: Summary of the literature reporting on the cross-sectional relationship between health-related quality of life (HRQoL) and overweight in children aged 5-18 years of age

CHQ-PF50: parent-report			
Publication Details (Setting, sample size)	Sample characteristics	Design and methodological details	Findings
<p>Friedlander et al (2003) (31)</p> <p>US community sample</p> <p>Parents of 371 children (186 males)</p>	<p>Age range: 8-11y Mean(SD) age: 9.0y (0.82)</p> <p>Mean(SD) BMI: 18.3kg/m² (3.54)</p> <p>Normal/under weight: 70.1% At risk of overweight :12.4% Overweight: 17.5%</p>	<p>4 weight categories based on the 2000 CDC BMI-for-age-and-sex growth charts:</p> <p>Relative underweight: BMI<20th %ile Normal wt: BMI 20-84th %ile At risk of overweight: 85-94th %ile Overweight: >95th %ile</p>	<p>When compared with normal weight children:</p> <ul style="list-style-type: none"> - <u>overweight children</u> have significantly lower scores for: <ul style="list-style-type: none"> • self esteem (p<0.001) • parental emotional well being (p<0.02) • physical functioning (p<0.01) • behaviour (p<0.001) • global general health (p<0.001) • global behaviour (p<0.02) - <u>parents of overweight children</u> more likely to exhibit higher levels of emotional distress (OR,2.0; 95%CI, 1.1-3.6) <p>Childhood obesity more closely linked with perceived limitations in psychological health than physical health</p>
PedsQL™4.0: child- and parent-report			
Publication Details	Sample characteristics	Design	Findings
<p>Schwimmer et al (2003) (33)</p> <p>US community and clinical sample</p> <p>106 children (C) (57 males) and 105 parents (P)</p>	<p><u>Obese sample:</u> n=106 C (57male) and 105 P Mean(SD) age: 12.1y (3.0) Mean(SD) BMIz: 2.6 (0.5)</p> <p><u>Healthy weight sample:</u> n=401 C (182 male) and 389 P Mean(SD) age: 10.9y (3.3) Mean BMIz: N/A</p> <p><u>Cancer sample:</u></p>	<p>Obesity defined as BMI≥95th based on the 2000 CDC BMI-for-age-and-sex growth charts</p>	<p>When compared with healthy weight children/parents of healthy weight children:</p> <ul style="list-style-type: none"> - <u>obese children</u>: significant lower scores in all domains (p<0.001) - <u>obese children</u>: more likely to have impaired HRQoL (total score: OR, 5.5 [95%CI, 3.5-8.7]) - <u>parents of obese children</u>: significant lower scores in all domains (p<0.001) <p>When compared to children with cancer:</p> <ul style="list-style-type: none"> - obese children reported similar HRQoL (total score: OR, 1.3 [95%CI, 0.8-2.3])

	n=106 C (57 males) and 104 P Mean(SD) age: 11.0y (4.3) Mean(SD) BMIz: N/A		BMIz of obese children inversely related to physical functioning Parents of obese children reported lower scores than children self-reported for most domains (unlike parents of healthy weight children who tended to score higher than their child)
Publication Details	Sample characteristics	Design	Findings
Williams et al (2005) (32) Australian community sample 1456 children (736 male) and 1229 parents	Age range: 9-12y Mean (SD) age: 10.4y (1.1) Mean (SD) BMIz: 0.50 (0.92) 75.5% not overweight 20.0% overweight 4.3% obese	Children classified as: - not overweight - overweight - obese using IOTF cut points (also examined results using CDC %iles and found no difference)	Significant decline in scores with weight for PedsQL domains of: - physical function (child and parent) - social function (child and parent) - total score (child and parent) - psychosocial function (child only) (p=0.004 for all) HRQoL (child and parent) for total, physical, psychosocial and social scores decline once child's weight above mean BMI and decline worsens with increasing BMI, so that scores lowest for obese children Overweight and obese children differed from healthy weight children most strongly on physical and social functioning scores Child self-report and parent proxy-report similar for all weight categories
Publication Details	Sample characteristics	Design	Findings
Pinhas-Hamiel et al (2006) (34) Israeli clinic sample 182 children (82 male) and 182 parents	<u>Normal weight:</u> n=94 (community) Mean(SD) age: 11.4y (4.2) <u>Obese sample:</u> n=88 (49 from hospital clinic, 39 from community clinic) Mean(SD) age: 11.3y (3.4)	Obesity defined as BMI>95 th based on the 2000 CDC BMI-for-age-and-sex growth charts	When compared with healthy weight sample, <u>obese children/parents of obese children</u> scored lower (p<0.01 for all) for PedsQL domains of: • physical (child and parent) • social (child and parent) • school (child and parent) • emotional (parent only) Parents of obese children scored significantly lower than children self-reported (unlike normal weight child and their parents) ↑ in BMIz associated with ↓ in HRQoL for all domains for children (p<0.03) and parents (p<0.01)

1.1.3.2b Body image

Body image is the perception that an individual holds of their appearance and the influence of these perceptions and attitudes on behaviour (37). Body image can be represented by an individual's satisfaction with their body shape. This is commonly measured by either asking an individual to rate how satisfied they are with their body weight or shape on a scale (38) or examining the discrepancy between an individual's perceived and desired body shape as selected from pictorial representations (39) (40).

Dissatisfaction with body shape is present in children as young as nine and the degree of this dissatisfaction tends to vary with gender and weight (39). Sixty-nine percent and 59% of nine year old boys and girls respectively have been found to be dissatisfied with their current body shape (39). This dissatisfaction increases to around 80% for both boys and girls classified as overweight. Dissatisfaction with body shape increases significantly with increasing weight in nine year old girls classified as normal weight, underweight or overweight and obese ($p < 0.001$) (41). In comparison with normal weight girls, underweight girls desire to be heavier whilst those overweight and obese wish for a significantly thinner frame. This trend is also present in adolescent girls and is thought to potentially impact negatively upon present and future quality of life (38).

Dissatisfaction with body shape in childhood and adolescence can track into adulthood, despite the achievement of a healthy adult weight (42). Obese youngsters are viewed as "lazy, stupid, cheats and ugly" by their 6 year old peers (43) and overweight children as young as five can develop a negative self image (44). Incorporation of such views into an enduring perception of self can lead to permanent disturbances of body image (42).

Promotion of positive body image is important for the present and future psychosocial health of all children, particularly those who are overweight. Body image is an important health outcome to monitor within a child weight management intervention to ensure that no unintended harm is caused to those enrolled and to also identify additional psychosocial benefits of involvement in such a program.

1.1.3.2c Self esteem

Self esteem is the result of perceived competence in areas deemed important for personal and cultural reasons (41). It has been conceptualised as a self-evaluation at both a global and domain specific level (45) and numerous tools have been developed to measure these aspects in children (30) (46) (47) (48) (49).

Being overweight in childhood may have detrimental consequences for childhood self-esteem, however studies to confirm its presence and magnitude report conflicting findings (50). A review conducted by French and colleagues examined the results from 35 studies investigating the relationship between self-esteem and obesity in children and adolescents (45). The majority of studies available were methodologically weak and found self esteem scores of overweight children and adolescents to be within normal ranges. Cross-sectionally, an inverse relationship was found between self-esteem and body weight in adolescents, but no clear trends were identified for younger children (aged 3-6 years and 7-12 years). A review of nine papers by Reilly and colleagues concluded that “low self esteem and behavioural problems were particularly commonly associated with obesity [in children]” (25).

Examination of the longitudinal relationship between body weight and self-esteem have found that a higher baseline BMI z-score predicts reduced self-esteem at follow-up (51) (50). Conversely, non-overweight children report no change in median self-esteem score over time and report higher scores than overweight and obese children at baseline and follow-up (51). Obese boys and girls are almost twice as likely as their normal weight peers to be scored below the 15th centile on the self esteem scale of the CHQ PF50 (52).

In summary, an inverse relationship between weight and self esteem has been observed in community samples of children. This finding further emphasises the pervasiveness of childhood overweight through its impact on varying dimensions of health.

1.1.3.3 Persistence into adulthood

The most significant long-term health consequence of overweight in childhood is its tracking into adulthood (Table 1.3) (53) (54) (55) (56). Approximately 40% of obese children are still obese as adults (57) and the likelihood of persistence increases with age of onset, severity of overweight (57) (54) (25) (8) and parental overweight (53) (58) (8) (59). Persistence may also be strengthened by weight gain during childhood and following puberty (57) (60) . After adjusting for parental obesity, the odds of an obese child compared to a non-obese child being obese as an adult are 1.3 at ages 1 to 2 years, increasing to 17.5 at ages 15 to 17 years (8). Overweight in adolescence is a greater predictor of risk of adult morbidity and mortality than overweight in adulthood (3) (except for NIDDM), highlighting the need for prevention and early intervention at the youngest age possible.

Table 1.3: Summary of the literature reporting on the longitudinal data examining the persistence of childhood overweight into adulthood

Study (country, n)	Baseline age (y) and birth year	Duration of follow-up(y)	Design and methodological details	Conclusions
Hesketh et al (2004) (61) (Australia, 1438)	5-10 1987-1992	3.2	Statewide school community sample – Health of Young Victorians Study (HOYVS) (1997– 2000/01) Weight status determined by IOTF definition BMI z-scores also calculated	BMI tracks through middle childhood Majority of changes in BMI towards heavier category Heavier children more likely to experience greatest increases in BMI (skewing distribution to the right) Baseline BMI stronger predictor of follow-up BMI than parental BMI
Gordon-Larsen et al (2004) (62) (US, 9795)	13-20 (mean age = 16.0y) 1976-1983	5	Community sample - National Longitudinal Study of Adolescent Health, waves II (1996) and III (2001) Obesity defined using IOTF cut points for 1996 sample and WHO for 2001 sample	High incidence and maintenance of obesity during transition to young adulthood Likelihood of persistence increases with age
Magarey et al (2003) (53) (Australia, 155)	2 1975-1976	18	Community sample – Adelaide Nutrition Study (1977/78 – 1993/94) Weight status defined using IOTF cut points and WHO adult definition once >18y	Strong tendency for BMI to track with age, esp with shorter age intervals/increased age in childhood Previous child wt status at every age greater determinant of overweight/obesity at 20y than parental weight 75% in same weight category from childhood to early adulthood Proportion of obese subjects who remained obese as adults (82%) > proportion of obese adults who were obese as children (30-50%)
Power et al (1997) (63) (UK, 11 212)	7 1951	26	Community - birth cohort born between 3 rd and 9 th March 1958 in England, Scotland and Wales Child BMI converted to %ile and compared with national reference standard Adult weight status defined using WHO definition	Persistence of overweight into adulthood increased by child age and severity of overweight BUT, most obese adults not fat children
Guo (1994) (54) (US, 555)	Birth 1929-1960	35	Pooled data from Fels, Guidance, Harvard and Oak longitudinal studies	Higher age-to-age correlation between BMI in childhood and adulthood for females than males Increased risk of adult obesity associated with increased age child is overweight and its severity

1.1.3.4 Other health outcomes - Biological

A number of biological consequences of overweight in childhood occur in increasing prevalence as a result of increased age and/or severity of overweight (12). These include complications of the cardiovascular, endocrine, orthopaedic, respiratory and gastroenterological systems (64) (65) (20) (1) (Figure 1.2). These biological consequences of extreme overweight in childhood are serious and pose long term health risks.

Longitudinal studies conducted in the UK and US have found that overweight in adolescence increases the likelihood of the presence of cardiovascular risk factors in adulthood, such as elevated lipids, hypertension and raised insulin levels, increasing associated morbidity and mortality rates (3) (60) (66). The clustering of cardiovascular risk factors in childhood and their persistence into adulthood increases with age and degree of overweight (67), having similar consequences on the cardiovascular system as seen in adults (25). Early intervention to prevent the development of overweight or its progression to obesity is critical to prevent the manifestation of enduring biological consequences.

1.1.3.5 Other health outcomes - Social

Being overweight during childhood can equate to unpopularity and lack of friendships which negatively affects the social development of the child and potentially the future adult. A study conducted by Richardson et al in the early 1960's concluded that overweight children were less desired as friends than children with various disabilities (68). More recently, Strauss and colleagues found that overweight 13-18 year old adolescents were significantly less likely than normal weight peers to have friendship nominations reciprocated ($p < 0.001$) (69). Weight-based teasing (whether over or under weight) is experienced by up to 30% of girls and 25% of boys, most commonly by peers (70). Children teased about their weight had 1.39 - 2.35 times greater likelihood of having emotional health problems than children who were not (70).

Indicators of success in adulthood are associated with weight during childhood and adolescence. After controlling for baseline SES and aptitude test results, overweight 16-24 year old females were less likely to be married ($p<0.001$), have lower household incomes and higher rates of poverty (both $p<0.001$), and had completed fewer school years ($p=0.009$) than non-overweight girls when compared seven years later (71).

In summary, the health outcomes of childhood overweight can have an enduring effect upon well-being, potentially jeopardising success in future life.

1.1.3.6 Summary – the health outcomes of childhood overweight

The health outcomes associated with being overweight in childhood have the potential to affect the child and future adult both physically and psychosocially. Increased rates of childhood overweight worldwide will increase the incidence of immediate adverse health outcomes. The persistence of many of these outcomes into adulthood presents a public health issue affecting current and future generations.

Effective prevention, early intervention and management strategies are required to halt the perpetuation of this dilemma. In order to design such strategies, the aetiology of the condition must be thoroughly understood.

1.1.4 The aetiology of childhood overweight

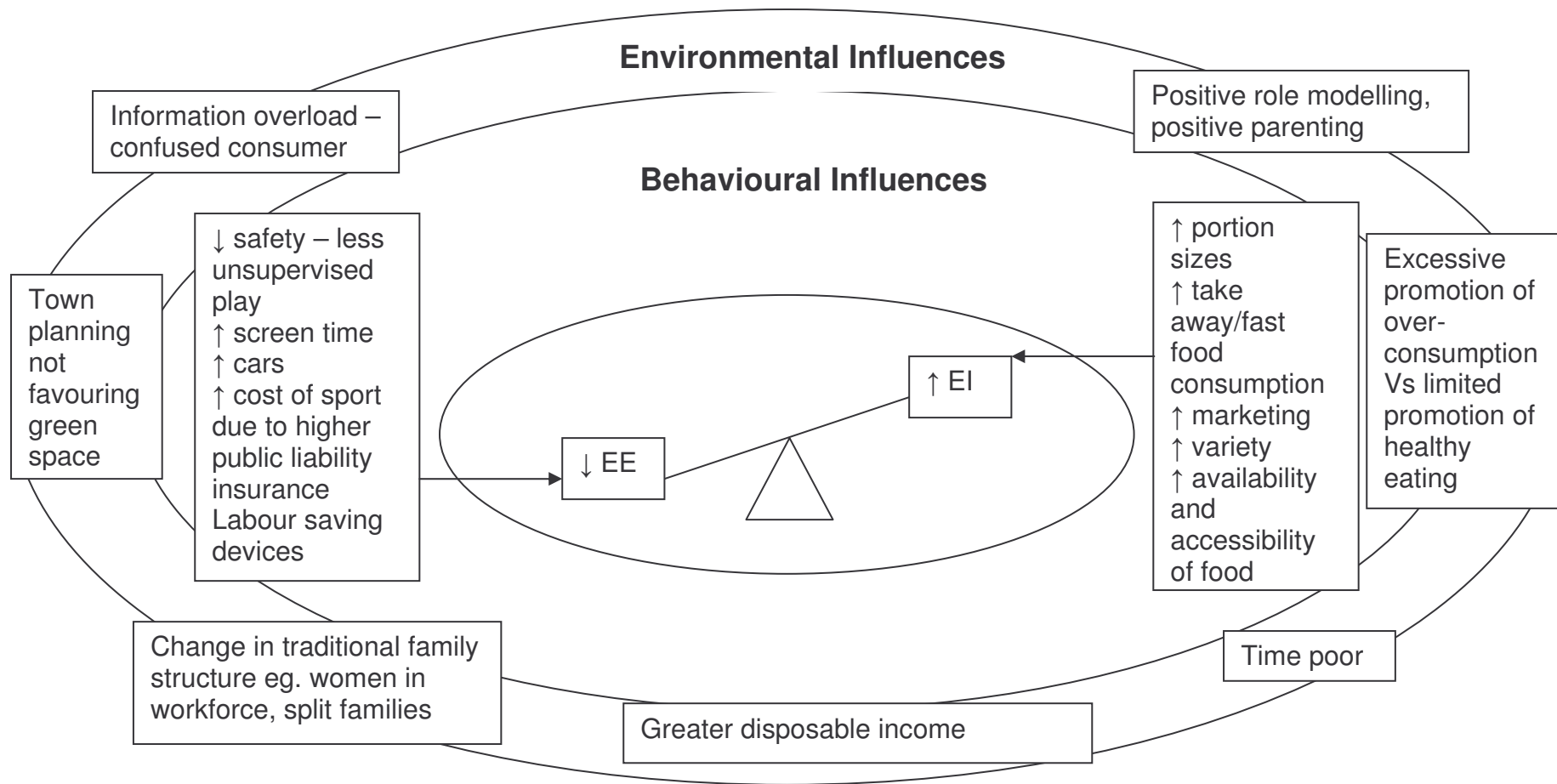
1.1.4.1 Introduction

Overweight develops from an imbalance between energy intake and energy expenditure. The cause of the imbalance is multifactorial and includes both behavioural and environmental influences (Figure 1.3).

A range of risk factors for childhood overweight have been identified and Table 1.4 summarises the relevant longitudinal studies. The majority of studies report on children aged 5-11 years old and identify a range of parental- and child-related risk factors. Two cross-sectional studies which undertook multiple linear regression to identify factors contributing to the development of overweight in childhood were also identified (72) (73). Campbell et al (2006) found that parental pressure to eat, television viewing and high cost/low preference for fruit and vegetables were significantly positively associated with increases in predicted daily energy intake for an Australian sample of 5-6 year old children ($p < 0.001$, $p = 0.001$ and $p = 0.005$, respectively) (72). Maffeis et al (2000) assessed the relationship between nutrient intake, portioning of food intake and parental overweight in a 530 7-11 year old Italian children (73). Their final model, which consisted of parental BMI, percent energy intake consumed as carbohydrate, breakfast, dinner and night snack and the ratio of energy intake to basal metabolic rate, explained 19% of the variability in the sample's percentage fat mass.

For the purposes of this review however, only family-specific and potentially modifiable factors contributing to the aetiology of childhood overweight will be discussed in order of behavioural, familial and environmental influences.

Figure 1.3: Summary of the behavioural and environmental influences contributing to the development of chronic positive energy balance



Adapted from: (74) , (2) and (75)

Table 1.4: Summary of the literature reporting on the longitudinal data examining risk factors for the development of overweight in childhood

Publication Details	Study Details	Risk Factors Identified (statistically significant)	Comments
Reilly et al (2005) (76)	<p>n= 8234 children aged 7y (entire cohort) n=909 children aged 7y (subsample analysing growth-related risk factors)</p> <p>Multivariable binary logistic regression models to examine risk factors independently associated with obesity at 7y</p> <p>Obesity defined as $\geq 95^{\text{th}}$ centile relative to 1990 UK reference data</p>	Birth weight	Increasing birth weight linearly associated with increasing prevalence of obesity at 7y (adjusted OR per 100g units: 1.55, 1.13-2.12) (p<0.001)
		Parental obesity	Risk of obesity at 7y increased if one parent obese and higher if both obese (adjusted OR for both parents obese: 10.44, 5.11 – 21.32) (p<0.001)
		Sleep duration	Shorter sleep duration at 30m associated with increased risk of obesity at 7y (adjusted OR for <10.5hr/night: 1.45, 1.10-1.89) (p<0.010)
		TV viewing	Greater time spent watching TV associated with increased risk of obesity at 7y (adjusted OR for >8hr/d: 1.55, 1.13-2.12) (p<0.010)
		Growth-related risk factors	
		Size in early life	Weight in highest quartile at 8m (adjusted OR: 3.13, 1.43-6.85) and 18m (adjusted OR: 2.65, 1.25-5.59) associated with increased risk of obesity at 7y (p=0.004 and p=0.011)
		Weight gain in infancy	High rate of weight gain in first 12m life associated with increased risk of obesity at 7y (adjusted OR (per 100g increase): 1.06, 1.02-1.10) (p=0.003)
		Catch-up growth	Catch-up growth between birth and 2y associated with increased risk of obesity at 7y (adjusted OR: 2.60, 1.09-6.16) (p=0.002)
Davison and Birch (2001) (77)	<p>N=185 girls aged 5 at baseline</p> <p>Hierarchical regression to predict factors increasing girls ΔBMI between ages 5 and 7 based on entry of risk factors</p>	Early adiposity rebound (AR)	Early AR associated with increased risk of obesity at 7y (adjusted OR for AR by 61m: 2.01, 0.81-5.20) (adjusted OR for AR by 43m: 15.00, 5.32-42.30) (p<0.010 for both)
		Girls' BMI at age 5 (p=0.0001 at entry into model)	The final model that included these six risk factors (at left) was significant (p=0.0001) and explained 26% of the variance in girls' change in BMI
		Family risk of overweight (p=0.005 at entry into model)	Having a higher BMI at age 5 explained 15% of the 26% variance in change in BMI explained by the model – necessary to control for baseline BMI

	reflecting developmental process leading to accelerated changes in BMI	<p>Mothers' change in BMI (p=0.05 at entry into model)</p> <p>Fathers' enjoyment of activity (p=0.01 at entry into model)</p> <p>Fathers' energy intake (p=0.09 at entry into model – marginally associated, controls for body weight)</p> <p>Girls' percentage fat intake (p=0.01 at entry into model)</p>	<p>Significant clustering of risk factors was observed in families</p> <p>Girls' BMI positively and significantly (although weakly) correlated with:</p> <ul style="list-style-type: none"> - family risk of overweight (r=0.19, p<0.01) - fathers' BMI (r=0.21, p<0.01) - mothers' BMI (r=0.14, p<0.05) - mothers' percentage fat intake (r=0.15, p<0.05)
Maffei et al(1998) (78)	<p>n = 112 children aged 8y at baseline</p> <p>Investigated relationship between diet, activity and parental obesity at baseline and fat gain in child over 4y</p> <p>Obesity defined as relative BMI>120% where: relative BMI= BMI/BMI at 50th centile for age and gender</p>	<p>No risk factors associated with child diet and activity habits found to be significantly associated with Δrelative BMI over 4y</p> <p>Parental BMI accounted for ~13.5% of relative BMI variance at age 12 (p<0.001) and predicted relative BMI in child (p<0.0001)</p>	<p>Parental obesity is the most important risk factor for obesity in children aged 8y</p> <p>Some relationships found between energy and nutrient intake and physical activity and inactivity and relative BMI, however no effect once parental BMI taken into account</p> <p>Relative BMI at baseline found to be significant risk factor for BMI at follow-up (p<0,0001) and relative BMI change over time, confirming persistence over time as a health outcome</p>

1.1.4.2 Behavioural influences on the development of childhood overweight

Lifestyle behaviours affecting dietary intake, physical activity and ultimately weight status develop following the formation of habits and preferences influenced by the experiences and practices promoted in the home environment and via examples set by family members, carers and peers (79) (80) (81) (82) (83).

Data available on behavioural influences are limited. Variations in methods to measure and define overweight and energy intake and expenditure make collection, analysis and comparison of data difficult. Furthermore, validation of methods to measure “usual intake” over time is difficult, and is often limited to the determination of the relative validity of methods. The majority of studies examining the relationship between energy balance and overweight are cross-sectional in design, limiting causal determination, as behaviour, particularly physical in/activity, can be both a cause and consequence of overweight (84, 85). Many studies have found weak and/or variable associations between markers for energy intake/expenditure and overweight, but may be the result of limitations in measurement. Mindful of these limitations, a review of the eating and physical activity behaviours undertaken by children and their influence on weight gain follows, in order to examine the underlying behavioural causes of the childhood obesity epidemic.

1.1.4.2a Dietary intake

Energy and macronutrient intake

The most recent nationally representative data on the dietary intake of Australian children is provided by the National Nutrition Survey conducted in 1995 (16). Comparison of this data with data collected by the 1985 Australian Health and Fitness Survey shows that the energy intake of 10-15 year old boys and girls increased by 15% (1400kJ) and 11% (900kJ) respectively, representing the consumption of an additional 3-4 slices of bread per day (86). Absolute fat intake remained unchanged. Carbohydrate intake however

increased significantly resulting in a proportional increase of 20%, or 3% of total energy intake for both boys and girls. This increase in carbohydrate and total energy intake resulted from increased consumption of cereal-based confectionary foods, non-alcoholic beverages and sugar based products (86). These types of high energy, low nutrient dense foods (termed “non-core foods”) provide 41% of the energy intake of 2-18 year old Australians, representing two to three times the recommended intake levels (87). Similarly, in the US 40% of the total energy in the diets of 2-19 year old children is provided by discretionary fat and added sugars (88).

Clearly the increases in energy intake observed for children over recent years are a result of an inappropriately large consumption of non-core, energy-dense foods. It is likely that increased consumption of such foods is displacing nutrient-rich, less energy dense foods (89).

Food consumption

Less than one third of Australian 4-11 year old children are meeting the national recommendations for fruit and vegetable consumption, and this pattern seems to worsen with age (90). Similar figures from the US report that in a survey of 1797 2nd and 5th grade children 40% ate no vegetables on the days studied and 36% consumed at least four different types of snack foods (91).

The WHO/FAO report there is convincing evidence that fruits and vegetables decrease the risk of obesity (based on their contribution of non-starch polysaccharides to the diet) and that a high intake of energy-dense foods increase this risk (92).

Beverage consumption

Beverages (including alcohol) contribute 16.3% of the total energy intake of all Australians and sucrose (added or otherwise) contributes the majority of this (16) (93). Over the past two decades, soft drinks have made an increasing contribution to the diet of young people (1). In Australia, per capita

intake of soft drink has increased by 2.4 times over the past 30 years to 113L per person per year (children and adults) (94). Consumption of soft drink/cordial in a group of 8 year old Australian children was found to be associated with excess weight gain 5 years later (95). Mean carbohydrate intake from these beverages was significantly higher for overweight/obese children at follow-up than children of acceptable BMI at baseline and follow-up ($p=0.002$) (95).

There is evidence to suggest that a high intake of sugar-sweetened soft drinks and fruit juices probably increases the risk of weight gain and obesity (92) (96). A US study has shown that children's soft drink consumption is positively associated with their daily energy intake (97). The reason for this is unclear, but may be due to the low satiating properties of sweetened drinks compared with solid food (94) and its association with other obesogenic factors such as snacking, time spent viewing television and physical inactivity (95) (89) .

Portion sizes

Although not available in Australia, trend data from the US indicate that food portion sizes served to children (both from fast food outlets and in the home) have increased between 1977 and 1996, providing up to an additional 600kJ per serve (cheeseburger) (98).

In a study of 32 three and five year old children, the amount of food consumed was positively associated with the portion size of the food served to the five year olds but not in the younger children (99). In a second study, the amount of food (and energy) consumed by a group of 35 four-year-olds was positively correlated to the portion size served, increasing energy intake by 15% (100). Over-consumption was reduced if children were allowed to serve themselves (100). These findings suggest that as children age or are offered inappropriately large servings, their ability to self-regulate their intake diminishes and energy consumption is driven more by external cues.

Eating patterns

Family meals have been shown to be associated with greater intake of fruits and vegetables and milk and lower intake of fried foods resulting in a diet of increased nutritional value and decreased energy density (101). Disruption of the traditional structured eating pattern with a “grazing” meal style as seen recently amongst children and adults, provides greater opportunity for food and drink consumption (102).

Amongst US children, increased frequency of meals and snacks has been observed and the percentage of meals and snacks eaten at fast food restaurants has increased by 200%-300% between 1977 and 1995 (74) (1). Skipping breakfast is increasingly common amongst children, and may increase the risk of weight gain (103). The displacement of these mealtimes can diminish the nutritional quality of children’s diets and promote excessive energy intake.

1.1.4.2b Activity behaviours

Physical activity

Current Australian physical activity recommendations for children call for “at least 60 minutes (and up to several hours) of moderate to vigorous physical activity every day” (104). Whilst there are no recommendations specific to obesity prevention, these guidelines for health provide a useful bench mark.

Although no nationally representative Australian data are available to indicate whether this target is being met, results from the 2004 New South Wales Schools Physical Activity and Nutrition Survey (SPANS) indicated that 75% of boys and girls aged 11-16 years of age achieved the national physical activity recommendations (105). These figures represent an increase in participation in physical activity of 15-25% from the 1985 Australian Health and Fitness Survey (105). Participation rates however were shown to decrease with age and this was experienced more so for girls than boys. This finding is supported by data from the US and Canada (84). A review of the cross-sectional and prospective studies examining the relationship between

physical activity and overweight in children found many conflicting results, but concluded by saying that an inverse relationship is observed between physical activity and overweight in all but the youngest children (ie. less than 10 years old) (85).

Of concern, the SPANS data showed that the time spent in sedentary behaviours increases with age, which independently increases the risk of the development of overweight and obesity (105).

Sedentary behaviour

The majority of studies examining sedentary activity patterns in children have used “screen time” (time spent watching television or videos, playing video games or working at the computer) as a marker for inactivity. Excessive amounts of time spent viewing television can promote weight gain through the displacement of active pursuits; increased calorie consumption due to snacking and increased requests for advertised energy-dense, nutrient-poor foods; and reduced resting metabolism (106) (107) (84) (108). The Australian Department of Health and Ageing recommend that children spend no more than 2 hours a day participating in screen-based activity (104).

The Australian Bureau of Statistics Children’s Participation in Cultural and Leisure Activities Survey sampled children aged 5-14 years and found that over the 12 months prior to April 2000, watching TV and videos was the most popular leisure activity undertaken outside of school hours (by 97% of boys and girls) (109). Computer activities were carried out by 95% of boys and girls. In contrast, 66% of boys and 52% of girls participated in organised sport in their leisure time (109). These figures demonstrate the popularity of screen based leisure activities chosen by children in the past few years and the imbalance between this and other active leisure time pursuits.

A review of the cross-sectional and prospective studies examining the relationship between physical inactivity and overweight in children found that seven out of nine prospective studies showed a positive relationship between time spent watching television and risk/measure of overweight at follow-up

(85). An Australian study of 1430 six year old children found that TV viewing had borderline significance for BMI at follow-up at two years, with each additional hour of TV viewed increasing the odds of overweight by 40% (59). Strong dose-response relationships have been found between TV viewing and overweight, suggesting that 10-15 year olds watching more than 5 hours of TV a day had 5 times greater odds of being overweight compared with those watching 0-2hours of TV/day (106). Furthermore, it has been reported that television may be more influential than families in setting children's food preferences (110).

Changes in physical activity patterns, both decreased energy expenditure and increased sedentary activity, brought about largely by environmental change over the past 2-3 decades, are conducive to weight gain without appropriate dietary modification. The amount of activity required to expend the 3500kJ of energy present in a typical fast food meal deal requires a 10 year old overweight boy to jog for 140 minutes. Clearly, targeting activity alone as a strategy by which to manage the obesity epidemic is unrealistic and energy intake must be where the majority of effort lies. Consideration of the family environment is crucial when developing such a strategy, particularly for young children.

1.1.4.3 Familial influences on the development of childhood overweight

Parents provide children with a genetic predisposition for obesity and the environment in which this can be expressed. Evidence from twin and adoption studies supports the direct genetic links between parent and child weight status (1) (12) (111) (112), whilst others emphasise the crucial importance of intermediary behaviours and environments (shared and non-shared) that influence weight status (72, 73, 77, 78, 113) (114). Clearly, the influence of genes and environment on the tendency for a child to gain weight are additive and almost impossible to separate. Focussing on those familial risk factors that are modifiable ie. environmental and behavioural will provide the greatest opportunity for management of childhood overweight.

Family environment

The shared family environment, controlled primarily by parents i) determines the quality, availability and accessibility of food and activity choices, ii) shapes preferences and iii) provides opportunities for the modelling of eating and activity behaviours that directly influence the development of obesity in children (115) (83).

Children of obese parents, living in an “obesogenic” environment are at an increased risk of being and remaining overweight themselves and acquiring similar weight promoting health behaviours as their parents (116) (117). Using cluster analysis, and defining parental habits as obesogenic or non-obesogenic, Davison and Birch showed that girls aged 5-7 years living in an “obesogenic” family were more likely to become overweight than girls living with non-obesogenic parents ($p < 0.05$, after controlling for parental BMI) (116). This study confirms that even after controlling for genetics, dietary and activity patterns promoted by parents and the family environment can expose or protect children from accelerated weight gain. A paper published by the same research team in 2005 reported the long term effects of these obesogenic behaviours of parents on weight gain experienced by the girls, now aged 9 and 11 years old. The significantly greater BMI z-scores reported by girls living in the obesogenic families at ages 5-7 years were maintained to 11 years of age ($p < 0.05$). In addition, these girls had higher percentage body fat and higher fat intakes than girls living in non-obesogenic families ($p < 0.05$) (117). Again, parental BMI was controlled for in these analyses, re-emphasising the importance of the family environment in the development and maintenance of childhood obesity.

These familial similarities were also observed in the Framingham Children’s Study which found that children (mean age of 4 years) whose parents were eating high amounts of total fat, saturated fat and cholesterol were three to six times more likely to consume a diet rich in these nutrients compared to children whose parents had low intakes of these nutrients (118). Findings from the same study for physical activity tendencies were similar, with children of active parents almost six times more likely to be active

themselves than children whose parents were inactive (95%CI: 1.9,17.4) (119). This finding was unchanged when controlled for child's weight or parents' ages.

Obesity and its risk factors tend to cluster within families (120) (121) and eating and activity habits that lead to their development are learnt in early childhood and track through to adulthood (81) (122) (123). Therefore, it is crucial that the family environment promotes healthful practices to children that will persist into adulthood and protect them from developing overweight.

Parenting practices

In a 1998 review of the literature, Birch and Fisher concluded that eating behaviours of children are influenced by many factors over which parenting and feeding practices have a very significant influence (91). They stated that parenting is related to i) exposure and accessibility of food (providing the food and eating environment), ii) modelling of eating behaviours, iii) providing food that leads to positive or negative physiological consequences, and iv) the feeding practices utilised. Specifically, parenting and feeding practices that increased parental control of the feeding experience of 3-5 year old children resulted in children who were less able to self-regulate their energy intake (124). Reductions in this ability were significantly negatively correlated to higher fat mass in girls ($p < 0.05$) and positively correlated to higher lean body mass in boys ($p < 0.05$).

Several studies have found a relationship between child-feeding practices and indices of child body weight. Specifically, greater maternal restriction of highly palatable foods is related to higher energy intake and fat mass in girls (121), and pressuring a child to eat explains more of the variance in total fat mass than energy intake (125).

Feeding practices and family environments that do not promote self-regulation of energy intake by children may promote excessive weight gain. Using data from the Framingham Children's Study, Hood et al demonstrated

that children of parents displaying high levels of disinhibited eating, especially when coupled with high dietary restraint, had greater increases in BMI and skin fold thicknesses than children of parents with low levels of dietary restraint and disinhibition (126). In this situation, parents may unwittingly be overriding their child's appetite control and also role modelling undesirable eating behaviours. Similar to the studies conducted by Davison and colleagues, parental BMI was controlled for with little effect on results. The findings from these longitudinal studies provide data on the early effect of parenting and feeding practices on the long term weight change in children and suggest that environmental rather than genetic factors may explain these results.

Genetics

Between 5% and 25% of weight variance has been attributed to genetic influences (127, 128). Environmental factors such as parental influence and the home setting explain the remaining variation and account for the discrepancies in the degree of obesity observed in twins raised together or apart (111) (112) (129).

Global prevalence rates of overweight have increased rapidly over the past 20 years indicating the predominant role played by a changing environment on a stable genetic susceptibility (130). Consideration must be given to the important role of environmental and behavioural factors in promoting or suppressing the expression of the obesity genotype (131). Researchers hypothesise that as children age, the prenatal environmental influences (provided by the mother) on weight status decrease and genetic and shared environmental influences provided by both parents emerge, strengthening the parent-child and between sibling correlations over time (132).

Genes may influence an individual's likelihood of developing obesity, but the expression of such a characteristic is reliant on a permissive environment and behaviours that promote weight gain. As summarised by Bray, "genes load the gun, the environment pulls the trigger" (133) as it is changes in our

eating and activity habits, not our gene pool, that appear to be the cause of this epidemic (115). Obesity studies within developing countries and of migrant populations highlight the crucial role that the environment plays in the expression of the obesity genotype (115) and justify the need to address this and the obesity promoting behaviours which encourage the accumulation of excess weight.

1.1.4.4 Wider environmental influences on the development of childhood overweight

Figure 1.3 provided an overview of the individual and broader environmental factors that influence behaviours contributing to energy imbalance. The environment influences behaviour and strongly influences expression of a genetic tendency to be overweight. An environment supportive of increased energy consumption and decreased expenditure, as exists in most of the present world, permits the expression of obesity promoting genes.

A number of models have been devised to analyse environments to identify the obesogenic properties that affect the mediators of energy equilibrium (134) (135) (2) (20). Generally, they highlight the impact of the environment on weight status, and re-emphasise that parent-child similarities in dietary patterns are more likely due to environmental than genetic disposition. The important role of parents in the development of healthy lifestyle choices and habits in children is stressed and the family environment prioritised as the initial point for the development of childhood overweight (2).

In order to be effective, child weight management must occur within the family context and be cognisant of the wider environments influencing this setting.

1.1.4.5 Summary - the aetiology of childhood overweight

The aetiology of childhood overweight is multifaceted and requires a multi-strategy approach to prevention and management. The recent increases in the global prevalence of childhood obesity have occurred too rapidly to be ascribed to genetics, inferring an environmental origin. This is likely due to an over-supply of energy dense foods and drinks within an environment that limits participation in physical activity and promotes sedentary behaviours (136) (137). Behavioural interventions to support parents and families to manage this increasingly obesogenic environment must be developed to promote healthy dietary and activity practices.

1.1.5 Summary of Section One – The Issue of Childhood Overweight

Global childhood overweight prevalence rates have increased dramatically over the past two decades and continue to rise, representing a major public health issue. The health outcomes associated with being overweight in childhood have the potential to affect the child and future adult both physically and psychosocially. Effective prevention, early intervention and management strategies focussing on lifestyle behaviours must occur within a family context to address modifiable behaviours that promote weight gain. In order to design such interventions, a thorough understanding of the cornerstones to management and familiarisation with the current evidence informing these is crucial.

1.2 Section Two: The Evidence to Guide Effective Management of Childhood Overweight

1.2.1 Introduction

Over recent years, a number of reviews have reported on the evidence to guide the treatment of overweight in children and adolescents (138) (139) (140) (141). In addition, a review of two of these reviews was published in late 2003 (142). Various professional organisations have also developed clinical practice guidelines and recommendations which are informed by these documents and the primary studies upon which they are based (12) (143) (144).

These documents provide comprehensive guidance for the management of overweight in children, although the evidence by which they are informed is recognised as limited. In addition, some of the processes undertaken to develop the reviews and guidelines varied, potentially leading to inconsistent interpretation of the literature.

This section critiques four key reviews of the literature published between 1997 and 2007 regarding effective management of childhood overweight. The cornerstones to management identified by these reviews are outlined and the evidence informing each of these cornerstones as assessed by the four separate reviews is compared. Specific attention is given to the cornerstone of management of parenting as the role of this component of treatment is at the core of this thesis. Finally, three national clinical practice guidelines for the management of childhood overweight are examined in order to review the consistency with which the evidence is applied to practice. Thus, this section of the literature review provides a review of the state of the evidence for effective management of childhood overweight from both a research and a practical perspective.

1.2.2 Reviewing the Reviews

1.2.2.1 Introduction

Table 1.5 provides an overview of the reviews (141) (138) (140) (139) (142) that summarise the evidence to guide the effective management of childhood overweight. Recommendations for treatment made by the reviews and also evidence gaps identified by and present in them highlight where the state of the art lies regarding effective management of childhood overweight. This section reviews the reviews regarding the methods by which they were undertaken and the general conclusions they drew.

The 82 primary papers included across these four reviews represent 40 individual references. It is notable that although each of the review papers had specific and relatively consistent inclusion criteria, the studies that were deemed acceptable for inclusion varied widely between the reviews, due largely to the variation in years searched.

For the purposes of this review, only papers addressing the management of overweight in childhood (not adolescence) are included in these tables. The study conducted by Brownell et al with an adolescent population is the exception to this criteria as it had a specific focus on parental involvement in weight management which is the focus of this thesis (145).

Table 1.5: Summary of the reviews that synthesise the evidence to guide the effective treatment of overweight in childhood

Publication details	Methodology	Primary papers reviewed*	Recommendations for research and practice
A. REVIEW OF REVIEWS			
Mulvihill et al, 2003 (142)	<p>Databases searched from January 1996 – October 2002: Cochrane Library, DARE, “Wider Public Health” report, MEDLINE, TRIP, HTA, DISN, Health Evidence Bulletins Wales, National Guidelines Clearinghouse, NCCHTA website, NICE website, REFER, National Research Register, Clinical Evidence, EMBASE, Sociological abstracts, PSYCHINFO, EPPI-Centre, Psychological abstracts, PSYCLIT, CINAHL, Sociofile, Social Science Citation Index</p> <p>Inclusion criteria: Systematic review or meta-analysis evaluating lifestyle intervention to prevent or treat overweight/obesity and maintain weight loss (did not include reviews of surgical or pharmaceutical interventions)</p>	3 reviews: (138, 139, 146)	<p>There is evidence to support:</p> <ol style="list-style-type: none"> 1. The effectiveness of targeting parents and children together 2. Multi-faceted family-based behaviour modification programmes (diet, exercise, reduced sedentary behaviour and lifestyle counselling, with training in child management, parenting and communication skills) where parents take primary responsibility for behaviour change 3. Laboratory-based exercise programs <p>There is limited evidence (ie ≤3 studies) to support:</p> <ol style="list-style-type: none"> 1. Behaviour modification programs with no parental involvement <p>There is a lack of evidence for:</p> <ol style="list-style-type: none"> 1. Family-based behaviour modification programs
B. SYSTEMATIC REVIEWS			
Glenny et al, 1997 (138)	<p>Databases searched from start date til end of 1995: MEDLINE, EMBASE, DHSS-Data, Current Research in UK, BIDS, SIGLE, Dissertation Abstracts, Sport, DRUG INFO, DRUG, PSYCHLIT, AMED, ASSI, CAB, HPA, NTIS, Directory of Published Proceedings, Purchasing Innovations Database, Health promotion database, DARE, NEED</p> <p>Inclusion criteria for treatment studies:</p> <ul style="list-style-type: none"> - Outcome defined as either change in weight, fat content or fat distribution - RCT design - Observed participants for a minimum of 1y 	12 papers: (147) (148) (149) (150) (151) (145) (152) (153) (154) (155, 156) (157)	<p>Conclusions:</p> <ul style="list-style-type: none"> - Reduction of sedentary behaviour appeared most effective - Role of parental involvement in treatment uncertain - further evaluation of parents’ role required - Targeting parents and children together for weight loss showed benefit versus targeting child alone - conclusions uncertain due to limited sample size and baseline characteristics data - Must express change in degree of obesity appropriately <p>Future research must:</p> <ul style="list-style-type: none"> - Include psychological and sociodemographic profile information – may help identify barriers to or predictors of successful treatment - Improve standards of conduct of trails and long-term follow-up

<p>Wilson et al, 2003 (139)</p>	<p>Provided limited detail of methodology re: search strategy and inclusion criteria apart from being “based upon Cochrane reviews” (140, 158)</p> <p>Inclusion criteria: RCT only At least 20 participants</p>	<p>22 papers: (148) (152) (159) (156) (160) (161) (150) (162) (155) (151) (149) (163) (145) (164) (165) (166) (167) (147) (168) (169) (170) (171)</p>	<p>Conclusions:</p> <ul style="list-style-type: none"> - Addition of PA to diet intervention did not improve effectiveness - Lifestyle activities appear more effective than structured, organised sport over long term - ↓ing sedentary behaviour more effective than ↑ing PA - Adding general parenting techniques and targeting parents as agents of change improves effectiveness of healthy lifestyle program - Including child in family-focussed treatment provides no advantages to treatment - Multifaceted family based programs that involve parents, increase PA, provide dietary education, and target reductions in sedentary behaviour may help children to lose weight - Some evidence that family based behaviour modification programs, where parents take the primary responsibility and act as agents of change, may help children lose weight - Cost effectiveness needs to be addressed <p>Future research must:</p> <ul style="list-style-type: none"> - Be of good methodological quality - Involve large numbers in appropriate settings - Be of longer duration and intensity
<p>Summerbell et al, 2003 (“Cochrane Review”) (140)</p>	<p>Databases searched from 1985 – July 2001: CCTR, MEDLINE EMBASE, CINAHL, PsychLIT, Science Citation Index and Social Science Citation Index</p> <p>Search re-ran from 1997-2001 for above databases and: DARE, NHS EED, HTA and Kings Fund</p> <p>Inclusion criteria: RCT to treat childhood obesity Observed participants for a minimum of 6m</p>	<p>17 papers: (152) (156) (159) (160) (172) (147) (149) (150) (151) (155) (162) (165) (166) (167) (168) (170) (173)</p>	<p>Conclusions:</p> <ul style="list-style-type: none"> - Parental (rather than child) responsibility for behaviour change provides additional benefit to behavioural management intervention - Reduction of sedentary behaviour and encouragement of PA beneficial - No generalisable conclusions can be drawn with confidence <p>Future research must assess:</p> <ul style="list-style-type: none"> - Role of physiological and social factors in treatment - family characteristics that promote success - Suitability of interventions for minority targets - Aspects of physical and social environment outside health sector that influence lifestyle behaviours

C. LITERATURE REVIEWS

<p>Epstein et al, 1998 (141)</p>	<p>Not detailed – stated used “predominantly” RCT’s to highlight dietary, activity and behaviour change interventions, but did also include drug and surgery interventions</p> <p>Inclusion criteria: Not stated, but included studies from as early as 1967</p>	<p>31 papers: (174) (154) (175) (176) (177) (148) (159) (152) (156) (178) (179) (180) (181) (168) (182) (150) (183) (149) (147) (166) (162) (151) (165) (184) (145) (157) (164) (155) (167) (185) (186)</p>	<p>Conclusions:</p> <ul style="list-style-type: none"> - Very little known about specific components of dietary recommendations such as macronutrient composition - Exercise should be combined with dietary intervention as it can enhance weight loss and improve long term maintenance - Less structured lifestyle exercise may be superior to more rigid, higher intensity aerobic exercise - Gastric bypass surgery not recommended for children - Insufficient evidence to recommend current pharmacological intervention - Behaviour change critical to long term success of treatment - Parental involvement important part of child obesity treatment <p>Future research must assess:</p> <ul style="list-style-type: none"> - Degree of flexibility within diets - Specificity of parent training to change diet and activity behaviour - Adaptability of parent training programs to changing child age - Process of behaviour change more comprehensively
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*listed only primary papers reporting on the treatment of overweight in children

1.2.2.2 The Reviews

Mulvihill et al, 2003

The review of reviews conducted by the Health Development Agency (now the National Institute for Health and Clinical Excellence) was conducted to provide a comprehensive synthesis of the evidence drawn from systematic and other kinds of reviews (142). The briefing searched for secondary data sources from a wide range of electronic databases from January 1996 to October 2002. A detailed explanation of the methodology used to systematically search the literature is provided. The briefing makes a number of summary statements regarding effectiveness of interventions and categories these into different levels of evidence (Table 1.5). Three systematic reviews were identified as addressing the management of childhood overweight; two are relevant to this thesis (138) (139) and one was very narrow, addressing only laboratory-based exercise programs (146) and was disregarded for the purposes of this thesis.

Glenny et al, 1997

The articles included in the 1997 review undertaken by Glenny et al for the UK's National Health Service (NHS) were identified through searching 21 electronic databases (including MEDLINE, EMBASE, BIDS and PSYCHLIT) from their start date to the end of 1995 (138). The review provides a clear outline of the search strategy used and study inclusion criteria (summarised in Table 1.5). The reader is directed to a website (www.york.ac.uk/inst/crd/obesity.htm) for further details of the review methodology. This review provides no assessment of the quality of trials it included, but does provide the results of individual studies for the consideration of the reader. In total, there were 12 primary papers examining the effectiveness of interventions to treat overweight in childhood included in this review.

Wilson et al, 2003

Similarly, the 2003 review undertaken by Wilson et al on behalf of the NHS's Centre for Reviews and Dissemination included only RCT's (with greater than

20 subjects) examining the effectiveness of interventions for the treatment of childhood overweight (139). Results of individual studies were provided as was an assessment of their quality. However, details of the search strategy used and study inclusion criteria were not published. The review identified 22 primary papers that investigating the effectiveness of strategies to manage childhood overweight, of which nine were included in the review by Glenny et al. Of the 13 papers which were not included in the review by Glenny et al, six were published after the inclusion period set by that group.

Cochrane Review, 2003

The 2003 Cochrane review of interventions for treating obesity in childhood provides a transparent and systematic explanation of its methodology (140). Only RCTs were included in this review and inclusion criteria were based on those adopted by the Glenny review. Only RCT's that observed subjects for a minimum of six months were included. Criteria regarding the type of participants, intervention and outcome measures were also provided. Details of the search strategy used to extract studies from various databases between 1985 and 2001 were provided (summarised in Table 1.5). The review summarises each of the primary papers included (17 relating to the management of childhood overweight) but does not assess their quality.

Epstein et al, 1998

No detail of methodology was provided in the literature review undertaken by Epstein et al in 1998 (Table 1.5). It included "predominantly" RCT's to highlight dietary, activity and behaviour change interventions, but also included non-conventional interventions. Studies published as early as 1967 were included. The undefined inclusion criteria may explain why this review included the most primary papers out of the four reviews examined (21) and also why 13 of these papers were not referenced by the other reviews. Of these 13 papers, four listed Epstein as the first author and eight were published prior to 1985.

1.2.2.3 Summary – Reviewing the Reviews

Whilst these reviews provide a comprehensive overview of the state of the evidence regarding the management of childhood overweight, there are limitations in relying on these summaries. They may not accurately reflect the primary papers which they summarise. Further limitations relate to the methodology of the reviews themselves and their inclusion criteria (142).

The majority of the primary papers included in the reviews have methodological weaknesses such as small sample sizes and unclear reporting of power calculations, allocation concealment and/or blindness of outcome assessment. Of the 40 primary papers included across the four reviews, 21 appeared in only one of the reviews examined (three in Cochrane, one in Glenny, four in Wilson and 13 in Epstein). Of the remaining 19 papers, four were reported in two reviews, eight in three reviews and seven in all four reviews. As a means of examining the consistency and accuracy of these reviews, summaries of primary papers appearing in more than one review were compared between reviews and to the primary paper to assess the consistency and accuracy of reporting in the review articles.

1.2.3 The Cornerstones of Management

Table 1.6 presents the 40 original primary papers included in the four reviews according to the specific strategies for treating overweight in childhood they address – **the cornerstones of management**. This table also shows the review in which each of the primary papers was included to give an indication of the consistency with which they were referenced.

Table 1.6: Matrix representing the 40 primary papers included in the four systematic reviews to guide effective management of childhood overweight: categorised under the cornerstone of management investigated and the review(s) in which included

References to primary papers cited in the reviews categorised under the cornerstone of management investigated	Review paper			
	Summerbell et al 2003(140) (17 primary papers)	Glenny et al 1997 (138) (12 primary papers)	Wilson et al 2003(139) (22 primary papers)	Epstein et al 1998 (141) (31 primary papers)
Diet				
Amador et al 1990 (174)				✓
Grouper et al 1987 (175)				✓
Figuroa-Colon et al 1993 (154)		✓		✓
Physical Activity and Sedentary Behaviour				
Epstein et al 1985 (159)	✓		✓	
Epstein et al 1985 (152)	✓	✓	✓	✓
Epstein et al 1995 (156)	✓	✓	✓	✓
Schwingshandl et al 1999 (172)	✓			
Epstein et al 2000 (160)	✓		✓	
Hills and Parker 1988 (178)				✓
Becque et al 1988 (176)				✓
Rocchini et al 1988 (179)				✓
Epstein et al 1982 (177)				✓
Epstein et al 1984 (148)		✓	✓	✓
Behaviour Change (eg. problem solving, cognitive behavioural therapy, reinforcement)				
Graves et al 1988 (166)	✓		✓	✓
Epstein et al 2000 (170)	✓		✓	
Epstein et al 1985 (150)	✓	✓	✓	✓
Epstein et al 1980 (182)				✓
Senediak and Spence 1985(165)	✓		✓	✓
Mellin et al 1987 (155)	✓	✓	✓	✓
Flodmark et al 1993 (147)	✓	✓	✓	✓
Duffy and Spence 1993 (168)	✓		✓	✓
Epstein et al 1994 (149)	✓	✓	✓	✓
Braet et al 1997 (169)			✓	
Goldfield et al 2001 (171)			✓	
Johnson et al 1997 (161)			✓	
Wheeler and Hess 1976 (184)				✓
DeWolfe and Jack 1984 (153)		✓		
Coates et al 1982 (181)				✓
Degree of Involvement by Child or Parent				
Israel et al 1985 (162)	✓		✓	✓
Wadden et al 1990 (167)	✓		✓	✓
Israel et al 1994 (151)	✓	✓	✓	✓
Golan et al 1998 (173)	✓			
Golan et al 1998 (163)			✓	
Brownell et al 1983 (145)		✓	✓	✓
Kirschenbaum et al 1984 (164)			✓	✓
Epstein et al 1981 (157)		✓		✓
Epstein et al 1986 (183)				✓
Miscellaneous/Non-Conventional Strategies				
Bacon and Lowrey 1967 (185)				✓
Aragona et al 1975 (180)				✓
Mendonca and Brehm 1983(186)				✓

1.2.3.1 Introduction

This section categorises the evidence informing the effective management of childhood overweight by the cornerstones of management. It is widely accepted that an effective child weight management intervention must be family-focussed and provide a multi-component intervention including aspects of diet, activity and behaviour modification. Parental involvement is also necessary (12). The evidence for each of these cornerstones as summarised in the reviews is presented. In addition, where a primary paper is referenced by more than one review article, consistency and accuracy of reporting is documented.

1.2.3.2 Diet

Overview

It is accepted that energy intake must be adjusted to achieve weight management however there is a lack of evidence regarding how best to modify dietary intake to moderate energy intake (12). Of the 40 primary papers identified above, only three specifically examined the effectiveness of different dietary components (Table 1.6). Two appeared only in the Epstein review (174) (175) and one was included in the Epstein and Glenny reviews (154) .

Reviewing the Reviews

As discussed in the Epstein review (141), Amador et al examined the effectiveness of two different levels of energy restriction (a restricted diet of 0.17MJ/kg of expected body weight for height versus a less restricted diet of 0.25MJ/kg of expected body weight for height) (174) whilst Gropper et al investigated the effect of increasing the fibre content (15g/day) of a reduced energy diet (175). These primary papers appeared only in the Epstein review.

Figuroa-Colon's team compared a protein-sparing modified fast (600-800kcal/day) with a hypocaloric balanced diet (800-1000kcal/day) in a group of 19 obese children (mean age: 11.4y) (154). This primary paper was cited

in both the Epstein and Glenny reviews, both of which reported accurate and consistent findings.

Summary

The most effective macronutrient balance for the achievement of weight management in childhood is unknown and it is unlikely that dietary intervention alone will achieve long term success (141). Dietary modification must be a part of a multi-component program and recommendations must be age appropriate and adhere to the healthy eating guidelines specific to the target population (Table 1.5). These conclusions are reflected in various clinical practice guidelines which are outlined in Section 1.2.4 (12) (144) (143).

1.2.3.3 Physical Activity and Sedentary Behaviour

Overview

Levels of physical activity and sedentary behaviour impact upon energy expenditure independently, and many studies have sought to determine which component has the greatest effect on energy balance and weight status. Between them, the four reviews made 21 references to 10 primary papers examining the role of physical activity and/or sedentary behaviour. Six of these 10 papers were published by the Epstein group (Table 1.6). Five of the primary papers were cited in only one of the four review papers (176) (177) (178) (179) (172). The consistency of reporting of the remaining five primary papers across review papers was generally high, however some discrepancies were identified.

Reviewing the Reviews

Of the five multi-referenced papers, three were reported consistently and accurately and two inconsistently.

The 1995 paper by Epstein et al (156) (n=61, age: 8-12y), compared three different activity regimens (1: reinforcement of increased physical activity, 2: reinforcement of decreased sedentary behaviour, 3: reinforcement of

increased physical activity and decreased sedentary behaviour) and was included in all four review articles. Whilst conclusions were consistent and correct, there were some inaccuracies regarding study detail and outcomes. Discrepancies between the values reported in the text and the table were noticed in the Glenny review (138) (values in table correct) and the Wilson review (139) referred to “weight loss” results when “decrease in percentage overweight” was the outcome reported in the primary paper. The Cochrane review (140) failed to report that families were provided the Traffic Light Diet and the Epstein review (141) included one year outcome data that was not reported in the primary paper.

The second, also by Epstein et al (152) compared increasing physical activity with usual care (diet vs. diet and exercise) for weight management among 23 8-12 year old girls. The Cochrane review incorrectly reported the sample size as 20 and mis-typed the standard deviation scores as percentages (140). The Glenny review reported only change in weight rather than change in percentage overweight, which for this population is more meaningful (138). The Epstein review failed to indicate that the study enrolled girls only and also misleadingly reported that the Diet and Exercise group maintained a significant difference from the Diet only group to 12 months (141). This was true for the outcome of Physical Work Capacity, but not for weight or percentage overweight for which between group differences were present only at 6 months, as reported in the other 3 reviews.

Summary

The evidence regarding the role of physical activity and sedentary behaviour in the management of overweight in children suggests that promoting a reduction in sedentary behaviours is as effective as focussing on increased physical activity (12). If physical activity is included as part of management, it should be flexible and unstructured and in conjunction with dietary changes (Table 1.5).

Increases in physical activity are also likely to increase muscle mass and improve confidence, self esteem and body image, providing other benefits apart from improvements in weight or fitness (1).

Section 1.2.4 presents three sets of clinical practice guidelines and highlights how these conclusions have been translated into practical recommendations within each.

1.2.3.4 Behaviour Modification

Overview

The inclusion of behaviour modification techniques (such as problem solving, goal setting or reinforcement) is crucial for the long term success of weight management interventions and can be applied to diet and activity components to achieve outcomes. This aspect of treatment received the most attention in the four review papers, with fifteen primary papers providing evidence regarding the effectiveness of this treatment modality (Table 1.6). Eight of these primary papers appeared in at least two of the review papers and inconsistencies in reporting across reviews were identified for seven of these.

Reviewing the Reviews

Duffy and Spence investigated the effectiveness of cognitive behavioural therapy as an adjunct to behavioural management in the treatment of childhood obesity (n=27, age: 7-13y) (168). The outcomes were reported consistently by the reviews undertaken by Cochrane (140), Wilson (139) and Epstein, however the Cochrane review failed to indicate that all subjects also received a version of the Traffic Light Diet and the Epstein review incorrectly reported on eight month follow-up rather than six month.

The Cochrane review (140) again failed to report the use of the Traffic Light Diet in the 1994 study by Epstein et al which examined the effects of mastery criteria and contingent reinforcement of mastery in child weight management (n=44, age: 8-12y) (149). This detail was also omitted by the Wilson review

(139). In addition, both the reviews by Wilson (139) and Glenny (138) incorrectly reported the sample size as 39 (number of completers), rather than 44 (number of subject randomised).

Another paper by Epstein cited by all four reviews compared a behaviourally orientated program to a control group (n=24, age: 5-8y) (150). All four reviews reported the same correct outcome, however the Epstein review failed to indicate that all subjects were female and both the Epstein and Wilson reviews reported the sample size as completers (n=19) rather than enrollers (n=24).

Flodmark et al (147) assessed the effect of adding family therapy to a conventional weight management program (n=94, age:10-11y) and was reviewed by all four review papers. Of these, three correctly concluded that the addition of family therapy did not provide any additional benefit to conventional management for decreases in BMI one year post intervention. However, the Cochrane group (140) did not explain that the difference between the two study interventions seen at program end were not maintained at the one year post-treatment time point. In addition, Epstein's review (141) failed to report that there was a control arm in this study.

Graves et al (166) found the addition of problem solving skills to a standard behavioural treatment to produce statistically significant reductions in weight, BMI and percent overweight (n=40, age: 6-12y) which was reported correctly by all three reviews that included this primary paper (141) (140) (139). The only misreporting identified was the failure of the Cochrane (140) and Wilson (139) reviews to report the use of the Traffic Light Diet in the intervention.

The 1987 paper by Mellin et al reporting on the effectiveness of the "Shapedown" program with adolescents (n=66, age: 12-18y) was described consistently by all four reviews, however the inclusion of varied outcomes (especially absolute weight loss vs. relative weight loss) made comparison between reviews difficult.

The effect of the frequency of delivery (rapid or gradual) of a behavioural program for weight management was examined by Senediak and Spence (165) (n=45, age: 6-13y) and was reviewed by three of the four reviews. Two of the reviews accurately reported that at six months both the rapidly and gradually delivered behavioural interventions produced statistically greater reductions in absolute weight loss and percentage overweight than the non-specific control and that the two interventions did not differ significantly at six months (140) (139). The Epstein review however, incorrectly reported that the gradually delivered behavioural intervention group had a significantly greater weight change than the rapid group at this time point.

Summary

Behaviour management is integral to the management of a condition that requires lifestyle modification, so must be part of any intervention concerned with managing overweight in childhood (12). However, limited evidence exists regarding the effectiveness of behaviour modification for child weight management in the absence of parental involvement (187). Therefore, behaviour modification must be part of a multi-component child weight management program that is family focussed and involves parents. How these conclusions are translated into clinical practice guidelines are outlined in Section 1.2.4.

1.2.3.5 Parental Involvement and Support

Overview

The World Health Organisation concludes that the evidence supporting the involvement of parents in preadolescent child weight management is strong (4). However, the degree to which parents should be involved in the management of their child's overweight and the type of support they require to do this are two areas requiring further examination and a key focus of this thesis.

Given the importance of this cornerstone to this thesis, an additional literature review was conducted to supplement the review of the reviews previously

undertaken. The literature review sought interventions examining the role of parents in the management of childhood overweight published after 2000 (ie. after the most recent date of inclusion into any of the four reviews) to the end of February 2007. The search strategy is outlined in Appendix One.

This literature search located three primary papers in addition to the nine cited across the four review articles (188) (189) (190). Following the undertaking of this literature search, a paper reporting on the PEACH pilot study (the HELPP study) was published (191). This paper is not included in this literature review as it was published outside of the inclusion dates of the literature search, however it is reviewed in the discussion of the PEACH study findings in Section 3.2.3.

All primary papers investigating the parenting cornerstone of management (ie. those included in the four review articles and the additional three published within the literature search inclusion dates) are summarised in Table 1.7. A further 10 general papers were identified through this search and are discussed in more detail below (192) (193) (194) (195) (196) (130) (197) (198) (199) (200).

Table 1.7: Summary of papers investigating the role of and support for parents in the effective management of childhood overweight

Publication details	Sample characteristics	Design and methodological details	Key Findings and Comments
PAPERS SOURCED FROM SYSTEMATIC REVIEWS UP TO 2001			
<p>Epstein et al, 1981 (157)</p> <p>Aim: To assess the importance of targeting the child or parent and child in a family-based obesity program with high-risk, preadolescent obese children</p>	<p>USA</p> <p>76 families</p> <p>One obese parent</p> <p>Preadolescent, overweight 6-12y children (mean=10.4y)</p> <p>20-100% overweight (mean=45%)</p>	<p>RCT (stratified by child age, child % overweight, and parental % overweight):</p> <ol style="list-style-type: none"> 1. Parent and child both targeted (n=30, 19 analysed) 2. Child only targeted (n=26, 17 analysed) 3. Non-specific target (n=30, 20 analysed) <p>Each group provided with TLD and exercise information</p> <p>8m program of 14 sessions: 8 weekly and 6 post-baseline (at 2.5, 3, 4, 5, 6.5 and 8m)</p> <p>Follow-up at 13m</p>	<p>Key Findings:</p> <p>At 21m, all groups demonstrated similar changes in % overweight Children who achieved non-obese status during treatment maintained this at follow-up, but parents did not Changes in eating behaviours directly related to changes in weight</p> <p>5y outcomes showed that group that targeted parents and children achieved decrease in % overweight, whereas other 2 groups showed increases (201)</p> <p>Comment: Very little of the analysis specifically examined effect of the intervention, rather the group as a whole is split to conduct correlations (eg. between parents and children, maintainers and regainers etc), therefore not sure how accurately paper addressed its stated aim Only included subjects in analysis who attended last weekly session + 6.5 or 8m session + 13m follow-up</p>
<p>Brownell et al, 1983 (145)</p> <p>Aim: To test 3 methods of parental involvement in the treatment of obese adolescents aged 12-16y</p>	<p>USA</p> <p>42 adolescent obese children aged 12-16 (mean age not given)</p> <p>At least 20% more than average weight</p>	<p>RCT (stratified by % overweight):</p> <ol style="list-style-type: none"> 1. Mother(M) and Child(C) separately (n=14, 13 at 16wk, 12 at 1y)) 2. M and C together (n=15, 12 at 16w, 12 at 1y)) 3. C alone (n=13, 12 at 16w, 12 at 1y)) <p>Each group provided with same program of behaviour management, nutrition education and exercise</p> <p>16w program consisting of 16 45-60min sessions and follow up every 2mth for 1y</p>	<p>Key Findings:</p> <p>Children in group 1 lost significantly more weight and showed greater reduction in % overweight than groups 2 and 3 (who showed no difference between each other) – this effect started during treatment and was maintained during 1y follow up Advantage could be due to:</p> <ul style="list-style-type: none"> - Children in child alone group displayed disruptive behaviour - Group 2 members reluctant to voice negative feelings about each other - Separate meetings allowed more teaching related to adolescence <p>Comment: Advantageous to include parent in treatment, separately from child</p>

<p>Kirschenbaum et al, 1984 (164)</p> <p>Aim: To examine the effect of parental involvement and environment on weight loss in parent-child dyads</p>	<p>USA</p> <p>40 parent-child dyads</p> <p>Pre-adolescent children aged 9-13y, at least 20% overweight</p> <p>Parent at least 10% overweight</p>	<p>Randomised (matched by parent and child sex, child age and parent and child initial % overweight):</p> <ol style="list-style-type: none"> 1. Parent and child group (P+C) (n=16, 13 analysed) 2. Child only group (CO) (n=15, 9 analysed) 3. WLC (received P+C program after 3m) (n=9, 8 analysed) <p>Each group provided with same information via 9 weekly 90min group session</p>	<p>Key Findings:</p> <p><u>At intervention end:</u> No difference between active groups, but both children and parents lost significantly more weight than WLC</p> <p><u>At 3mth and 1yr follow-up:</u> Children in both active groups maintained weight loss compared with WLC Parents in P+C group had better maintenance than CO or WLC Positive intra-dyad correlation of weight loss in P+C group only</p> <p>Comment: Beneficial to include parents in treatment</p>
<p>Israel et al, 1985 (162)</p> <p>Aim: To evaluate effect of training in child management skills in context of behavioural treatment of childhood overweight</p>	<p>USA</p> <p>33 parent-child dyads</p> <p>Pre-adolescent children aged 8-12y (mean = 11.4), at least 20% overweight</p>	<p>Randomised:</p> <ol style="list-style-type: none"> 1. Weight reduction only group (WRO) (n=12) 2. Parent training group (PT) (n=12) 3. Control (C) (n=9) <p>WRO was multi-component behavioural weight reduction program of 9 weekly 90min group sessions (parent and child in separate sessions). PT group received WRO following general child management skills training (2x1hr group session) for parents only</p>	<p>Key Findings:</p> <p><u>At intervention end:</u> No treatment effect for change in child or parent weight Reduction in % child overweight greater for WRO only than for PT group than for C</p> <p><u>At 1yr follow-up:</u> Significant group by time effect for change in weight for children – PT had non-significant decrease and WRO had significant increase</p> <p>Comment: Superiority of PT group achieved during the follow up period Inclusion of parent training in general child management improved long term effectiveness of child weight management</p>
<p>Epstein et al, 1986 (183)</p> <p>Aim: To examine role of parental weight and self-management in treatment</p>	<p>USA</p> <p>41 children aged 8-12y</p> <p>20-80% >ideal body weight</p>	<p>Randomised:</p> <ol style="list-style-type: none"> 1. Parent-control (n not given) 2. Child self-control (n not given) <p>8 weekly meetings and 10 monthly meetings</p>	<p>Key Findings:</p> <p>Both groups showed significant weight loss, with no significant effect of treatment between groups</p> <p>Children of obese parents showed more rapid regain of weight over time than children of non-obese parents</p> <p>Comment: Results related more to parental weight status than the intervention – targeting children added no additional benefit to targeting parents</p>

<p>Wadden et al, 1990 (167)</p> <p>Aim: To investigate efficacy of a behavioural weight control program in black female adolescents involving different levels of parental participation</p>	<p>USA</p> <p>47 12-16yo adolescent black females (mean age=14y)</p> <p>≥10kg overweight</p>	<p>Randomised (stratified by BMI):</p> <ol style="list-style-type: none"> 1. Child Alone (n=19, 16 completed analysed) 2. Mother and child in same session (n=14, 10 completed analysed) 3. Mother and child in separate session (n=14, 10 completed analysed) <p>Each group provided with 16 weekly 1hr sessions delivered by 2 psychologists and 1 dietitian + 6m follow-up</p>	<p>Short-term changes in weight (ie. end of intervention, n=28)</p> <ul style="list-style-type: none"> - significant decrease in weight and BMI over time (p<0.001), but not by group <p>Long-term changes in weight (ie. 6mth follow up, n=31)</p> <ul style="list-style-type: none"> - all groups increased weight and BMI remained constant from baseline <p>Children whose mothers attended more sessions has significantly more weight loss than children whose mothers did not attend many sessions</p> <p>Self esteem increased and levels of depression decreased in all groups, but this was not associated with weight change</p>
<p>Israel et al, 1994 (151)</p> <p>Aim: To examine the contribution of child self-regulation to a multiple-component intervention for the management of childhood overweight</p>	<p>USA</p> <p>34 pre-adolescent children aged 8-13yo (mean age=11y)</p> <p>≥20% overweight</p>	<p>Randomised</p> <p>Interventions:</p> <ol style="list-style-type: none"> 1. Standard treatment (ST) (n=18, 14 at 26wk, 11 at 1 and 3y) Multi-component self-regulation intervention including goal setting, self-monitoring, self-evaluation Parent has primary responsibility 2. Enhanced child involvement (ECI) (n=16, 12 at 26wk and 9 at 1 and 3y) As for ST but with less emphasis on parental responsibility and greater focus on child – received training in self-regulation techniques <p>For both groups parents and children attend 8 weekly and 9 fortnightly 90min group sessions separately (26wk of treatment)</p> <p>Follow up at 1 and 3yr post intervention</p>	<p>% overweight:</p> <ul style="list-style-type: none"> - at intervention end: decrease both groups - at 1yr: inc over baseline for both groups - at 3yr: plateaued for ECI and increased for ST, but no significant effect of group or group x time <p>Although both groups increased % overweight post-intervention, ECI group had a smaller increase at 3yr and was better able to hold decrease in % overweight to 3yr than ST group</p> <p>No data given to show if statistically significant differences between groups</p>

<p>Golan et al, 1998 (163)</p> <p>Aim: Test efficacy of a family-based approach in which parents were agents of change Vs. children as agents of change (<i>with respect to anthropometric changes</i>)</p>	<p>Israel</p> <p>60 families, child aged 6-11yo, weighed >20% rec wt-for-age, wt-for-ht and wt-for-sex, no history of psychiatric disorders and have both parents living at home</p>	<p>Randomised, matched for sex and age</p> <p>Interventions: <u>1. Parent only group (PO) 14 x 1hr sessions</u> - nutrition education, 15 couples/group - first 4 sessions weekly, next four biweekly, last 6 once every 6wks + 5 additional 15min sessions during last 7mo for whole family <u>2. Child only group (CO) 30 x 1h sessions</u> - prescribed 6.3MJ/d diet, 15 children/group - first 8 sessions weekly, remainder (22) biweekly – 12mth in total - individual counselling session held if child missed session, had difficulties, or wished to change diet</p> <p>Outcome measures reported: Adherence to program Anthropometry (%overweight, weight, weight status)</p>	<p>Adherence: - 29/30 from PO group attended 12m visit vs 21/30 in CO group (p<.02) (drop out 10 times greater in CO group than PO group (202))</p> <p>Findings: - Decrease in % overweight in both groups (paired t-tests) - Significant difference in wt reduction between groups (ANCOVA), greater for parent group (-15% for parent only group Vs. -8% in child only group (p<0.03) (202)) - At 12mth, 79% in parent group lost >10% of excess wt and 35% were non-obese (ie.<10% overweight) VS. 38% and 14% in child group</p> <p>Parents as sole agents of change had several advantages: -lower dropout rate, greater adherence -greater wt loss and better maintenance in children -potential wt loss in parents -cost effectiveness -possible avoidance of adverse effects of dieting -easily integrated into education and health care settings</p>
<p>Golan et al, 1998 (173)</p> <p>Aim: Test efficacy of a family-based approach with parents as agents of change Vs. children as agents of change (<i>for behavioural changes</i>)</p>	<p>As above</p>	<p>As above except for:</p> <p>Outcome measures reported: - Activity Levels (4 items) - Stimulus Exposure (8 items) - Eating related to hunger (4 items) - Eating style (13 items) (all from Family Eating and Activity Habits Questionnaire – see Table 1.15) - Energy Intake (from 7d food record validated with 24h recall)</p>	<p><u>Activity Level:</u> - significant increase only in mothers in parent group</p> <p><u>TV viewing:</u> - no change</p> <p><u>Stimulus exposure (snacks, sweets, cakes, ice-cream):</u> - significant difference between gps in overall reduction of food stimuli (p<.05), children asking permission to take (p<.001) and buy food (p<.05)</p> <p><u>Eating related to hunger:</u> - parents in PO group asked if child hungry significantly more than CO group (p<.01)</p> <p><u>Eating style:</u> - reduction in negative eating styles significantly greater in PO group (p<.05)</p> <p><u>Energy Intake:</u> - both groups significantly reduced EI (paired t-test, p<.00 for both), but significantly greater for children in PO group (ANCOVA, p<.001)</p>

PAPERS SOURCED FROM LITERATURE REVIEW SEARCHING 2001-2007

<p>Beech et al, 2003 (188)</p> <p>Aim: To assess the feasibility, acceptability and outcomes of 2 versions of a family-based intervention to prevent excess weight gain in pre-adolescent African-American girls</p>	<p>USA</p> <p>60 8-10yo African American girls with a BMI of ≥ 25th percentile on CDC chart and their parents/caregiver</p>	<p>Pilot RCT 3 arm, 12week parallel group Not powered to detect differences in anthropometric outcomes</p> <p>2 active intervention arms focussing on knowledge and behaviour change skills to promote healthy eating and increased PA. 90min group sessions ran weekly for 12wks with either: 1. children only (CO) (n=21) or 2. parents only (PO) (n=21) AND 1 comparison group (n=18) with a focus on increasing self-esteem. 90min group sessions ran monthly for 3 months and were supported by bi-monthly mailed greeting cards and health messages</p>	<p>Outcomes: - analysed (CO+PO) vs comparison group and also each intervention group against comparison group and each intervention group against each other PO vs CO: - the only significant difference between CO and PO was observed for low fat food practices ($p=.02$) - trends favouring PO over CO for increased level of physical activity and fewer calories derived from fat</p> <p>Process evaluation: - 88% of participants attended at least 80% of sessions - 34 interviews conducted regarding participants expectations of the program</p>
<p>Golan et al, 2004 (189)</p> <p>Aim: To report on long term follow up (7yr) of study examining parents only Vs. child only (1998 IJO and AJCN papers)</p>	<p>Israel</p> <p>50 of the original 60 subjects described in Golan et al, 1998 above (163) (5 subjects lost from each group)</p>	<p>As above for (163, 173)</p> <p>Wt and ht measured at 1, 2 and 7 yr after intervention end</p>	<p><i>Weight loss at intervention termination</i> - as in 1998 papers <i>Follow-up visits</i> - 1yr follow up: Wt loss in PO group significantly greater than CO group (-13.6% Vs 0, $p<.05$) - 2yr follow up: Significant group difference maintained from 1yr (-15% Vs +2.9%, $p<.01$) - 7yr follow up: Both treatment groups demonstrated wt loss, but significant group difference remained (PO: -29% Vs CO: -20%, $p<.05$)</p> <p>Concluded by recommending comparing parent only group with child+parent group (see 2006 paper following.....)</p>

<p>Golan et al, 2006 (190)</p> <p>Aim: To compare intervention targeting parent only with parent and child together to examine if child needs to be involved at all in treatment (previously compared parent alone and child alone)</p>	<p>Israel</p> <p>Children aged 6-11y and stratified by age: 6&7yo, 8&9yo and 10&11yo before random allocation to group</p> <p>32 families enrolled</p>	<p>Intervention arms:</p> <ol style="list-style-type: none"> 1. Parent Only group (PO) (n=17) 2. Parent + Child group (P+C) (attended sessions together) (n=20) <ul style="list-style-type: none"> - programming similar for both groups, but program for parent + children group adapted to suit child involvement - each group received 16 x 1h group sessions, 1st 10 weekly, next 4 biweekly, last 2 x1/mth = 6 month, also during these 6mth, 40-50min individual appointments held once/mth for each family - follow-up meeting and anthropometric measures 12mth after program ended <p>Outcomes:</p> <p>Attendance rates</p> <p>Weight loss (% overweight and BMIz)</p> <p>Behavioural changes (from Family Eating and Activity Habits Questionnaire – see Table 1.15)</p> <p>Parenting style</p>	<p><i>Attendance rates</i></p> <ul style="list-style-type: none"> - PO group: full attendance at 80% of sessions - P+C group: full attendance at 55% of sessions <p><i>Weight loss</i></p> <p><u>At end of intervention (6mth):</u></p> <ul style="list-style-type: none"> - treatment effect was significant for PO group only (-9.5%, 0.4 BMIz, $p < .003$) - Significant differences between groups for both change in % overweight and BMIz ($p < .02$ for both) <p><u>At 1yr follow up (18mth):</u></p> <ul style="list-style-type: none"> - PO group: significant reduction in % overweight (-12%, $p < .05$) and BMIz (0.5BMIz, $p < .03$) - P+C group: ns increase in % overweight (+0.4%) and BMIz (0.1BMIz) <p><i>Behavioural changes (measured only to 6mth)</i></p> <ul style="list-style-type: none"> - both groups significantly increased PA and decreased sedentary behaviours and reduced overall obesogenic habits ($p < .05$ for all), however only significant group difference for exposure of children to presence of food stimuli at home ($p < .03$) and total obesogenic habits ($p < .05$) <p><i>Parenting style</i></p> <ul style="list-style-type: none"> - No significant changes for either group - for both groups, more permissive the mother, the less change in child's BMI <p>Omitting child from program and targeting only parent resulted in greater child weight loss</p>
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TLD=Traffic Light Diet
WLC=wait list control

Reviewing the Reviews

Of the nine papers investigating the degree of involvement of parents and/or children in the management of childhood overweight, six were included in more than one of the four reviews (see Table 1.6). Most of these multi-referenced articles were reported accurately and consistently across the reviews, however some anomalies were identified.

The study by Brownell (145) tested three methods of parental involvement in the treatment of overweight in 12-16 year olds (n=42) (see Table 1.7). This primary paper appeared in the Glenny, Wilson and Epstein reviews, and whilst the overall conclusions were complementary and accurate, the Glenny review reported the outcome as change in weight, which for the target group is not as appropriate as change in percentage overweight (which was also provided by the authors).

Epstein's controlled study (157) that compared a parent and child targeted intervention with a child alone intervention and a non-specific target group (n=76, age: 6-12y) was included in the Glenny (138) and Epstein (141) reviews. Whilst both reviews accurately reported a significant difference in percentage change in overweight at 10 years between the parent and child intervention and control group, the Epstein review failed to indicate that there was a non-significant difference between the two active intervention arms at this time point.

The comparison of a standard treatment condition (parent given primary responsibility for management) with an enhanced child involvement intervention (child received training in self-regulation techniques) was undertaken by Israel et al (n=34, age: 8-13y) (151) and included in the four key review papers. The findings were reported consistently across the four reviews, however only the Cochrane review (140) reported the randomised sample size correctly.

Wadden's (167) examination of the level of participation of mothers in their adolescent daughter's weight management (n=47, age: 12-16y) was included

in three of the reviews (Table 1.6). The results were reported accurately across the reviews, however the Epstein review failed to indicate that this intervention was undertaken with girls only.

The two remaining multi-referenced studies concerned with the effect of parental involvement in treatment were reported accurately and consistently across the four review articles (162) (164) (see Table 1.7 for study details).

Additional Primary Papers

As mentioned above, a search of the literature for papers published after the most recent date of inclusion into any of the four review articles located a further three primary papers that examined the role of parents/parenting skills in the treatment of childhood overweight and obesity. These papers, along with the primary papers addressing the cornerstone of degree of involvement by child or parent in a weight management program are summarised in Table 1.7.

The paper by Beech et al reports on the Memphis GEMS pilot study which was conducted to inform a large multi-site RCT (188). The pilot study was designed to compare the effectiveness and acceptability of offering an intervention for overweight pre-adolescent African American girls targeting only the parent or only the child (n=60, age: 8-10y). The results of this 12 week pilot were limited predominantly to process and impact evaluation (although results for BMI and WC are presented) and included such indicators as physical activity preference, food practices and servings of sweetened beverages/day. The findings of the two active arms were averaged and compared against a control group, and were also compared separately against each other and the control group. Although the impact of the pilot was limited by its small sample size and short duration, there were trends in eating and activity behaviours seen in the parent-only group that suggested it would be more effective than the child only group (Table 1.7). Overall, this small pilot study lends some support to the design of interventions to target parents only. It should be noted that the pilot's

rationale for targeting only parents was inspired by the earlier work of Golan et al (163) (198).

More recent work by Golan et al reported on the seven year outcomes of an RCT comparing a parent-only with a child-only intervention (189), which was the follow-up to the 1998 publications cited in the reviews and outlined in Table 1.7 (163) (173). The 2004 paper included weight and height outcomes for 50 of the original 60 randomised children (now aged: 14-19y, equal drop out across groups). Both intervention groups displayed significant weight loss (as defined as percent overweight: $100 \times (\text{actual weight} - \text{desirable weight}) / \text{desirable weight}$) over time and in addition, a significant difference was observed between groups with the parent-only group reporting greater percentage weight loss (29% vs. 20%, $p < 0.05$). The authors admit that compulsory military training for “some of the participants from both groups” may have promoted weight loss, but concluded that targeting parents as the exclusive agents of change for child weight management is more effective than targeting children-only.

Following on from this work, the Golan group compared a parent-only intervention with one that targeted children and parents together (190). This study enrolled 32 families of children aged 6-11 years of age in a six month group intervention and reported changes in weight, lifestyle behaviours and parenting style at 18 months. With respect to changes in degree of overweight, significant reductions in percentage overweight and BMI z-score were observed only for the parent-only group (-12%: $p = 0.05$ and -0.5: $p = 0.03$, respectively), whilst non-significant increases were reported for outcomes in the parent and child group (+0.4% and +0.1, respectively). The authors state that this is the first study to “demonstrate that omitting the child from attendance in intervention sessions has the advantage of more weight loss compared with sessions in which the parent and child both attend”. This finding is supportive of the design of this thesis study which targeted parents only for the management of their children’s weight (described in Chapter 2).

As previously mentioned, two areas requiring further investigation are the degree of parental involvement and the type of support offered to parents for the management of overweight in childhood. These two aspects will now be presents as discussed by the 12 papers reviewed in this section.

Degree of Parental Involvement

Nine of the twelve papers identified as examining the role of parents in child weight management specifically investigated the degree to which parents and/or children should be involved in treatment (Table 1.8). These studies compared:

- i) parent and child together vs. child only interventions (157) (164),
- ii) parent and child separately vs. parent and child together vs. child only (145) (167)
- iii) parent only vs. child only interventions (163, 173, 188, 189),
- iv) parent and child vs. parent only (190).

Overall these studies indicate that involving parents in treatment enhances long term reductions in children's degree of overweight (157, 164) and some studies suggest offering separate sessions for parents and children enhances effectiveness (145) (167). However these two studies were conducted with adolescents and the results were inconsistent. Stronger findings in pre-adolescent subjects show that targeting parents only in a weight management program induces greater improvements in weight loss (as defined as reduction in percent overweight) (163, 189) and health behaviours (173) (188) in obese children compared with targeting children only. Golan's 2006 study was the first to demonstrate that targeting parents only is more effective than targeting parents and children, confirming that actively involving children in program sessions does not enhance outcomes (190).

Table 1.8: Classification of papers investigating either a) the degree of parental involvement or b) the type of support provided to parents most likely to assist in the effective management of childhood overweight

Degree of Parental Involvement			
Parent and Child together vs. Child only	Child only vs. Parent only	Parent and child together vs. Parent only	Parent and child separately vs. Parent and child together vs. Child only
Epstein et al 1981 (157) • n=76, 3 groups, 6-12y Kirschenbaum et al 1984 (164) • n=40, 3 groups, 9-13y	Golan 1998 (163) Golan 1998 (173) <i>(both 1998 papers reported on the same study, but different outcomes)</i> Golan 2004 (189) <i>(2004 paper reported on the long term outcomes of the 1998 study)</i> • n=60, 2 groups, 6-11y Beech et al 2003 (188) • n=60, 3 groups, 8-10y	Golan 2006 (190) • n=32, 2 groups, 6-11y	Brownell et al, 1983 • n=42, 3 groups, 12-16y Wadden et al, 1990 • n=47, 3 groups, 12-16y
Type of Support Provided to Parents			
Nutrition Education only vs. Nutrition Education + Parent Training		Parent Control vs. Child self-control	
Israel et al, 1985 (162) • n=33, 3 groups, 8-12y		Epstein et al, 1986 (183) • n=41, 2 groups, 8-12y Israel et al, 1994 (151) • n=34, 2 groups, 8-13y	

Type of Support Offered to Parents

Only three studies, all over 10 years old, with mean sample sizes of only 36 and targeting upper primary school aged children (8-13y), have investigated the most effective type of support to provide to parents undertaking a program to manage their child's weight (Table 1.8). They specifically compared:

- i) the addition of a brief general child management skills training to a standard behavioural weight reduction program (162) and
- ii) a parent-control intervention vs. a child-control intervention (151, 183).

Israel et al's 1985 controlled study (n=33, age: 8-12y) demonstrated that a standard weight management program enhanced with a general child management skills training program for parents produced significantly better long term (12 month) reductions in percentage overweight than a standard program ($p<0.05$) (162).

The studies investigating the effect of placing greater responsibility on children produced inconsistent results (151, 183). The 1994 study by Israel et al randomised children to a standard treatment (ST) which targeted parents or one that had enhanced child involvement (ECI) (151) (Table 1.7). The paper did not report details to determine statistical significance (possibly troubled by the small sample size (n=34)), however the ECI appeared to result in greater maintenance of initial reductions in percentage overweight. Epstein et al's investigation of the role of parental weight and self management in child weight management randomised children to a parent control or a child self-control treatment condition (n=41, 8-12y). The study reported results related more to the effect of parental weight status than the intervention itself, so little insight can be drawn from this intervention in regards to the most effective type of support to provide to parents managing their children's overweight.

A number of reviews recommend incorporating general parenting techniques into weight management programs (139) (140), but as demonstrated here the

primary evidence base is limited and inconclusive. This therefore remains an area that warrants further investigation.

Comments from Additional General and Review Papers

As mentioned above, 10 general papers providing commentary on the role of parents/parenting in child weight management were identified by the supplementary literature search described (Appendix One). Of these, three were review articles (192) (193) (194), one of which (193) appeared in issue 1 of the 2007 Database of Abstracts and Reviews of Effects (203). The remaining seven were general reports.

The three additional reviews included 55 primary papers between them, of which only seven were additional to the papers reviewed in the four key reviews already examined. All the additional seven primary papers appeared in the review by Kitzmann et al (194), possibly due to less stringent inclusion and exclusion criteria (eg. small sample size (20/31 had sample sizes of 40 or less), short duration, single arm, or non-randomised designs). This review included interventions that included active parental involvement in the management of childhood overweight. It organised primary papers according to whether the intervention and the outcomes had a broad or narrow focus with respect to family function or parenting skills. Evidence from the 31 interventions reviewed suggested that family-based interventions are effective relative to control conditions (194).

The remaining two reviews by McLean et al (192) and Berry et al (193) did not add to the pre-established evidence. The review by McLean et al however does provide an efficient taxonomy by which to classify the degree of family involvement investigated by individual studies based on characteristics of the family member (age and gender) and characteristics of the intervention (eg. degree of family involvement, format of delivery). This review recommends studies to include a qualitative component to provide insights into the factors that impact on the effectiveness of interventions. This recommendation supports the conclusion of the Kitzmann review (194) that argued for an ecological perspective that focuses on parent-child interactions

and the larger social context. They recommend a more general family focus as children's weight problems develop and are maintained in a family context, in which parents play an important role.

The role of parenting is difficult to consider when examining older papers as the relationships between children and their parents and the responsibilities and expectations placed on children have increased in the last decade (204). This shift signals a change in expectations of children that would not have been considered or examined in past papers and their findings must be interpreted with caution.

The seven general reports outlined the roles of family environment, parental support and parenting practices on the establishment of eating and activity behaviours and/or prevention/management of childhood overweight (195) (196) (130) (199) (197) (200) (198). Based on the evidence supporting the involvement of parents in child weight management interventions, a number of these general papers make strong recommendations for enhancing general parenting skills in parents to support them to manage their children's weight (196) (130).

Summary

All the reviews examined supported the inclusion of parents in treatment, with responsibility for behaviour change falling to them (187) (139) (141) (140) (192) (194) (193).

It appears that including children in treatment does not provide any additional benefit (189) (190). Targeting parents as the exclusive agents of change and providing them with support around parenting skills to promote the development of healthy lifestyle habits by the child (and whole family) seems to be the most promising avenue for investigation (196) (130).

1.2.3.6 Miscellaneous/Non-Conventional Strategies

Papers reporting on interventions that did not address the recognised cornerstones of management were classified as miscellaneous/non-conventional strategies. Only three papers reported on such interventions and they all appeared in the Epstein review (141).

Extreme dietary manipulation (eg. VLCD, macronutrient manipulation) for weight management with normal children may compromise growth and development and is therefore not recommended. Likewise, surgical and pharmaceutical intervention is not appropriate for overweight/slightly obese children without significant co-morbidities (12) (4). Given these contraindications, only one paper discussed in the four reviews examined the benefits of the addition of a drug (fenfluramine) to a dietary intervention (n=20, age: 5-17y) (185). This controlled study found no significant effect of the drug on weight or body fat outcomes. There were no primary papers discussing the role of other non-conventional treatment strategies such as surgery or very low calorie diets in children.

Another two primary papers were included in the Epstein review that did not fall within the four cornerstones of management previously outlined. Aragona et al (180) and Mendonca and Brehm (186) both detailed aspects concerned with the logistics of conducting a child weight management trial – the effect of providing reinforcement for weight loss (n=100, age: 5-11y) and the effect of the perception of choice in therapeutic outcome on subject response (n=18, age: 8-15y), respectively (180) (186). There was an absence of treatment effects at the 11 and nine month follow-up points for both these studies, however the provision of reinforcement and the perception of choice of therapy did appear to result in positive results in the short term.

1.2.3.7 Summary – the Cornerstones of Management

Generally, the reviews and review of reviews accurately and consistently summarised the evidence presented in the primary papers informing the effective management of childhood overweight. However some inaccuracies were identified principally in three areas: i) inconsistent reporting of sample sizes, ii) inconsistent reporting of outcomes and iii) incomplete reporting of findings.

Inconsistent reporting of sample sizes

Inaccurate reporting of sample size values has an impact on intention-to-treat analysis, currently the preferred method to assess the effectiveness of an intervention (205). For example, many studies reported sample sizes of only those subjects included in the final analysis, or did not include subjects who were randomised but dropped out prior to treatment commencing. These omissions can lead to an overestimation of effect size, leading to inaccurate conclusions regarding the value of the study. Adherence to the CONSORT statement (206) prevents this and ensures accurate and consistent reporting.

Inconsistent reporting of outcomes

The use of various weight related outcomes ie. percentage overweight, absolute weight loss, relative weight loss made comparison across studies difficult, preventing the undertaking of meta-analysis. In some cases outcomes used were inappropriate for the study population. A consistent reporting method is required, and national and international bodies and journals recommend change in BMI z-score as the most appropriate measure in clinical research (207) (208) (209) (12).

Without long-term outcomes (at least to 12 months post-baseline) it is difficult to assess the true effectiveness of an intervention. Interventions seeking to change habits and behaviours, such as weight management interventions, require long term follow-up to assess ongoing effectiveness. Ensuring a minimum follow-up period of 12 months post-baseline for trials seeking

publication and inclusion into reviews will assist to maximise the quality of trials in this regard.

Incomplete reporting of findings

Another major issue identified across the reviews related to the transparency of reporting and systemacity of the search strategy on which they were based. Providing details of the databases and year searched, the search strategy used, study inclusion criteria, an assessment of the quality of studies included and their results increases the quality of review articles (142).

Some reviews also failed to document the detail of the intervention provided. For example, stating that the Traffic Light Diet was the dietetic intervention.

Finally, inaccuracies were also identified that could have been avoided by ensuring strict editing and proofing. Typing errors led to confusion in some cases and some reviews exhibited non-specific reporting of findings. For example, reporting that groups responded differently over time without any indication of effect size and therefore statistical or clinical significance.

Conclusion

This literature review highlights a number of weakness in study design that need to be addressed in order to strengthen the evidence base which informs the management of childhood overweight. These weaknesses are summarised at the end of Chapter Two which also highlights how this thesis study has addressed these aspects, thus providing high quality data to contribute to the existing evidence.

Despite the identified limitations of the reviews and some primary studies, there is adequate evidence to support the four cornerstones to management as:

1. Diet
2. Activity (both physical activity and sedentary behaviour)
3. Behaviour Modification
4. Parent Involvement and Parental Support

The translation of these cornerstones into practice requires the dissemination of the research findings in the form of clinical practice guidelines. The following section examines how accurately these findings are translated into practice guidelines from three countries and the consistency between them.

1.2.4 The Clinical Practice Guidelines

1.2.4.1 Introduction

Clinical practice guidelines are informed by judicious, objective appraisal of the available evidence; synthesising the scientific literature into recommendations for best practice (210). Provided they are developed in a systematic way, clinical practice guidelines should reflect the state of the evidence and offer a practical illustration of how it may be applied. Hence, a review of clinical practice guidelines for the management of childhood overweight provides a “proxy-review” of the literature.

This section describes how the clinical practice guidelines for the management of childhood overweight from three countries: Australia, the UK and the US were developed. It also examines how these three sets of guidelines address each of the four cornerstones of management of childhood overweight as identified in the literature and presented in Section 1.2.3. As a result, the consistency by which the evidence is translated into practice internationally is examined.

1.2.4.2 Clinical Practice Guidelines: An International Overview

1.2.4.2.1 Australia

The National Health and Medical Research Council’s Clinical Practice Guidelines for the Management of Overweight and Obesity in Children and Adolescents (12) were published in 2003 as a response to the release of *Acting on Australia’s Weight: a strategic plan for the prevention of overweight and obesity* in 1997 (211).

The Guidelines were based on a systematic review of the literature and the strength of the evidence was determined using criteria adapted from the National Health and Medical Research Council (NHMRC) levels of evidence for clinical interventions (212) and the US National Institutes of Health clinical guidelines (213) (Table 1.9).

Grades of Recommendation relevant to the Levels of Evidence were assigned to recommendations for practice as outlined in the footnote in Table 1.9. These Recommendations ranged from B-D, indicating a lack of evidence from a large number of high quality RCTs to inform the NHMRC Clinical Practice Guidelines for the Management of Overweight and Obesity in Children and Adolescents.

Table 1.10 presents the evidence statements, their rankings and recommendations for practice. It is worthwhile noting the variation in which the three nations apply the levels of evidence across the cornerstones of management. For example, the component of “parental involvement” is assigned an evidence level of III-2 (Australia), 1+++ (UK) and I (US). Given the conclusions reached at the end of the previous two sub-sections, the presence of Level 1+++ (UK) or I (US) evidence is very unlikely and the awarding of these levels of evidence by these groups is questionable. Rather, there are large gaps in the evidence regarding many of the cornerstones of management of childhood overweight, especially the role of and involvement of parents, that warrants further investigation (as discussed in Section 1.2.3.5).

Table 1.9: The levels of evidence used to classify literature for the development of Clinical Practice Guidelines (CPGs) for the management of childhood overweight in Australia, the UK and the US

Australia ^a		UK ^b		US ^c	
Level of evidence	Study design	Level of evidence	Study design	Level of evidence	Study design
I	Evidence obtained from systematic review of all relevant RCTs	1++	High-quality meta-analyses, systematic reviews of RCTs or RCTs with very low risk of bias	I: Good/Strong	One to several good quality studies of strong design
II	Evidence obtained from at least one properly designed RCT	1+	Well-conducted meta-analyses, systematic reviews of RCTs or RCTs with a low risk of bias	II: Fair	Several studies of strong design with minor methodology concerns / studies of weaker design
III-1	Well-designed pseudo-randomised controlled trials (alternative allocation or some other method)	1-	Meta-analyses, systematic reviews of RCTs or RCTs with a high risk of bias	III: Limited/Weak	Limited number of studies of weak design OR inconclusive findings due to design flaws, bias or execution problems
III – 2:	Comparative studies with concurrent controls and allocation not randomised (cohort studies), case-control studies, or interrupted time-series with control	2++	High-quality systematic reviews of non-RCT, case-control, cohort, CBA or ITS studies	IV: Expert Opinion Only	No studies available – conclusions based on usual practice, expert opinion/experience, or extrapolated from basic research
III – 3	Comparative studies with historical control, ≥2 single-arm studies or interrupted time series with parallel control		High quality non-RCT, case-control, cohort, CBA or ITS studies with very low risk of confounding, bias or chance and a high probability that the relation is causal	V: Level Not Assignable	No evidence available
IV	Evidence obtained from case series, either post-test or pre-test and post-test	2+	Well-conducted non-RCT, case-control, cohort, CBA or ITS studies with very low risk of confounding, bias or chance and moderate probability of causal relation		
Level Not Assignable	No evidence available	2-	Non-RCT, case-control, cohort, CBA or ITS studies with high risk of confounding, bias or chance and significant risk that relationship not causal		
		3	Non-analytic studies (eg. case report or series)		
		4	Expert opinion, formal consensus		

^a Based on criteria adapted from the National Health and Medical Research Council levels of evidence for clinical interventions (212) and the US National Institutes of Health clinical guidelines (213). Levels of evidence translate to the following grades of recommendation for practice (A-D): A=level of evidence I, B= level of evidence II-III-2, C= level of evidence III-3-IV, D=level not assignable, as represented by differing levels of shading across CPGs

^b Taken from Table 4.1 of the full guidelines (available at www.nice.org.uk/CG043fullguideline), RCT – randomised controlled trial; CBA – controlled before-and-after; ITS – interrupted time series, * Studies with a level of evidence ‘-’ should not be used as a basis for making a recommendation

^c Adopted by the American Dietetic Association from Greer et al (214)

Levels of evidence printed in bold apply to recommendations for the management of childhood overweight for each of the CPGs

Table 1.10: Consistency by which the Clinical Practice Guidelines for the management of childhood overweight from Australia, the UK and the US address the recognised cornerstones of management

	Australia	UK ^b	US ^c
Diet	<p><u>Evidence:</u> - No direct evidence for which dietary modification works best in child and adolescent weight management (Evidence Level Not Assignable)</p> <p><u>Recommendations:</u> - For weight management, children and adolescents should be encouraged to follow the Dietary Guidelines for Children and Adolescents in Australia and the Australian Guide to Healthy Eating (Recommendation Grade D)</p>	<p><u>Evidence:</u> - No clear evidence on which dietary intervention is the most effective in weight reduction and management in children and adolescents (Evidence Level Not Assignable)</p> <p><u>Recommendation:</u> - Age-appropriate recommendations consistent with healthy eating advice to be delivered as part of a multi-component intervention</p>	<p><u>Dietary counselling and nutrition education</u> - Limited evidence available to support use of dietary therapy and/or nutrition education alone (Evidence Level III) - Sufficient evidence for inclusion of dietary therapy and/or nutrition education within multi-component family-based group intervention in school aged children (Evidence Level I)</p> <p><u>Dietary counselling on altered macronutrient within a multi-component program</u> - Limited evidence to support use of particular altered macronutrient approach as opposed to standard dietary therapy (Evidence Level III)</p>
Physical Activity (PA) and Sedentary Behaviour	<p><u>Evidence:</u> - Limited evidence that increasing PA improves weight-loss outcomes in children or adolescents and may be effective by itself if vigorous (Evidence Level III-2)</p> <p><u>Recommendations:</u> - More PA than is currently being engaged in should be prescribed for the management of obesity in children and adolescents.... the prescription should be based on age-appropriate activity (Recommendation Grade B)</p> <p><u>Evidence:</u> -Reducing sedentary behaviours in obese children as effective for weight management as increased activity (Evidence Level III-3)</p> <p><u>Recommendations:</u> - Reduce time spent in sedentary behaviours/d (Recommendation Grade C)</p>	<p><u>Evidence:</u> - No evidence on effectiveness of PA alone in treatment of childhood obesity in a clinical setting (Evidence Level Not Assignable) - Targeting sedentary behaviour shown to be as effective as promoting PA in managing weight in obese children aged 8–12y (Evidence Level 1+) - Lifestyle exercise more effective than aerobic and calisthenics exercise in maintaining weight loss in obese children aged 8–12y (Evidence Level 1+)</p> <p><u>Recommendation:</u> - Aim for at least 60min of at least moderate activity/day and reduce sedentary activity</p>	<p><u>Physical activity</u> - Fair evidence to support using PA alone (Evidence Level II) - Sufficient evidence to routinely recommend including PA within multi-component family-based group intervention for school-aged children (Evidence Level I)</p> <p><u>Sedentary behaviours</u> - Limited evidence to support reducing sedentary behaviours vs. increasing PA for children (Evidence Level III)</p>

Behaviour Modification	<p><u>Evidence:</u> -No evidence about detail of how, when and what behaviour-modification approaches should be used for childhood and adolescent obesity (Evidence Level Not Assignable)</p> <p><u>Recommendations:</u> - Age-appropriate behaviour modification should be incorporated in any weight-management program for obese children and adolescents (Recommendation Grade D)</p>	<p><u>Evidence:</u> - Behavioural treatment with PA and/or diet is effective in treatment of obese children and adolescents aged 3–18y (Evidence Level 1++) - No evidence on components of behavioural treatment most effective for obesity management (Evidence Level Not Assignable)</p> <p><u>Recommendation:</u> - Multi-component interventions treatment of choice, should include behaviour change strategies ie. stimulus control, self monitoring, setting goals and rewards, problem solving, praise and parental role modelling</p>	<p><u>Behavioural counselling</u> - Limited evidence to support behavioural counselling alone (Evidence Level III) - Sufficient evidence to routinely recommend inclusion of behaviour component to multi-component family-based group intervention for school aged children (Evidence Level I)</p>
Parental Involvement	<p><u>Evidence:</u> - For children of primary school age, evidence that program that involves parents alone does better than one that requires regular attendance by child (Evidence Level III-2)</p> <p><u>Recommendations:</u> - Involve parents in management of overweight and obesity in children and adolescents. Parents can alter environments substantially, especially for children of primary school age (Recommendation Grade B)</p>	<p><u>Evidence:</u> - Behavioural treatment can be more effective if parents, rather than children (aged 6 to 16y), are given main responsibility for behaviour change (Evidence Level 1++)</p> <p><u>Recommendation:</u> Not addressed in clinical guidelines</p>	<p><u>Multi-component programs</u> - Sufficient evidence for multi-component, family-based group intervention of diet, PA, behaviour change and parent training for reducing overweight in 5-12y(Evidence Level I)</p> <p><u>Parent training with multi-component interventions</u> - Limited evidence to support use of parent training in absence of multi-component program (Evidence Level III) - Sufficient evidence to support parent training techniques as part of multi-component family-based group intervention in school-aged children (Evidence Level I)</p>
Miscellaneous	<p><u>Evidence:</u> - Use of very low energy diets, drugs and bariatric surgery considered only for extreme degrees of obesity and life-threatening co-morbidities (Evidence Level III-3 to IV)</p> <p><u>Recommendations:</u> - Pursue these strategies only in tertiary institutions with specialist obesity services (Recommendation Grade C to D)</p>	<p><u>Evidence:</u> Not addressed within lifestyle interventions for child weight management</p> <p><u>Recommendation:</u> -Pharmacological and surgical interventions generally not recommended unless severe co-morbidities exist</p>	<p><u>Individual-based counselling</u> - Limited evidence to support routinely recommending individualised intervention for overweight in children (Evidence Level III)</p>

1.2.4.2.2 The UK

The most recent guidelines for the management of overweight weight and obesity in the UK were developed by the National Institute of Clinical Excellence (NICE) in December 2006 (143). The guidelines address both clinical and public health recommendations, and for the purposes of this thesis, the clinical recommendations relating to the management of overweight in childhood will be reviewed. The guidelines were developed in accordance with the methods set out by the NICE in 'Guideline Development Process – Information for National Collaborating Centres and Guideline Development Groups' (available at www.nice.org.uk). The specific search strategy undertaken for the development of these guidelines are reported in Section 4.4 of the Full Guidelines (available at www.nice.org.uk/CG043fullguideline).

As for the Australian Clinical Practice Guidelines, the evidence statements established from the literature were graded according to a hierarchy of research designs (Table 1.9). Evidence was translated into clinical recommendations for lifestyle interventions which are presented in Table 1.10. Most of the evidence used to inform these clinical recommendations was ranked 1++ and 1+ (Table 1.9), indicating that it was sourced from well-conducted meta-analyses and systematic reviews with low risk of bias. However some practice recommendations were based on evidence to which an evidence level was not assignable.

1.2.4.2.3 The US

The American Dietetic Association's (ADA) position paper (rather than clinical practice guidelines) on interventions for paediatric overweight is based on conclusions drawn from an extensive review of literature on intervention programs and rigorous systematic evidence-based analysis (144).

The position paper grouped studies into three categories:

1. individual or family-based (all were tertiary prevention/treatment interventions)
2. school-based (the majority of these interventions focussed on primary and secondary prevention)
3. community-based (the majority were primary and secondary prevention interventions)

For the purposes of this thesis, levels of evidence and recommendations relating to the first group only are presented.

Evidence informing the management of childhood overweight was graded according to a system developed by Greer et al (214) in a similar manner to the other two countries (Table 1.9). Recommendations made by the ADA Position Paper regarding the management of childhood overweight were informed by evidence graded from I – III, representing evidence of limited/weak strength to good/strong strength. Table 1.10 presents the recommendations for practice (referred to as “conclusion statements” in the position paper) that have been informed by this review of the evidence.

1.2.4.3 Clinical Practice Guidelines: The Cornerstones of Management

1.2.4.3.1 Diet

All countries agreed that diet is an essential component of a child weight management intervention (the US assigned an Evidence Level of I to this statement) but that there is a lack of evidence to inform what dietary modification (eg. macronutrient distribution, glycaemic index level, prescriptive approach (ie. Traffic Light Diet) vs. food based approach (ie. Australian Guide to Healthy Eating) would be most effective (Australia and the UK were unable to assign a level of evidence to this statement, whilst the US applied a level of III). Recommendations for practice are consistent across countries, namely dietary counselling/nutrition education should be

age-specific and follow healthy eating advice and be part of a multi-component intervention.

1.2.4.3.2 Physical Activity and Sedentary Behaviour

All guidelines recommend the inclusion of physical activity in a multi-component program for children weight management, however the grading of evidence informing its role varied across countries. American guidelines graded the evidence as level II, which is much higher than the Australian grading of III-2, which in turn is higher than the unassignable ranking granted by the UK. In addition, there is some disagreement on the beneficial role of physical activity alone in child weight management.

The reduction of sedentary behaviours was unanimously supported, however again the grading of evidence informing recommendations varied across countries. The UK guidelines graded the evidence for this modality as 1+, indicative of evidence from well-conducted meta-analyses, systematic reviews of RCTs or RCTs with a low risk of bias. However, both the Australian and US guidelines gave similar limited gradings of III-3 and III respectively.

Physical activity guidelines promoted across these countries are generally consistent, recommending increasing usual active time to at least 60 minutes per day and limiting time spent in sedentary pursuits to no more than two hours per day (104) (143).

1.2.4.3.3 Behaviour Modification

Whilst behaviour modification is recognised as being a necessary component of management for childhood overweight by all three countries (awarded the highest level of evidence by the UK and US guidelines), the Australian and UK guidelines highlight that there is no evidence of the detail of the most effective behaviour modification approaches to employ. The US guidelines do not recognise this.

Practical recommendations from Australia and the UK outline key, age-appropriate behaviour change strategies to include in management (Table 1.10).

1.2.4.3.4 Parental Involvement and Support

The importance of involving parents in a multi-component, family-based group intervention for the management of children's weight is emphasised by the guidelines from all three countries. However, only the guidelines from Australia and the UK highlight the value of targeting parents *only* as the agents of change. In addition, these countries grade the evidence supporting this recommendation inconsistently as III-2 (limited, Australia) and 1++ (high quality, UK).

The US recommendations however were the only ones to specifically recommend the incorporation of parenting skills to a multi-component, family-based group intervention (evidence level I). The evidence for the use of parenting training only for management was not as strong (level III).

1.2.4.4 Summary – The Clinical Practice Guidelines

Australia, the UK and the US have responded to the recent increases in rates of childhood overweight by developing clinical practice guidelines for its management. The evidence informing the development of such guidelines and subsequent recommendations is globally consistent, however the methods and hierarchies by which this evidence is graded by professional organisations is varied.

Given the limitations in the evidence recognised by the review of reviews in Section 2 of the literature review, it is perplexing to see the award of high grades of evidence within clinical practice guidelines. Clearly, consistent methods of grading evidence to inform clinical practice guidelines need to be established so as recommendations for practice address this global epidemic through a co-ordinated international approach.

1.2.5 Summary of Section Two – The Evidence to Guide Effective Management of Childhood Overweight

In summary, the evidence to support the use of a multi-component intervention that includes diet, activity, behaviour modification and parental involvement is strong. The clinical practice guidelines agree that an intervention is more likely to be effective if it promotes a healthy eating plan, encourages lifestyle activity and aims to reduce sedentary behaviours, and takes a whole of family approach. However, the evidence informing some of these cornerstones of management is limited and areas requiring further research have been identified.

With regards to dietary management, well-designed studies are needed to determine the optimal dietary prescriptions and approaches for weight management in children and adolescents. Currently, general healthy eating guidelines that take a whole of diet, food-based approach are recommended, however the specific macronutrient composition of the diet to maximise weight management efforts needs further investigation.

The physical activity/sedentary behaviour component of management also relies on general population recommendations for active and sedentary pursuits. Evidence does suggest that encouraging lifestyle activity rather than active play and focussing on decreasing sedentary behaviours is beneficial. There is a need for research into the optimal prescriptions for physical activity and for reducing sedentary behaviours for effective weight loss in overweight children.

Behaviour modification is recognised as an essential component of a family-focussed multi-component child weight management program, however there is a need for research to identify age-appropriate behaviour-modification approaches that promote long-term maintenance of weight control in overweight children.

Finally, the involvement of parents in child weight management and the degree to which they are supported within a program is an area of research and practical interest. Evidence suggests that developmentally-appropriate parental involvement in child weight management is important and there is strong evidence to suggest that for pre-adolescent children, parents should be the sole targets of treatment. How parents are targeted and the role of effective parenting in treatment approaches to childhood overweight are areas worthy of further investigation.

In conclusion, there is strong support for inclusion of the modalities of diet, activity, behaviour modification and parental involvement and support in a multi-component family-focussed intervention for the effective management of childhood overweight (Tables 1.5 and 1.10). The strength of the evidence to inform these recommendations however is variable and dependent on the system used to assess it (Table 1.9).

The final Section of the literature review examines the quality of program evaluation undertaken by the 12 papers summarised in Table 1.7 which reported on interventions investigating the role of and support for parents in the management of childhood overweight.

1.3 Section Three: Evaluation of Interventions to Manage Childhood Overweight

1.3.1 Introduction

Randomised controlled trials (RCTs) are recognised as the “gold standard” of research design, providing the highest level of evidence for clinical interventions (215) (216). The RCT design is well suited to trials of efficacy as it was developed in the setting of clinical drug trials, or interventions requiring the relatively simple commitment of subjects to take a medication or receive a clinical treatment (217). The evaluation of the *efficacy* of these types of trials is straightforward: what health effect did the medication produce? In addition, the measurement of intervention delivery and adherence is straightforward: was the medication administered and how well was it tolerated? Conversely, interventions examining the *effectiveness* of treatments that require subjects to take primary responsibility for their behaviour change (rather than receive a clinical treatment) within the context of an environment that may or may not be supportive of this change (rather than a clinical laboratory) require more complex evaluation designs than do clinical trials.

Whilst behavioural interventions may still be designed using the rigor of an RCT, it is valuable to measure broader evaluation indicators in addition to primary study outcomes. Measures of the behaviour changes affecting the primary outcome and consideration of the environment in which participants exist that influence these behaviours are required (218). The intrinsic and extrinsic environment of the participant, including barriers and facilitators to behaviour change, has a direct impact on the individual’s/family’s ability to implement the prescribed behaviour changes, which is a key mediator of effectiveness. Although some of these influences may be beyond the reach of the intervention, they form the environment in which it is delivered and thus have a direct effect on its potential effectiveness.

This section summarises recommendations from the program evaluation literature and examines the degree to which these have been addressed by the 12 studies identified in the previous section which investigated the role of parental involvement and support in the management of childhood overweight. The section concludes by providing recommendations for how evaluation of interventions promoting healthy lifestyle behaviours can be strengthened.

1.3.2 Program Evaluation

1.3.2.1 Introduction

The evaluation literature recommends three different levels of evaluation be conducted throughout the duration of an intervention to examine its effectiveness. Table 1.11 provides definitions of each of these levels of program evaluation which are further outlined in the following sub-sections.

Table 1.11: Types of program evaluation: definitions and examples specific to the evaluation of a child weight management intervention

	Outcome Evaluation	Impact Evaluation	Process Evaluation
Definition	Measures the long-term effect of the program <i>(Does it meet its goals/ what effect does it have on the primary outcome?)</i>	Measures the immediate effect of the program <i>(Does it meet its objectives/what effect does it have on the secondary outcomes?)</i>	Measures the activities of the program, program quality and who it is reaching <i>(Are the program/intervention strategies consistent?)</i>
Examples	Assessment of change in degree of overweight <i>ie. via measurement of BMI and waist circumference z-scores</i> Assessment of change in indicators of psychosocial health <i>ie. via analysis of indicators of QOL and degree of body shape dissatisfaction</i>	Assessment of change in health behaviours <i>ie. via analysis of dietary intake and activity records</i> Assessment of change in parenting practices <i>ie. via measurement of parenting satisfaction and efficacy</i>	Assessment of program reach and proportion of components received by participants <i>ie. via attendance rates</i> Assessment of participant satisfaction <i>ie via participant satisfaction questionnaire</i> Assessment of degree of program implementation <i>ie. via audit of facilitator running sheet</i> Assessment of program materials <i>ie. via participant satisfaction questionnaire</i>

Adapted from (219)

1.3.2.2 Outcome and Impact Evaluation

Outcome and impact evaluation indicators both assess the effects of a program/intervention, but at different levels (219). Outcome evaluation examines the longer term effects of a program/intervention by determining the achievement of program goals, or the effects an intervention has on the primary study outcome. In contrast, impact evaluation indicators assess the immediate effects of a program. The program evaluation literature defines this as measuring the achievement of program objectives, whilst the research community refers to this as measuring the effect of an intervention on the study's secondary outcomes or mediating factors. Table 1.11 provides some examples of outcome and impact evaluation indicators that are typically used in interventions investigating the effectiveness of child weight management interventions.

The inclusion of both these levels of evaluation indicators is crucial to elucidate the hypothesised relationships between treatment, behavioural mediators and final health outcome when conducting interventions targeting behaviour change (220). For example, if the effectiveness of a program/intervention was assessed via outcome evaluation indicators only (eg. degree of weight loss), the changes to lifestyle behaviours necessary to achieve that outcome and the effectiveness of the intervention to alter these target behaviours could not be verified.

Outcome evaluation

The primary outcome of child weight management interventions is to produce a reduction of the degree of overweight experienced by the sample and is therefore the indicator assessed by outcome evaluation. The best method/definition to measure this change is controversial and is discussed in Section 1.3.3.2.

As overweight impacts upon other aspects of health beyond weight and health encompasses physical, emotional, mental and spiritual health (221),

secondary outcomes that represent broader health outcomes may also be assessed as part of outcome evaluation. These may include measures of psychosocial health such as quality of life, indicators of body shape satisfaction, confidence or self-esteem (Table 1.11)

Impact evaluation

Impact evaluation indicators commonly include measures of knowledge, attitudes, skills and behaviours (222). These are the immediate effects of an intervention, or the indicators that contribute to the achievement of the overall program goal (223).

It is accepted that behaviours that contribute to a reduction in the degree of overweight (the goal of child weight management interventions) are those that induce a negative energy balance, namely eating and physical activity behaviours. For interventions examining the role of parenting skills in a family-focussed child weight management intervention, change in parenting practices and parental weight status are also appropriate examples of indicators by which to evaluate study impact (Table 1.11).

1.3.2.3 Process Evaluation

Process evaluation indicators focus on program *activities* rather than *outcomes* and can include measures of how a program is implemented, its reach and the degree to which it satisfies participants' expectations (219). If impact and outcome evaluation demonstrate an intervention to be effective, the findings from a process evaluation can identify *what* it is that worked (or not). Identification of ineffective or inefficient aspects of programming assists with program improvement and more efficient use of resources. Process evaluation can also provide a quality assurance mechanism and increase the generalisability of an intervention.

Experimental studies that do not include indicators to measure process cannot determine participant satisfaction, whether a program was received by the target population or if it was implemented as planned (219).

Process evaluation indicators appropriate for the evaluation of a child weight management intervention include attendance rates, consistency of program delivery and satisfaction with and engagement in the program (Table 1.11). Inclusion of qualitative research methods such as interviews or focus groups can also assist in the interpretation of such process evaluation findings (140).

1.3.2.4 Summary – Program Evaluation

To extend the understanding of the mechanisms that lead to changes in a health outcome, it is essential to measure change in the mediators of that outcome ie. impact evaluation indicators such as behaviours, skills, knowledge, attitudes (224). Furthermore, evaluation of intervention processes enable a deeper understanding of the factors contributing to observed changes in impact and outcome evaluation indicators. Pawson and Tilly (1997) highlight that classic experimental design can raise the problem of the “black box” whereby outcomes can be described but knowledge of why a program did or did not work is unknown (225). Thorough evaluation that includes the indicators discussed above will assist in avoiding such a scenario.

Clearly, inclusion of a robust evaluation plan in the design of any intervention, particularly one being undertaken in a social context focussing on behaviour change, will help define the relationship between the hypothesised mediators of behaviour change and health outcomes. Articulation of this relationship provides a greater appreciation of the full effect of the intervention and identification of program components and behavioural changes contributing to change in the primary outcome.

1.3.3 Evaluation Indicators Reported in the Literature Examining the Role of or Support Required for Parents to Effectively Manage Childhood Overweight: A Review

1.3.3.1 Introduction

The Cochrane review included in Section 1.2.2 concluded by making fourteen suggestions for further research of which five referred to evaluation design (140). Specifically, it recommended future research:

- consider the physical and social environment that influence healthy lifestyle behaviours;
- be carefully designed and evaluated;
- include qualitative research to highlight why interventions may or may not be successful;
- define appropriate short- and long-term outcomes ie. behaviours such as healthy eating and incidental exercise and psychosocial outcomes;
- include process indicators to determine whether the intervention was delivered to all participants as intended.

In addition, a recent review of RCTs focussing on dietetic intervention for the management of childhood overweight by Collins et al concluded that few studies adequately describe the dietary intervention itself or the change in dietary intake in response to the intervention because the focus of reporting was change in weight status (220). They called for more thorough reporting of such detail to enable reproduction, but also so that the broader effects of interventions can be measured ie. beyond weight outcomes alone. This review was not included in the review of reviews in Section 1.2.2 as it included studies measuring the effectiveness of *dietetic interventions only* in the management of childhood overweight.

There is a definite need for more thorough evaluation of interventions examining effective management of childhood overweight. This section reviews the evaluation indicators reported in the literature examining the role of parental involvement and support in the management of overweight in childhood. Table 1.12 summarises the aims of such studies (as identified in Section 1.2.3.5) and indicates the evaluation indicators reported.

Table 1.12: Summary of evaluation indicators reported in key papers investigating the role of or support required for parents to effectively manage childhood overweight

Publication Details	Study Aim	Outcome Indicator	Impact Indicator	Process Indicator
Epstein et al 1981 (157)	To assess importance of targeting child vs. parent and child in a family-based obesity program with high-risk, preadolescent obese children	✓	✓	
Brownell et al 1983 (145)	To test 3 methods of parent involvement in treatment of obese 12-16y	✓		
Kirschenbaum et al, 1984 (164)	To examine effect of parental involvement and family environment on weight loss in parent-child dyads	✓	✓	
Israel et al 1985 (162)	To evaluate effect of explicit and additional training in general child management skills in context of a behavioural treatment program for overweight children	✓	✓	
Epstein et al 1986 (183)	To examine role of parental weight in treatment and whether self-management enhances child weight control	✓	✓	
Wadden et al 1990 (167)	To investigate efficacy of behavioural weight control program in black female adolescents involving different levels of parent participation	✓		
Israel et al 1994 (151)	To examine the contribution of multi-component self-regulation intervention to assess effectiveness in child obesity treatment	✓	✓	
Golan et al 1998 (163)	To compare efficacy of a family-based approach with parents as exclusive agents of change vs. children as agents of change (<i>with respect to anthropometric changes</i>)	✓	(reported in Golan et al 1998 (173))	
Golan et al 1998 (173)	To compare the efficacy of a family-based approach with parents as exclusive agents of change vs. children as agents of change (<i>with respect to behavioural changes</i>)	(reported in Golan et al, 1998 (163))	✓	
Beech et al 2003 (188)	To assess feasibility, acceptability and outcomes of 2 versions of a family-based intervention to prevent excess weight gain in pre-adolescent African-American girls	✓	✓	✓
Golan et al 2004 (189)	To report on long term follow up (7y) of study examining parents only vs. child only (163, 173)	✓		
Golan et al 2006 (190)	To compare intervention targeting parent only vs. parent and child together (previously compared parent alone vs. child alone)	✓	✓	

1.3.3.2 Outcome Evaluation Indicators

Reporting of outcome evaluation indicators

Outcome evaluation indicators were reported in all 12 papers identified in Section 1.2.3.5 (including one for which the primary outcomes had been reported elsewhere (173)) (Table 1.12). The frequency of reporting of outcome evaluation indicators was not surprising as these represent the primary outcomes of studies making them essential to report in order to accept or reject the null hypothesis posed by the research. However, the outcome indicators reported by the 11 interventions varied greatly (Table 1.13).

All 11 interventions included a measure of the degree of overweight as the primary outcome and four also included an indicator of adiposity distribution (eg. waist circumference, triceps skinfold thickness). Degree of overweight was calculated for parent/s and children for six of the studies (157) (164) (162) (183) (163) (190) and for children only for the remaining five (145) (167) (151) (188) (189). Six of the studies reported at least two measures of degree of overweight (145) (164) (151) (188) (189) (190). Percentage overweight was reported in nine of the 11 studies, absolute weight in four and BMI in three. Of note, only four studies indicated the reference population used to calculate percentage overweight. The most recent study was the only one to report the BMI z-score as the primary outcome, as recommended by the IOTF (190).

The substantial diversity in reporting of primary outcomes results in difficulty for comparison between studies and prevents the conduct of meta-analyses in this area.

Table 1.13: Details of outcome and impact evaluation indicators reported in papers investigating the role of and support required for parents in the effective management of childhood overweight

Publication Details	Outcome Indicators	Impact Indicators
Epstein et al 1981 (157)	<u>Child and parent:</u> % overweight (no reference data given) Absolute weight	Children's diet diaries analysed re: consumption of red, yellow and green foods from Traffic Light Diet
Brownell et al 1983 (145)	<u>Child only:</u> Absolute weight % overweight (no reference data given) BMI "Developmental Index" BP (although not analysed by group)	N/A
Kirschenbaum et al 1984 (164)	<u>Child and parent:</u> "Child adjusted weight" (Edwards 1978) Parental % overweight Child % overweight (Edwards, 1978) Feinstein's (1959) weight reduction index for children and adults	<u>Completed by parent:</u> Family Environment Scale (Moos , 1974) measured "family type" as: Liberalism Competitiveness Chaos Religiousness
Israel et al 1985 (162)	<u>Child and parent:</u> Absolute weight % overweight (US reference data – NCHS 1979)	<u>Completed by parent:</u> Eating Habit Checklist (of child) measured degree to which child engaged in recommended eating behaviour Knowledge of Behavioral Principles as Applied to Children measured parental knowledge of social learning principles of child management
Epstein et al 1986 (183)	<u>Child and parent:</u> % overweight (no reference data given)	Fitness (of child) via Montoye Step Test <u>Completed by parent:</u> Eating Behavior Inventory (of child)
Wadden et al 1990 (167)	<u>Child only:</u> Absolute weight Kilograms of fat (Densitometry) BMI Cholesterol BP Self-esteem (Piers-Harris Self-Concept Scale) Depression (Children's Depression Inventory)	N/A
Israel et al 1994 (151)	<u>Child only:</u> % overweight (no reference data given) %over triceps norm	<u>Self control measured by:</u> - Locus of Control Scale for Children - Self-Control Rating Scale - Eating and Activity Self-Control Scale (specific to weight-related behaviours) <u>Problem solving skills measured by:</u> - Means-End Problem Solving Test - Situational Competency Test for Overweight Children - Parent's Situation Record <u>Parental perception of child responsibility for tasks measured by:</u> - Homework Questionnaire

Golan et al 1998 (163)	<u>Child and both parents:</u> % overweight (US reference data – NCHS 1979) Body frame (elbow breadth with callipers) Biochemical measures (not described)	N/A (reported in Golan et al, 1998 (173))
Golan et al 1998 (173)	N/A (reported in Golan et al, 1998 (163))	<u>Completed by parent:</u> Family Eating and Activity Habits Questionnaire (acceptable reliability and validity) which measured: Activity level (including TV viewing) Obesogenic factors in environment Eating related to hunger Eating style <u>Completed by family:</u> 7d food diaries (validated against 24hr recall by study dietitian) measured child's energy intake
Beech et al 2003 (188) Ethnicity and Disease	<u>Child only:</u> BMI Waist circumference Body image/weight concern	Physical activity Diet psychosocial variables Physical activity psychosocial variables
Golan et al 2004 (189)	<u>Child only:</u> % overweight (US reference data – NCHS 1979) Obese/non-obese status	N/A
Golan et al 2006 (190)	<u>Child and both parents:</u> % overweight (no reference data given) Child BMIz (IOTF)	<u>Completed by parent:</u> Family Eating and Activity Habits Questionnaire (see above) Parental Authority Questionnaire measured parenting style

Recommendations regarding ideal outcome indicators

Change in degree of overweight is widely used as the primary outcome for child weight management interventions. Recently however there has been much debate in the scientific literature regarding the ideal indicator by which to report this. A recent review identified 168 papers reporting on childhood obesity published in the first four months of 2005, of which only 22 used the internationally recommended IOTF definition (207).

The main point of contention surrounds the use of nationally representative data (eg. via a continuous measure such as z-scores) versus the use of the IOTF definition, which defines overweight and obesity categorically. Five reasons for using a national reference distribution rather than the IOTF definition emerged from the review. The use of the IOTF definition:

- does not permit the analysis of a continuous variable (unlike z-scores)

- does not classify weight categories other than overweight and obesity eg. underweight or extreme obesity
- may under or overestimate obesity in comparison to national definitions
- does not classify overweight and obesity for children less than two years of age
- does not permit comparisons with earlier studies not using IOTF definition (and raw data unavailable)

In addition, it must be remembered that the use of a categorical definition to measure effectiveness is less sensitive, thus making detection of change difficult and increasing the sample size required to detect it. Despite these limitations, the author summaries that whilst there are valid reasons against using the IOTF definition, the principles underpinning it are robust and the need to resolve current inconsistencies in definitions outweigh these.

Further strengths of the IOTF definition include that it is based on a large data set and is simple to use for both children and adolescents (208). If researchers desire to use national or previous definitions of overweight in childhood, they are encouraged to also report prevalence based on the IOTF definition to permit international comparisons (209) (208). Use of the IOTF definition to define overweight and obesity in childhood is a requirement for publication in the journal "Obesity".

Furthermore, as highlighted in a recent mini-review of population-based applications of BMI in childhood and adolescence, the IOTF definition is the only standard reference to define overweight and obesity in childhood that offers a smooth transition from childhood into adulthood (209). The authors also identify the need for consistent terminology regarding "overweight" and "obesity" be used. For example, the UK and Australia have adopted the IOTF terminology, however the US use the terms "at risk of overweight" and "overweight" rather than "overweight" and "obesity". This is a potential source of confusion and misreporting, particularly when other countries are using the US BMI reference data but not adopting the "at risk" terminology.

The reporting of anthropometric indicators of abdominal adiposity along with BMI-related measures of adiposity is also recommended (209). Only one of the studies included in Table 1.13 included waist circumference as an outcome measure (absolute values only) (188). Consistent inclusion of measures of abdominal adiposity in child weight management studies will help address the limitation BMI has in distinguishing between lean and fat mass. Furthermore, this will help to identify changes in body composition occurring at the population level as was evidenced by the increase in waist circumferences of British children between 1987 to ~1997 that exceeded the increase in BMI (15).

In conclusion, variation in reporting of outcome data leads to inconsistencies between studies and difficulties when comparing the effectiveness of studies, making meta-analysis impossible. Program outcome evaluation based on the reduction of the degree of overweight requires agreement on an indicator to consistently report this outcome. The best measure by which to evaluate this is the IOTF definition with referral to a national reference and the addition of an indicator of abdominal adiposity. The measures used by this thesis study were outlined in Section 1.1.1.

1.3.3.3 Impact Evaluation Indicators

Reporting of impact evaluation indicators

Eight of the 12 studies reviewed reported various impact evaluation indicators which can be arranged into seven categories as presented in Table 1.14. Five of these seven categories had at least two different tools by which they were measured and replication of tools across studies was seen only for the Golan studies (for the Family Eating and Activity Habits Questionnaire). The total number of different tools reported was 24 and the number of impact evaluation indicators measured per study ranged from one to eight. The paper reporting eight impact evaluation outcomes was a pilot study conducted to test the appropriateness and acceptability of the tools, perhaps explaining the inclusion of such a large number of impact evaluation measures.

Table 1.14: Categories of impact evaluation indicators reported in papers investigating the role of and support required for parents in the effective management of childhood overweight

Impact Evaluation Category	Measurement Tool/Method and Study appearing in
Quantitative dietary analysis	7-day food diaries to measure EI (173)
Qualitative dietary analysis	7-day food diary compared against the Traffic Light Diet (157) 24hr dietary recall (188)
Eating/food behaviours	Eating Habit Checklist (162) Eating Behavior Inventory (183) Family Eating and Activity Habits Questionnaire (173) (190) Food preparation questionnaire (188)
Physical activity/fitness	Monotype Step Test (183) Family Eating and Activity Habits Questionnaire (173) (190) CSA accelerometer (188) GEMS Activity Questionnaire (188) Athletic Competence sub-scale from the Self-Perception Profile for Children (188) Physical activity preference measure (188) Physical activity outcome expectations measure (188) Physical activity self-efficacy measure (188)
Parenting style/Family type	Family Environment Scale (164) Knowledge of Behavioral Principles as Applied to Children (162) Parental Authority Questionnaire (190)
Obesogenicity of environment	Family Eating and Activity Habits Questionnaire (173) (190)
Child's self control/management	Locus of Control Scale for Children (151) Self-Control Rating Scale (151) Eating and Activity Self-control Scale (151) Means-end Problem Solving Test (151) Situational Competency Test for Overweight Children (151) Parent's Situation Record (151) Homework Questionnaire (151)

Table 1.15 details the design characteristics of the tools falling under each of the seven impact evaluation indicator categories identified in the previous table. Many of these details were not published in the intervention paper and had to be sourced from the paper referencing the tool itself. Where available, these references are provided in the table.

Table 1.15: Design characteristics of the tools used to measure impact evaluation of interventions assessing the role of parental involvement/support in the management of childhood overweight

Quantitative dietary analysis	
Tool	Details
7-day food diary	<p>Method: Nutrient consumption quantified by nutritional analysis software (Nutritionist III, version 6)</p> <p>Completed by: Parents</p> <p>Validity: Validated via 24hr recall performed by clinical dietitian</p> <p>Reliability: n/a</p> <p>Published: n/a</p>
Qualitative dietary analysis	
Tool	Details
7-day food diary compared against the Traffic Light Diet	<p>Method: Seven day self-recorded food intake records kept using standardised forms and compared to the Traffic Light Diet to determine number of servings from each of the three colour codes of foods</p> <p>Completed by: Parents and children</p> <p>Validity/Reliability: No detail provided</p> <p>Reliability: No detail provided</p> <p>Published: No</p>
24hr dietary recall	<p>Method: 2 dietary recalls (the first face-to-face and the second via telephone) conducted on non-consecutive days within a 2 week timeframe. Intake data averaged over the two days and servings of fruit, juice, vegetables, sweetened beverages and water calculated. No detail provided re: method to calculate nutrient intake or serving size references.</p> <p>Completed by: Conducted with child, with assistance of parent if required</p> <p>Validity: No detail provided</p> <p>Reliability: No detail provided</p> <p>Published: n/a</p>
Eating/food behaviours	
Tool	Details
Eating Habit Checklist	<p>Method: Designed specifically for the research study. 7-item tool to measure degree to which child engages in types of eating behaviours recommended by behavioural weight management program.</p> <p>Completed by: Parents</p> <p>Validity: No detail provided</p> <p>Reliability: No detail provided</p> <p>Published: No</p>

Eating Behavior Inventory	<p>Method: 30 item scale, each item rated with 5-point scale</p> <p>Completed by: Child</p> <p>Validity: Correlations between self-report and report of significant other: correlation coefficients significant at $p \leq 0.005$ for 17 items. Correlation of 7 items with eating dairy: significant correlations for 4 out of 7 items.</p> <p>Reliability: Test-retest reliability over 2 weeks ($n=52$): $r=0.74$ ($p < 0.01$)</p> <p>Published: Reproduced in reference article (226)</p>
Family Eating and Activity Habits Questionnaire	<p>Method: Developed specifically for the study based on the findings of a literature search to identify factors that were divided into four scales which were used to design the questionnaire: Activity Level (4 items), Stimulus Exposure (8 items), Eating Related to Hunger (4 items) and Eating Style (13 items).</p> <p>Completed by: Parents</p> <p>Validity: Content validity assessed by panel of ten experts. Internal consistency - mean correlation coefficient (r) = 0.83.</p> <p>Reliability: Test-retest 3 weeks apart for each of the item scores and total score yielding satisfactory Pearson correlation coefficients (0.78 – 0.90).</p> <p>Published: Reproduced in reference article (227)</p>
Food Preparation Questionnaire	<p>Method: Designed specifically for the study. 25 item scale regarding methods mothers used over past month to prepare food for daughters. Each item rated with 3-point likert scale.</p> <p>Completed by: Parents</p> <p>Validity: No detail provided</p> <p>Reliability: 2 scales reported in the paper: low-fat food practices (8 items) and high-fat food practices (7 items) (both $\alpha = 0.59$)</p> <p>Published: No</p>
Physical activity/fitness	
Tool	Details
Montoye Step Test	<p>Method: A submaximal exercise test to measure heart rate (HR) response as an indicator of fitness. Subjects step onto 8-inch bench at rate of 24 steps/min for 3min and ECG measures heart rate prior to, during and for 5min post test.</p> <p>Completed by: Child</p> <p>Validity: No detail provided</p> <p>Reliability: No detail provided</p> <p>Published: Method described in reference article (228)</p>
Family Eating and Activity Habits Questionnaire	Refer to “Eating/food behaviours” category
CSA accelerometer	<p>Method: Worn over 3 consecutive days and used to calculate average daily counts per minute and number of minutes of moderate-vigorous physical activity occurring between 12noon and 6pm.</p> <p>Completed by: Child</p> <p>Validity/Reliability: No detail provided</p> <p>Published: No</p>

GEMS Activity Questionnaire	<p>Method: Checklist of 36 physical and 7 sedentary activities. Subject indicated how long undertook each one on previous day (0min, <15min, >15min) and how often “usually” undertaken (none, a little, a lot)</p> <p>Completed by: Child</p> <p>Validity: No detail provided</p> <p>Reliability: No detail provided</p> <p>Published: Described in reference article (229) – reports that validation undertaken, but unpublished</p>
Athletic Competence sub-scale	<p>Method: 9 item Athletic Competence subscale from the Harter Self-Perception Profile for Children (46) to assess physical performance self-concept</p> <p>Completed by: Child</p> <p>Validity: No detail provided</p> <p>Reliability: $\alpha=0.70$</p> <p>Published: Not reproduced in reference article</p>
Physical activity preference measure	<p>Method: Designed specifically for the study. 37 item scale, each item rated with 4 point likert scale, to calculate scores for physical and sedentary activity preference.</p> <p>Completed by: Child</p> <p>Validity: No detail provided</p> <p>Reliability: Physical activity preference ($\alpha=0.86$) and sedentary activity preference ($\alpha=0.60$).</p> <p>Published: No</p>
Physical activity outcome expectations measure	<p>Method: Designed specifically for the study. 17 item measure modified from the Healthy Growth Study (unpublished).</p> <p>Completed by: No detail provided</p> <p>Validity: No detail provided</p> <p>Reliability: Single score for positive expectations for PA calculated ($\alpha=0.72$)</p> <p>Published: No</p>
Physical activity self-efficacy measure	<p>Method: Designed specifically for the study. 9 item scale, each item rated with 3-point likert scale, to assess girls perceived level of difficulty in engaging in activity</p> <p>Completed by: Child</p> <p>Validity: No detail provided</p> <p>Reliability: Perceived level of difficulty in engaging in activity ($\alpha=0.71$)</p> <p>Published: No</p>
Parenting style/Family type	
Tool	Details
Family Environment Scale	<p>Method: 10 subscales representing 4 family types: Liberalism, Competitiveness, Chaos, Religiousness</p> <p>Completed by: Parent</p> <p>Validity/Reliability: No details provided</p> <p>Published: Reference article (230) and tool not freely obtainable*</p>

Knowledge of Behavioral Principles as Applied to Children	<p>Method: 50-item multiple forced-choice test to assess parental understanding of application of basic behavioural principles with children</p> <p>Completed by: Parents</p> <p>Validity: Content validity based on behavioural principles literature</p> <p>Reliability: Kuder-Richardson reliability coefficient = 0.94</p> <p>Published: Reproduced in reference article (231)</p>
Parental Authority Questionnaire	<p>Method: 30 item scale, each item rated with 5-point likert scale, yielding permissive-, authoritarian- and authoritative-style parenting scores according to Baumrind (232)</p> <p>Completed by: Parent</p> <p>Validity: Content validity confirmed via panel of 21 experts. Discriminant-related validity showed responses to items from each of the 3 scales were divergent and statistically different from each other.</p> <p>Reliability: Test-retest: n=61, 2 weeks apart, 0.77 – 0.92. Internal consistency: n=185, α = 0.74 – 0.87. Socially desirable reporting was investigated and found to be non-existent.</p> <p>Published: Reproduced in reference article (233)</p>
Obesogenicity of environment	
Tool	Details
Family Eating and Activity Habits Questionnaire	Refer to “Eating/food behaviours” category
Child’s self control/management	
Tool	Details
Locus of Control Scale for Children	<p>Method: 40-item scale, yes/no questions</p> <p>Completed by: Child</p> <p>Validity: Construct validity tested against 3 other measures of locus of control – significantly correlated</p> <p>Reliability: Tested with sample of 1 017 children in Grades 3-12 (grouped by year level: 3-5, 6-8, 9-11,12): Internal consistency: $r=0.63 – 0.81$, Test-retest reliability (6 wks apart): 0.63 – 0.71</p> <p>Published: Reproduced in reference article (234)</p>
Self-Control Rating Scale	<p>Method: 33 item scale, 7 point likert scale, 3 subscales (self-control, impulsivity, self-control and impulsivity)</p> <p>Completed by: Child’s teacher</p> <p>Validity: Validation (n=110) showed significant correlation with measures of cognitive and behavioural impulsivity and behavioural observations</p> <p>Reliability: Coder reliability (assessed against videotaped behaviour sample): 86% Internal and test-retest reliability (over 3-4 weeks): $\alpha=0.98$ and 0.84 respectively</p> <p>Published: Reproduced in reference article (235)</p>

Eating and Activity Self-control Scale	<p>Method: Derived from previously published tool (236) which consists of 4 composite variables: self-regulation of weight, parental regulation of weight, social activity, physical activity. Reports adapting reference tool to assess perceived control over weight-related behaviours, including self-control and parental control subscales, but no detail provided re: adaptations made.</p> <p>Completed by: No detail provided</p> <p>Validity: No detail provided</p> <p>Reliability: Tested with sample (n=42) to assess internal consistency: $\alpha = 0.71 - 0.85$.</p> <p>Published: No</p>
Means-end Problem Solving Test	<p>Method: Researcher reads beginning and end of 6 stories to child and the asks child to “fill in the middle” to assess general ability to supply means towards achieving goals in hypothetical interpersonal situations.</p> <p>Completed by: Child</p> <p>Validity: No detail provided</p> <p>Reliability: Only inter-rater reliability (91%)</p> <p>Published: Method outlined in reference article (237)</p>
Situational Competency Test for Overweight Children	<p>Method: Developed specifically for study to evaluate children’s problem solving skills. Assessed children’s temptation to overeat in <i>hypothetical</i> situations. Method of administration and scoring not described.</p> <p>Completed by: Child</p> <p>Validity/Reliability: No detail provided</p> <p>Published: No</p>
Parent’s Situation Record	<p>Method: Developed specifically for study to evaluate children’s problem solving skills by measuring child’s response to <i>actual</i> tempting situations regarding food. Scoring of tool described in limited detail.</p> <p>Completed by: Parents</p> <p>Validity/Reliability: No detail provided</p> <p>Published: No</p>
Homework Questionnaire	<p>Method: Measured parents’ impressions of the percentage of responsibility children assumed for completion of weekly homework tasks – no detail provided re: how this was measured.</p> <p>Completed by: Parents</p> <p>Validity/Reliability: No detail provided</p> <p>Published: No</p>

* The reference to the Family Environment Scale was to a 1974 version of a preliminary manual that is no longer accessible. Information on a more recent version of this manual (1994) however was obtained. It’s construction has been modified to report on 3 dimensions of family environment typologies, reporting internal consistency reliability ranging from 0.61 – 0.78 and test-retest reliability ranging from 0.52-0.91 for the tool’s various subscales. (www.cps.nova.edu/~cpphelp/FES.html)

Dietary intake

Dietary intake was assessed by three of the studies included in this review (Table 1.14). One used quantitative methods to analyse the diet, whilst the other two used qualitative methodology. The seven day food records used to undertake quantitative dietary analysis by Golan et al were validated against a 24hr recall, however the details of this validation were not published (173). Qualitative dietary analysis was conducted by Epstein et al and Beech et al using a 7-day food diary and 24hr recall respectively to estimate servings of different food types (157) (188). The methodology of both of these methods was provided and seemed reasonable. However limited information was provided regarding data analysis and no evidence of the validity or reliability of either method was reported.

Eating/food behaviours

Eating/food behaviours were measured by five different studies using four different tools (Table 1.14) of which details were provided in varying degrees (Table 1.15). Three of the tools were designed specifically for the studies they were used in (Eating Habit Questionnaire, Family Eating and Activity Habits Questionnaire and Food Preparation Questionnaire). Two of the tools were reproduced in referenced articles describing their development, validity and reliability (Family Eating and Activity Habits Questionnaire and Food Preparation Questionnaire and the Eating Behavior Inventory). Details provided regarding the other two tools were limited.

The Family Eating and Activity Habits Questionnaire (Table 1.15) used by Golan et al assessed three categories of impact evaluation (Table 1.14). A methodological paper describing its development (227) was published after the earlier paper appearing in this review (173), but prior to the later one (190). The earlier intervention paper provided a detailed description of the tool, its validity and reliability and the later intervention paper referred the reader to the methodological paper that also provided this detail and a reproduction of the tool. The Eating Behavior Inventory (EBI) (Table 1.15) used by Epstein et al (183) was also reproduced in a referenced paper (226). Of note is that the referenced paper assessed the tool's validity and reliability

amongst a sample of adults whereas the Epstein intervention was conducted with 8-12 year old children. It is unclear from the Epstein paper who completed the EBI, but the tool's demonstrated validity and internal consistency (when assessed in adults) should not be assumed if child self-reports were undertaken.

The limited details provided regarding the Eating Habit Checklist (162) and the Food Preparation Questionnaire (188) make it difficult to be confident with their use (Table 1.15). In addition, the alpha coefficients reported for the Food Preparation Questionnaire were only moderate (0.59) suggesting questionable reliability.

Physical activity

Changes to indicators related to physical activity and/or fitness were measured by eight different methods across four different studies included in this review (188) (183) (173) (190) (Table 1.14). Physical activity was directly measured by Beech et al using a CSA accelerometer (188). Beech et al and Golan et al (173) (190) also assessed activity level indirectly via self-reported and parent-reported questionnaires, respectively. As outlined in Table 1.15 and discussed above, the tool used by Golan has been validated and is published, while the tool used by Beech et al is not.

Epstein et al (183) measured heart rate response to submaximal exercise as an indicator of fitness using the Montoye Step Test. The method of this test is outlined in Table 1.15, however details regarding its reliability were not documented in the referenced article.

The remaining tools were included in the Beech paper to measure psychosocial indicators related to physical activity (Table 1.14). These included self-concept of physical performance, preference for physical activity and sedentary activity, physical activity outcome expectations and perceived self-efficacy for physical activity. As described in Table 1.15, the author reports reasonable alpha coefficients for these scales, however data

on tool design and validation were not presented. Where described, the majority (four out of five) of these tools were completed by the child.

Parenting style and/or family type

Parenting style and/or family type were included as impact evaluation indicator in three studies (162) (164) (190) (Table 1.14). Kirschenbaum et al referenced the 1974 version of the Family Environment Scale which uses ten subscales to define four family types (Table 1.15). The reference for this tool was a preliminary manual and has since been superseded and therefore its strength is unknown. The most recent details of the tool are included as a footnote in Table 1.15. The Knowledge of Behavioural Principles as Applied to Children Scale used by Israel et al is reproduced in a referenced article and satisfactory content validity and good internal consistency are reported (231) (Table 1.15). This tool was designed to assess parental understanding of the application of basic behavioural principles with children. Finally, the Parental Authority Questionnaire (Table 1.15) used by Golan et al measures the three parental authority prototypes (authoritarian, authoritative and permissive) as classified by Baumrind (232). The tool is reproduced in the referenced article and reports high test-retest reliability coefficients and Cronbach alpha values (233).

Obesogenicity of the environment

The studies by Golan et al are the only ones to include impact evaluation measures relating to the obesogenicity of the environment (173) (190). This limited attention may be because “obesogenicity” is a relatively new concept/term in the obesity research field, however the increasing acknowledgement of the environmental influences on the development of obesity make it a key indicator for monitoring. The Family Eating and Activity Habit Questionnaire includes an eight item scale measuring exposure to obesity-promoting stimuli. As discussed above, the instrument’s content validity was evaluated by a team of ten experts and it exhibits good reliability and internal consistency (Table 1.15).

Child self-control/-management

The seven indicators of child self control/management were reported in the one study (151) (Table 1.14). This study by Israel et al aimed to examine the contribution of a multiple-component self-regulation intervention to the effectiveness of a child obesity treatment, hence the inclusion of so many self management instruments. Of the seven indicators, referenced articles reproduced two of the tools (Locus of Control Scale for Children and Self-Controlling Rating Scale) and outlined details of another two (Eating and Activity Self-control Scale and Means-end Problem Solving Test) (Table 1.15).

General cognition was measured by the Locus of Control Scale for Children (234) and Self-Control Rating Scale (235). No information regarding reliability, validity or method of administration was reported for either tool in the Israel paper, however these details were provided in the referenced articles and are summarised in Table 1.15. Israel et al's Eating and Activity Self-Control Scale was adapted from a tool developed by Cohen et al, appearing in the referenced article (236) . It is administered independently to the child and parent and reports acceptable internal consistency. However, details on how Israel et al modified the Cohen tool are not clear, nor the method of administration. Therefore, the strength of the tool reported by Cohen et al cannot be assumed for the Israel et al study. The Means-End Problem Solving Test was included to evaluate children's problem solving skills. Its methodology and inter-relater reliability is outlined in a referenced paper (237), however the tool is not reproduced (Table 1.15).

Tools developed specifically for the Israel et al study were the Situational Competency Test for Overweight Children, the Parent's Situation Report and the Homework Questionnaire. Copies of these tools were not published and their methodology and accuracy are largely unknown (Table 1.15).

Summary

Of the 12 papers reviewed, only eight reported impact evaluation indicators (Table 1.14), and of these only one reported changes in these indicators following intervention end (162). The remainder of the papers reported such impact evaluation indicators only at the end of the interventions, unlike the outcome evaluation indicators for which maintenance effects were reported beyond the end of the intervention. For example, the 1981 paper by Epstein et al (157) reported change in diet before and after the intensive initial part of the intervention only, whereas weight change was reported to 21 months (13 months after intervention end). The group's 1986 paper reported changes in eating behaviour and physical activity at baseline and the two-, six- and 12-month time points (whereas anthropometric measures were collected up until the 23 month time point). Similarly, the 1998 paper by Golan et al (173) did not report any maintenance data for impact evaluation indicators (it compared results from the Family Eating and Activity Habits Questionnaire at baseline and 12 months (program end)). The group's 2006 paper also reported behavioural changes only at the beginning and end of the six month intervention, despite maintenance of anthropometry being measured up to 12 months after the termination of the program. As presented in Section 1.3.2.2, failure to collect and report on such impact evaluation data limits the interpretation of the success or otherwise observed for outcome evaluation indicators.

Recommendations regarding ideal impact indicators

It is apparent that the selection of impact evaluation indicators is dependent upon the aim of each study. In general, interventions investigating the role of parental involvement and support in the management of overweight in childhood often include cognitive and behavioural strategies to influence practices which should be measured and evaluated. Such indicators were included in only eight of the 12 such papers reviewed. Of these, indicators were reported for a shorter duration than that of the outcome indicators. Furthermore, a diverse range of measurement tools were used, of questionable validity and reliability and limited reproduction, creating difficulties regarding consistent reporting, accuracy and generalisability

Appropriate tools are needed for evaluating behavioural change (primarily behaviours affecting energy intake and expenditure) targeted by interventions examining the role of parental involvement and support in the management of overweight in childhood. These behaviours relate directly to the advice and strategies included in intervention programs and the behaviour change required for child weight management and would assist with clarifying the relationship between recommended lifestyle behaviours and change in outcome (degree of overweight).

With respect to energy consumption, the term “behaviour” does not necessarily mean *nutrient intake* as measured by 24hr recalls or food records, but may refer to the consumption of targeted foods as measured by short food frequencies, some composite index of foods or actual behaviours (238). The popularity of “food index” questionnaires is increasing. They are less time consuming and provide a clearer picture of *food intake patterns* that are positively or negatively associated with healthy eating (such as the consumption of fruits and vegetables and low fat dairy products and healthy parental modelling vs. the consumption of energy dense, non-core foods and the use of restrictive feeding practices) (239). Use of such tools would decrease responder burden and demand on resources and would also be less likely to have an intervention effect than the recording of daily intake over a number of days.

Similarly, inventories or indexes that include markers of physical activity or sedentary behaviours may provide sensitive proxies of those behaviours that would alternatively be measured via time consuming and expensive means (eg. accelerometers, pedometers). In addition, inclusion of tools to improve the understanding of behavioural change processes could include measures of change in health values/knowledge, motivation, sense of personal empowerment, self-efficacy and behavioural skills (238).

There is a need for the development, validation and publication of standard tools to measure the intended (short and long term) impacts of lifestyle interventions. Use of such tools will help to elucidate the relationship between

program lifestyle recommendations and health outcomes – critical to evaluate the effectiveness of a behavioural intervention. In addition, the development and use of such tools would permit consistent reporting and meaningful comparison across studies.

1.3.3.4 Process Evaluation Indicators

Reporting of process evaluation indicators

Only one of the 12 RCTs included in this review examining the role of parental involvement and support in child weight management reported process evaluation indicators (188) (Table 1.14). This paper reported post-intervention process evaluation which took the form of interviews conducted with parents of children enrolled in the study, and brief questions to the children and intervention staff.

Parents were asked five open-ended questions to illicit their opinions on such things as their initial impression of the study, their expectations and valuable learnings for themselves and their daughters. The girls were also asked to respond “yes”, “no” or “not sure” to the question: “I enjoyed participating in the Memphis GEMS intervention”. In addition, intervention staff were asked: “Overall, how satisfied would you say you were with your participation in the Memphis GEMS project?” (response options were not detailed).

Valuable insights were gained from these interviews. For example, it was found that the majority of parents reported desirable outcomes regardless of group assignment and that most would have preferred their child to be involved in the program with them. The most important thing parents reported learning from the program was the importance of having a weight management/healthy lifestyle focus rather than a strict weight loss approach. Parents reported that their daughters had most commonly increased their knowledge regarding nutrition and exercise and also improved their self-esteem. Ninety five percent and 100% of children and staff respectively responded positively regarding their level of satisfaction with the program.

The findings from these interviews were to inform the development of the second phase of the GEMS trial, the details of which are yet to be published.

Recommendations regarding ideal process indicators

It is likely that process evaluation indicators were included in the Beech et al (188) paper because it was reporting on a pilot study. More detailed reporting of such indicators should be encouraged for all study types as they can provide rich and valuable information to guide decisions regarding intervention design and delivery. Such findings are also valuable for multi-site studies to ensure that the intervention is being delivered and accepted consistently across sites. Ultimately, inclusion of such data can contribute to the generalisability of programs, maximising their reach and effectiveness.

1.3.3.5 Summary – Evaluation Indicators Reported in the Literature

Outcome, impact and process evaluation indicators were reported in 11, eight and one respectively of the 12 studies examining the role of parental involvement and support in the management of overweight in childhood included in this review (Section 1.2.3.5).

The 11 papers reporting outcome evaluation used change in degree of overweight as the indicator, which was defined by at least two measures in six of the studies. Nine studies reported percentage overweight as one of the outcome evaluation indicators and of these only four defined the population against which this was referenced. Only one study reported BMI z-score as the primary outcome, as recommended by the IOTF.

The impact of the interventions was evaluated by 24 different tools measuring seven different aspects of impact evaluation indicators. Validity and/or reliability of the tools was generally not reported (reported in six out of 12 papers) and copies of the tools, or descriptions of the method of administration were available for only nine of the tools.

Process evaluation indicators were reported in only one study.

Consistent evaluation indicators are required and there is an urgent need for the development and dissemination of valid tools to evaluate all components of child weight management interventions. Furthermore, the selection of a limited number of specific and sensitive outcome and impact evaluation indicators should be encouraged. Considered selection of these indicators will standardise program evaluation and result in a more clearly articulated definition of effectiveness. Finally, the routine inclusion of process evaluation indicators will provide vital information to researchers and practitioners of the practical and logistical considerations that must be made to deliver an effective, accessible and well accepted intervention. They provide a quality assurance component to interventions and promote a participant-centred approach to program delivery. Consideration of such evaluation indicators will result in continuous improvement of intervention quality at the stages of program development, implementation and evaluation.

1.3.4 Summary of Section Three – Evaluation of Interventions to Manage Childhood Overweight

Thorough evaluation of program process, immediate (impact) and long term (outcome) effects and also the external forces affecting subject adherence and implementation will provide a comprehensive picture of how and why a behavioural intervention may be successful - beyond that obtained via the assessment of final outcome measures alone. The importance of including such indicators and using and reporting consistent measures is essential to permit complete evaluation of study effectiveness and comparison across studies, populations, countries and settings. In addition, reporting of study impact and process evaluation indicators will enhance the likelihood of study replication in order to improve generalisability.

Combining the best practice principles of research with those of evaluation theory provide the opportunity to examine the effectiveness of research interventions in a “real-world” setting, increasing the transferability of findings to practice.

1.4 Conclusion: Literature review, thesis aims and hypothesis

1.4.1 Literature review summary

Section One of the literature review summarised the issue of childhood overweight, identifying that the recent changes to populations' energy intake and expenditure patterns have occurred largely as a result of micro- and macro-environmental change over the past 2-3 decades. The evidence available to guide effective management of this global epidemic was reviewed in **Section Two** which presented the cornerstones to management. **Section Three** of the literature review critiqued the strength of program evaluation regarding interventions investigating the involvement of and support for parents in the management of childhood overweight.

The recent and rapid increases in rates of childhood overweight internationally suggest an environmental origin requiring management at an individual and public health level. Behavioural interventions to support parents and families to manage this increasingly obesogenic environment must be developed to promote healthy dietary and activity practices.

The evidence however to inform the development of such interventions is limited in number, scope, quality and design. A review of four commonly referenced reviews of the treatment of childhood overweight identified 40 primary papers informing four cornerstones of management (Table 1.6) Power calculation were rarely undertaken to determine sample sizes for these interventions, which ranged from 4-50 subjects per intervention arm. The research originated from a small number of research groups, mainly in the US, the majority of which was conducted during or prior to the 1980's. Given that the increase in prevalence rates of childhood overweight has been experienced most sharply in the past decade, there is a need for recent research addressing the current environment to inform interventions.

The inclusion of aspects of diet, activity and behaviour change within a multi-component treatment intervention for the management of a condition which results from a chronic energy imbalance is well accepted. The most recent research has been investigating the cornerstone of management related to the degree of involvement by the child or parent in child weight management. Targeting parents as the primary agents of change is recognised as best practice for the management of overweight in young children, however the evidence regarding how to support parents in child weight management is limited (194). Targeting parents as the exclusive agents of change and providing them with support around parenting skills to promote the development of healthy lifestyle habits by the child (and whole family) seems to be a promising avenue for investigation.

Furthermore, the need to evaluate the effectiveness of such interventions against a broad evaluation framework using consistent and where possible validated tools is another research requirement. The effectiveness of interventions examining the role of and support for parents in the management of childhood overweight is assessed inconsistently, with only one out of 12 studies reporting the internationally recognised definition for childhood overweight and obesity. The impact of interventions was measured against seven different aspects using 24 different tools, of which only seven were validated and ten reproduced or described in detail. Process evaluation was reported by only one intervention. Recognition of the contextual nature of the condition through the inclusion of qualitative research methodology will strengthen such an evaluation framework.

In summary, supporting parents to manage their children's overweight appears a promising avenue for practice, but requires further investigation via well-designed researched assessed against robust evaluation indicators.

1.4.2 Thesis aims

This thesis study has been designed to address the evidence gaps identified in the literature regarding the effective management of childhood overweight (highlighted in Sections 2 and 3 of the literature review). It aims to address the primary research question:

“Does the addition of a **parenting skills training program** improve the **long-term effectiveness** of a parent-led, family focussed healthy lifestyle intervention for the management of overweight in 5-9 year old pre-pubescent children?”

The aims of the thesis study are to:

- Develop an evidence-based, parent-led, family-focussed healthy lifestyle intervention for the management of overweight in 5-9 year old children utilising parenting skills training to support parents' ability to initiate and maintain healthy family lifestyle behaviours. To address the primary research question, two variations of the program will be developed. They will have equivalent healthy lifestyle program components but will be with and without a parenting skills training program. This research design will examine the role of providing parents with parenting skills training in the management of their child's overweight (**Study Methodology – Chapter Two**). In recognition of the need to evaluate program effectiveness comprehensively, the study design includes indicators of outcome, impact and process evaluation using broad health and behavioural indicators beyond markers of weight status only. The study design was complemented by qualitative methodology to address the final study aim. These design strengths are elaborated in the following aims.
- Measure the effectiveness of the intervention to reduce children's degree of overweight as defined by BMI z-score and waist circumference z-score (**Primary Outcome Evaluation – Chapter Three**). Secondary outcome evaluation indicators are also included to assess the impact of the intervention on children's psychosocial health

(defined as health-related quality of life and body image) and growth (defined as height z-score) (**Secondary Outcome Evaluation – Chapter Three**).

- Examine the associated changes in children’s lifestyle behaviours and parents’ parenting practices resulting from the intervention that may contribute to a change in the degree of childhood overweight (**Impact Evaluation – Chapter Four**)
- Evaluate the program *activities* in terms of participant attendance and satisfaction and maintenance of the program integrity across sites (**Process Evaluation – Chapter Four**)
- Examine the factors external to the intervention that support or inhibit families achieving the healthy lifestyle changes promoted through the program (**Qualitative Evaluation – Chapter Five**)

1.4.3 Thesis hypothesis

The study research questions will test the null hypothesis that:

“Pre-pubertal children whose parents participate in a six month parent-led, family focussed child weight management program comprising parenting skills training and intensive lifestyle education will have BMI z-scores and waist circumference z-scores at 12 months that are no different to children whose parents participate in a six month parent-led, family focussed child weight management program utilising intensive lifestyle education only.”

Chapter Two: Study Methodology

2.1 Introduction

This chapter outlines the methodology of the PEACH study which assessed the effectiveness of the addition of a parenting skills training program to a parent-led, family-focussed healthy lifestyle program for the management of overweight in 5-9 year old pre-pubescent children.

The study was conducted between May 2004 and June 2006 at teaching hospitals in Adelaide and Sydney (one hospital per site). Ethics approval was granted by the Flinders Clinical Research Ethics Committee and the Westmead Research Ethics Committee.

2.2 Overview of the intervention programs

The intervention programs consisted of an intensive healthy lifestyle program (involving a nutrition component delivered to parents and a child focussed physical activity component) with or without the provision of a parenting skills training program adapted from the Triple P – Positive Parenting Program[®], Level 4 Group Triple P[®] (240). The programs consisted of 8-12 group sessions (8 healthy lifestyle ± 4 parenting skills training sessions) and 4 individual telephone consultations (Table 2.1).

The group education sessions were for parents only. The Group Triple P[®] sessions were conducted in the evening to facilitate ease of child care for families, although limited child minding facilities were provided as requested. While parents attended the healthy lifestyle sessions, children participated in supervised physical activity sessions as described in Section 2.2.2.2.

Table 2.1: Sequence and content of the two intervention arms of the PEACH Study

Week	HL intervention sequencing	HL+P intervention sequencing
1	Healthy Lifestyle Session 1 - Introductory session Group rules Factors influencing weight gain Pros and cons of being a healthy weight	Healthy Lifestyle Session 1 - Introductory session Group rules Factors influencing weight gain Pros and cons of being a healthy weight
2		Group Triple P[®] Session 1 - Triple P[®] Overview Positive parenting principles Influences on child behaviour Goal setting and monitoring behaviour
3	Healthy Lifestyle Session 2 - The Australian Guide to Healthy Eating Food groups and serve sizes Nutrition recommendations Monitoring food intake	Group Triple P[®] Session 2 - Promoting Children's Development Developing positive relationships with children Encouraging desirable behaviours Teaching new skills and behaviours
4		Group Triple P[®] Session 3 - Managing behaviour change Behaviour management strategies Compliance and behaviour correction routines Behaviour charts
5	Healthy Lifestyle Session 3 - Nutrition Skills Label reading and shopping tips Snack and lunchbox ideas Recipe modification	Group Triple P[®] Session 4 - Planning Ahead Family survival tips High risk situations Planned Activities Routines™
6		Healthy Lifestyle Session 2 - The Australian Guide to Healthy Eating Food groups and serve sizes Nutrition recommendations Monitoring food intake
7	Healthy Lifestyle Session 4 - Being Active in a Variety of Ways Physical activity recommendations Overcoming obstacles to being active and limiting physical inactivity	
8		Healthy Lifestyle Session 3 - Nutrition Skills Label reading and shopping tips Snack and lunchbox ideas Recipe modification

9	Phone Support Session 1	Phone Support Session 1
10		Healthy Lifestyle Session 4 - Being Active in a Variety of Ways Physical activity recommendations Overcoming obstacles to being active and limiting physical inactivity
11	Healthy Lifestyle Session 5 - Family Food Tasks and Managing Appetites Encouraging healthy eating habits Responsibilities around food and eating	
12		Healthy Lifestyle Session 5 - Family Food Tasks and Managing Appetites Encouraging healthy eating habits Responsibilities around food and eating
13	Phone Support Session 2	
14		Phone Support Session 2
15	Healthy Lifestyle Session 6 - Recipe Modification/Eating on the Run Healthy eating out choices Healthy eating for busy families Food and special occasions	
16		Healthy Lifestyle Session 6 - Recipe Modification/Eating on the Run Healthy eating out choices Healthy eating for busy families Food and special occasions
17	Phone Support Session 3	
18		Phone Support Session 3
19	Healthy Lifestyle Session 7 - Self Esteem and Teasing Promoting self esteem and positive body image	
20		Healthy Lifestyle Session 7 - Self Esteem and Teasing Promoting self esteem and positive body image
21	Phone Support Session 4	
22		Phone Support Session 4
23	Healthy Lifestyle Session 8 - Progress Review Review of progress and future planning	
24		Healthy Lifestyle Session 8 - Progress Review Review of progress and future planning

The education approach used in the healthy lifestyle only intervention (HL) is very *content* focussed, mirroring a typical nutrition education style. In comparison, the healthy lifestyle plus parenting intervention (HL+P) emphasises the *process* of behaviour change which is supported by the promotion of parental competency via the parenting skills training sessions. While both interventions encouraged traditional behaviour modification strategies, the HL+P intervention included the Triple P[®] specific strategies and included discussion around achievement of lifestyle goals, primarily around the framework provided by the Planned Activity Routine[™] (see Section 2.2.1). Unlike the HL intervention, significant time was spent at the beginning of the HL+P sessions reviewing homework tasks and problem solving barriers to change as a group, prior to the delivery of new content. Table 2.2 presents the format of the intervention sessions which highlights these differences.

A group-based approach was employed for both intervention arms as it is more likely to i) foster social support and shared problem solving, ii) match established health care delivery patterns in community settings, iii) be accessible to large numbers of overweight children and their families, iv) be cost effective compared with individual counselling sessions (163), and v) be more effective than individual counselling sessions (138). Dietitians facilitated the parent group sessions, comprising representatives from up to 18 families. Trained university students supervised the children's physical activity sessions.

Table 2.2: Outline of the format of PEACH study intervention sessions, with key differences between intervention arms indicated in *italics*

HL+P intervention (process-focused, promoting parental self-efficacy and competence)	Time (min)	HL intervention (content-focused)	Time (min)
<u>Session objectives and agenda</u>	2	<u>Session objectives and agenda</u>	2
<u>Previous session review</u> Key points (HL content principles <i>and links to Triple P[®] principles</i>) Opportunity to ask questions to consolidate nutrition/activity knowledge and skills	5	<u>Previous session review</u> Key points (HL content principles) Opportunity to ask questions to consolidate nutrition/activity knowledge and skills	5
<u>Homework review</u> Homework tasks Goal review What goals were, have they been achieved, barriers/issues. <i>Respond to any questions with <u>process-based</u> answers</i> <i>Link back to PAR* to highlight how it can facilitate the process of overcoming barriers to behaviour change</i>	20	<u>Homework review</u> Homework tasks Goal review What goals were, have they been achieved, barriers/issues. <i>Respond to any questions with <u>content-based</u> answers</i> <i>No link to PAR*</i>	20
<u>Problem-solving and PAR* discussion**</u> <i>Assessment of achievement of goals – for those not achieved, discuss how to overcome barriers, reinforce strategies promoted by Triple P[®] and link back to the PAR* where possible</i>	15-30 (~20)	<u>Content</u> Present information based on HL content principles Some assistance from group activities (role plays, quizzes etc)	Up to 30
<u>Content</u> Present information based on HL content principles Some assistance from group activities (role plays, quizzes etc) <i>Briefer than HL to allow more time for problem solving</i>	15-30 (~20)	<u>Summary</u> Content covered	2
<u>Summary</u> Content covered <i>with links to PAR*</i>	2	<u>Goal Setting</u>	5
<u>Goal Setting</u>	5	<u>Question time</u> <i>Respond to any questions with <u>content-based</u> answers</i>	10
<u>Homework tasks and outline next session</u> <i>Refine goals in relation to PAR*</i>	1	<u>Highlight homework tasks and outline next session</u>	1
<u>Group education session time</u>	75	<u>Group education session time</u>	75
Parents observe children in activity session	15	Parents observe children in activity session	15
Total time	90	Total time	90

*PAR = Planned Activity Routine™ (see Section 2.2.1)

2.2.1 Parenting skills training program

The Triple P[®] - Positive Parenting Program is an established and evaluated general parenting program based on social learning principles and child development theory (241). The Triple P[®] aims to promote parental competence to facilitate appropriate child behaviour by providing parents with the skills to plan, implement and maintain behaviour change (240). The program is widely used in Australia for general child behaviour management, and has only been recently been combined with family-focused healthy lifestyle advice for the aim of child weight management (191).

The program offers five levels of intervention, ranging from Level 1 Universal Triple P[®] - an information campaign which targets populations, to Level 5 Enhanced Triple P[®] - offering an individually-tailored behavioural family intervention (240). For the purposes of this thesis study, facilitators (dietitians) received Level 4 Group Triple P[®] Professional Training and facilitated the standard Group Triple P[®] with strategies modified to focus on dietary and activity weight-related behaviours. For example: to *develop positive relationships* (Triple P[®] week 2), quality time was recommended as an opportunity to promote play; to *encourage desirable behaviours* (Triple P[®] week 2), parents were urged to role model healthy lifestyle habits and to *manage behaviour change* (Triple P[®], week 3), the establishment of ground rules about TV viewing time and clear instructions about between meal access to food was advised.

The four weekly sessions culminate in providing parents with a framework for promoting lifestyle behaviour modification – the “Planned Activities Routine[™]” (PAR[™]). This tool is the interface between the acquisition of parenting skills and lifestyle knowledge and is an integral part of the program (241). The PAR[™] provides parents with a problem-solving framework to manage “high risk situations” (eg school holidays, birthday parties, after-school snacking) that could jeopardise achievement of healthy family goals or rules. The PAR[™] highlights the importance of identifying and preparing for potential high risk situations, setting positive rules and limits, and having

backups or consequences for times of misbehaviour. It aims to promote behaviour change by emphasising preparedness and forward thinking and reinforcing positive behaviour. An example of how this may be applied is presented in the table below (Table 2.3).

Table 2.3: An example of the application of the Planned Activities Routine™ to a situation that could jeopardise achievement of healthy family lifestyle goals

Identify the high risk situation Visiting the show or holiday theme park
List any advance planning and preparation needed Have lunch/dinner before going to the show or theme park Take own healthy snacks and water from home Children to choose 2 show bags only from guide beforehand
Decide on rules or goals Only buy show bags that were selected prior to attending Eat snacks brought from home Talk in a pleasant voice and stay happy Stay close to Mum/Dad Ensure appropriately occupied using non-food activities eg. visiting the pet zoo
List rewards for new behaviours or habits Praise child using specific, descriptive phrases eg "I am really pleased with the way you are staying close to me while we walk" Give the child positive attention eg. a pat on the back, a wink, the thumbs up
List strategies to manage old behaviours or habits Remind child of the rules – used when child forgets rule (involves getting the child's attention, stating the problem, explaining why it is a problem and getting child to recall rule) Planned ignoring eg. not reacting to child's repeated requests for food show bags Immediate consequences for disobeying rules eg. not being able to go on a certain ride
Hold follow up discussions and note any new goals Praise child for following the rules and adjust rule to choosing non-food show bags As described in (241)

2.2.2 Healthy lifestyle program

2.2.2.1 Nutrition component

The nutrition component of the healthy lifestyle program consisted of eight lifestyle-focussed sessions (Table 2.1). The first five sessions were delivered fortnightly and the final three monthly in order to encourage independence and maintenance.

The Australian Guide to Healthy Eating (AGHE) (242) was used as the framework to underpin the nutrition component of the healthy lifestyle program of the intervention. It is the national food selection guide providing information on the type and quantity of foods required to meet the nutrient

and energy requirements of children and adults (242). The food intake pattern recommended by the AGHE has a focus on food groups and underpins the Dietary Guidelines for Children and Adolescents in Australia (12, 243). It focuses on eating patterns rather than nutrients and calories, providing a practical guide to healthy food selection that can be used in the active and maintenance phases of weight loss. Dietary modelling demonstrates that an eating pattern consistent with the AGHE and linked to a series of food-based recommendations (Table 2.4) results in a reduction in the amount of saturated fat and energy in Australian children’s diets (244).

Table 2.4: Recommendations used throughout the PEACH program to promote healthy eating and activity behaviours

Nutrition Recommendations (242, 244)
<ul style="list-style-type: none"> • Encourage lunch box and snack choices from breads and cereals, vegetable, fruit & dairy food groups Use cereal-based ‘extras’ sparingly eg. muesli bars, cakes, muffins • Encourage water as primary fluid Switch to low joule beverages if high sugar fluids are present in diet Limit juice to 150ml per day • Ensure 2-3 serves dairy/day to maintain calcium intake Promote 1-2% fat products Limit ice-cream/cheese to 1-2 serves per week and use reduced fat varieties
Physical Activity Recommendations
<ul style="list-style-type: none"> • Limit total ‘screen time’ to 7 to 10 hours per week • Be active in a variety of ways (eg play, transport, during chores, family activities) • Aim for 30 minutes physical activity per day

The AGHE is a standard nutrition education tool for individuals aged four years and over in Australia and its use for child weight management is recommended by the NHMRC Clinical Practice Guidelines for the Management of Overweight and Obesity in Children and Adolescents (12). The recommendations provided are age and gender specific, addressing changing nutrition needs across the life-span and thus making it relevant to all family members.

Parents were encouraged to compare current eating patterns of each family member with age-appropriate AGHE food group serve recommendations (242). Based on their findings and family eating patterns and habits, modifications required to meet AGHE recommendations were individually identified and goals for change set. Gradual ‘whole family’ changes were promoted.

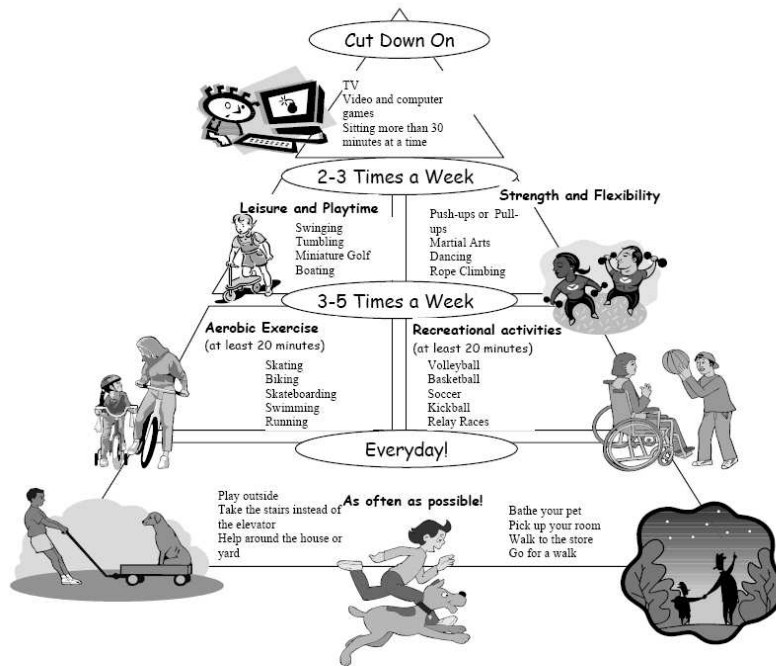
2.2.2.2 Physical activity component

While parents attended the healthy lifestyle sessions, children participated in supervised physical activity sessions, providing both a child minding facility and the opportunity for the development of fundamental movement skills. Siblings were also invited to attend these sessions, reinforcing the whole of family approach promoted by the intervention. Sessions were conducted in a non-threatening environment with children of similar ability. These sessions were developed by physical activity experts and a facilitator's guide was provided to supervisors. Sessions were supervised by trained university students studying exercise science, education or physiotherapy. The sessions consisted of non-competitive, fun games that aimed to improve children's fundamental movement skills and aerobic capacity and increase their confidence to participate in physical activity. Sessions required minimal space and equipment, could be delivered by non-expert staff and activities were easily transferable to the home environment.

Parents observed the final minutes of the children's activity sessions providing an opportunity for positive reinforcement of their child's participation in the group. Parents remained responsible for setting activity goals at home, supported by a booklet outlining the activities undertaken during each session. Parents also received information regarding physical activity recommendations in the group education sessions. These recommendations reflected a physical activity pyramid encouraging 30 minutes of physical activity per day and a limit of 7-10 hours of screen time per week (Figure 2.1) and are similar to the recommendations promoted by the Australian physical activity guidelines for children (60 minutes of vigorous intensity physical activity per day and a daily limit of 2 hours of screen time) (245). These national guidelines were unpublished at the time of intervention development. The activity recommendations aimed to address both physical and sedentary behaviours to gradually increase child and family activity levels (see Table 2.4). Parents considered child and family barriers to being active and were asked to plan ways to overcome these.

Figure 2.1: Physical activity model provided to parents to guide the achievement of PEACH program physical activity goals (246)

Physical Activity for You and Your Child



The Physical Activity Pyramid is a guide to healthy choices for activity and fitness!

- **First (Bottom) Level:** Activities you and your child should do every day, such as walking, household chores, active play.
- **Second Level:** Aerobic activities and sports, such as soccer, skating, aerobic dance, cycling, and swimming. You and your child should participate in these activities for at least 20 minutes, 3 to 5 times a week.
- **Third Level:** Includes activities to build strength and flexibility as well as leisure activities. Your child should do something from each of these groups 2 or 3 times a week.
- **Fourth (Top) Level:** Activities your child should do *less* of, such as watching TV, playing electronic games, and playing on the computer.

2.3 Study design

2.3.1 Design

The effectiveness of the two child weight management programs described in Section 2.2 (healthy lifestyle only (HL) and healthy lifestyle plus parenting (HL+P)) were assessed against each other using a single-blinded randomised design. As outlined in Sections 1.4.2 and 1.4.3, the study tested the hypothesis that the addition of parenting skills training will enhance the long-term effectiveness of an intensive family-focussed healthy lifestyle program designed to manage overweight in pre-pubertal children.

The study did not include a waiting list control condition given the considerable evidence that degree of overweight typically remains stable or increases in the absence of intervention over a 6-12 month interval (61) (162) (164) (165) and the high prevalence rates of metabolic syndrome in subjects from pilot work (247). In addition, findings from pilot work also indicated that 90% of control families made lifestyle behaviour changes while wait listed suggesting that simply distributing an information pamphlet or collecting measurements can have an intervention effect (247). Instead, the HL arm acted as a relative control group. Therefore the design can be summarised as:

1. HL group: Healthy lifestyle program
2. HL+P group: Healthy lifestyle plus parenting skills training program

2.3.2 Target population

2.3.2.1 Justification

Study eligibility criteria were set to ensure that 1) the population recruited required weight management, 2) the degree of the population's "overweightness" was not such that the children were likely to have co-morbidities requiring specialist paediatric intervention and 3) the intervention program would be appropriate for the child's developmental stage.

Assessment of pubertal stage was necessary given the occurrence of early maturation in the target population and the impact this has on growth (64). Multiple family members could not be enrolled as the shared family environment would reduce the sample variability, increasing sample size requirements.

2.3.2.2 Study inclusion criteria

Children were eligible for the study if they were:

- 1) aged between 5 and 9 years (up to 10th birthday),
- 2) pre-pubertal (Tanner Stage 1 (248)) and
- 3) classified as overweight according to the standard international definition for children (11).

The child had to have at least one parent prepared to attend all sessions who had facility with written and spoken English.

2.3.2.3 Study exclusion criteria

Children were ineligible to enrol in the study in they:

- 1) had an extreme degree of obesity (BMI z-score >4.0) (14),
- 2) had a known syndromal cause of obesity,
- 3) were taking medications known to be associated with weight gain,
- 4) had a chronic illness including physical disability or developmental disability,
- 5) had a sibling enrolled in the study or
- 6) had a major dietary restriction due to metabolic disorder, allergy or gut absorption problems.

2.3.3 Overview of study evaluation

Thorough program evaluation that includes measures of outcome, impact and process evaluation is an essential part of any lifestyle intervention to measure the effectiveness and acceptability of a program and to provide evidence to inform best practice (219, 222).

2.3.3.1 Outcome evaluation

As outlined in Section 1.3.2.2, outcome evaluation examines whether a program is successful in achieving its goals and usually measures the effect of a program on a population's health status (223). The primary outcome of the PEACH study is the change in the degree of overweight of the children enrolled.

In addition, it is possible that involvement in a weight management intervention such as the PEACH study may affect health beyond weight status. Therefore, it is useful to include secondary outcome measures to determine the effect of an intervention on broad health outcomes as improvements in these may be beneficial irrespective of changes in adiposity (as discussed in Section 1.3.2.2). Inclusion of such indicators is also useful to monitor the occurrence of unintended intervention effects.

Primary outcome - BMI z-score

BMI is accepted internationally as a suitable proxy for overall adiposity in children due to its reasonable correlation with body fat, its validation against measurements of body density, low risk of observer and measurement error and demonstrated reliability (10) (1). During childhood, BMI changes with age and differs between the sexes and thus a set cut point to define overweight and obesity during this time is not appropriate (9) (7). Instead, the BMI z-score is applied. This is an age and gender-adjusted expression of BMI that compares an individual with the mean of a reference population, where a BMI z-score of 0 equates to the 50th percentile, or mean of the reference population (11) (12). BMI z-score charts are not available for the Australian

population so BMI z-score for the study population were based on a UK reference population (14) and calculated using software applying the LMS method (Available at: <http://shop.healthforallchildren.co.uk/pro-epl?DO=PRODUCT&WAY=INFO&ID=185>). Children were classified as being overweight or obese using the IOTF definition (11).

Primary outcome - waist circumference z-score

Waist circumference is an indirect but validated and readily obtainable measure of truncal adiposity which may provide the best predictor of obesity-related health risk in children (249, 250). As for BMI, waist circumference varies with age and gender and thus accurate assessment requires the monitoring of changes in z-score over time. In the absence of local gender and age-adjusted reference population data for waist circumference in children, UK reference data is used (15).

Secondary outcomes - health-related quality of life

Health related quality of life (HRQoL) is a multidimensional measure that provides a patient centred perspective of the experience of a condition (26). Over recent years, the evaluation of HRQoL has become an essential therapeutic and research outcome and is also important to assure no harm is caused by an intervention (28, 35, 251).

Assessment of child HRQoL poses a number of challenges and in the past parent proxy-reports of child HRQoL only have been reported (28). However, the discrepancies observed between parent and child reports of child HRQoL (26, 35, 251) and the subjectiveness of HRQoL (28), signal the need to capture both the child's and parent's perspective of paediatric HRQoL. No obesity-specific HRQoL tools exist for children so generic instruments that measure global HRQoL from the perspective of the child and parent are required.

The PedsQL™ 4.0 is a 23-item child HRQoL measure consisting of four components – physical functioning (8 items), emotional functioning (5 items), social functioning (5 items) and school functioning (5 items) (29, 251). The tool has been developed from work with children suffering a number of chronic and acute illness and integrates generic core scales with disease-specific modules (251) . It is age specific and has versions for 2-4 year olds (parent proxy-report format only), 5-7, 8-12 and 13-18 year olds (child self-report and parent proxy-report formats). This was the tool used to measure HRQoL in this study and for the purpose of this thesis, child self-reports and parent proxy-reports were collected using questionnaires for 5-7 and 8-12 year olds (Appendix Two).

Most of the child self-report scales and parent proxy-report scales for this tool have internal consistency reliability alpha coefficients approaching or exceeding 0.70, indicating their acceptability for use with group comparisons. The Total Score for both forms of reporting approached a reliability criterion of 0.90, recommended for analysing individuals' scores (29, 251). Analyses of the construct validity of the tool indicate that healthy children score significantly higher on the PedsQL™ 4.0 than children who are unwell (29, 251). The tool has been successfully used to measure health-related quality of life in samples of overweight and obese children (32-34) and is recommended for use in clinical trials and research (251).

Secondary outcomes - body size dissatisfaction

Overweight children express greater dissatisfaction with their body size than normal weight children and there are concerns that involvement in a child weight management intervention may exacerbate this (252, 253). Dissatisfaction with body shape was measured pre- and post-intervention using the Children's Body Image Scale to determine if involvement in the study affected this parameter (40). The tool displays seven gender-specific digitally altered photographs (labelled A to G) of children with body shapes representing BMI's equivalent to underweight (2), acceptable weight (3), overweight (1) and obese (1) (Appendix Three). Children are asked to

indicate which image they feel best represents the way their body looks at present (perceived body figure) and which image they would like their body to look like (desired body figure). Body dissatisfaction is defined as the discrepancy between perceived and desired body figure and ranges from zero (ie. satisfied with body size) to +/-6 (degree of dissatisfaction with body size).

Secondary outcomes – linear growth

Manipulation of energy intake in children to achieve weight loss has the potential to affect growth and slow height velocity. Assessment of change in individuals' height z-score will provide a measure of the impact of the intervention on height potential so as to assess whether the intervention caused any unintended effects on linear growth.

2.3.3.2 Impact evaluation

Measures of impact evaluation examine the immediate effects of an intervention, or the indicators that contribute to the achievement of the overall program goal (223) (Section 1.3.2.2). Achievement of these indicators implies there is a high likelihood that the program will be successful as the changes necessary to achieve the program goal have been reached. Impact evaluation indicators commonly include measures of knowledge, attitudes, skills and behaviour (222).

Impact evaluation – child health behaviours

In order to achieve change in weight status, practices that moderate energy balance must be altered. In addition, an assessment of the effectiveness of a lifestyle intervention must examine whether the lifestyle changes it promotes are being achieved. Therefore, evaluation of changes in children's dietary and activity behaviours are assessed as part of the impact evaluation for this thesis.

Changes in dietary behaviours were assessed using the parent-completed Children's Dietary Questionnaire, a semi-quantitative 26-item food frequency tool representing five key aspects of food intake: fruit and vegetables, sweetened beverages, fat in dairy products, high fat/high sugar foods and food behaviours (eg eating family evening meal at table, eating in front of TV, having second helpings) (Appendix Four). This tool was developed during pilot work for this study and has since been validated for use in 5-16 year old children (239).

Changes in activity behaviours were measured using the parent-completed Activity Inventory which requires parents to recall the amount of time their child usually spends being physically active and sedentary on week days and weekends (Appendix Five). This inventory aims to assess how well parents achieve the program recommendations regarding physical activity (Table 2.4). It is not a validated tool and does not aim to provide an estimate of energy expenditure.

Impact evaluation – parenting skills

The aim of the Triple P[®] training is to increase the competence and confidence of parents to parent effectively through the promotion of positive parenting practices (241). Parenting skills were measured using the Parenting Sense of Competence Scale (254) and the Alabama Parenting Questionnaire (255) (Appendix Six and Seven, respectively).

The Parenting Sense of Competence Scale is a 16 item questionnaire assessing parents' views of their competence as parents on 2 dimensions - satisfaction with their parental role and feelings of efficacy as a parent. The Total score (16 items), Satisfaction factor (9 items) and the Efficacy factor (7 items) show a satisfactory level of internal consistency ($\alpha = 0.79, 0.75$ and 0.76 respectively) (256). The 42 item Alabama Parenting Questionnaire measures 5 constructs of parenting - parental involvement with child (10 items), use of positive parenting (6 items), monitoring and supervision (10 items), consistency in applying discipline (6 items) and corporal punishment

practices (3 items). Seven additional items measuring specific discipline practices other than corporal punishment are included to avoid a negative bias towards responses to the corporal punishment items. It was developed with parents of 6 to 13 year old children and found to give the following Cronbach's alpha coefficients for: parental involvement with child (0.80), use of positive parenting (0.80), poor monitoring/supervision (0.67), inconsistent discipline (0.67) and corporal punishment (0.46) (255).

Impact evaluation – parental weight status

Change in parental weight status should occur if changes to a child's lifestyle habits are also adopted by other members of their family. Parental weight status was therefore included as a proxy measure to determine if a "whole of family approach" to lifestyle change had been applied.

2.3.3.3 Process evaluation

Process evaluation indicators focus on program *activities* rather than *outcomes* and can include measures of how a program is implemented, its reach and the degree to which it satisfies participants' expectations (219) (223) (Section 1.3.2.3). Inclusion of process indicators is essential to ensure that the observed outcomes are due to the intervention being delivered in the way it was intended (219) and can help explain adherence to the intervention protocol.

Process evaluation – attendance

Program attendance is considered a proxy for adherence to the protocol/engagement in the program and also gives an indication of the acceptability of the program to its audience. The frequency of attendance to sessions may be regarded as the "program dosage" received by the participant.

Process evaluation – satisfaction

Parent satisfaction with the program was assessed using anonymous questionnaires adapted from Sanders and colleagues (241). The satisfaction questionnaire developed by Sanders et al has high internal consistency ($\alpha=0.96$) and inter-item correlations to 0.87 (241) and was adapted to reflect the healthy lifestyle focus of the PEACH program.

Parents in the HL+P group were asked to complete the Triple P[®] satisfaction questionnaire at the completion of the four week parent skills training component and all parents were asked to complete the PEACH satisfaction questionnaire at the completion of the healthy lifestyle component of the program (at the six month time point) (Appendix Eight and Nine, respectively).

Process evaluation – maintenance of program integrity

Apart from the addition of the parenting skills training program to the HL program, the integral difference between the two intervention programs was the manner in which information was delivered. The principles underpinning both interventions and the cornerstones of child weight management are intrinsically the same, however the education approach and the behaviour modification skills promoted are distinct from each other (Table 2.2). To confirm that these differences were maintained, all group sessions were tape recorded and randomly audited by an assessor external to the study.

2.3.3.4 Qualitative evaluation

Factors external to a program but central to its participants, such as personal, social and environmental characteristics, are likely to influence the extent to which participants engage in a program and achieve its objectives and goals (217). Although they are not an integral part of program content, identification of these factors can inform program design and delivery so that these aspects are taken into consideration, thus enhancing the likelihood of program acceptability and success in a real world setting. Qualitative

research methods can provide a better understanding of these factors (257) and have been employed to examine such aspects.

Facilitators and barriers to the achievement of program goals

A deep, qualitative exploration of the factors affecting families' achievement of the program goals was undertaken by conducting semi-structured interviews with study parents at the 12 month time point. Semi-structured interviews provide in-depth information regarding individuals' experiences and perceptions of an issue and can be administered in a relatively short period of time (258). This style of interviewing limits interviewer-effect and maximises the richness of responses by providing prescribed interview questions and permitting open-ended responses (257-259).

2.4 Study procedures

2.4.1 Recruitment

Subjects were recruited between May 2004 and March 2005 in Adelaide and June 2004 and April 2005 in Sydney. A variety of recruitment channels were utilised including school newsletters inserts, local and regional newspaper advertisements and articles and posters and leaflets in various health and community venues. Initially suburbs surrounding the location of the program (Flinders Medical Centre in Adelaide and The Children's Hospital at Westmead, Sydney) were targeted, however local and statewide media interest resulted in a greater reach. Three cohorts were recruited consecutively at each site. A cohort size of 28 subjects (14 per intervention arm) was desired however final numbers varied according to the success of recruitment to minimise the waiting time between recruitment and intervention commencement.

2.4.2 Eligibility screening

Following receipt of recruitment material, interested parents/carers contacted their respective study site via telephone or email. Study personnel informed parents/carers of the study details and requirements and also assessed their eligibility to participate via telephone using a standardised screening form. Upon completion of a successful telephone screen, an appointment was made for the child with study personnel and a paediatrician at the relevant study site. At this appointment, study personnel measured the child to confirm eligibility based on BMI and other inclusion and exclusion criteria (see Sections 2.3.2.2 and 2.3.2.3). In addition, assessment of pubertal stage and illnesses or medications that may exclude enrolment were assessed by a paediatrician. Families not meeting study inclusion criteria at either of these screenings were provided with written information on healthy lifestyle tips to assist with child weight management and contact details of dietetic services in their area.

2.4.3 Consent

Following a successful medical screen at the study site, families were provided with a study information sheet and the details of the study were explained by study personnel. Attention was drawn to the differences in group allocation, time commitment required and request for blood samples from the children. Parents and children were assured that they could withdraw from the study at anytime without consequence. Written, informed consent from parents (for their own participation and that of their child) and child assent was obtained from those eligible and interested. This was collected in duplicate and a copy provided to parents.

2.4.4 Randomisation

Separate randomisation schedules were computer generated for each cohort per site and stratified by gender. Group allocations were sealed in numbered opaque envelopes and the next envelope relevant to gender was opened

upon completion of a child's baseline measurements. Group allocation was recorded by study personnel. Study personnel were blinded to the randomisation schedule and subsequent measures of subjects were conducted by assessors blinded to subject group allocation.

2.4.5 Delivery of interventions

2.4.5.1 Healthy lifestyle only intervention group

The healthy lifestyle only intervention consisted of a combination of eight face-to-face group sessions and four individual telephone sessions as outlined in Table 2.1.

Groups consisted of 10-18 families, depending on cohort size and were conducted in the late afternoon (4.30 – 6pm) to accommodate work and school commitments. The groups were conducted with parents only, as evidence suggests that for this age group, parent-led behaviour change is most effective (198). Whilst parents were attending the group sessions, children participated in the activity sessions as described in Section 2.2.2.2. Families who failed to attend two consecutive sessions were contacted by study personnel and encouraged to re-engage in the program.

Four individual telephone sessions lasting no more than 20 minutes were scheduled at times nominated by parents. The individual telephone sessions followed a strict agenda that prompted parents to lead the discussion, minimising any additional intervention effect that these sessions could introduce. If parents were unavailable at the nominated time, study personnel made an attempt to contact at another time.

2.4.5.2 Healthy lifestyle plus parenting skills training intervention group

The healthy lifestyle plus parenting skills training intervention followed the same protocol as the healthy lifestyle only intervention but was preceded by

a four week parenting skills training program. The four week parenting program outlined in Section 2.2.1 was conducted in the evening (6.30 – 9pm) with parents/carers only. Limited child care facilities were available.

2.4.5.3 Quality assurance

In order to limit site bias, each intervention was delivered by the same facilitator for all three cohorts at each site (ie. 2 facilitators per site, each one delivering only the HL or HL+P intervention). The facilitators who delivered the HL+P group (this was the candidate at the Adelaide site) had undertaken the Triple P[®] Group Facilitators training course through the Victorian Parenting Centre (now the Parenting Research Centre: www.parentingrc.org.au/). To avoid contamination of the healthy lifestyle only intervention with strategies promoted by Triple P[®], the HL group facilitators were not familiar with the Triple P[®] training nor the principles it promotes.

To further ensure rigour and internal validity, facilitators at both sites were provided with detailed facilitator notes and checklists specific to their intervention. Facilitators of each intervention across both sites regularly debriefed via email and telephone to discuss any issues that arose regarding the delivery of the intervention. This further ensured that the content and format of intervention sessions were consistent across sites. Parents were also provided with detailed written lifestyle resources that covered session content and outlined homework tasks specific to their intervention group. As discussed above, the individual telephone sessions were also protocol driven (Section 2.4.5.1).

2.4.6 Data collection

Baseline data was collected prior to randomisation and outcome measures were recorded at intervention completion (6 months) and 12 months after baseline (six months following intervention end with no further program contact). Exit interviews were conducted with parents at the 12 month time

point to explore factors external to the PEACH program that facilitated or inhibited achievement of healthy lifestyle goals set as a result of the program.

Measurement sessions were predominantly conducted between 7.00 and 8.30am, lasting 60 to 90 minutes, to facilitate the collection of fasting blood samples for the monitoring of metabolic risk factors – a parameter beyond the scope of this thesis. In order to maximise follow up, afternoon appointments were offered to those families who found it difficult to attend morning sessions and self-report packs were also sent to some families.

Data were collected via either direct measurement by trained assessors using a standardised data collection form, parent- or child-report or interview schedule. Completion of questionnaires was checked by study personnel at measurement sessions prior to the departure of families to minimise the occurrence of missing data.

2.4.6.1 Demographic information

Standard demographic information was collected at baseline using the 33-item Family Background Questionnaire adapted from a data collection form developed at the University of Melbourne (260). The form asked parents to record information about their own and their child's health and well being and included items about the family structure and indicators of socioeconomic status (SES).

SES was determined using Socio Economic Indexes for Areas (SEIFA) which assign low scores to areas which are relatively disadvantaged (261). The SEIFA are standardised to have a mean of 1000 and a standard deviation of 100 (262). They consist of four indexes derived from 2001 Census data that measure different aspects of socio-economic conditions by geographic area (261). The indexes are:

1. Index of Relative Socio-Economic Disadvantage (IRSD): reflects makers of low levels of income, employment and education

2. Index of Relative Socio-Economic Advantage/Disadvantage (IRSAD): includes indicators of advantage and disadvantage relating to income levels and skill-base of employment
3. Index of Economic Resources (IER): relates to family income, rental and mortgage payments and dwelling size
4. Index of Education and Occupation (IEO): reflects the education and occupational structure of communities (261, 262)

The IRSD and the IRSAD are the most commonly used indexes in health research.

SEIFA are available for a range of geographic areas of various size, including postal areas, state suburbs, state electoral divisions and commonwealth electoral divisions (261). For the purposes of this thesis, postal area was the unit of geographical classification.

2.4.6.2 Primary outcome evaluation - BMI z-score

Height (cm) and weight (kg) were measured with children lightly clothed and without shoes. Height to the nearest millimetre was measured using a Trumeter™ stadiometer (Manchester, UK) in Adelaide or Sony™ Digiruler NA-20 stadiometer (Ermington, Australia) in Sydney. Children stood barefoot with feet together and heels pressed against the wall. The head was placed in the Frankfort plane and the head piece brought down to rest firmly on the vertex as a gentle traction was applied alongside the mastoid process. The reading was taken to the nearest millimetre. Weight was measured to the nearest 0.1kg with SECA™ (Hamburg, Germany) or AND™ FW-150K (Silverwater, Australia) electronic scales in Adelaide or Sydney respectively. BMI was calculated as weight in kilograms divided by height in metres squared.

Values for height, weight and BMI were converted to a decimal age and gender specific BMI z-score using a computer program containing UK reference data (Child Growth Foundation, London UK) (14). For categorical

analysis, children were classified as healthy weight, overweight or obese according to the cut-points established by Cole and colleagues (11).

2.4.6.3 Primary outcome evaluation - waist circumference z-score

A child's waist was taken to be the point midway between the tenth rib and the iliac crest. The waist circumference was measured using a flexible metallic measuring tape (Lufkin) held over skin or light clothing while the child stood in an upright position. Two measures were recorded and if a discrepancy of more than 10% was observed a third reading was taken. These values were then averaged and recorded to the nearest millimetre before being converted to an age and gender-specific z-score using UK reference data (15).

2.4.6.4 Secondary outcome evaluation - Health-related quality of life

Parents and children aged 8 years and over were asked to respond to each item of the PedsQL™ 4.0 using a 5-point response scale (0 = never a problem, 1 = almost never a problem, 2 = sometimes a problem, 3 = often a problem, 4 = a lot of a problem). To enhance ease of response for children aged 5-7 years, the 5-point scale was reduced to 3 points (0 = not at all a problem, 2 = sometimes a problem, 4 = a lot of a problem) and each response was tied to a happy to sad face scale (Appendix Two).

The child self-reports were administered to children individually by trained assessors in a quiet room where parents were not present. The parent proxy-report was included in the questionnaire booklet provided to parents at the measurement sessions and verbal clarification was provided as required. Families unable to attend measurement sessions were sent questionnaires in a self-report pack. Children aged less than 8 years old were not sent a questionnaire to complete. Written instructions for standardised completion of the questionnaire by parents and children over 8 years was included in the pack.

Responses to questionnaires were reverse scored and linearly transformed to a range of 0-100 (0 = 100, 1 = 75, 2 = 50, 3 = 25, 4 = 0), with a higher score indicating better HRQoL. Scale scores were calculated by summing the items and dividing by the number of items answered, so as to account for missing data. If more than 50% of items in a scale were unanswered, the Scale Score was not computed. The scales produce a Physical Health Summary Score (the total of the physical functioning subscale) and a Psychosocial Health Summary Scale (from the emotional, social and school functioning subscales) which add to give a Total Score.

2.4.6.5 Secondary outcome evaluation - body size dissatisfaction

A standard interview process was followed when administering the Children's Body Image Scale to children in the study (40). Questions were read to the children individually by an assessor in a quiet room without the presence of parents. Children were able to clarify any points and had the option of not responding to the questions. The data was treated as scale data and analysed using parametric statistical techniques.

2.4.6.6 Secondary outcome evaluation – linear growth

Children's height was measured in centimetres during sessions as described in Section 2.4.6.2. Absolute values were converted to age- and gender-specific z-scores and compared against a UK reference population (15).

2.4.6.7 Impact evaluation – child health behaviours

Children's dietary and activity behaviours were reported by parents completing the Children's Dietary Questionnaire and the Activity Inventory, respectively (Section 2.3.3.2). The questionnaires were included in the questionnaire pack provided to parents at measurement sessions. Verbal clarification was provided by study staff as requested.

2.4.6.8 Impact evaluation – parenting skills

Similarly, parents completed the Alabama Parenting Questionnaire and the Parenting Sense of Competence Scale during measurement sessions (Section 2.3.3.2). Verbal clarification was provided by study staff as requested.

2.4.6.9 Impact evaluation – parental weight status

Parental weight (kg) and height (cm) data was collected following the same protocol outlined in Section 2.4.6.2. Weight and height were used to calculate parental BMI which was then converted to weight status according to the WHO definitions (underweight: BMI<18.5, normal weight: BMI: 18.5-24.9, overweight: BMI: 25.0-29.9, obese: BMI≥30.0) (4).

2.4.6.10 Process evaluation – attendance

The group facilitators recorded attendance to group sessions and individual phone consults against a participant list. There were 12 sessions for the HL group and 16 sessions for the HL+P group. An individual family's attendance rate was considered good if 75% or more of sessions were attended and poor if the family only attended the four individual phone consultations. A "fair" attendance indicated an adherence level between these two extremes (which varied by group due to the different number of sessions provided).

2.4.6.11 Process evaluation – satisfaction

Parents in the HL+P group were asked to complete the Triple P[®] satisfaction questionnaire at completion of the four week parent skills training component and all parents were asked to complete the PEACH satisfaction questionnaire at the completion of the healthy lifestyle component of the program (at the six month time point) (Section 2.3.3.3). Likert scale, yes/no and multiple choice responses were entered into SPSS and summarised as frequencies. Responses to open-ended questions were coded under relevant themes and summarised as frequencies.

2.4.6.12 Process evaluation – maintenance of program integrity

To confirm that the education approach used by the HL and HL+P sessions was different *within* each study site, tapes of sessions conducted after the Triple P[®] training (ie. Healthy Lifestyle Sessions 2 – 8 (Table 2.1)) were paired by site and intervention (ie. Adelaide Healthy Lifestyle Session 2: HL and HL+P recording or Sydney Healthy Lifestyle Session 5: HL and HL+P recording) and randomly selected for assessment. Ten percent of tapes were selected, providing eight tapes covering four different sessions (Number of tapes = 7 sessions x 2 interventions x 3 cohorts x 2 sites = 84 tapes x 10% = 8 tapes, which are paired by intervention, so cover 4 different sessions). The tapes were assessed by an independent auditor against a checklist consisting of criteria highlighting key differences between the intervention processes and content.

2.4.6.13 Qualitative evaluation – facilitators and barriers to the achievement of program goals

Semi-structured interviews lasting no more than ten minutes were conducted with all parents attending twelve month measurement sessions. The interviews were conducted by one trained interviewer at each site and followed a prescribed interview format. The ten minute time limit was allocated for logistical reasons and was confirmed by a qualitative research expert as adequate to gain sufficient detail on a discretely defined topic (263). Pre-established categories for coding responses were not used and depth of responses were limited only by a ten minute time restriction. The interviewers were anonymous to the interviewee, external to the intervention and blinded to randomisation. The interviewees were assured of confidentiality and anonymity of response.

Participants were informed that the interviewer was interested in what factors external to the PEACH program made it a) easier or b) harder for them to make changes to their family's lifestyle habits in line with the program recommendations. Time permitting, parents were also given the opportunity to comment on any other broader environmental and social factors

influencing their family's progress through the PEACH program. Parents were encouraged to answer the questions in as much detail as possible and reminded that a ten minute time limit applied to the interview. They were reassured that complete and in-depth responses to the questions were desired and not responding to all questions due to lack of time was not detrimental to the project.

All interviews were recorded using a digital or cassette voice recorder and transcribed by an independent, confidential service.

2.4.7 Retention

Participant retention in child weight management studies ranges from 10 to 50% (140). Poor retention rates have implications for intention to treat analysis so every effort must be made to limit attrition. Standardised follow-up, retention and withdrawal protocols were employed across both sites in order to preserve the study's sample size and enable collection of the maximum amount of data from subjects.

Scheduling of the measurement sessions was flexible and where necessary individual appointments and home visits were offered. Reduced assessment schedules were offered (eg. anthropometric measures only, mailed self-report packs) to increase acceptability. Families were provided with \$10 following attendance at measurement sessions to assist with petrol and/or parking costs. Birthday and Christmas cards were sent to families and site-specific newsletters were distributed to families quarterly. Standardised letters outlining the child's anthropometric outcomes were sent to families following each six-monthly measurement. To maximise on-going correspondence, families were requested to provide two alternative contact persons not residing with them in the event the family could not be contacted directly.

2.5 Data analysis

2.5.1 Sample size calculation

The sample size calculation was based on clinical relevance and the impact of growth on BMI. It was calculated based on an estimated reduction in BMI z-score of 30% in the HL+P group and 10% in the HL group over 12 months. A common BMI z-score standard deviation of 0.49 was assumed based on the standard deviation for BMI z-scores of overweight 6-9 year olds in the National Nutrition Survey (264).

Using a two group t-test with a 0.05 two-sided significance, a sample size of 28 in each group was calculated to have 80% power to detect this difference. To accommodate a drop out rate of one-third (based on adult studies) 42 children were required to enrol in each intervention per site ie. 168 in total.

2.5.2 Data handling and management

Data was collected using standardised, de-identified forms that were checked for completion when collected. Hard copies of all forms were stored in a locked filing cabinet organised according to site and cohort. Data entry and analysis was centralised (Adelaide site) using SPSS for Windows 14.0 (SPSS Inc, Chicago). Data entry was checked for accuracy and outliers were checked visually and by examining the Descriptives and Extreme Value tables produced using the Explore function in SPSS. Discrepancies were cross checked against the raw data and corrected if necessary.

2.5.3 Data preparation

2.5.3.1 Checking randomisation

Differences in baseline characteristics by treatment group and site were examined and statistical models were adjusted to account for any significant differences identified.

2.5.3.2 Data normality

Frequency histograms were produced for outcomes at baseline and visually assessed for normality. In addition, the primary analysis method (univariate ANOVA, see Section 2.5.4.1) provided an assessment of the normality of the outcome distribution via plotting the residuals of the variables.

2.5.3.3 Potential covariates

Potential covariates were identified from the literature and were measured at baseline (weight status, height, gender, age, parental weight status, ethnicity and socioeconomic status). Randomisation was performed to distribute potential covariates between the study groups and was stratified by gender, cohort and site.

2.5.4 Quantitative analysis

2.5.4.1 Primary Analysis

Intention to treat analysis

Intention to treat analysis (ITT) is a method of analysis for randomised trials in which all subjects assigned to one of the treatments are analysed together, regardless of whether or not they completed or received that treatment (205). It is a complex area and there are many definitions of what constitutes ITT (265). The CONSORT statement requires authors to indicate whether analyses were performed on an ITT basis, however do not outline how ITT should be approached (206). Hollis and Campbell have formulated recommendations to address this which guide the analysis and reporting presented in this thesis (265).

For the purposes of this thesis, ITT analysis was conducted on all subjects for whom data were available on the basis of the group they were allocated regardless of their adherence to the protocol (ie. attendance). Missing data were not imputed therefore only subjects for whom outcome data was

available were included in the analysis at the six- and twelve-month time points. Baseline differences between the randomised, full sample and the model samples were examined and handled accordingly.

Univariate ANCOVA

Data was analysed in a way to answer the research question “Does the addition of a parenting skills training program improve the long-term effectiveness of a parent-led, family focussed healthy lifestyle intervention for the management of overweight in 5-9 year old pre-pubescent children?”

The study was powered to examine the effect of parenting skills on the child BMI z-score immediately following the completion of the six month intervention and six months following this time (during which no further program contact was provided). Therefore, univariate ANCOVA was conducted to examine the *between* group effect at the six-month time point (intervention end) and the 12-month time point (six months following intervention end following no further program contact), allowing the examination of the intervention and maintenance effects by group, respectively. ANCOVA was also performed on the change scores between baseline and six-months and baseline and twelve-months for the primary outcomes of BMI and WC z-score to enable reporting of the change in degree of overweight over time.

Paired t-tests by group were conducted between the baseline and six month and baseline and 12 month time points to examine significant changes over time *within* each group.

Depending on the outcome being investigated, the models were adjusted for factors such as site, group or gender and covariates such as baseline age or the baseline value of the dependent variable being analysed.

Models were refined and the assumptions of the model were tested (homogeneity of slopes (if a covariate by factor interaction was present),

assumption of constant variance and normality of residuals (examined by QQ plots)). In the event that the assumptions of the ANCOVA model were not met, standardised residuals were examined. Presence of standardised residuals beyond the range -3 to +3 indicated a high likelihood that the model was inappropriate for such points and the ANCOVA was re-run following their omission. Adjusted means and standard errors were reported for all values resulting from ANCOVA modelling.

2.5.4.2 Secondary Analysis

Univariate ANCOVA was also performed “per protocol” to examine program efficacy rather than effectiveness. Attendance at sessions was used as a proxy indicator of adherence to study protocol for the purposes of this secondary analysis. Only subjects who attended at least 75% of scheduled program sessions (group sessions and individual telephone sessions) were included in per-protocol analyses.

2.5.5 Qualitative Analysis

The aim of qualitative research is to understand and present the experiences and actions of people as they encounter a situation under study (266). Qualitative research methods add context to quantitative research and give researchers a better understanding of the social and personal factors that influence the management of a health condition, providing a real-world or human aspect to research findings (257). As a result, a number of experts in the field support a mixed methods approach to research design (267-269).

Application of a mixed methods approach enables each analysis method to address the weaknesses of the other, increasing understanding and also validity (258, 269). This is particularly important in research examining behaviour change in individuals living in a free environment. In this scenario, there are many influences that impact upon subjects'/informants' progression through an intervention/experience. Such contextual factors may not be captured through quantitative research methods but must be considered

when examining overall program effectiveness (217). This crucial information can be provided through qualitative enquiry.

In recognition of these points, this thesis supplements its quantitative foundations with a qualitative investigation of the factors external to the intervention that promote or inhibit families' ability to achieve lifestyle behaviour change. This qualitative research component is informed by post-positivism theory and utilises thematic analysis techniques to interpret the findings from the semi-structured interviews.

The Theoretical Paradigm: Post-Positivism

Post-positivistic theory is closely related to positivism which is commonly associated with quantitative methods. Both theories promote standardised, repeatable measures to answer research questions in the belief that a true and objective result may be obtained (257) (258). The researcher takes on a "disinterested scientist" role and remains detached from the subjects in order to gather unbiased and objective data (259). Post-positivism differs most from positivistic theory by its inclusion of qualitative methods of research and its inductive approach to data analysis. The methods guided by post-positivism ensure maximum structure, rigour and consistency to provide reliable results which sit well within both qualitative and quantitative research designs, making them ideal for inclusion in a mixed methodology framework.

The Analytical Technique: Thematic analysis

Thematic analysis comes from the grounded theory tradition of qualitative research. Both thematic analysis and grounded theory use similar data analysis techniques but thematic analysis does not employ theoretical sampling and does not look to develop theory (257) (270). Its theoretical freedom means that thematic analysis can be applied across a range of epistemological approaches, providing a flexible research tool (270). It is an inductive form of data analysis whereby themes are drawn *from* the data (unlike content analysis which codes data into pre-defined categories

established by the researcher) in order to provide a *rich description* of the phenomena under investigation (unlike grounded theory which aims to develop theories based on the data under investigation) (258).

Thematic analysis is a commonly used, yet poorly explained and rarely acknowledged qualitative analytical method (271). Braun and Clarke have recently provided a theoretically and methodologically sound guide for undertaking thematic analysis which has been applied to the analysis in this thesis (270) (Figure 2.2).

Figure 2.2: Process of thematic analysis¹ undertaken to analyse the transcripts of the 95 semi-structured interviews conducted with PEACH parents at the 12 month time point

Phase	Description of the process
1. Familiarizing yourself with your data:	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

¹as described in (270)

Phase One of Thematic Analysis: Familiarisation with the data

The candidate initially transcribed ten interviews (10%) verbatim to gain familiarity with the data. The remaining 85 were transcribed by a professional, confidential service. All transcriptions were read and notated by the candidate. Transcription occurred in batches as interviews were completed at 12 month measurement sessions, and were collected over the period between June 2005 and May 2006.

Phase Two of Thematic Analysis: Generating initial codes

Once a batch of electronic transcripts was returned to the candidate, they were printed and the hard copies were coded using two different coloured highlighters (yellow – factors that inhibited success, pink – factors that

promoted success). An independent coder coded 10% of the full sample to ensure consistency of coding.

Once all interviews were complete and hard copies of the transcriptions had been highlighted, the electronic transcripts were uploaded into the qualitative research analysis computer package, NVivo 7 (QSR International Pty Ltd, 1999-2006). The highlighted sections of text were coded as initial codes (termed “free nodes” by the NVivo program) which were placed under the heading of either i) facilitator (F) or ii) barrier (B).

The analysis program automatically created an electronic link between each initial code and the highlighted pieces of text from which it was identified. The number of times each initial code was referenced and the number of sources that referenced it were also displayed. These numbers often varied as some sources referenced an individual node more than once resulting in a higher number of references than sources.

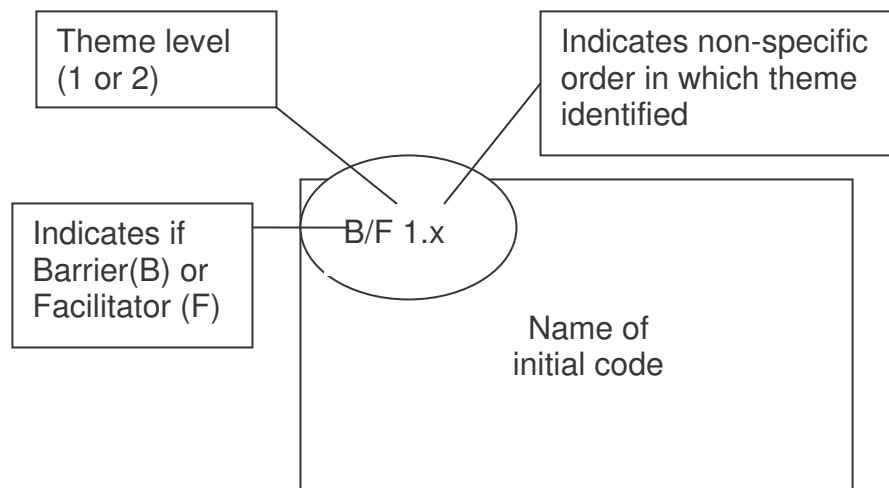
Phase Three of Thematic Analysis: Searching for themes

Initial codes that shared commonalities were grouped into “theme-piles”. To facilitate this, the name of each initial code was written onto a flash card (Figure 2.3) and grouped together with other common initial codes. Each pile represented a first level theme. A log was kept of these first level themes and the initial codes contributing to them.

Each theme was ascribed a number in the format “B/F 1.x” where B/F identified the theme as a barrier or facilitator, the number one identified the theme as a first level theme and x represented the non-specific order in which the theme was identified. For example, the first level theme “Social outings/Special occasions” was attributed the number B1.3, to indicate it was the third first-level theme identified as a barrier to the achievement of lifestyle goals. These numbers were written on the top left hand corner of the relevant initial code flash cards which was used to refer to the first level theme log.

Envelopes were labelled with each theme title and the flash cards corresponding to each theme were placed in the relevant envelope. The theme name and identification number was written on the front of the envelope followed by a list of the initial codes it contained.

Figure 2.3: Template of flash card used to organise themes relating to barriers or facilitators to the achievement of healthy family lifestyle goals identified from interviews conducted with PEACH parents at the 12 month time point



Phases Four and Five of Thematic Analysis: Reviewing the themes and Defining and naming themes

As for the first phase of theme identification, all first level themes identified in Phase Three were written on flash cards, this time on yellow paper. Again, first-level themes that shared commonalities were grouped together in theme piles to represent broader second-level themes. A log of these second-level themes and the first-level themes supporting them was kept and a similar numbering system used, this time in the format of B/F 2.x.

During this process the initial codes making up each theme were reviewed, as were the extracts of data included in each initial code. At this point, first level themes that were supported by a minimal number of initial codes or a large number of infrequently referenced initial codes were discarded.

The resultant second level themes provided a further refinement of the themes identified from the interviews. Many of them contained first level

themes, forming sub-themes that demonstrate the complexity and/or hierarchy of meaning within the data.

This process of thematic analysis follows the format prescribed by Braun and Clarke ensuring systematic qualitative analysis of the data (270).

2.5.6 Conclusion: Study Methodology

This thesis study (the PEACH study) was designed to address the gaps in the evidence identified by Sections 2 and 3 of the literature review. Key study design and evaluation features to address these weaknesses are summarised in the table below, which also indicates the sections of this thesis in which they are presented.

Table 2.5: Summary of key features of study design and evaluation required to ensure robustness of study findings

Key study design and evaluation feature	Reported in thesis
Key study design features	
Use of high quality design	✓ Section 2.3
Sample size calculation to ensure adequate power	✓ Section 2.5.1
Attrition rates provided	✓ Section 3.1 & Fig 3.1
Period of observation at least 1 year	✓ Section 2.3
Key study evaluation features	
Appropriate definition of childhood overweight and obesity used	✓ Section 1.1.1
Inclusion of appropriate short (impact) and long term outcomes	✓ Chapter 4
Assessment of the psychosocial impact of interventions	✓ Section 3.3
Inclusion of process/qualitative indicators	✓ Section 4.2 and Ch 5
Barriers to translation of research to practice considered by collection of qualitative data on views of participants to highlight why interventions may be more or less successful	✓ Chapter 5
Intention to treat analysis undertaken	✓ Section 2.5.4.1

The design and evaluation strengths of this thesis study maximise its strength and robustness to ensure greater generalisability of its findings.

These findings are presented in the following three chapters which report on the study outcomes, impact and process, and qualitative evaluation findings respectively and are summarised in the final sixth chapter.

Chapter Three: Outcome Evaluation

This chapter opens by describing the participant flow through the study according to the Consolidated Standards of Reporting Trials (CONSORT) statement (206). The baseline characteristics of the 169 study participants are described as a full sample and also by site and group.

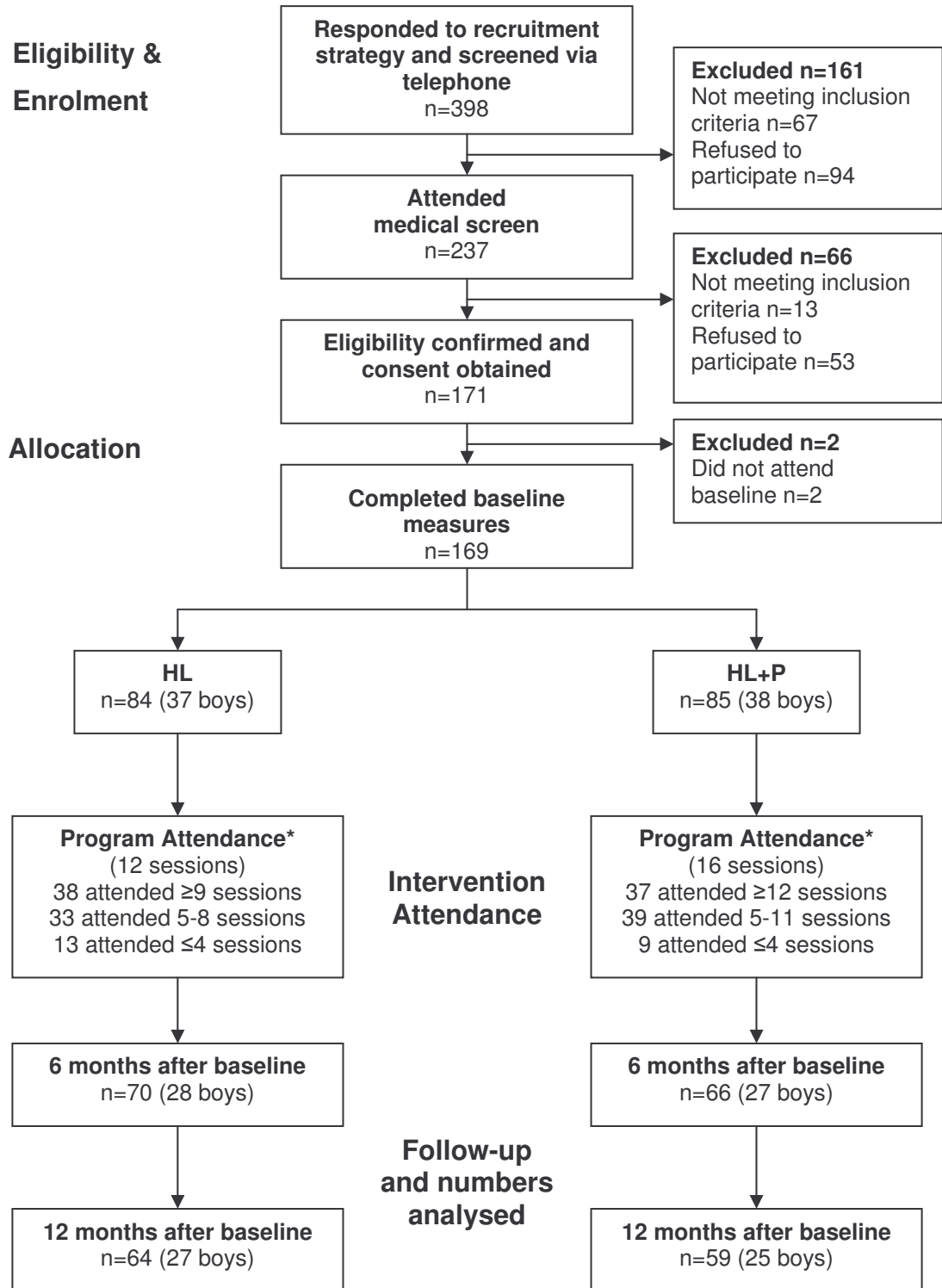
Primary and secondary outcome findings are then reported, using the analysis described in Section 2.5.4.1. Group differences were analysed by univariate ANCOVA at the six and 12 month time points to determine respectively the intervention and maintenance effects of the intervention. For the primary study outcomes, ANCOVA was also performed on the change scores between baseline and these two time points to determine change in degree of overweight over time. Paired t-tests by group were conducted between the 0-6 and 0-12 time points to examine significant changes *within* each group over time.

Each set of results (subject recruitment, primary outcomes, secondary outcomes) is immediately followed by a discussion of the findings in relation to the existing literature.

3.1 Subject recruitment and baseline characteristics

This section describes the flow of participant through the study in accordance with the CONSORT statement from screening through to twelve months post-baseline (206) (Figure 3.1). Characteristics of children and parents at baseline are then presented. The section concludes with a discussion of the implications these findings have for practice with regard to the recruitment of subjects to child weight management interventions.

Figure 3.1: Progression of subjects through the phases of the PEACH study from recruitment to analysis by group allocation to either intensive healthy lifestyle education (HL) or intensive healthy lifestyle education plus parenting (HL+P)



*See Section 2.4.6.10 for rationale of three levels of program attendance

3.1.1 Subject enrolment

Of the 398 families that enquired about the study, eighty did not meet study inclusion criteria due to age (50), weight status (24), medical history (3) or being enrolled in another family weight management study or having a sibling enrolled in the current study (3). Another 147 families (37%) declined to participate due to a lack of interest (70), lack of time (29), inconvenient location (24) or other unknown reasons (24). The ineligibility and refusal rates were similar across the two sites (Adelaide: 24% and 37% respectively, Sydney: 22% and 31% respectively). In addition, two families in Sydney failed to attend baseline assessment and were not enrolled in the study. Therefore the final sample size of 169 families represented 53% of enquiries from eligible families (Figure 3.1). The majority of families were recruited via newspaper articles and schools (40% and 38% respectively) (Table 3.1).

Table 3.1: The number of enquiries received from families interested in participating in the PEACH study and the number (percentage) of families enrolled in the study by recruitment strategy

Recruitment strategy	Enquiries	Enrolled in study (%)
Newspaper	153	68 (40)
Schools	114	64(38)
TV/radio	39	12(7)
Health professional – medical	14	9(5)
Media – other	16	6 (4)
Word of mouth	13	5 (3)
Health professional – other	15	3 (2)
Unknown	34	2 (1)
Total	398	169 (42)

3.1.2 Group allocation

Figure 3.1 shows the number of subjects randomly allocated to each group. A comparison of subject characteristics at baseline with the study inclusion

and exclusion criteria (see Sections 2.3.2.2 and 2.3.2.3) identified one false inclusion based on age (10.10 years of age at baseline). This was due to a longer than anticipated period of time between screening and baseline measures.

3.1.3 Adherence to study protocol

Program session attendance was used as a proxy measure of adherence to the study protocol. The level of adherence by study arm is presented in Figure 3.1.

Program session attendance was divided into three categories to represent different levels of adherence. The number of program sessions (group sessions and individual phone consults) differed by study arm (HL: 12 sessions, HL+P: 16 sessions). Participants in both study arms were offered four individual telephone consultations, which represented the minimum level of adherence for both groups (poor). The highest level of adherence was calculated to be attendance to 75% of scheduled sessions (HL: $\geq 9/12$ sessions, HL+P: $\geq 12/16$ sessions) (good). A mid level of adherence was defined as a rate in between these two extremes (HL: 5-8/12 sessions, HL+P: 5-11/16 sessions) (fair).

3.1.4 Attendance at measurement sessions

Figure 3.1 presents the number of subjects analysed for the primary outcome at the time points six- and twelve-months after baseline. At six months, 33 subjects (20%) were lost to follow-up (HL: 14/84, HL+P: 19/85). At twelve months, there were a total of 46 subjects (27%) lost to follow up (HL: 20/84, HL+P: 26/85). The overall retention rate at 12 months was 73%. The outcome status of subjects lost to follow up cannot be accounted for and they were excluded from the intention-to-treat analyses (272). Discussion of the method of the intention-to-treat analysis employed in this thesis is found in Section 2.5.4.1.

3.1.5 Family and parent characteristics at baseline

The Family Background Questionnaire (Section 2.4.6.1) was completed and returned by 165 of the 169 families enrolled in the study. The average age of the parent/carer completing the study questionnaires at baseline was 38 ± 6 years and 92% were mothers. Seventy four percent of families were “original families” (ie. mother, father and child(ren)) and 70% of families consisted of at least two children. One hundred and twenty of the 165 respondents (73%) were born in Australia, with the remaining 45 parents immigrating from other parts of Australasia (7), Europe (26) or “other” countries (12). Twenty six of these 45 parents had lived in Australia for 20 years or more. One hundred and fifteen of 162 mothers (71%) and 89/100 fathers (89%) were classified as overweight ($25\text{kg/m}^2 \leq \text{BMI} \leq 30\text{kg/m}^2$) or obese ($\text{BMI} \geq 30\text{kg/m}^2$).

Indicators of socioeconomic status are shown in Table 3.2. Site differences in indicators of socioeconomic status were in line with overall differences between their states of origin (New South Wales indicators were higher than South Australia). Exploration of these site differences by group allocation found that there were no significant differences for any baseline characteristics (all SEIFA indices: $p > 0.40$). This suggests that the randomisation, which was stratified by gender and generated for each cohort in each site, was successful in avoiding any significant group differences at baseline.

Table 3.2: Mean±SD for indicators of socioeconomic status of PEACH families at baseline of the study as a) full sample and b) split and compared by site

	Full sample (n=165/169)	Adelaide site sample (n=82/86) / SA population ¹ (n=1 457 639)	Sydney site sample (n=83/83) / NSW population ¹ (n=6 292 015)	p value ²
SEIFA index³				
-Disadvantage	1027±78	999±66 / 995	1055±80 / 1000	<0.001
-Advantage/Disadvantage	1029±67	1022±58 / 975	1036±75 / 1015	0.21
-Economic Resources	1033±87	980±54 / 968	1086±82 / 1031	<0.001
-Education and Occupation	1018±75	1004±70 / 978	1033±78 / 1010	0.01

¹ Data from the 2001 Australian Census, www.abs.gov.au

² Independent t-test by site

³ Socio-Economic Index for Areas, higher values indicate high socioeconomic status (for details refer to Section 2.4.6.1)

3.1.6 Child characteristics at baseline

Child characteristics and differences at baseline by gender are shown in Table 3.3. The sample consisted of an almost equal proportion of girls to boys and the majority were over eight years of age (63%) and obese (77%). There were significant gender differences between age- and sex-specific indicators of weight, BMI and waist circumference ($p < 0.001$ for all).

Table 3.3: Baseline mean \pm SD anthropometric measures and weight status of children enrolled in the PEACH study

	All	Boys	Girls	p value ¹
n	169	75	94	
Age (years)	8.2 \pm 1.2	8.3 \pm 1.2	8.1 \pm 1.2	0.29
Height (cm)	135.0 \pm 9.2	136.9 \pm 9.8	133.6 \pm 8.4	0.02
Height z-score ²	1.2 \pm 1.0	1.4 \pm 1.0	1.1 \pm 0.9	0.06
Weight (kg)	44.4 \pm 9.8	46.4 \pm 10.2	42.9 \pm 9.3	0.02
Weight z-score ²	2.6 \pm 0.6	2.8 \pm 0.6	2.4 \pm 0.7	<0.001
BMI (kg/m ²)	24.1 \pm 3.2	24.5 \pm 3.2	23.8 \pm 3.2	0.16
BMI z-score ²	2.7 \pm 0.6	2.9 \pm 0.5	2.5 \pm 0.6	<0.001
Waist circumference (cm)	77.2 \pm 8.6*	79.3 \pm 8.6*	75.5 \pm 8.3*	<0.01
WC z-score ²	3.1 \pm 0.6*	3.3 \pm 0.5*	2.5 \pm 0.6*	<0.001
Weight status ³ (n)				0.51
Overweight	39	15	24	
Obese	130	60	70	

¹ Independent t-test by gender for continuous dependent variables, chi square analysis for categorical dependent variable (weight status)

² z-scores calculated by comparing subjects against UK reference population (14)

³ Weight status calculated by comparing subject BMI against age- and gender-specific BMI cut points (11)

* n value for waist circumference measures: 168 for full sample (Boys: 75, Girls: 93)

3.1.7 Discussion of subject recruitment and baseline characteristics

Subject recruitment

Recruitment of the 169 study subjects was challenging and took 12 months across both sites (86 in Adelaide, 83 in Sydney). On average, two and half families were contacted for every one recruited. The main reasons given for declining to enrol in the study were lack of time, inconvenience of the location

and disinterest. Anecdotal comments from enrolled families suggested that parents may have preferred an individualised, child-centred approach, which may explain the disinterest in enrolling in a parent-centred group intervention such as the PEACH study. Recruitment challenges are common (273) and similar experiences have been reported by a recent study conducted in Finland (215).

General practitioners and other primary health care professionals are often considered to be well positioned to monitor child growth and development and identify cases of overweight suitable for referral to such a program as PEACH (274). However, reports from the US and Australia show that GPs often do not weigh children and instead rely on clinical impression to assess weight status (275) (276). The PEACH study found GPs to be a less productive recruitment channel than media and school networks. Ninety percent of subjects were recruited via these two networks, whilst GPs provided only 5% of study subjects (Table 3.1).

A recent survey of GPs (n=34) in Melbourne, Australia found that less than half reported weighing and measuring children at least annually, only one reported calculating BMI and none reported plotting weight, height or BMI on the CDC growth charts as recommended in the NHMRC Guidelines (277). Another Australian survey of GPs found that reliance on clinical impression resulted in under-recognition of overweight and obesity in children (278). Without accurate measurement of child anthropometrics, the identification, early intervention and treatment of childhood overweight is unlikely. This highlights the importance of accurate weighing, measuring and, as recommended by the NHMRC 2003 Clinical Practice Guidelines for the Management of Overweight and Obesity in Children and Adolescents, calculation and plotting of the child's BMI for monitoring purposes (12).

A number of barriers to the management of childhood overweight have been cited by GPs (277) (279) (280) including that the highly sensitive nature of the issue makes it potentially unacceptable to raise with parents (276) (281). GPs often choose to discuss overweight only if the issue is raised by the

parent. Unfortunately, the likelihood of this occurring is low (276) and should not be relied upon to instigate treatment. Numerous studies in Australia, the US and UK have shown that less than 25% of parents of overweight 4-10 year old children correctly identify their child as being overweight (282) (283) (284) (285). Of these, only 35-40% report concern regarding their child's weight, which increases only once the child's weight is at an obese level (284) (282) (52). Parental unawareness of overweight in children has been reported internationally and given the long recruitment period, despite record levels of childhood overweight nationally, it appears this was also true for our target populations.

These findings raise the issue of lack of parental awareness regarding their own child's overweight and limited capacity of GP's to engage families about the issue. These phenomena impede the early identification and effective treatment of childhood overweight and also hamper subject recruitment into research studies. Public awareness campaigns and professional development to assist with effective identification and management of this public health issue are required.

Baseline characteristics

There were no significant differences between sites according to parental weight status ($p > 0.40$ for both maternal and paternal weight status) or child age or gender ($p > 0.10$ for both). However, there were significant differences by site according to child BMI z-score and WC z-score ($p < 0.001$ and $p = 0.02$, respectively) (Table 3.4).

Examination by gender showed that the differences were due to Sydney girls being significantly heavier and rounder than Adelaide girls (BMI z-score $p < 0.001$, WC z-score $p = 0.001$) (Table 3.4). There were no significant differences for boys between sites.

Exploration of these differences by group found that there were no significant differences at baseline for any potential covariates such as child age, BMI z-score or waist circumference z-score ($p \geq 0.30$ for all) (Table 3.4). This

suggests that the randomisation, which was stratified by gender and generated for each cohort in each site, was successful in avoiding any significant group differences at baseline.

Table 3.4: Baseline mean±SD anthropometric measures for subjects enrolled in the PEACH study by intervention site and group

	Adelaide site	Sydney site	p value ¹	HL ² arm	HL+P ³ arm	p value ¹
n value	86	83		84	85	
Age (years)	8.0±1.3	8.3±1.2	0.11	8.1±1.3	8.3±1.2	0.30
BMI z-score ⁴	2.6±0.7	2.9±0.5	<0.001	2.7±0.7	2.8±0.6	0.38
<i>BMI z-score - females</i>	(n=52) 2.3±0.6	(n=42) 2.8±0.5	<0.001	<i>(n=48)</i> <i>2.5±0.7</i>	<i>(n=46)</i> <i>2.6±0.6</i>	<i>0.64</i>
<i>BMI z-score - males</i>	<i>(n=34)</i> <i>2.9±0.5</i>	<i>(n=41)</i> <i>3.0±0.5</i>	<i>0.45</i>	<i>(n=36)</i> <i>2.9±0.6</i>	<i>(n=39)</i> <i>3.0±0.5</i>	<i>0.49</i>
WC z-score ⁴	3.0±0.7	3.2±0.6	0.02	3.1±0.7	3.1±0.6	0.72
<i>WC z-score - females</i>	(n=51) 2.8±0.6	(n=42) 3.2±0.5	0.001	<i>(n=48)</i> <i>2.9±0.7</i>	<i>(n=45)</i> <i>2.9±0.5</i>	<i>0.90</i>
<i>WC z-score - males</i>	<i>(n=34)</i> <i>3.4±0.6</i>	<i>(n=41)</i> <i>3.3±0.6</i>	<i>0.54</i>	<i>(n=36)</i> <i>3.3±0.7</i>	<i>(n=39)</i> <i>3.4±0.6</i>	<i>0.63</i>

¹ Independent t-test by site or group

² HL = Healthy lifestyle only intervention arm

³ HL+P = Healthy lifestyle plus parenting intervention arm

⁴ z-scores calculated by comparing subjects against UK reference population (14)

3.2 Primary study outcome findings

As described in Section 2.3.3.1, the primary study outcomes of the PEACH study were BMI and waist circumference z-scores. The study was powered to produce a group effect for change in BMI z-score 12 months after baseline (six months following the completion of the six month intervention and following no further program contact). Group effect on BMI z-score and waist circumference (WC) z-score according to intervention (six month time point) and maintenance (12 month time point) effects were determined via ANCOVA and undertaken using intention to treat analysis and per protocol analysis are presented below. The intervention and maintenance effects of the PEACH program on BMI and WC z-scores are now presented, followed by a discussion of these findings.

3.2.1 Intervention effect (baseline – six months)

3.2.1.1 Intention to treat analysis

Univariate ANCOVA was conducted for all subjects with measures at six months post-baseline (at the conclusion of the intervention) (BMIz: n=136, HL: 70, HL+P: 66. WCz: n=135, HL: 70, HL+P: 65). There were no significant differences in baseline z-scores between the full study sample (n=169) and the samples for these models (BMIz: p=0.89, WCz: p=0.10).

Preliminary analysis and model building to conduct ANCOVAs for BMI and WC z-scores resulted in final models that both included baseline z-score (BMI or WC) and age; site, group and gender and the interaction between group and gender. The BMI z-score model detected significant differences between group (p=0.005), gender (p=0.001) and site (p=0.01) at the six month time point (Table 3.5). The only significant difference observed in the WC z-score model was for gender (p=0.004) (Table 3.5). As the group by gender interaction was not significant in either model, this effect of gender is independent of the effect of group, signalling that boys responded better to the intervention than girls with respect to both primary outcome indicators. For BMI z-score only, the Sydney site subjects responded better to the

intervention than the Adelaide site sample. As expected, baseline z-scores also had a significant effect on the six month z-scores, so that for every unit increase in z-score at baseline, the six month value increased by 1.11 and 0.96 for BMI and waist circumference respectively (both $p < 0.001$).

Both groups demonstrated a significant reduction in BMI and WC z-scores over the first six months of the intervention (Figures 3.2 and 3.3: paired t-test, $p < 0.001$ for both groups). The 0-6 month change scores for BMI and WC z-scores were examined via ANCOVA, and the models included the same factors and covariates as the six month models. Adjusted mean change in BMI z-score for each of the groups was -0.21 (-8%) for HL and -0.35 (-13%) for HL+P ($p = 0.005$). Adjusted mean change in WC z-score for each of the groups was -0.29 (-9%) for HL and -0.35 (-11%) for HL+P ($p = 0.39$). Table 3.6 summarises both these time and group effects over the intervention period for both BMI and WC z-scores.

3.2.1.2 Per protocol analysis

Per protocol analyses were also conducted with children of parents who attended at least 75% of scheduled sessions (BMIz: $n = 72$, HL: 37, HL+P: 35; WCz: $n = 73$, HL: 38, HL+P: 35). With regards to BMI z-score, the significant group and gender differences observed in the intention to treat analysis were maintained ($p = 0.02$ and $p < 0.001$ respectively in the per protocol analysis). The significant site difference observed in the intention to treat analysis was not present and the expected significant effect of baseline BMI z-score remained ($p < 0.001$). The results of the intention to treat analysis of the WC z-score outcome did not change when data were analysed by a per protocol analysis.

3.2.2 Maintenance effect (baseline – 12 months)

3.2.2.1 Intention to treat analysis

Univariate ANCOVA was conducted with all subjects with measures at 12 months post-baseline (six months after the conclusion of the intervention and

following no further program contact) (BMIz: n=123, HL: 64, HL+P: 59; WCz: n=122, HL: 64, HL+P: 58). There were no significant differences in baseline z-scores between the full study sample (n=169) and the samples for these models (BMIz: p=0.40, WCz: p=0.13). Adjusted model means for BMI and WC z-score are shown in Table 3.5.

Preliminary analysis and model building to conduct ANCOVA for each outcome resulted in final models that were similar to those at six months. Each included baseline z-score (BMI or WC) and age; site, group and gender. The 12 month WC z-score model also included the interaction between group and gender.

At 12 months post-baseline, the only variable with a significant effect on BMI z-score was baseline BMI z-score ($p < 0.001$). For every unit increase in BMI z-score at baseline, the 12 month value increased by 1.05. The significant differences between group, gender and site observed at six months no longer existed (Table 3.5). With regards to WC z-score, the only significant difference observed at 12 months was between gender ($p = 0.04$, boys responded better than girls) (Table 3.5). As expected, baseline WC z-score continued to have a significant effect on WC z-score at 12 months ($p < 0.001$), so that for every unit increase in WC z-score at baseline, the 12 month value increased by 1.00.

Despite the absence of group differences at the 12 month time point, both groups did demonstrate a significant reduction in BMI and WC z-scores from baseline (Figures 3.2 and 3.3: paired t-test, $p < 0.001$ for both groups). The 0-12 month change scores model included the same factors and covariates as the six month models for both outcome indicators. Adjusted mean change in BMI z-score for each of the groups was -0.22 (-9%) for HL and -0.31 (-11%) for HL+P ($p = 0.09$). Adjusted mean change in WC z-score for each of the groups was -0.30 (-10%) for HL and -0.36 (-11%) for HL+P ($p = 0.41$). Table 3.6 summarises both these time and group effects over the maintenance period for both BMI and WC z-scores.

3.2.2.2 Per protocol analysis

Per protocol analysis of BMI z-score (n=70, HL: 35, HL+P: 35) conducted with children of parents who attended at least 75% of scheduled sessions revealed significant gender differences at intervention termination that were not observed by the intention to treat analysis (p=0.03). The expected significant effect of baseline BMI z-score remained (p<0.001). A per protocol analysis of the long term changes in WC z-score (n=69, HL:35, HL+P:34) did not show the significant gender differences observed in the intention to treat analysis. The significant effect of baseline WC z-score remained however.

Table 3.5: Summary of adjusted means of BMI and WC z-scores¹ (\pm SE) for children enrolled in the PEACH study at baseline, six and 12 months (Intention to treat analysis)

	0mth (n=169)	p ²	6mth* (n=135)	p ³	12mth* (n=123)	p ³
BMI z-score						
Group	(HL=84,HL+P=85)		(HL=69,HL+P=66)		(HL=64,HL+P=59)	
HL⁴	2.68 \pm 0.07	0.38	2.52 \pm 0.03	F(1,128)=8.36	2.48 \pm 0.04	F(1, 117)=2.87
HL+P⁵	2.77 \pm 0.06		2.38 \pm 0.03	0.005	2.39 \pm 0.04	0.09
Gender	(m=75, f=94)		(m=55, f=80)		(m=52, f=71)	
Males (m)	2.95 \pm 0.06	<0.001	2.37 \pm 0.04	F(1,128)=11.24	2.38 \pm 0.04	F(1, 117)=3.62
Females (f)	2.54 \pm 0.07		2.53 \pm 0.03	0.001	2.49 \pm 0.04	0.06
Site	(A=86, S=83)		(A=69, S=66)		(A=67, S=56)	
Adelaide (A)	2.55 \pm 0.07	<0.001	2.51 \pm 0.03	F(1,128)=6.47	2.48 \pm 0.04	F(1, 117)=2.17
Sydney (S)	2.91 \pm 0.06		2.39 \pm 0.03	0.01	2.39 \pm 0.04	0.14
WC z-score						
Group	(HL=84,HL+P=84)		(HL=70, HL+P=65)		(HL=64, HL+P=58)	
HL⁴	3.09 \pm 0.07	0.72	2.78 \pm 0.05	F(1,128)=0.75	2.77 \pm 0.05	F(1,122)=0.69
HL+P⁵	3.13 \pm 0.06		2.72 \pm 0.05	0.39	2.72 \pm 0.05	0.41
Gender	(m=75, f=93)		(m=55, f=80)		(m=52, f=70)	
Males (m)	3.31 \pm 0.07	<0.001	2.64 \pm 0.05	F(1,128)=8.73	2.66 \pm 0.06	F(1,122)=4.17
Females (f)	2.95 \pm 0.06		2.85 \pm 0.04	0.004	2.82 \pm 0.05	0.04

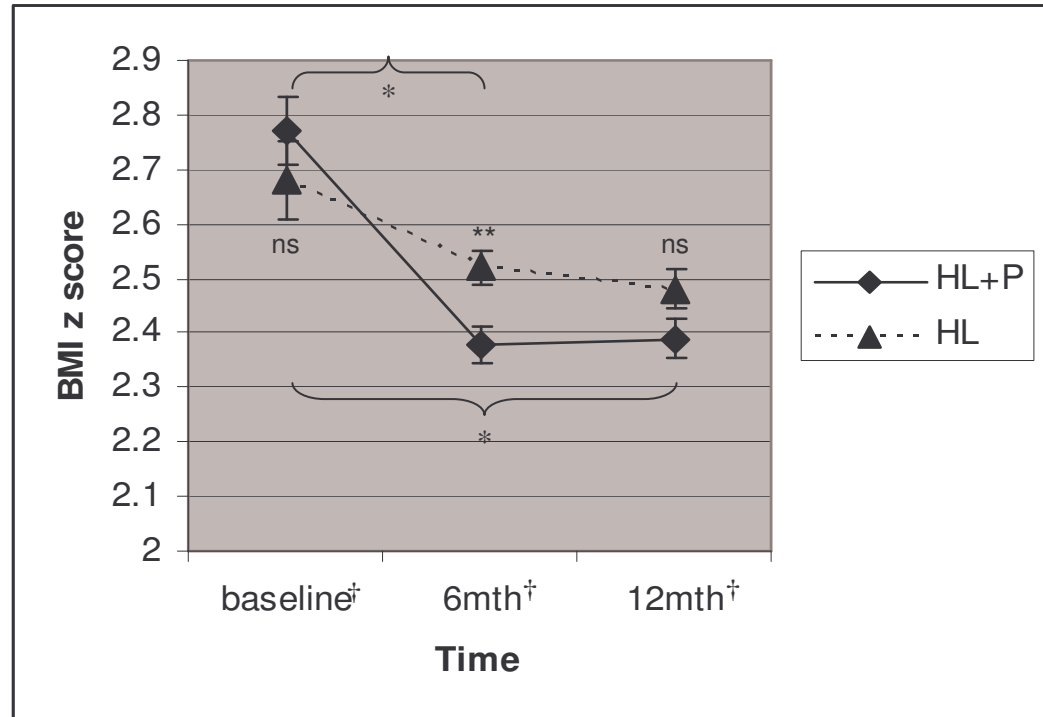
¹ z-scores calculated by comparing subjects against UK reference population: BMIz (14), WCz (15) ² Independent t-test

³ ANCOVA including site, group, gender, baseline age and BMI/WC z-score (and group*gender interaction for the 6mth model). No significant difference between baseline BMI or WC z-score of full study sample and model samples at 6mth and 12mth

⁴ HL = Healthy lifestyle only intervention arm ⁵ HL+P = Healthy lifestyle plus parenting intervention arm

* 6mth = intervention end, 12mth = 6mth after intervention end without further program contact

Figure 3.2: Mean BMI z-score¹ (\pm SE) for children enrolled in the PEACH study at baseline (n=169), six months (n=135) and 12 months (n=123) according to group (healthy lifestyle only (HL) or healthy lifestyle plus parenting (HL+P))



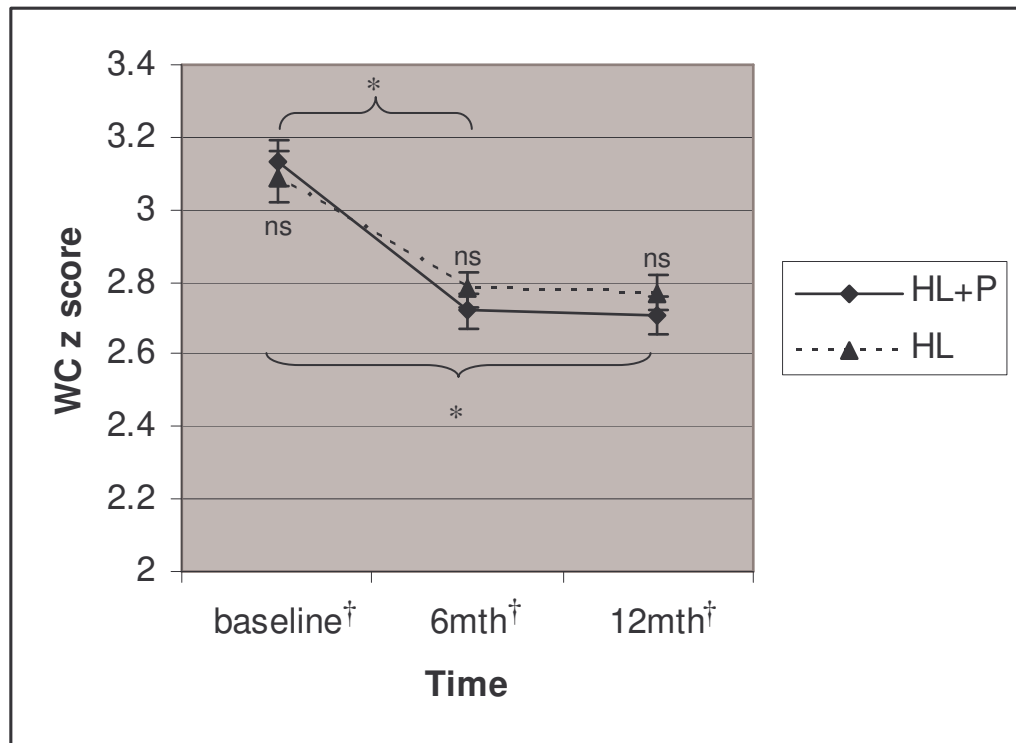
¹z-scores calculated by comparing subjects against UK reference population (14)

* Significant reduction in BMI z-score over time between 0-6mth (intervention effect) and 0-12mth (maintenance effect) for both groups (paired t-test, $p < 0.001$ for both groups for both time intervals)

** Significant group difference at 6mth (ANCOVA, $p = 0.005$)

[†]n values: baseline: HL=84, HL+P=85, 6mth: HL=69, HL+P=66, 12mth: HL=64, HL+P=59

Figure 3.3: Mean WC z-score¹ (\pm SE) for children enrolled in the PEACH study at baseline (n=168), six months (n=135) and 12 months (n=122) according to group (healthy lifestyle only (HL) or healthy lifestyle plus parenting (HL+P))



¹z-scores calculated by comparing subjects against UK reference population (15)

* Significant reduction in WC z-score over time between 0-6mth (intervention effect) and 0-12mth (maintenance effect) for both groups (paired t-test, $p < 0.001$ for both groups for both time intervals)

†n values: baseline: HL=84, HL+P=84, 6mth: HL=70, HL+P=65, 12mth: HL=64, HL+P=58

Table 3.6: Estimated means of change in BMI and WC z-scores¹ from baseline to six months and baseline to 12 months according to group allocation for children enrolled in the PEACH study: time and group effects

	0-6mth	Time effect	Group effect	0-12mth	Time effect	Group effect
		p ²	p ³		p ²	p ³
BMI z-score	(n=135)			(n=123)		
Group	(HL=69,HL+P=66)			(HL=64,HL+P=59)		
HL⁴	-0.21 (-8%)	p<0.001	0.05	-0.22 (-9%)	p<0.001	0.09
HL+P⁵	-0.35 (-13%)	p<0.001		-0.31 (-11%)	p<0.001	
WC z-score	(n=135)			(n=122)		
Group	(HL=70,HL+P=65)			(HL=64, HL+P=58)		
HL⁴	-0.29 (-9%)	p<0.001	0.39	-0.30 (-10%)	p<0.001	0.41
HL+P⁵	-0.35 (-11%)	p<0.001		-0.36 (-11%)	p<0.001	

¹z-scores calculated by comparing subjects against UK reference population: BMIz (14), WCz (15)

²paired t-test

³ANCOVA including site, group, gender, baseline age and BMI/WC z-score

⁴Healthy lifestyle only intervention arm

⁵HL+P = Healthy lifestyle plus parenting intervention arm

3.2.3 Discussion of primary outcome findings

Examination of the BMI z-scores at six months via ANCOVA revealed significant main effects of group ($p < 0.005$), gender ($p < 0.001$) and site ($p < 0.01$). The main effects of gender and site occurred independently of group signalling that they existed equally between the groups and did not impact upon the group effect. ANCOVA modelling of WC z-score at six months revealed a main effect only for gender ($p = 0.004$). Therefore, boys responded better than girls to the intervention with respect to both BMI and WC z-score.

The significant main effect of group for BMI z-score at six months signalled that HL+P group had significantly lower values than the HL group at this time point ($p < 0.005$, Table 3.5), indicating that the addition of parenting skills training improved the short-term effectiveness of a family-focussed child weight management program to reduce BMI z-score in overweight 5-9 year old pre-pubertal children. The difference in WC z-scores between the groups at this time point however was not statistically significant ($p = 0.39$, Table 3.5).

Cross sectional examination of the 12 month data by ANCOVA modelling found only a significant main effect of gender in the WC z-score model ($p = 0.04$, Table 3.5). However, it is worth noting that the 12 month group difference for BMI z-score approached significance ($p = 0.09$, Table 3.5).

The significant effect of site was observed at the six month time point only for BMI z-score ($p < 0.01$), indicating that Sydney children responded better than Adelaide children with regards to this outcome. Per protocol analyses saw the disappearance of this significant site effect and did not alter any of the other findings of the intention to treat analyses.

A significant gender effect observed at the six month time point for both anthropometric indicators (BMI z-score: $p = 0.001$, WC z-score: $p = 0.004$) persisted through to 12 months only for WC z-score ($p = 0.04$) (BMIz: $p = 0.06$). This finding suggests that boys experienced greater reduction in BMI and

WC z-scores than girls during the intervention period, which remained during the maintenance period for WC z-score only. This is discussed in more detail below.

Despite the lack of group differences, significant reductions in BMI- and WC z-scores were observed *within* both groups during the six month intervention period and these were maintained to 12 months following no further program contact (paired t-tests: 0-6mth $p < 0.001$, 0-12mth $p < 0.001$, all for both parameters and both groups, Figures 3.2 and 3.3 and Table 3.6). These patterns represent a stabilisation of the z-score reductions observed during the first six month intervention period, signifying successful maintenance of adiposity reduction equally in both groups during a period of no program contact. There was a decrease in the percent of obese children but this was not significantly different between time points or study groups (Table 3.7).

Table 3.7: Weight status¹ of children enrolled in the PEACH study at baseline, six and 12 months: frequency (% of total sample at each time point)

	0mth (n=169)	6mth (n=135)	12mth (n=123)
Healthy weight range			
<i>Full sample</i>	0	6 (4%)	5 (4%)
HL	0	3 (2%)	3 (2%)
HL+P	0	3(2%)	2 (2%)
Overweight			
<i>Full sample</i>	39 (23%)	51 (38%)	43 (35%)
HL	26 (15%)	25 (19%)	20 (16%)
HL+P	13 (8%)	26 (19%)	23 (19%)
Obese			
<i>Full sample</i>	130 (77%)	78 (58%)	75 (61%)
HL	58 (34%)	41 (30%)	41 (33%)
HL+P	72 (43%)	37 (27%)	34 (28%)

¹ Weight status calculated by comparing subject BMI against age- and gender-specific BMI cut points (11)

Interpretation of findings

The absence of a significant effect of group on the primary study outcomes of BMI and WC z-score at the 12 month time point may be due to i) absence of additional value in parenting skills ii) limitations of parenting component iii) inadequate long term support, iv) inadequate power, v) lack of difference in group interventions, vi) inappropriate primary outcomes. These possibilities are outlined in more detail below.

Absence of additional value in parenting skills

The absence of long term group differences in primary outcomes may suggest that the addition of parenting skills training provides no additional value to a parent-led, family focussed healthy lifestyle intervention for the management of overweight in 5-9 year old children. This conclusion is not supported by clinical practice guidelines (as presented in Section 1.2.4) which recognise the importance of incorporating parental involvement and behaviour modification in child weight management strategies. Furthermore, surveys conducted with Australian dietitians in 1997 and 2002 highlighted that many do not feel well prepared to manage overweight and obese clients, particularly children (286) (287). Lack of training in specialist counselling skills was cited as a limitation to their capacity to work in the area. Acquiring expertise in parenting skills may provide dietitians with a useful age-appropriate child behaviour modification approach to address family lifestyle and weight-related behaviours (288).

In summary, the disappearance of the significant group difference observed at the six month time point ($p=0.005$) suggests that perhaps the *type* and *duration* of the parenting support provided in the HL+P arm were inappropriate/inadequate to produce a sustained and significant group difference. Although the group difference at the 12 month time point was not significant, it did approach significance at the $p=0.09$ level.

Limitations of parenting component

Parenting skills training was added to a parent-led, family focussed healthy lifestyle intervention to determine if the promotion of parental self-

management and competence resulted in greater reductions in BMI z-score of children, and improved maintenance. The study extended the work of Golan by recognising parents as the exclusive agents of change (163) and examined further the type of support required to up-skill parents in this role.

The Triple P[®] was selected as the parenting skills training component of the RCT as it is an extensively evaluated parenting intervention that has displayed good generalisability and provides standardised training internationally (241). The program offers five levels of intervention on a tiered continuum of increasing strength and narrowing reach. Level 4 Triple P[®] was selected as the parenting skills component of the RCT as it can be delivered in a group format. This level of intervention is described as an intensive training “typically targets parents of children with more severe behaviour problems, such as aggressive or oppositional defiant behaviour or conduct problems” (289). The PEACH study parents were not enrolling in the program to address such issues and were seeking assistance with *behaviour modification* rather than *behaviour management*, suggesting that the strategies promoted by Triple P[®] were not perceived as relevant by them. At present, the creators of Triple P[®] are developing a “Lifestyle Triple P[®]” which will specifically target health and weight behaviours. This work is currently unpublished, however its contribution towards the effective management of childhood overweight warrants further investigation. Growing evidence exists in the adult literature that education and supportive interventions directed at helping individuals to change risky behaviours or become better self managers improve outcomes across a range of chronic illnesses (290).

Inadequate long term support

It was hypothesised that the HL+P group would be better equipped to maintain healthy lifestyle and anthropometric changes as a result of receiving parenting skills training that promoted self-management. Perhaps these self-management skills should have been strengthened through the provision of on-going support, for example via booster sessions to more closely mirror a true chronic disease self-management model. This potential limitation of the

study is discussed in more detail in Section 6.4 and the need to recognise overweight as a chronic disease is discussed further in Section 6.7.2.

Inadequate power

Despite achieving the calculated sample size, it is possible that the study was underpowered to show statistically significant differences between the intervention arms. This is discussed in more detail in Section 6.4.

Lack of difference in group intervention

It is possible that the group interventions were too similar, resulting in changes that were not statistically significantly different from each other. As discussed in Section 2.2, the key differences between the intervention arms were the presence of the parenting skills training program and following from this, the style in which the nutrition component sessions were delivered. It is possible that these theoretical differences were not powerful enough to produce differences in lifestyle behaviours between the groups, thus failing to illicit statistically different anthropometric outcomes.

This possibility was eliminated following the audit of session tape-recordings confirming that the differences between group sessions were upheld between facilitators and across both sites. It may be that the content and concepts regarding family food management included in the healthy lifestyle sessions in both study arms were too similar to parenting concepts promoted in the HL+P arm, thereby reducing the differences between the groups. The inclusion of generic family-focussed healthy lifestyle tips in Healthy Lifestyle Session 5 (Table 2.1) may have triggered parents in both groups to alter the way they managed their child's lifestyle behaviours. Specifically the concept of "division of responsibility" introduced by Satter (in which the parent is responsible for *what* food is provided, and the child is responsible for deciding *how much* is eaten (291)) may have contaminated the intervention arms. This is an approach that she applies generally for children from birth to adolescence and specifically for weight management (292). Inclusion of this concept may have significantly altered the way in which parents in both

intervention arms managed their children's eating behaviours and overridden the differences produced by the parenting component alone.

Inappropriate primary outcomes

An alternative explanation for the lack of group difference at the 12 month time point may be that the primary outcomes selected to determine effectiveness were not sensitive enough/appropriate to detect the differences occurring as a result of the intervention. The need to consider primary outcomes that are meaningful to both participants and researchers is discussed in Section 6.7.3.

Gender effect

At baseline, boys displayed significantly greater age and gender specific measures of weight, BMI and WC than girls (Table 3.3). This difference supports previous findings that mothers do not recognise overweight in their sons as readily as they do in their daughters (284) (293).

Over the duration of the study, boys recorded greater reductions in primary outcome indicators than girls during both the intervention (BMI and WC z-scores: $p < 0.001$ and 0.004 respectively) and maintenance periods (WC z-score only, $p = 0.04$) (Table 3.5). This was a phenomenon also displayed by the pilot study sample (191), identified during the time of the delivery of the PEACH intervention. In anticipation of this, randomisation was stratified by gender and all children were pre-pubertal at time of enrolment (which was maintained as verified by re-assessment at subsequent measurement sessions). This ensured equivalent energy and nutrient requirements and an assumed absence of gender-specific differences in growth and development. The study however was not powered to account for different gender responses to the intervention.

The gender differences in BMI and WC z-score responses may be explained by the greater degree of overweight at baseline observed in boys compared with girls. An equal amount of absolute weight loss will translate to a greater reduction in z-score for individuals with baseline values lying at the more

extreme end of the distribution tail (204). Children displaying greater baseline levels of overweight have been shown to display greater mean BMI z-score reductions following treatment in previous studies (294) (295).

The effect of gender on the effectiveness of child weight management interventions has been examined by only four other studies (296) (215, 295) (294), and the PEACH pilot study (191). Sabin et al (294) set out specifically to determine which factors are associated with successful outcome in a child weight management program. The UK service was hospital based and patients were aged from 2.2-17.8 years (mean age=11.7y, n=137). They found that, although not significant, boys responded better than girls. This was also observed in a study by Epstein et al in the US which compared responses of boys and girls randomised to a diet and behaviour intervention with varying physical activity recommendations (age range=8-12y, n=56) (296). Boys also responded better than girls in the PEACH pilot study (191). In contrast, a Finnish group (215) found that girls responded better than boys to their six month group intervention (mean age=8y, n=70) and a German group (295) found no effect of gender when analysing the results from their one year outpatient intervention (mean age=10.5y, n=170).

The varying gender effects may represent physiological, environmental or societal differences. Given the wide range of countries and settings that previous studies reporting these differences have been implemented in, the gender differences may also be related to contextual factors affecting intervention delivery. Furthermore, recent Australian data show that truncal adiposity is increasing more rapidly for girls than for boys (297), which may suggest that forces external to the intervention make it more difficult for girls to reduce adiposity than boys. In conclusion, as gender effects are being observed more commonly in child weight management programs, consideration must be given to tailoring intervention design, delivery and analysis to address these different responses.

Relevance to the literature

Comparison of the intervention and maintenance effects of the PEACH study on these anthropometric outcomes is limited to previously reported studies that report comparable outcomes over similar time periods. As outlined in Section 1.2, the average follow up period for studies investigating the effective management of childhood overweight is considerably less than the 12 months reported by PEACH and many only report findings at the intervention end-point. Furthermore, as outlined in Section 1.3.3.2, only one identified paper investigating the role of and support required for parents managing their children's overweight reported BMI z-score as an outcome indicator (190). A broader search of studies examining the effectiveness of interventions to treat childhood overweight as defined by change in BMI z-score to at least 12 months post-baseline, but without a specific focus on the role of parental support/involvement identified a further 5 interventions (170) (171) (191) (215) (295). The design and results of these studies are summarised in Table 3.8.

Table 3.8: Key design characteristics and findings of interventions for the management of overweight in pre-pubertal children using BMI z-score to measure effectiveness to at least 12 months post-baseline

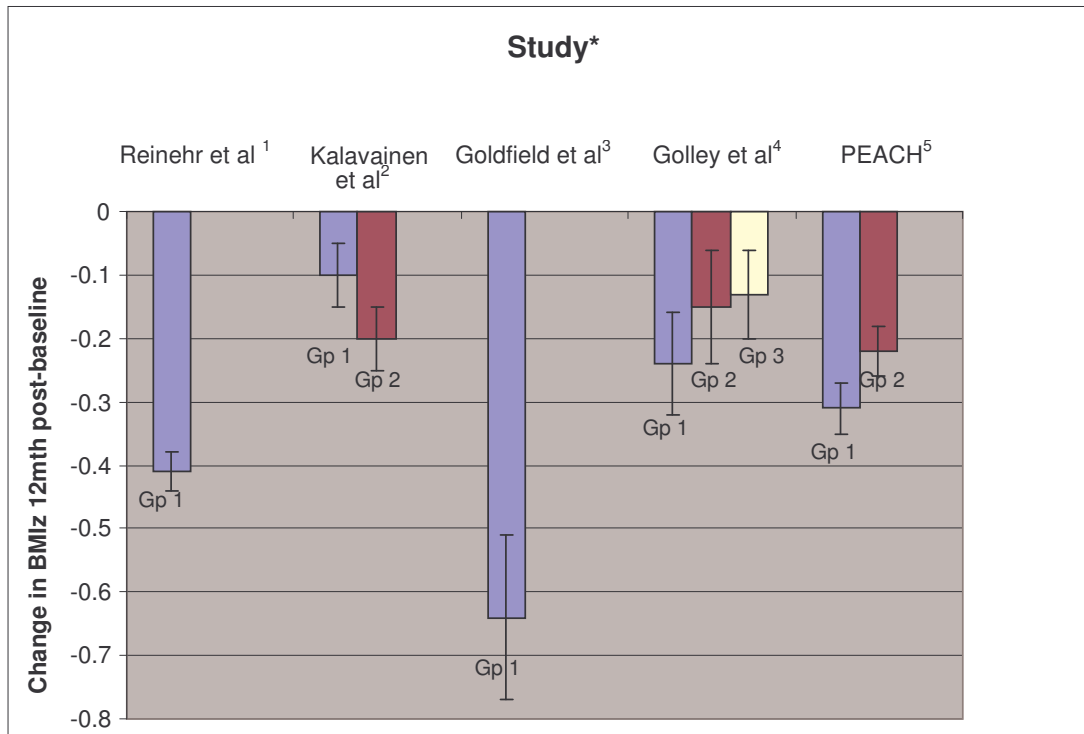
Publication details	Sample and study design	z-score reference population	Intervention duration	Follow up duration	Key findings
Reinehr et al 2007 (295)	n=170 clinic patients n at 12mth=151 Age=6-16y (mean=10.5) Clinic cohort, screened for motivation (non-RCT, no sample size calculated) - follow-up of patients attending the "Obeldicks" program, based on exercise, nutrition education and behaviour therapy ITT analysis conducted	German reference population	12mth	4yr post-baseline	Mean baseline BMIz (95% CI): 2.54 (2.46-2.62) Mean reduction in BMIz (95% CI) at 12 months post-baseline: 0.41 (0.37-0.46) Significant reduction (p<0.001) in BMIz in first 3mth of intervention only Gender effect examined - none detected Baseline BMIz associated with change in BMIz at 4y – more obese children had greater reduction
Kalavainen et al 2007 (215)	n=70 n at 12mth: "routine"=35, "group"=34 Age=7-9y (mean=8.1) RCT, randomised to either: - routine counselling: 2 individual appointments for the child (+/- parent(s)) - family-based group treatment: 15 sessions for children and parents ITT analysis conducted Sample size calculated	UK reference population	6mth	12mth post-baseline	Mean baseline BMIz (sd): - routine program: 2.5 (0.6) - group program: 2.6 (0.6) Mean reduction in BMIz (sd) at 12mth post-baseline: - routine program: -0.1 (0.3) - group program: -0.2 (0.3) Group program more effective Gender effect examined - girls performed better than boys
Golley et al 2007 (191)	n=111 n at 12mth: P+DA=31, P=29, WLC=31 Age=6-9y (mean=8.2) RCT, randomised to either: 1. Parent skills training + diet and activity information (P+DA) 2. Parent skills training only (P) 3. Wait list control (WLC)	UK reference population	6mth	12mth post-baseline	Mean baseline BMIz (sd) / WCz (sd): - P+DA: 2.74 (0.58) / 3.27 (0.73) - P: 2.76 (0.58) / 3.20 (0.67) - WLC: 2.75 (0.39) / 3.14 (0.56) Mean reduction in BMIz (sd)/WCz (sd) at 12mth post-baseline: - P+DA: -0.24 (0.43) / -0.31 (0.53) - P: -0.15 (0.47) / -0.17 (0.50) - WLC: -0.13 (0.40) / -0.02 (0.58)

	ITT analysis conducted Sample size calculated				All groups showed significant reduction in BMIz over 12mth, and WCz fell significantly in the P+DA and P groups Gender effect examined – boys performed better than girls
Golan et al 2006 (190)	n=32 n at 18mth: PO=31, P+C=29, WLC=31 Age=6-11y (mean~8.7) RCT Randomised to either: 1. Parent Only group (PO) 2. Parent + Child group (P+C) Sample size calculated ITT analysis conducted	UK reference population	6mth	12 mth post-intervention end ie. 18mth post-baseline	Mean baseline BMIz (sd not given): - PO: 2.00 - P+C: 2.10 Mean reduction in BMIz (sd not given) at 18mth post-baseline: - PO: -0.40 - P+C: -0.10 PO group showed significantly greater reduction in BMIz than P+C at 18mth post-baseline Gender effect examined – none detected
Epstein et al 2000 (170)	n=67 Mean age=10.3y Randomised to either: 1. Problem solving to parent and child 2. Problem solving taught to child 3. Standard family based treatment Did not conduct ITT analysis	US reference population	6mth	24mth post-baseline	Mean baseline BMIz (sd): 2.7 (0.9) Change scores not published Addition of problem-solving did not add to treatment effectiveness of standard family-based treatment Gender effect not examined
Goldfield et al 2001 (171)	n=31 n at 12mth=24 Age=8-12y (mean~10) RCT to determine relative cost-effectiveness of 2 different modes of treatment delivery: - Mixed treatment: group and one-to-one - Group treatment only Did not conduct ITT analysis	US reference population	~6mth	12mth post-baseline	Mean baseline BMIz (sd): - mixed treatment: 3.0 (1.2) - group treatment: 2.7 (0.6) Mean reduction in BMIz (sd) at 12mth post-baseline (for full sample only): -0.64 (0.63) Significant reduction in BMIz seen for both groups but no difference between them Gender effect not examined

The studies included in this table all provide follow-up data to at least 12 months post-baseline. The findings from Golan et al report follow-up data at 12 months post-intervention end, which is actually 18 month post-baseline (190). Unfortunately, the authors did not report the standard deviation scores of the change in BMI z-score over this time period, so cannot be graphed for comparison to the PEACH study. In addition, Epstein et al only reported mean values at six and 12 months post-baseline, not the change scores. A group in the UK is examining effects of a nine week child centred weight management intervention at 6 months post-baseline (298). The study is including BMI z-score and WC z-score as outcome variables, however due to the limited follow-up period of this study it was not included in this table for comparison to the PEACH findings.

The characteristics of the PEACH study sample (mean age: 8.2 ± 1.2 y, mean baseline BMI z-score: 2.7 ± 0.6) are comparable to those of the six studies presented in Table 3.8 (age ranges: 6-16y, baseline BMI z-score ranges: 2.54-2.75). However, the PEACH study has a larger sample size than any of the RCTs and was based on a power calculation (reported only for two of the other studies (191) (215)). Meta-analysis is not possible due to the variations in study design, interventions, samples and outcomes reported. Instead, values from two of the studies presented in Table 3.8 (191) (215) which permitted calculation of mean change in BMI z-score (\pm SE) over 12 months (dependent on reporting of group sample sizes and standard deviations) have been graphed to illustrate where the findings from the PEACH study “fit” in the literature (Figure 3.4). The findings from the studies by Reinehr et al (295) and Goldfield et al (171) are also illustrated, however these papers reported 12 month changes in BMI z-score for full samples only due to their design (non-RCT) and method of reporting, respectively. In addition, the Reinehr sample was admitted to the clinic only if they “proved their motivation” to be involved, potentially explaining the pronounced treatment effect (295).

Figure 3.4: Size effects of interventions testing the effectiveness of parenting support for the management of overweight in childhood



* Refer to Table 3.8 for full study details

¹ Reinehr et al (295): non-RCT – subjects attended 12m out-patient intervention based on physical activity, nutrition education and behaviour therapy

² Kalavainen et al (215): RCT - Gp 1=Routine group, Gp 2=Family-based group treatment

³ Goldfield et al (171): RCT - provided mean change for full sample only

⁴ Golley et al (191): RCT - Gp 1=parenting + healthy lifestyle, Gp 2=parenting only, Gp 3: WLC

⁵ PEACH RCT: Gp 1=healthy lifestyle + parenting, Gp 2=healthy lifestyle only

Figure 3.4 illustrates the effect size the PEACH had on subjects' BMI z-scores. This suggests the findings surpassed those achieved in the pilot study and also appear greater than those reported for both groups in the Finnish study. The content and approach in Group 1 of the PEACH study and its pilot by Golley et al (191) were quite similar.

3.3 Secondary study outcome findings

The findings for each of the secondary outcomes of health-related quality of life, body size dissatisfaction and linear growth are now detailed. A discussion of these findings is then presented.

3.3.1 Health-related quality of life

As outlined in Section 2.3.3.1, health-related quality of life (HRQoL) as measured by the PedsQL™4.0 was included as an outcome of the PEACH RCT. This outcome gives an indication of the potential benefits of involvement with respect to broader health outcomes and also to assure that no harm is associated with the intervention. The study was not designed or powered to bring about significant group differences in HRQoL, therefore the majority of the results discuss the changes over time of the whole sample, according to child and parent reports of HRQoL. This method of analysis is also appropriate since both groups participated in a weight management program.

The residuals from the ANCOVA models were normally distributed, so parametric statistics were used to describe the baseline characteristics of the sample. At baseline, parents consistently reported their child's HRQoL to be lower than their child perceived it to be on all three scales of the PedsQL™4.0 ($p \leq 0.01$ for all three measures). Table 3.9 presents these differences and also those identified for children and parents according to gender, site and child weight status

There were no differences in child or parent reports according to group at baseline indicating the randomisation to have been effective.

Table 3.9: Baseline mean±SD health-related quality of life scores¹ for children (C) and parents (P) enrolled in the PEACH study

	Psychosocial Child	Psychosocial Parent	p ²	Physical Child	Physical Parent	p ²	Total Child	Total Parent	p ²
Full sample	(n=167) 70.4±17.5	(n=160) 66.92±15.10	0.01	77.7±16.1	70.2±17.9	<0.001	73.0±15.7	68.1±14.5	<0.001
Group	(HL=83,HL+P=84)	(HL=77,HL+P=83)							
HL	68.6±19.0	68.2±17.1	C: 0.28	77.0±16.6	71.9±19.0	C: 0.44	71.6±16.7	69.4±16.4	C: 0.29
HL+P	71.6±15.7	65.7±12.9	P: 0.31	78.9±15.2	68.6±16.6	P: 0.24	74.1±14.4	66.7±12.4	P: 0.24
Site	(A=85, S=82)	(A=82, S=78)							
Adelaide (A)	72.9±16.5	67.6±14.5	C: 0.04	80.0±16.9	72.5±18.0	C: 0.10	75.3±15.4	69.3±14.4	C: 0.04
Sydney (S)	67.2±17.9	66.2±15.7	P: 0.57	76.0±14.5	67.7±17.5	P: 0.09	70.3±15.4	66.7±14.5	P: 0.27
Gender	(m=75, f=92)	(m=72, f=88)							
Males (m)	66.2±17.8	65.8±14.1	C: 0.009	75.0±17.8	70.5±18.2	C: 0.30	69.3±16.4	67.4±13.6	C: 0.007
Females (f)	73.3±16.4	67.8±15.8	P: 0.41	80.5±13.7	69.9±17.6	P: 0.82	75.8±14.3	68.5±15.2	P: 0.65
Weight Status³	(ow=39, o=128)	(ow=38, o=122)							
Overweight (ow)	74.5±14.7	72.3±13.8	C: 0.07	81.0±12.8	76.0±15.5	C: 0.12	76.7±13.2	73.6±13.1	C:0.08
Obese (ob)	68.8±18.0	65.2±15.1	P: 0.01	77.1±16.6	68.4±18.2	P: 0.02	71.7±16.1	66.3±14.5	P:0.006
Group	(HL=83,HL+P=84)	(HL=77,HL+P=83)							
HL	68.6±19.0	68.2±17.1	C: 0.28	77.0±16.6	71.9±19.0	C: 0.44	71.6±16.7	69.4±16.4	C: 0.29
HL+P	71.6±15.7	65.7±12.9	P: 0.31	78.9±15.2	68.6±16.6	P: 0.24	74.1±14.4	66.7±12.4	P: 0.24

¹ Health-related quality of life scores measured using the Peds QL 4.0 (251) where a higher score indicates a better quality of life

² Independent t-test, significant differences presented in bold font (p<0.05)

³ Weight status calculated for a) children: by comparing subjects BMI against age- and gender-specific BMI cut offs (11) and b) parents: by using the WHO definition for overweight (25≤BMI≤30) and obesity (BMI≥30) (4)

3.3.1.1 Child-report

Baseline health-related quality of life

An examination of only the child-reported HRQoL measures at baseline revealed significant differences between gender and site for the psychosocial sub-score ($p=0.009$ and 0.04 respectively) and the total score ($p=0.007$ and 0.04 respectively) (see Table 3.9). Males scored significantly lower than females on these scores, and the Sydney sample scored significantly lower than the Adelaide sample. There were no significant differences between obese and overweight children for any of the measures of HRQoL.

There were no baseline differences between groups for any of the child-reported measures of HRQoL, indicating that the randomisation successfully controlled for these baseline differences.

Health-related quality of life between groups and over time

Examination of the three measures of HRQoL at the six and 12 month time points via a refined ANCOVA model adjusted for site, group, gender, weight status, age, baseline HRQoL measure and various interactions between these did not reveal any group differences. This indicates that children from either group did not differ significantly in their self-reported HRQoL at any of the time points.

As a full sample, there were no significant changes in child reported HRQoL from 0-6mth ($n=133$), however significant improvements were observed for the psychosocial sub-score and the total score over the 0-12 month time interval (paired t-test, $p=0.01$ and 0.02 respectively) ($n=116$) (Table 3.10).

There were no significant differences in any of the baseline HRQoL scores between the full study sample ($n=167$) and the reduced samples at six and 12 months.

3.3.1.2 Parent-report

Baseline health-related quality of life

An examination of the parent-reported HRQoL measures at baseline revealed significant differences only between the parents of overweight and obese children (Table 3.9). Parents of obese children scored significantly lower than overweight children for all measures of HRQoL ($p \leq 0.02$ for all). Unlike the child-reported measures, there were no significant differences between child gender or study site for parent-reported measures of HRQoL.

There were no baseline differences between groups for any of the parent-reported measures of HRQoL, indicating that the randomisation successfully controlled for these baseline differences.

Health-related quality of life between groups and over time

Examination of the three measures of HRQoL at the six and 12 month time points via a refined ANCOVA model adjusted for site, group, gender, weight status, age, baseline HRQoL measure and various interactions between these did not reveal any group differences. This indicates that parents from either group did not differ significantly in the degree to which they reported their children's HRQoL at the six and 12 month time points.

As a full sample, there were significant increases in all parent scores of child HRQoL from 0-6mth ($n=125$) (paired t-test, $p < 0.01$ for all three) and from 0-12months ($n=110$) (paired t-test, $p < 0.001$ for all three) (Table 3.10). As a result, by the six month time point the significant differences observed between all the child and parent baseline scores remained only for the physical ($p=0.001$) and total ($p=0.05$) sub-scores. By 12 months, there were no significant differences between the parent and child scores.

There were no significant differences in any of the baseline HRQoL scores between the full study sample ($n=160$) and the reduced samples at the six and 12 month time points.

Table 3.10: Mean±SD health-related quality of life scores¹ for children (C) and their parents (P) enrolled in the PEACH study at baseline, six months and 12 months (Intention to treat analysis)

	0mth (C: n=167, P: n=160)	6mth* (C: n=133, P: n=128)	p ²	12mth* (C: n=116, P: n=110)	p ³
Child self report					
Total score	73.0±15.7	74.5±15.4	0.57	76.1±15.9	0.02
Psychosocial Summary	70.4±17.5	72.0±17.1	0.62	74.2±17.5	0.01
Physical Summary	77.7±16.1	79.1±15.3	0.59	79.8±15.7	0.17
<hr/>					
Parent-proxy report					
Total score	68.1±14.5	72.0±13.8	<0.001	75.0±12.7	<0.001
Psychosocial Summary	66.9±15.1	71.0±14.1	<0.001	73.4±13.2	<0.001
Physical Summary	70.2±17.9	74.0±16.7	0.003	78.0±16.0	<0.001

¹ Health-related quality of life scores measured using the Peds QL 4.0 (251) where a higher score indicates a better quality of life

² Paired t-test 0-6mth. No significant difference between baseline HRQoL scores of full study sample and model sample at 6mth (n=132).

³ Paired t-test 0-12mth. No significant difference between baseline HRQoL scores of full study sample and model sample at 12mth (n=116).

* 6mth = intervention end, 12mth = 6mth after intervention end without further program contact

3.3.1.3 Comparison of the Health Related Quality of Life of the PEACH sample to an Australian community sample

The HRQoL of PEACH subjects was also compared to a community sample of Australian children (32). Overweight and obese PEACH subjects and healthy weight children at six and 12 months were compared with the equivalent weight status children in the Williams et al sample (Table 3.11).

There were no significant differences between PEACH study children and community children of the same weight status for any of the domains of HRQoL at any of the time points (Table 3.11). However, when parent proxy reports from the PEACH study were compared with those from the community a number of significant differences were noted.

At baseline, parents of overweight and obese PEACH children scored significantly lower than their counterparts in the community sample on most of the HRQoL domains (Table 3.11). At six months, this difference existed only for the total score and by 12 months, there were no significant differences between the PEACH sample and the community sample (Table 3.11 and Figure 3.5). This finding is discussed further in the Section 3.3.4.

Table 3.11: Mean±SD health-related quality of life scores¹ for children and their parents enrolled in the PEACH study according to child weight status² at baseline, six months and 12 months compared with an Australian community sample of 9-12 year olds³

	Child self-report				Parent-proxy report			
	n	Psychosocial	Physical	Total	n	Psychosocial	Physical	Total
Australian community sample³								
Full sample	1 456				1 456			
HWR	1 099	77.7±14.1	85.7±12.4	80.5±12.2	1 099	77.6±14.5	87.8±14.3	83.1±12.5
Overweight	294	77.0±14.0	83.5±13.0	79.3±12.8	294	76.1±14.4	82.6±17.2	80.8±13.6
Obese	63	72.1±14.1	77.5±17.9	74.0±14.2	63	73.9±15.3	76.3±17.6	75.0±14.5
PEACH sample								
Baseline	167				160			
HWR ⁴	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Overweight	39	74.5±14.7	81.0±12.8	76.7±13.2	38	72.3±13.8	76.0±15.5	73.6±13.1
Obese	128	68.8±18.0	77.1±16.6	71.7±16.1	122	65.2±15.1	68.4±18.2	66.3±14.5
6mth*	132				125			
HWR ⁴	6	85.3±10.6	88.5±8.5	86.5±8.0	6	70.6±10.8	80.7±16.0	74.1±11.8
Overweight	50	73.8±14.9	81.9±13.1	76.6±13.2	49	72.9±12.6	81.9±13.1	74.1±11.8
Obese	76	69.7±18.4	76.6±16.6	72.1±16.7	70	69.0±15.0	71.5±18.2	69.9±15.0
12mth*	116				110			
HWR ⁴	5	84.7±6.6	90.0±6.4	86.5±6.1	5	73.0±4.3	88.8±8.4	78.5±5.2
Overweight	38	74.4±17.7	81.2±14.2	76.8±15.6	39	77.7±12.7	81.9±13.4	79.2±11.2
Obese	73	73.3±17.8	78.4±16.6	75.0±16.4	66	70.9±13.3	74.9±17.0	72.3±13.3

¹Health-related quality of life scores measured using the Peds QL 4.0 (251)

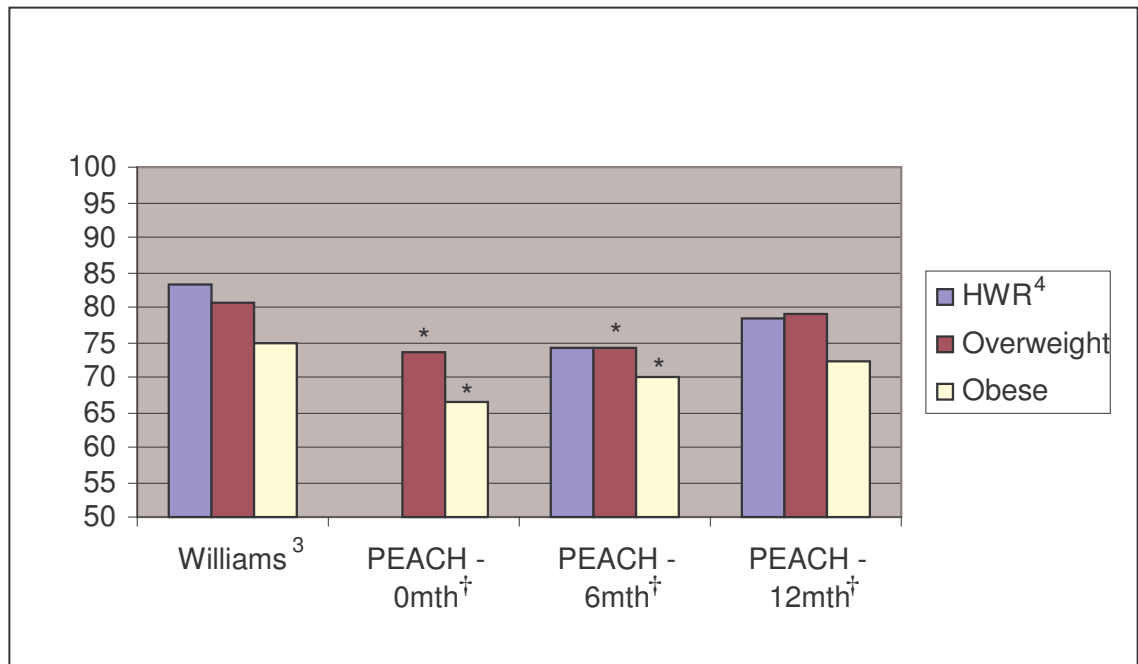
²Weight status calculated by comparing subjects BMI against age- and gender-specific BMI cut-off (11)

³n=1 456, HWR⁴: n=1099, overweight: n=294, obese: n=63 (32)

⁴HWR = healthy weight range *6mth = intervention end, 12mth = 6mth after intervention end without further program contact

PEACH values in bold indicate significant difference from Williams sample (independent t-test, p<0.005)

Figure 3.5: Parent-proxy health-related quality of life total score¹ for children enrolled in the PEACH study according to child weight status² at baseline, six months and 12 months relative to parent-proxy scores from an Australian community sample of 9-12 year olds³



¹ Health-related quality of life scores measured using the Peds QL 4.0 (251)

² Weight status calculated by comparing subjects BMI against age- and gender-specific BMI cut-off (11)

³ n=1 456 (HWR⁴: n=1099, overweight: n=294, obese: n=63) (32)

⁴ HWR = healthy weight range

[†] Baseline n=160 (overweight=38, obese=122), 6mth n=125 (HWR=6, overweight=49, obese=70), 12mth n=110 (HWR=5, overweight=39, obese=66)

* Significant difference between the PEACH sample and the community sample: independent t-test, p<0.005

3.3.2 Body size dissatisfaction

As described in Section 2.3.3.1, dissatisfaction with body shape was measured pre- and post-intervention using the Children's Body Image Scale to determine if involvement in the study affected this parameter (40). Body dissatisfaction is defined as the discrepancy between the child's perceived and desired body figure and ranges from zero (ie. satisfied with body size) to +/-6 (magnitude that child wishes to be heavier (+) or thinner (-)).

This secondary outcome was included for the purposes of ensuring no harm was associated with participation in the intervention. Therefore, this data was analysed for the full study sample, as group differences were not anticipated. Table 3.12 presents the body size desired by PEACH children at the three time points and also reports the direction of change in body size satisfaction from 0-6mth and 0-12mth.

Table 3.12: Body size dissatisfaction¹ at baseline, six and 12 months and change from baseline reported by children enrolled in the PEACH study

	0mth (n, %)	6mth* (n, %)	12mth* (n, %)
Desired body shape (n)			
Thinner	149 (90)	114 (89)	102 (91)
<i>Underweight</i>	89 (54)	45 (35)	35 (31)
Remain the same	11 (7)	13 (10)	9 (8)
Heavier	5 (3)	1 (1)	1 (1)
<hr/>			
Direction of change in degree of body size dissatisfaction from baseline (n)			
Unchanged	n/a	29 (23)	32 (29)
Improved	n/a	71 (57)	61 (56)
Worsened	n/a	25 (20)	16 (15)

¹ Body size dissatisfaction measured using the Children's Body Image Scale (40)

*6mth = intervention end, 12mth = 6mth after intervention end without further program contact

The percentage of children wishing to be thinner remained constant over the duration of the study. The percentage of children indicating a desired body shape that represented an underweight child decreased over time from around 50% at baseline to around 30% by 12 months. In addition, the majority of children expressed a stable or improved degree of body dissatisfaction from baseline to both the six (80%) and 12 month (85%) time points. There were no group or gender differences for any of these measures.

3.3.3 Linear Growth

As for the other secondary outcomes, linear growth was included as an outcome to monitor potential unintended harm associated with participating in the PEACH study (Section 2.3.3.1). Linear growth was assessed by examining change in height z-scores based on a UK reference population (14). There were no significant group differences at any of the three time points (independent t-test, $p > 0.20$ for all).

Examination of change in height between baseline and six months and baseline and 12 months for the full sample revealed a significant increase over both time intervals (paired t-test, $p < 0.01$ for both) (Table 3.13). Conversely, height z-score significantly decreased over both of these time periods (paired t-test, $p = 0.005$ and $p < 0.001$ respectively) (Table 3.13).

Table 3.13: Mean height and height z-score¹±SD for children enrolled in the PEACH study at baseline, six and 12 months

	0mth (n=169)	6mth* (n=136)	p ²	12mth* (n=123)	p ³
Height (cm)	135.03±9.17	137.87±9.60	<0.001	140.54±9.53	<0.001
Ht z-score¹	1.22±0.95	1.13±1.00	0.005	1.09±0.97	<0.001

¹z-scores calculated by comparing subjects against UK reference population (14)

*6mth = intervention end, 12mth = 6mth after intervention end without further program contact

² Paired t-test 0-6mth

³ Paired t-test 0-12mth

3.3.4 Discussion of secondary outcome findings

Health-related quality of life

As explained in Section 2.5.1, the PEACH RCT was not designed to bring about significant group differences in psychosocial outcomes, so it was not surprising that none were observed for the indicator of health-related quality of life (HRQoL). The results did however suggest that the study did not negatively impact upon the HRQoL of subjects and in fact resulted in increased levels of parent proxy-reports to a level similar to that of an Australian community sample.

At baseline, parents reported significantly lower levels of HRQoL for their children than the children reported for themselves ($p \leq 0.01$). Similar discrepancies between parent and child reported HRQoL have been reported elsewhere (33, 34) (299), highlighting the differences in perception of quality of life indicators and emphasising the importance of measuring both child-reported and parent-proxy HRQoL. Parents are the initiators of health care service utilisation, and only once *they* experience concern regarding their children's health is professional assistance likely to be sought. Voluntary enrolment into a family-focused child weight management program therefore requires parental recognition and concern regarding childhood overweight. Monitoring of this via measures of HRQoL prior to and during involvement in such a program is valuable to improve program targeting and the evaluation of effectiveness.

At baseline, parents of obese children reported significantly lower levels of HRQoL for their children than did parents of overweight children ($p \leq 0.02$ for all scores). This was in contrast to child self-reports which showed no such difference according to weight status. Again, this is a trend which has been reported in other studies (33, 34) (32). HRQoL has been shown to decrease with increasing degree of overweight (32) and this was seen in the parent-proxy reports. The absence of such a relationship for the child self-reports may be due to the children's ages, highlighting the importance of long term follow-up to monitor such co-morbidities that may track with age.

In addition, the PedsQL™4.0 - a generic HRQoL tool - may not have been sensitive enough to detect changes in quality of life indicators specifically affecting overweight children. Disease-specific HRQoL tools are frequently more responsive to change after treatment than generic instruments (300), as has been shown in adult studies (301). At the time of study development, HRQoL tools specific to overweight were not available, however one such tool has been recently validated for use with adolescent children (11-19 years old) (300). Use of such a tool in future child weight management studies may be more responsive and detect significantly more and greater change in both child and parent reports.

Children's self-reported HRQoL scores did not increase over the first six months of the study, however psychosocial and total scores did increase significantly over the time period between baseline and 12 months ($p=0.01$ and $p=0.02$ respectively). Gender did not have a significant effect on change in child reported HRQoL over time, however there were gender differences observed at baseline for the psychosocial sub-score and the total score ($p=0.009$ and $p=0.007$ respectively), signalling that boys reported significantly lower levels than girls. This was unexpected and may reflect the "internal", non-observable aspects of quality of life that boys "bottle up" which may go undetected by both health professionals and parents, but which is felt directly by the child. This finding may also be worth taking into consideration during the development of condition-specific HRQoL tools.

Parent-proxy reports increased significantly from baseline to six months and baseline to 12 months for all three domains ($p<0.01$ and $p<0.001$ respectively). This effectively reduced the significant baseline differences observed between child and parent reports so that by the 12 month time point they were no longer significantly different from each other. Similar improvements have been reported elsewhere following involvement in an in-patient program (302) and participation in a family therapy program (303).

The improvements in parental perceived child HRQoL by the 12 month time point also brought them in line with reports from an Australian community

sample against which they were significantly lower at baseline (32). This community sample was an ideal comparison group as Williams et al also used the IOTF cut points to define overweight and obesity and employed the PedsQL™4.0 to measure HRQoL. Parent-proxy reports of child HRQoL from the PEACH RCT and the community sample were compared against each other according to child weight status. The significantly lower scores reported by PEACH parents further illustrated the lack of awareness and concern regarding the negative health consequences of childhood overweight expressed by the community in general. Parents reporting lower levels of HRQoL for their child/ren are more likely to enrol in a family-focused child weight management program such as PEACH.

There were no group differences observed for improvement in HRQoL following involvement in the PEACH study, indicating that both groups experienced equal improvement in HRQoL. The absence of a control group prevents comparison to no intervention, however findings from a pilot study reported that a wait list control group did not show improvements (304). This finding reinforces the need to measure broad health outcomes following treatment for child weight management.

In summary, the inclusion of a HRQoL tool that measures both child and parent indicators in the evaluation of a family-focused child weight management intervention is particularly important. As illustrated by the findings from PEACH RCT and other studies, discrepancies between sources is common and participation in a family-focussed child weight management affects reports differently. The appropriateness of using an obesity-specific HRQoL tool developed for use with adolescent children is worth exploring. However until the validity of using such a tool within a pre-pubertal sample is determined, use of a generic tool such as the PedsQL™4.0 is recommended.

Body size dissatisfaction

As discussed in Section 1.1.3.2b, body size dissatisfaction in childhood can track into adulthood, leading to permanent disturbances in body image (42). For this reason, levels of body size dissatisfaction experienced by PEACH children were monitored.

The percentage of children wishing to be thinner remained constant over the duration of the study, demonstrating that participation in the PEACH study was not associated with an increase in body size dissatisfaction. Despite remaining constant, dissatisfaction with body shape/desire to be thinner was reported by around 90% of subjects over the 12 month period. This is consistent with other published findings of overweight nine year olds (39) and higher than an Australian community sample of 7-12 year olds (40). Encouragingly, the number of children desiring to be underweight decreased over time, suggesting that a healthier/more realistic perception of ideal body shape developed over time.

The minority of children who expressed a desire to be heavier tended to be younger (mean age at baseline and ages of children at 6 and 12mth = 6.3 ± 1.54 , 6.5 and 6.4 years respectively). This may indicate a lack of understanding of the question due to age which is not surprising given that younger children often required repeated explanation regarding the completion of this task.

A small number of other studies have examined the effect of treatment for childhood overweight on children's body size dissatisfaction (305) (306), as did the pilot study to PEACH (304). In comparison to PEACH and its pilot study, the earlier studies were conducted with older samples (8-12 years and 7-17 years) and treatment was directed at the child. One study reported a stabilisation in degree of body size dissatisfaction 4.6 years after commencing treatment (305), whilst the other showed an increase in dissatisfaction 24 months after baseline (306). The PEACH pilot study showed similar findings to PEACH.

Stabilisation of the degree of body size dissatisfaction and a reduction in the percentage of children desiring to be underweight are very favourable findings. This may have resulted from i) removal of the focus of management to target the parents as the primary agents of change, ii) inclusion of the whole family in the management of childhood overweight and iii) utilisation of a “healthy lifestyle” rather than a prescriptive diet and exercise regimen.

The findings from this study support the inclusion of measures and strategies to assess and promote healthy body image in the management of childhood overweight. This could be achieved by assessment and monitoring of body image at initiation and for the duration of treatment, inclusion of discussion around body image, media stereotypes, the promotion of self esteem and positive body image throughout treatment and avoidance of a weight focus of treatment.

Linear Growth

Previous studies involving significant energy restriction have reported growth retardation raising concern that weight management interventions in childhood may impede the attainment of maximum height potential (174) (307). In order to address such concerns, the PEACH study monitored the height of children at each measurement time point (Section 2.4.6.6).

For the full sample, average height increased over time ($p < 0.001$ for both 0-6 and 0-12mth) and although still above average at all time points, height z-score decreased significantly over time (0-6mth: $p = 0.005$, 0-12mth: $p < 0.001$). Therefore, mean absolute height continued to increase and remained above average at each time point. These findings observed in the PEACH study (which encouraged a healthy eating pattern consistent with national guidelines rather than a prescriptive or VLCD diet) more likely represent a normalisation of the accelerated growth velocity that is commonly observed amongst overweight child populations (308).

The observed reduction in linear growth however must be interpreted with caution. Due to the unavailability of Australian data, the z-scores were

calculated using a UK reference population (14). It is possible that the pattern observed may reflect differences in growth patterns between these two populations.

In summary, involvement in a family-focussed, healthy lifestyle intervention for the management of childhood overweight may assist in normalising the accelerated linear growth without reducing height to below average levels. Monitoring of linear growth within such a treatment program is recommended and concerns regarding growth retardation should not prevent intervention.

3.4 Conclusion: Outcome evaluation

Examination of primary and secondary outcomes revealed the benefits of participation in a parent-led, family focussed healthy lifestyle intervention for the management of childhood overweight extend beyond just weight to also positively impact upon the psychosocial health of children.

The primary outcome findings demonstrated that indicators of adiposity were significantly reduced in both groups and this reduction was maintained six months after the completion of a six month family focussed child weight management program without further program contact. The reduction in BMI z-score was significantly different between groups at the end of the intervention period, indicating the beneficial short-term effect of the addition of a parenting skills training program to a parent-led, family focussed healthy lifestyle intervention. However, the disappearance of this group difference at the 12 month time point indicated that these beneficial effects were not maintained beyond the intervention period, necessitating the acceptance of the null hypothesis (Section 1.4.3). Despite the improvements in both groups' degree of adiposity, the persistence of a high prevalence of child overweight suggests there may be a need for continued support following intervention end. The design of the PEACH study is unfortunately unable to explore this.

Maintenance of child reported HRQoL and levels of body size dissatisfaction indicate that participation in the intervention did not negatively impact on children's psychosocial health. In fact, a reduction in the proportion of children desiring an underweight body image illustrates improvement in body image. Improvements in child HRQoL as perceived by parents is a further positive outcome of the study. As the study was powered only to detect group differences in indicators of child adiposity, changes to indicators of psychosocial health are limited to the study sample as a whole. Children's linear growth was not impeded by involvement in the study. In fact, it is quite likely that participation assisted to reduce the acetated growth velocity of these overweight children.

Inclusion of such broad health outcomes to evaluate the effectiveness of the PEACH study assisted to address the limitations in intervention evaluation as described in Section 1.3. In chapter 4, examination of the changes to lifestyle and parenting behaviours occurring as a result of participation in the PEACH study provide an even broader evaluation of its effectiveness.

Chapter Four: Impact and Process Evaluation

This chapter reports the impact and process evaluation findings of the PEACH study. Impact evaluation examines the immediate effects of an intervention, or the indicators that contribute to the achievement of the overall program goal (Section 1.3.2.2). For the case of a parent-led, family-focussed child weight management intervention, appropriate impact evaluation indicators include measures of children's diet and activity behaviours, parenting practices and parental weight status. Process evaluation measures the degree to which an intervention is carried out as intended and its appropriateness for participants (Section 1.3.2.3). For the purposes of this thesis, the PEACH study processes were evaluated according to:

- i) attendance at sessions – used as a proxy for adherence to protocol or “program dosage”,
- ii) participant satisfaction – assessed via anonymous questionnaires and
- iii) maintenance of program integrity – assessed via auditing of group sessions by an assessor external to the study.

The details of the procedures undertaken to conduct impact and process evaluation of the PEACH study are outlined in Sections 2.4.6.7-12.

As discussed in Section 1.3.2.4, inclusion of impact and process indicators in study evaluation design is highly desirable to enable thorough understanding of the mechanisms leading to program success or failure, quality assurance and to ensure increased repeatability and generalisability of interventions. Despite this, evaluation of study impact and process represents a gap in the literature regarding child weight management interventions, as discussed in Section 3 of the literature review. Therefore, this study was designed to include broad evaluation indicators so as to provide high quality and thorough evidence regarding the effectiveness of the intervention to address these needs.

The aim of this section is to report on the findings of the impact and process evaluation results and position them in the existing literature.

4.1 Impact Evaluation

The behaviours examined for the purposes of study impact evaluation were those identified as contributing to the changes in study outcome. Given that the aim of the study was to evaluate the effectiveness of the addition of a parenting skills training program to a parent-led, family-focussed healthy lifestyle program for the management of overweight in 5-9 year old children, the impact evaluation indicators were:

- i) child health behaviours (dietary and activity behaviours),
- ii) parenting skills and
- iii) change in parental anthropometry.

The following three sub-sections present and discuss the study findings according to each parameter.

4.1.1 Child health behaviours

4.1.1.1 Dietary behaviours

The Children's Dietary Questionnaire (Section 2.3.3.2) was used to assess changes in PEACH children's dietary behaviours from which five subscales were generated: fruit and vegetables, sweetened beverages, fat in dairy products, high fat/high sugar foods and food behaviours. Subscale scores were not calculated if responses to items within the subscale were missing, so response rates to subscales varied at each time point. Although not all variables were normally distributed, all assumptions for ANCOVA were met, eliminating the need for the use of non-parametric statistics.

As for the primary outcomes, univariate ANCOVA was conducted with all subjects with measures at six and 12 months post baseline to determine differences at these time points corresponding to the intervention and maintenance effects, respectively. Baseline means of these reduced model samples were compared against the full sample to determine the presence of significant differences. To examine change over time between baseline and six- and 12-month time points, paired t-tests were also conducted.

Table 4.1 outlines the questionnaire items constituting each subscale; the score range and recommended score; and the response rate, mean±sd scores and score ranges at each time point of the PEACH study. Differences at baseline according to site, gender, weight status and group were examined. The only significant differences seen at baseline were for the sweetened beverages subscale score between site ($p=0.01$: Sydney greater than Adelaide) and gender ($p=0.02$: males greater than females) and the fat in dairy subscale, again for site ($p=0.01$: Sydney greater than Adelaide) (data not shown). There were no significant differences for any of the baseline subscale scores according to weight status or group.

Preliminary analysis and model building to conduct ANCOVA was undertaken for each of the subscale scores at six and 12 months. There were no significant differences in baseline subscale scores between the full study sample ($n=169$) and the reduced model samples (see Tables for n values). The ANCOVA models always included the main effects of group, site, gender and the baseline value of the subscale under examination. Some models also included interactions between some of these factors. No significant differences were found for any of the subscale scores at either time point for any of these factors, including group, so the full sample was examined for change over time.

Examination of the change in subscale scores from baseline to six months for the sample as a whole showed statistically significant improvements for all subscale scores except the fat in dairy subscale (paired t-test: $p<0.001$ for all, except fat in dairy subscale score ($p=0.10$)) (Table 4.1). Analysis by group found similar results for each of the groups (data not shown).

Change in subscale scores from baseline to 12 months for the sample as a whole again reflected significant differences from baseline for all subscale scores except fat from dairy (paired t-test, $p<0.001$ for all, $p=0.17$ for fat in dairy subscale score) (Table 4.1). Analysis by group found similar results to those observed at 6 months (data not shown).

In conclusion, examination of group differences by ANCOVA found no significant differences *between* groups at either the six or 12 month time points. The full sample showed improvements in four of the five Children's Dietary Questionnaire subscales from baseline at six months which were maintained to 12 months to a level better than that observed at baseline. These improvements over time were also experienced to a similar degree by each of the groups.

Table 4.1: The Children's Dietary Questionnaire subscales, possible and recommended scores and actual scores (mean±SD) and response ranges for PEACH children at baseline, 6 and 12 months

Subscale	Possible score (recommended ^f)	0mth (n)	6mth (n)	p ⁱ	12mth (n)	p ^j
Fruit and vegetables^{ag}	0-28 (≥18)	(165) 8.7±3.7 (0.0-19.9)	(132) 10.4±3.7 (0.6-21.6)	<0.001	(112) 10.8±4.0 (0.4-21.7)	<0.001
Sweetened beverages^{bh}	0-6 (≤1)	(164) 1.6±1.3 (0.0-5.9)	(130) 1.0±0.9 (0.0-4.3)	<0.001	(112) 0.9±0.9 (0.0-3.9)	<0.001
Fat from dairy^{ch}	0-15 (0)	(146) 1.6±1.3 (0.0-5.0)	(112) 1.1±1.2 (0.0-6.0)	0.10	(96) 1.2±1.4 (0.0-10.0)	0.17
Non-core foods^{dh}	0-10.3 (≤2)	(156) 2.3±1.2 (0.0-6.1)	(128) 1.5±1.0 (0.1-5.3)	<0.001	(113) 1.5±0.9 (0.1-4.9)	<0.001
Food behaviours^{eg}	2-54 (≥30)	(164) 23.1±5.1 (12.0-37.0)	(131) 27.0±4.6 (15.0-36.0)	<0.001	(107) 25.7±4.6 (14.0-36.0)	<0.001

^a**Fruit and vegetables subscale:** for fruit and vegetables: (the number of different types consumed in the last week divided by 7) + (the number of different types consumed yesterday) + (the number of occasions consumed yesterday)

^b**Sweetened beverages subscale:** (the frequency of fruit juice/fruit drink on the previous day) + (the frequency of soft drink/non-diet cordial in the previous week divided by 7)

^c**Fat in dairy products subscale:** (the frequency of full fat milk on the previous day) + (the frequency of full fat yoghurt/custard on the previous day) + (the frequency of full fat cheese on the previous day)

^d**High fat/high sugar foods subscale:** the frequency in the previous week of each of 12 items divided by 7

^e**Food behaviours subscale:** [the frequency per week that: (child eats breakfast) + (family eats evening meal at dinner table) + (child eats meal/snack in front of TV*)] + [the frequency that: (child is allowed to help self to food*) + (parents asks if child is hungry before providing food) + (child expresses hunger within 1 hour of eating meal/snack*) (on 5pt likert scale: Never – Always)] + (the time taken to eat compared with others (3pt likert scale: Ahead - Behind)) + (the size of main meal* (5pt likert scale: Half a bread and butter plate – Dinner plate)) + (frequency of second helpings* (on 5pt likert scale: Never – Always)) (*=reversed scored)

^fBased on the Australian Dietary Guidelines for Children and Adolescents (243) and the Australian Guide to Healthy Eating (242)

^gA higher score indicates a healthier intake

^hA lower score indicates a healthier intake

ⁱpaired t-test, 0-6mth

^jpaired t-test, 0-12mth

4.1.1.2 Activity behaviours

As described in Section 2.3.3.2, the Activity Inventory (Appendix Five) was used to assess changes in PEACH children's active and sedentary behaviours from which two subscales were generated: "total activity per day" and "total small screen time usage per day" (used as a proxy for sedentary behaviour). Subscale scores were not calculated if responses to items within the subscale were missing, so response rates to subscales varied at each time point. All the assumptions for ANCOVA were met, so parametric statistics were used and reported.

As for the primary outcomes, univariate ANCOVA was conducted with all subjects with measures at six and 12 months post baseline to determine differences at these time points. Baseline means of these reduced model samples were compared against the full sample to determine the presence of significant differences. To examine change over time between baseline and six- and 12-months, paired t-tests were also conducted.

Active time per day

There were no significant differences at baseline according to site, gender, weight status or group. The baseline values of the reduced samples of the six and 12 month ANCOVA models (n=130 and 113 respectively) were not significantly different from the full sample (p=0.21 and p=0.10 respectively).

The refined six month ANCOVA model included the main effects of group, site, gender, baseline age and baseline daily activity level. Of these, only baseline activity level displayed a significant effect (as expected). There were no differences in activity levels according to group at the six month time point.

The 12 month model residuals were not normally distributed, requiring log transformation of this variable. This resulted in a much improved QQ plot and a refined model which displayed significant differences by site (p<0.001), age at baseline (p=0.025) and for the interaction between group and gender

($p=0.04$). The findings indicated that at the 12 month time point and irrespective of group allocation, the Sydney site subjects reported higher levels of activity per day (156 vs 97 min/d) and that for every one year increase in age at baseline, daily activity levels dropped by 1.13 minutes. Closer examination of the significant interaction between group and gender revealed a significant difference only for females between groups ($p=0.04$). On average, girls in the HL group reported 1.44min/day more activity than girls in the HL+P group.

Changes in reported activity levels over time were also explored for the full sample and by group. Non-significant increases were observed for the full sample between baseline and six months and baseline and 12 months (Table 4.2). Change in time spent being active over time was also examined by group and showed similar findings to the full sample (data not shown).

Table 4.2: Mean±SD minutes per day engaged in active play¹ and small screen use¹ for PEACH study children at baseline, six and 12 months

Activity Score	0mth	6mth	p^a	12mth	p^b
Total time spent being active (min/d)	(n=167) 129.4±88.7	(n=130) 131.9±80.8	0.77	(n=113) 150.6±111.7	0.14
Total small screen time (min/d)	(n=168) 141.8±80.4	(n=130) 114.0±71.7	<0.001	(n=115) 110.1±62.4	<0.001

¹ assessed according to duration only (not intensity) using a non-validated, parent report Activity Inventory (Appendix Five)

^a paired t-test, 0-6 mth

^b paired t-test, 0-12mth

Small screen time per day

Significant differences were observed at baseline according to site ($p=0.02$, Sydney greater), gender ($p<0.01$, boys greater) and weight status ($p<0.01$, obese greater). There were no significant differences according to group however, indicating the randomisation process to be effective. The baseline values of the reduced model samples for the six and 12 month small screen

time scores were not significantly different from the full sample ($p=0.40$ and $p=0.10$ respectively).

The assumptions of the ANCOVA model were not clearly met at either time point due to the presence of outliers at both (different individual at both time points). The effect of removing these extreme values on the QQ plots for both time points was examined. Removal of the outlier at the six month time point did not alter the outcome of the refined model for the full sample, which showed a significant difference according to the three-way interaction between site, group and gender ($p=0.03$). Closer examination of this interaction revealed significant differences between males only (Adelaide site: HL greater than HL+P, $p=0.03$) (Sydney site: HL+P greater than HL, $p=0.05$).

Removal of the outlier at the 12 month time point *did* alter the conclusion of the original refined model. The original refined model displayed a significant effects of site ($p=0.04$) and the interaction between site and gender ($p=0.03$), however when the case with the extreme value was removed these factors were no longer significant. The effect of the outlier suggests that the results are influenced by this extreme value and are therefore inconclusive.

The effect of group was not significant at either time point, however when the full sample was examined for change over time, significant reductions in small screen usage were observed between baseline and six months ($p<0.001$) and baseline and 12 month time point ($p<0.001$) (Table 4.2). These findings were similar for each group (data not shown)

4.1.1.3 Discussion of child health behaviours

Dietary behaviours

There were no group differences observed for indicators of dietary behaviours, so the sample was analysed as a whole. The full sample demonstrated significant improvements compared to baseline at both the six and 12 month time points.

The key nutrition messages promoted by the PEACH program are outlined in Table 2.4 and it appears that the changes observed in the five CDQ sub-scores are reflective of these recommendations (Table 4.1). The food behaviour subscale score was the only one that appeared to relapse from 6-12 months despite the 12 month value remaining significantly improved from baseline (Table 4.1). This sub-score was made up of nine items, many of which reflected the enforcement of rules and limits concerning meal time behaviours, and thus relied heavily on parental involvement. This finding may reflect a decrease in family/parental involvement secondary to no further program contact over this time period. It also illustrates the difficulty in engaging the family unit, or at least parents in the management of an issue that is often perceived as one belonging to individuals rather than the social unit in which they exist.

In further recognition of the environmental and contextual influences on the development of overweight in childhood, it may be useful in future to include an “obesogenic environment” sub-score in the CDQ. A similar type of score has been included in the Family Eating and Activity Habits Questionnaire developed by Golan et al which contains eight items relating to the presence and visibility of specific “non-core” foods in the home and boundaries of child’s autonomy in buying or accessing these foods (227). These represent obesity-promoting structures and behaviours present in the family environment that could be modified through involvement in a family-focussed child weight management program such as PEACH and are thus important to monitor.

During the course of the PEACH study, the reliability and validity of the CDQ was established amongst a group of 5-16 year olds (n=92) (239). The authors concluded that the five CDQ subscales have acceptable test-retest reliability but variable internal consistency (alpha coefficients ranged from 0.34 – 0.73). The majority of the sub-scales in the tool demonstrated an acceptable level of relative validity at the group level. The sub-scales relating to fruits and vegetables, non-core foods and food behaviours scored well (slopes of mean bias not significantly different from zero), however the fat

from dairy products and sweetened beverages sub-scales did not perform as well (slopes of mean bias significantly different to zero). Therefore, the accuracy of these two subscales is questionable and interpretation of the results should be undertaken with caution.

As highlighted in Section 1.3.3.3, only a limited number of high quality studies have undertaken qualitative assessment of dietary intake and/or eating behaviours to provide indicators of impact evaluation (Table 1.12). The inclusion of a validated tool to measure diet intake qualitatively that is reflective of national and best practice recommendations and that includes recommended sub-scale scores is a great strength of the PEACH study. The tool is not as time intensive, costly and burdensome as more traditional methods of dietary collection methods such as the diet history, food diary or food recall (309). Furthermore, the CDQ allows comparison to food-based, healthy eating recommendations, unlike the more traditional methods which generally focus on energy and nutrient intake (310). This enables researchers and practitioners to meaningfully translate findings to healthy eating guidelines.

Application of such recommended scores to the PEACH study sample showed that the number of children achieving these targets did increase during the six month intervention period, however a pattern of recidivism was apparent at the 12 month time point (Table 4.3). This finding highlights the need for long-term management of what is a chronic condition, which is discussed further in Chapter Six.

Table 4.3: The number and percentage of children who achieved the recommended scores for each of the Children’s Dietary Questionnaire subscales at baseline, 6 and 12 months of the PEACH study

Subscale	Possible score (recommended ^f)	0mth (n)	6mth (n)	12mth (n)
Fruit and vegetables^{ag}	0-28 (≥18)	(165) 2 (1%)	(132) 5 (4%)	(112) 3 (31%)
Sweetened beverages^{bh}	0-6 (≤1)	(164) 64 (39%)	(130) 77 (59%)	(112) 74 (66%)
Fat from dairy^{ch}	0-15 (0)	(146) 30 (21%)	(112) 40 (36%)	(96) 31 (33%)
Non-core foods^{dh}	0-10.3 (≤2)	(156) 65 (42%)	(128) 97 (76%)	(113) 88 (78%)
Food behaviours^{eg}	2-54 (≥30)	(164) 16 (10%)	(131) 40 (31%)	(107) 25 (23%)

^a**Fruit and vegetables subscale:** for fruit and vegetables: (the number of different types consumed in the last week divided by 7) + (the number of different types consumed yesterday) + (the number of occasions consumed yesterday)

^b**Sweetened beverages subscale:** (the frequency of fruit juice/fruit drink on the previous day) + (the frequency of soft drink/non-diet cordial in the previous week divided by 7)

^c**Fat in dairy products subscale:** (the frequency of full fat milk on the previous day) + (the frequency of full fat yoghurt/custard on the previous day) + (the frequency of full fat cheese on the previous day)

^d**High fat/high sugar foods subscale:** the frequency in the previous week of each of 12 items divided by 7

^e**Food behaviours subscale:** [the frequency per week that: (child eats breakfast) + (family eats evening meal at dinner table) + (child eats meal/snack in front of TV*)] + [the frequency that: (child is allowed to help self to food*) + (parents asks if child is hungry before providing food) + (child expresses hunger within 1 hour of eating meal/snack*) (on 5pt likert scale: Never – Always)] + (the time taken to eat compared with others (3pt likert scale: Ahead - Behind)) + (the size of main meal* (5pt likert scale: Half a bread and butter plate – Dinner plate)) + (frequency of second helpings* (on 5pt likert scale: Never – Always)) (*=reversed scored)

^fBased on the Australian Dietary Guidelines for Children and Adolescents (243) and the Australian Guide to Healthy Eating (242)

^gA higher score indicates a healthier intake

^hA lower score indicates a healthier intake

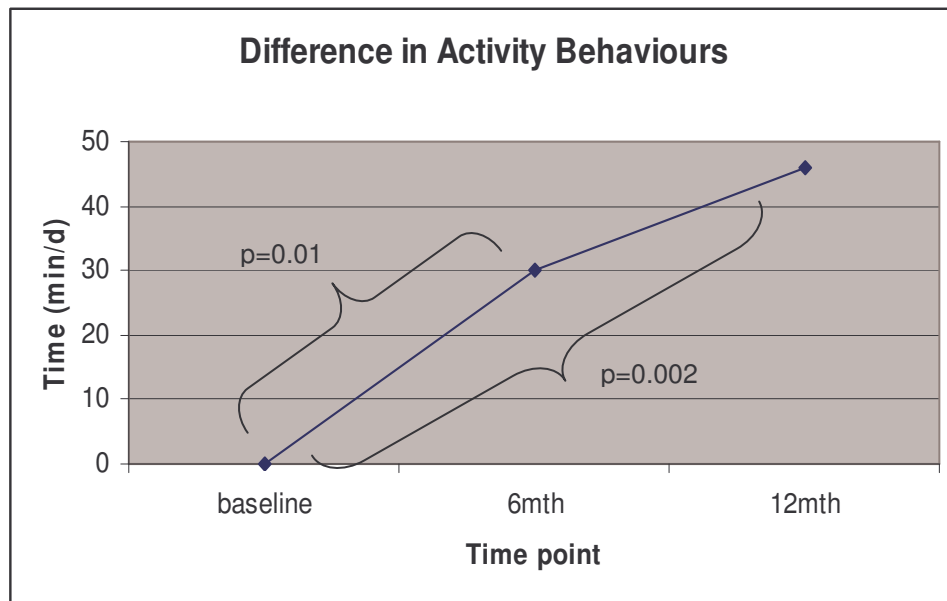
Activity behaviours

Examination of the findings from the Activity Inventory showed that as baseline age increased activity levels at the 12 month time point significantly decreased by 1.13min/day. This finding is indicative of the trend seen elsewhere of a general age-related decline in physical activity in general and specifically decreased levels of participation in sport with increasing age, especially amongst girls (105).

The key activity messages promoted by the PEACH program are outlined in Table 2.4, and it appears that that the changes observed in the two activity scores are reflective of these recommendations. Table 4.2 demonstrates that at baseline, children were on average spending more time per day viewing a small screen than being active. This relationship reversed at six months and continued to improve at 12 months. In order to further investigate the pattern of change in activity behaviours a new variable was created that represented the change from baseline at six months and 12 months for each of the activity behaviours (active time per day and small screen time per day). The difference between each of these new variables at each time point was then calculated to represent the combined effect of decreased small screen time and increased active time per day. These “difference in activity behaviour” scores were then analysed for change over time from baseline. As these values were computed to be relative to baseline, the difference between them at baseline was zero. The difference in activity behaviours increased significantly from baseline at the six and 12 month time points ($p=0.01$ and $p=0.002$ respectively) (Figure 4.1).

The combination of a non-significant increase in physical activity and a significant decrease in small screen usage resulted in an overall large discrepancy between these two values at 12 months – of a much greater magnitude and in the opposite direction to that seen at baseline.

Figure 4.1: Difference between time spent in physical activity and small screen usage (min/day) relative to the difference observed at baseline for PEACH children at baseline, six and 12 months



The significant reduction in small screen time largely represented a reduction in television viewing. Television viewing is a risk factor for overweight, primarily by the displacement of physical activity (311) and its direct relationship to energy intake (312). This relationship may be reinforced by effects of television food marketing to children. Research has found that the majority of foods advertised to Australian children are high in fat, salt, and/or sugar and low in fibre (313) and American research tells us that children who watch more television are more likely to have a preference for advertised foods (314). Television viewing is associated with increased consumption of high energy beverages and decreased fruit and vegetable consumption (315), and is thought to be more influential than families in setting children's food preferences (110). Therefore, the significant reduction of small screen viewing observed in PEACH study children is especially encouraging.

The non-significance of change in time spent in physical activity may be a result of the difficulty of defining and quantifying such activity. In order to simplify and standardise this task, parents were asked to indicate from a list the amount of time their child spent in different activities during the week. Despite this effort, activities may be classified differently between parents

and parental knowledge of the time spent in activities may be limited. Conversely, small screen viewing is more readily observed by the parent and is easier to define, recall and record, perhaps resulting in a more accurate and significant difference over time.

Regardless of these limitations, the findings reinforce the need to monitor both physical activity and sedentary behaviours in interventions promoting healthy lifestyle change. Decreased sedentary activity is not simply the equivalent to increased physical activity but also increases the risk of overweight by influencing food choice and eating patterns as discussed earlier. They are two discrete outcomes and need to be independently collected and analysed.

4.1.2 Parenting skills

Parenting skills are an appropriate indicator by which to evaluate the impact the addition of a parenting skills training program has on the effectiveness of a parent-led, family-focussed child weight management program such as PEACH. As described in Section 2.3.3.2, two validated tools were used to measure different aspects of parenting – the Parenting Sense of Competence Scale and the Alabama Parenting Questionnaire. All the assumptions for ANCOVA were met for models of these variables, so parametric statistics were used and reported.

As for the primary outcomes, univariate ANCOVA was conducted with all subjects with measures at six and 12 months post baseline to determine differences at these time points. Baseline means of these reduced model samples were compared against the full sample to determine the presence of significant differences. To examine change over time between baseline and six- and 12-months, paired t-tests were also conducted. The findings from these analyses on both aspects of parenting are presented below, followed directly by a discussion of their interpretation.

4.1.2.1 Perceived sense of competence as a parent

As described in Section 2.3.3.2, the Parenting Sense of Competence Scale (254) was used to assess parents' views of their competence as parents by reporting a satisfaction factor, an efficacy factor and a total score (Appendix Six).

Randomisation checks according to site, gender, weight status and group found no significant differences according to these factors at baseline. There were no differences in baseline values for any of the subscales between the full study sample and the reduced samples used to model differences at six and 12 months (see Table 4.4 for n values).

Preliminary analysis and model building to conduct ANCOVA for each of the scores at 6 and 12 months resulted in models that always included the main effects of group, site, gender, age at baseline and the baseline value of the subscale under examination. Some models also included interactions between some of these factors. No significant differences were found for any of the subscale scores at either time point for any of these factors, including group.

Examination of the change in scores from baseline to six months and baseline to 12 months for the sample as a whole showed statistically significant improvements for all three scores ($p < 0.001$ for all) (Table 4.4). Analysis by group found similar results, with both groups demonstrating significant improvements between baseline and six months and baseline and 12 months for each of the three scores.

Table 4.4: The Parenting Sense of Competence Scale¹ subscale scores (mean±SD) for parents of PEACH children at baseline, 6 and 12 months

	0mth (n)	6mth (n)	p ^a	12mth (n)	p ^b
Satisfaction	(153) 36.28±6.87	(118) 38.92±6.04	<0.001	(89) 39.30±5.80	<0.001
Efficacy	(162) 28.28±5.82	(126) 29.41±5.51	<0.001	(111) 30.12±5.09	<0.001
Total	(149) 64.22±10.89	(115) 68.19±10.10	<0.001	(88) 69.27±9.10	<0.001

¹ see Appendix Six - an increase in score indicates a improvement in the measure

^a paired t-test, 0-6mth

^b paired t-test, 0-12mth

4.1.2.2 Constructs of parenting

As described in Section 2.3.3.2, the Alabama Parenting Questionnaire (APQ) (255) (Appendix Seven) was used to measure group differences and changes over time of five constructs of parenting as presented below (Table 4.5).

Baseline values for each of these constructs were analysed to examine differences according to site, gender, weight status and group. Significant differences were observed for the “corporal punishment” score according to site ($p=0.001$, Sydney higher) and gender ($p=0.03$, males higher) and for the “parental involvement with child” score according to weight status ($p=0.02$, obese children higher). These differences were successfully controlled for by the randomisation process as there were no significant differences according to group for any of the parenting construct scores at baseline.

Table 4.5: The Alabama Parenting Questionnaire¹ scores (mean±SD) for PEACH parents at baseline, 6 and 12 months

Score	0mth (n)	6mth (n)	p ^a	12mth (n)	p ^b
Parental involvement^c	(164) 39.36±4.16	(126) 39.56±4.36	0.06	(113) 40.16±4.56	0.06
Positive parenting^c	(167) 25.47±4.16	(127) 25.37±2.68	0.59	(113) 25.22±2.67	0.50
Poor monitoring/ supervision^d	(148) 12.63±2.81	(106) 12.89±3.10	0.83	(95) 11.97±2.00	0.005
Inconsistent discipline^d	(165) 15.49±3.54	(126) 14.17±3.36	<0.001	(112) 13.63±2.94	<0.001
Corporal punishment^d	(165) 5.08±1.61	(126) 4.46±1.58	<0.001	(112) 4.14±1.33	<0.001

¹ see Appendix Seven

^a paired t-test, 0-6mth

^b paired t-test, 0-12mth

^c an increase in score indicates a improvement in the measure

^d a decrease in score indicates a improvement in the measure

Parental involvement with child

This score included statements regarding parental involvement in activities, games, homework tasks, and communicating with their child. Improvement is indicated by an increase over time.

The baseline values of the reduced model sample for the six month involvement scores of the APQ were significantly different from the full sample ($p=0.009$). Although the difference between the means of the two models was not great, its significance indicates that the six month model analysis could be biased for this parenting construct. In contrast, there were no significant differences between the baseline values of the 12 month model sample and the full sample ($p=0.80$).

The refined six and 12 month ANCOVA models included the main effects of group, site, gender, baseline age and baseline involvement score and the interaction between site and gender. Of these, only gender had a significant effect on outcome for both the six and 12 month models ($p=0.02$ and 0.005 respectively, parents of males scored higher).

Examination of change over time failed to identify any significant changes from baseline to six or 12 months for the full sample (Table 4.5) or either of the groups (data not shown).

Use of positive parenting

Increase in this score over time is desired and it reflected such things as providing rewards, compliments and praise for obedience.

A significant difference was observed between the baseline values for the six month model sample and the full sample for the “positive parenting” score ($p=0.04$). Such a difference was not evident for the reduced sample of the 12 month model ($p=0.44$).

At both six and 12 months, the refined ANCOVA models included only the main effects of site, group, gender, baseline age and baseline positive parenting score. At both time points there was a significant effect of gender (6mth: $p=0.03$, 12mth: $p=0.008$, parents of males scoring higher at both time points). The six month model also displayed a significant effect of site ($p=0.04$, Sydney parents scored higher) while the 12 month model showed a significant effect of age at baseline ($p=0.05$, score decreases by 0.34 per year of increase in child’s age).

Examination of change over time failed to identify any significant changes from baseline to six or 12 months for the full sample (Table 4.5) or either of the groups (data not shown).

Poor monitoring and supervision

Improvement in this score is indicated by a decrease over time. Therefore, statements were worded negatively and included such events as children being out late at night and parents being unaware of their location or company.

The baseline values of the reduced model samples for the six and 12 month “poor monitoring/supervision” score were not significantly different from the full model sample ($p=0.14$ and $p=0.50$ respectively). No significant main effects or interactions were identified in the ANCOVA models constructed at either the six or the 12 month time points.

Examination of change over time however identified a significant improvement from baseline to 12 months for the full sample ($p=0.005$) (Table 4.5). Exploration of change by group showed significant improvement over this time period also for the HL+P group ($p=0.03$), but not the HL group ($p=0.10$) (data not shown).

Inconsistent discipline

This score consisted of items regarding empty threats and unpredictable consequences, for which a reduction in score over time was desired.

The baseline values of the reduced model samples for the six and 12 month “inconsistent discipline” scores were not significantly different from the full model sample ($p=0.80$ and $p=0.54$ respectively).

Modelling at six and 12 months always included the main effects of site, group, gender, baseline age and value of the dependent variable; and for the 12 month model also the interactions between site and group; and site, group and gender. These models did not recognise any significant main effects or interactions.

Examination of change over time however identified a significant improvement from baseline to six months and baseline to 12 months for the full sample (paired t-test, $p<0.001$ for both) (Table 4.5). Exploration of change by group showed similarly significant improvements for both over this time (data not shown).

Corporal punishment

It was desirable for the corporal punishment score, which consisted of three items, to decrease over time.

The baseline values of the reduced model samples for the six and 12 month “corporal punishment” scores were not significantly different from the full model sample ($p=0.43$ and $p=0.26$ respectively).

The six month model identified a significant effect of the interaction between site and gender, and further examination showed that parents of males in Adelaide scored significantly higher than parents of males in Sydney ($p=0.02$). There were no significant effects identified in the 12 month model.

Examination of change over time identified a significant improvement from baseline to six months and baseline to 12 months for the full sample ($p<0.001$ for both) (Table 4.5). Exploration of change by group showed similarly significant improvements for both over this time period (data not shown).

4.1.2.3 Discussion of parenting skills

Measures of parenting satisfaction and efficacy improved over the duration of the study for both groups and no group differences were observed at any time point. This is an unexpected finding (given that one group did not receive any specific support regarding parenting skills), for which there are a number of possible explanations.

The Parenting Sense of Competence Scale was included in the PEACH study in line with its use in evaluating the Triple P[®]. This program typically targets parents of children with behavioural problems, who may typically be experiencing low levels of competence and feelings of dissatisfaction with parenting (316). This was not a feature of the PEACH study sample characteristics, demonstrated by high baseline values comparable to a normative sample of similarly aged children in Canada (256). Perhaps the

tool was not sensitive enough to detect changes in a sample representing relatively well managed children and competent parents. This possibility is further reinforced by the finding that a significantly greater number of parents in the HL+P than the HL group reported that the PEACH program assisted them to make changes to their parenting style/strategies in response to a process evaluation questionnaire designed specifically for the study ($p=0.04$).

Involvement, positive parenting, monitoring and consistency are key messages promoted via the Triple P[®] and are also four of the five constructs of parenting examined by the Alabama Parenting Questionnaire (APQ) (the fifth being corporal punishment). The tool has demonstrated good internal consistency in a mixed sample (aged 6-13 years) representing community volunteers ($n=36$) and clients of a behavioural disorders clinic ($n=124$) ($\alpha = 0.46 - 0.80$) (255). However, normative data is not available to provide a comparison for the PEACH study findings.

Analysis of findings via ANCOVA at the six and 12 month time points did not show any group differences. However, a number of other factors included in the modelling exerted significant effects, as summarised in Table 4.6. Gender exerted a significant effect at both time points for the “involvement” and “positive parenting” scores (Table 4.6). A possible interpretation of this finding is the gender differences relating to parental concern regarding children’s weight and eating habits. Literature shows that parents are more likely to identify overweight exhibited in daughters than sons (283) (317). The significantly lower scores for the “positive parenting” scales for girls than boys may be reflective of this concern and consequent restrictive or negative approaches to parenting.

Age also had a significant inverse effect on the “positive parenting” score at 12 months. The statements in the APQ relating to this score cover such practices as providing rewards, compliments and praise for obedience. These are common parenting practices used for young children and reduction in these practices with increasing child age may be due to parental unawareness of the benefit of their continued use. Anecdotally, many parents

in the study commented how they had unconsciously ceased using these practices as children aged, but were pleased with the positive effects they had on child behaviour and parent-child relationships once re-initiated.

Significant improvements over time for the full sample were seen only in scores for which a reduction in the targeted behaviour was desired (the “undesirable” constructs - “poor monitoring and supervision”, “inconsistent discipline” and “corporal punishment”). The finding of no change in the “desirable” parenting behaviours (“involvement” and “positive parenting” constructs) may reflect the fact that parents in the sample were already practicing such parenting skills and capacity for improvement was limited.

Generally, when significant improvements were observed over time for the full sample, they were experienced to the same degree by both groups. The exception is for the “monitoring” score between 0 and 12mth, for which only the HL+P group showed a significant improvement. This group difference may be reflective of the Triple P[®] principles that encouraged monitoring child behaviours via behaviour charts and diaries. These strategies were not discussed in the HL group.

In conclusion, the study was powered to detect group differences in change in BMI z-score over time, so may have had an inadequate sample size to detect such differences in indicators of parenting competence. Regardless, it is encouraging that the significant improvement observed for both groups during the intervention period was maintained during the following six months without further program contact. Future work may benefit from the inclusion of tools that measure aspects of parenting relating specifically to child weight management, such as i) parenting style – possible to define using the Parental Authority Questionnaire (233) which measures the parental authority prototypes of permissiveness, authoritarianism and authoritativeness as defined by Baumrind (232)), ii) child feeding practices – which could be measured using the Child Feeding Questionnaire (121), or iii) maternal dietary restraint – monitored via the restraint subscale of the Eating Inventory (318)).

Table 4.6: Summary of the differences seen in the five constructs of parenting as defined by the Alabama Parenting Questionnaire at baseline, six and 12 months reported by parents enrolled in the PEACH study

	6mth ANCOVA model	0-6mth paired t-test	12mth ANCOVA model	0-12mth paired t-test
Parental involvement with child	Significant gender effect (p=0.02: parents of males reported significantly higher scores than parents of females)	No significant change observed	Significant gender effect (p=0.005: parents of males reported significantly higher scores than parents of females)	No significant change observed
Use of positive parenting	Significant gender effect (p=0.03: parents of males reported significantly higher scores than parents of females) Significant site effect (p=0.04: Sydney parents reported significantly higher scores than Adelaide parents)	No significant change observed	Significant gender effect (p=0.008: parents of males report significantly higher scores than parents of females) Significant age effect (p=0.05: significant decrease in score with increasing age at baseline)	No significant change observed
Poor monitoring/supervision	No significant effects observed	No significant change observed	No significant effects observed	Significant improvement for full sample (p=0.005) and for HL+P only (p=0.03)
Inconsistent discipline	No significant effects observed	Significant improvement for full sample (p<0.001) and both groups (p<0.001)	No significant effects observed	Significant improvement for full sample (p<0.001) and both groups (p<0.001)
Corporal punishment	Significant site x gender effect (p=0.02: parents of Adelaide males scored significantly higher than parents of Sydney males)	Significant improvement for full sample (p<0.001) and both groups (p<0.001)	No significant effects observed	Significant improvement for full sample (p<0.001) and both groups (p<0.001)

4.1.3 Parental anthropometry

Parental anthropometry was monitored as an indicator for whole of family adoption of the healthy lifestyle principles/practices promoted by the PEACH study. As the program (both groups) targeted parents as the primary agents of change and promoted a whole of family approach, it is reasonable to expect this to be reflected by a change in parental anthropometric measures of BMI and waist circumference.

Parental BMI and waist circumference were collected at baseline from 96% and 95% of mothers and 59% and 52% of fathers, respectively. Table 4.7 highlights how this response rate declined over time and how self-reporting of anthropometric measures was much more common for fathers than mothers.

Table 4.7: Response rates (RR) for the collection of anthropometric data from parents at baseline, six and 12 months of the PEACH study: comparison to child response rates and demonstration of reliance on self-reporting

	0mth (RR, % self-reported) (169 children)	6mth (RR, % self-reported) (135 children)	12mth (RR, % self-reported) (123 children)
Mothers			
- BMI (kg/m ²)	162 (2.5)	117 (7.7)	106 (11.3)
- Waist circumference (cm)	160 (4.4)	111 (6.3)	103 (6.8)
Fathers			
- BMI (kg/m ²)	100 (40.8)	52 (43.3)	48 (44.2)
- Waist circumference (cm)	88 (43.2)	48 (33.3)	44 (34.1)

ANCOVA models were built for maternal and paternal BMI and WC at six and 12 months and always included the main effects of site, group and baseline BMI/WC. The only covariate that demonstrated any significant effect on the dependent variable was its baseline value. For both mothers and fathers, as baseline BMI/WC increased, so too did the outcome at six and 12 months.

Change in maternal and paternal BMI, WC and weight over time from baseline to six and 12 months was examined via paired t-testing (Table 4.8). There was a significant reduction in maternal WC from 0-6 months, however this was not maintained to the 12 month time point. Analysis of father's values showed a number of significant changes over time, however given the reduced sample size and heavy reliance placed on self-reporting, these need to be interpreted with care.

Table 4.8: Mean±SD weight, BMI and waist circumference of parents enrolled in the PEACH study at baseline, six and 12 months

	0mth	6mth	p ¹	12mth	p ²
Mothers (n)	162	117		106	
- Weight (kg)	81.77±20.12	80.81±20.40	0.95	81.28±20.00	0.54
- BMI (kg/m ²)	30.34±7.39	30.28±8.26	0.58	30.30±7.44	0.43
- WC* (cm)	93.36±16.57	91.46±15.57	0.05	92.10±15.02	0.06
Fathers (n)	100	52		48	
- Weight (kg)	96.83±20.41	95.51±16.26	0.03	100.27±22.91	0.98
- BMI (kg/m ²)	30.53±5.87	30.12±5.13	0.02	31.25±6.98	0.95
- WC* (cm)	105.99±17.10	102.49±13.67	0.001	105.89±14.84	0.002

¹ paired t-test, 0-6mth

² paired t-test, 0-12mth

*n value for waist circumference measures:

Mothers: baseline=160, 6mth=109, 12mth=102

Fathers: baseline=88, 6mth=48, 12mth=44

4.1.3.1 Discussion of parental anthropometry

Parental weight change may influence child weight change through the (parent-led) modification of the shared family environment (319) and was included as an indicator to gauge the adoption of healthy lifestyle behaviours by the whole family. The high rates of parental overweight and obesity at all time points of the study demonstrate that the majority of children come from “high risk” families – possibly due to both genetic and environmental factors. This is consistent with the literature that shows a trend for overweight children to have overweight parents (320) (76).

The collection of anthropometric data from parents was more difficult than for children, especially for fathers. Although 74% of families had both parents residing at home, fathers were less likely to attend measurement (and program) sessions. Therefore, there was a heavy reliance on self-reporting, of which accuracy is questionable. In addition, some parents refused to supply anthropometric data or have measurements taken by study staff. This may indicate reluctance by parents to acknowledge their own weight issues and a resistance to fully engage in the program and recognise it as a whole of family commitment.

The poor response rate and reliance on self-report introduce the possibilities of lack of power and bias and these limitations need to be kept in mind when interpreting results. A positive finding from these analyses is that mean anthropometric values for both mothers and fathers appeared to have remained constant over the duration of the study. This is suggestive of a resistance by parents to follow secular trends of increasing levels of adiposity over time. This is possibly a result of protection afforded by acquisition of knowledge and skills regarding healthy lifestyle choices provided by the PEACH study.

4.2 Process Evaluation

Process evaluation is conducted to ensure that an intervention is delivered as intended and is appropriate for its audience. The indicators selected to measure such outcomes of the PEACH study were:

- i) attendance rates,
- ii) participant satisfaction and
- iii) maintenance of program integrity between study groups.

These three aspects of process evaluation are reported in the next three subsections followed by a brief discussion.

4.2.1 Attendance

Parent attendance rates at both the HL and HL+P intervention sessions are presented in Table 4.9. The attendance rates for each group are presented for the full sample and also per site. Section 2.4.6.10 describes the rationale for splitting program attendance into three levels to represent different degrees of adherence to the study protocol.

Attendance to sessions was similar between groups for the full sample (chi-square, $p=0.54$). Four parents in the HL group and eight in the HL+P group attended 100% of sessions and five and three parents respectively attended no sessions over the six month intervention. Comparing attendance by site showed that parents at the Sydney site displayed a significantly higher rate of attendance (chi-square, $p=0.04$), due to the higher rate of attendance to the HL+P sessions than at the Adelaide site. Possible reasons for this significant difference are discussed later.

Table 4.9: Frequency of parent attendance to PEACH study intervention sessions by group (HL¹ or HL+P²) for the full study sample and by site

	Full study sample		Adelaide site sample			Sydney site sample		
	HL (n=84)	HL+P (n=85)	HL (n=44)	HL+P (n=42)	Full site (n=86)	HL (n=40)	HL+P (n=43)	Full site (n=83)
Rate of attendance³								
Good	38	37	19	13	32	19	24	43
Fair	33	39	16	22	38	17	17	34
Poor	13	9	9	7	16	4	2	6

¹ HL=Healthy lifestyle only intervention arm

² HL+P=Healthy lifestyle plus parenting intervention arm

³ Rate of attendance (rationale described in Section 2.4.6.10):

HL arm: Good= $\geq 9/12$ sessions, Fair=5-8/12 sessions, Poor= $\leq 4/12$ sessions

HL+P arm: Good= $\geq 12/16$ sessions, Fair=5-11/16 sessions, Poor= $\leq 4/12$ sessions

4.2.2 Satisfaction

All parents were asked to complete an anonymous satisfaction questionnaire at the end of the six month intervention (Appendix Nine). In addition, parents in the HL+P intervention arm were asked to complete a similar questionnaire at the conclusion of the Triple P[®] training (Appendix Eight). Table 4.10 presents the response rates to these questionnaires, the perceived quality of the service provided and the degree to which the program satisfied parents' expectations.

Service quality was rated medium-high by all parents and more than 95% of parents reported at least a medium level of satisfaction with the full program. There were no significant differences between sites for the Triple P[®] satisfaction questionnaire (chi-square, $p > 0.30$ for both quality and satisfaction ratings). Examination of satisfaction and quality ratings at the end of the six month intervention showed no significant differences between sites or groups (chi-square, $p > 0.50$ for both quality and satisfaction ratings according to site, and $p > 0.40$ for both quality and satisfaction ratings according to group).

Examination of responses to questionnaire items at the end of the six month intervention found that the most common of the 122 valid responses given for enrolling in the study were "to get assistance with lifestyle education" (45), "behaviour management" (23) and "weight management" (22). Only 14 parents reported seeking additional assistance outside the program to manage their child's weight, most commonly via their GP (6). Sixty parents suggested ways the program could be further improved, the most common being "more food and nutrition resources" (14), "more contact" (12) and "involving child" (10).

Table 4.10: Service quality and satisfaction ratings of the PEACH study intervention from parents a) at the completion of the four week Triple P[®] training¹ for the HL+P² intervention arm full sample and by site and b) at the completion of the six month intervention for the full study sample and by group

	Satisfaction at end of Triple P [®] training			Satisfaction at end of 6month intervention		
	Total HL+P ²	Adelaide site	Sydney site	Total study	HL+P ² arm	HL ³ arm
Response rate	49/85	24/42	25/43	131/169	65/85	66/84
Quality rating⁴:						
1-2 (low)	0	0	0	0	0	0
3-4 (medium)	3	1	2	8	4	4
5-7 (high)	44	22	22	123	61	62
No response	2	1	1	n/a	n/a	n/a
Satisfaction rating⁵:						
1-2 (low)	2	1	1	1	0	1
3-4 (medium)	13	7	6	11	6	5
5-7 (high)	24	16	18	119	59	60

¹ (240)

² HL+P=Healthy lifestyle plus parenting intervention arm

³ HL=Healthy lifestyle only intervention arm

⁴Quality rating: Quality as ranked on a 7-point likert scale where 1=poor and 7=excellent (Appendices Eight and Nine)

⁵Satisfaction rating: Satisfaction as ranked on a 7-point likert scale where 1=not at all and 7=extremely (Appendices Eight and Nine)

Parents were asked to indicate via yes/no tick boxes whether they felt the intervention assisted them to make changes to their parenting style/strategies and their child's eating and/or activity behaviours. One hundred and twenty one out of 123 parents reported that the PEACH program assisted them to make changes to their *child's eating and/or activity behaviours*. There were no group differences (HL: 58/60, HL+P: 63/63, $p=0.12$). In contrast, significantly more parents in the HL+P group than the HL group reported that the program assisted them to make changes to their *parenting style/strategies* (HL: 46/59, HL+P: 56/64, $p=0.04$).

Eighty four percent of the 121 parents who reported making changes to their *child's eating and/or activity behaviours* listed examples of these changes. The most commonly reported related to "improved intake" (19), "increased awareness" (18) and "improved home food supply" (12). Of the 102 parents who indicated they had made changes to their *parenting style/strategies*, 58 provided specific examples to illustrate the change. The most common examples related to "managing misbehaviour" (20) and "encouraging desirable behaviours" (10).

Parents were asked to indicate factors that prevented their attendance to sessions or application of program resources between sessions. One-hundred and five valid responses were received for reasons preventing attendance to sessions, the most common being "family commitments" (34) and "work commitments" (32). In addition, "lack of time" (64) and "family commitments" (12) were the most common of the 89 reasons given for not using program resources between sessions.

Ninety four percent of respondents reported receiving the help they desired from the program and ninety-nine percent of parents reported they would recommend the program to others (no group differences, $p=0.72$ and 0.28 respectively).

4.2.3 Maintenance of program integrity

As described in Section 2.4.6.12, tape recordings of the intervention sessions were randomly audited by an assessor external to the study. The four tapes accounted for 10% of sessions and equally represented the two study sites. The assessor used a checklist to assess key defining features that distinguished the group sessions from each other.

Assessment of the presence of these features are summarised in Table 4.11. As can be seen in the table, the four sessions randomly selected for auditing displayed consistent differences regarding key features used to distinguish the HL group sessions from the HL+P.

As was expected, the HL arm facilitators did not refer to the Triple P[®] Planned Activities Routine[™] (PAR) framework, as this concept was discussed only in the HL+P intervention following introduction in the Triple P[®] sessions. In addition, the HL+P facilitators consistently reflected more questions back onto participants - a strategy purposefully undertaken to encourage problem solving. Furthermore, the HL+P facilitators spent less time delivering content and more time working through barriers to goal achievement and PAR[™] development than the HL facilitators. This was another strategy included to promote problem solving and self-regulation as opposed to a pure nutrition education approach used by the HL facilitators.

Table 4.11: Results of quality assurance audit of four randomly selected PEACH sessions

Key distinguishing features of difference between intervention sessions	Differences between interventions identified (✓ or ✗)	Comments
Homework review - The HL+P facilitator responds to questions with <u>process-based</u> answers while the HL facilitator responds with <u>content-based</u> answers - The HL+P facilitator makes reference to the <u>PAR</u> and discusses behaviour change strategies, the HL facilitator does not	Tapes: A: ✓, B: ✓, C: ✓, D: ✓	Number of times the HL facilitator reflected questions back onto group: Tapes: A: 0, B: 0, C: 0, D: 0
	Tapes: A: ✓, B: ✓, C: ✓, D: ✓	Number of times the HL+P facilitator reflected questions back onto group: Tapes: A: 3, B: 3, C: 2, D: 2
Problem-solving and PAR* discussion - This component of the session not present in the HL intervention - HL+P facilitator discusses achievement of goals with group and discusses how to overcome barriers by linking back to the PAR	Tapes: A: ✓, B: ✓, C: ✓, D: ✓	None of the HL facilitators mentioned the PAR
	Tapes: A: ✓, B: ✓, C: ✓, D: ✓	All the HL+P facilitators referred to the PAR
Content - This component of the HL+P intervention session shorter in duration that the HL intervention session	Tapes: A: ✓, B: ✓, C: ✓, D: ✓	HL Time (min): Tapes: A: 34, B: 36, C: 38, D: 36 HL+P Time (min): Tapes: A: 31, B: 30, C: 43, D: 30
Summary - The HL+P facilitator makes reference to the PAR, the HL facilitator does not	Tapes: A: ✓, B: ✓, C: ✓, D: ✓	
Question Time - This component of the HL+P intervention session very short, if present at all - If asked, the HL+P facilitator responds to questions with <u>process-based</u> answers while the DA facilitator responds with <u>content-based</u> answers	Tapes: A: ✓, B: ✓, C: ✓, D: ✓	Tapes: A: A few questions in the HL group – content based answers given B: Very few questions asked in either HL or HL+P groups C: Questions from HL responded with content-based answers D: Very few questions asked in either HL or HL+P groups
	Tapes: A: ✓, B: ✓, C: ✓, D: ✓	

Tape A: Adelaide Cohort 1 Session 5, Tape B: Adelaide Cohort 2 Session 7, Tape C: Sydney Cohort 2 Session 6, Tape D: Sydney Cohort 2 Session 8

4.2.4 Discussion of process evaluation

Attendance

The program sessions were generally well attended with almost 50% of the full study sample attending at least 75% of scheduled sessions. This attendance rate is identical to the rate observed for the pilot study informing the PEACH study (191). However it is lower than that reported by other multi-component child weight management interventions which have reported full attendance by 70-82% of subjects (321) (322) (173) (323). Three of these studies were child-focussed (321) (322) (323) and one encouraged attendance via a reimbursement of a monetary deposit (173) – factors which could enhance attendance.

The PEACH program promoted parental self-competence and self management so purposefully encouraged parental self-commitment to attend sessions. Families were provided with study programs, however reminders of session times were not provided, nor were monetary (or otherwise) incentives. In this way, the study aimed to encourage parents to assume the responsibility of attending sessions and undertaking homework tasks.

The main reasons for not attending sessions were related to factors external to the intervention, suggesting that aspects of the program were not cause for non-attendance. This finding is similar to that found for reasons of non-attendance to an individualised behavioural weight management clinic at a US university which found that 25% of parents cited time and location as the most important barrier to attendance (324). This suggests that a deeper examination of these inhibitive factors is required to enhance program effectiveness in the future. For example, is attendance to sessions really impeded by a lack of time or is it more a result of poor time management or a lack of prioritisation. Exploration of alternative modes of program delivery, such as web-based programs also needs to be undertaken to identify more efficient modes of program delivery.

Attendance rates were similar between groups (Table 4.9), despite the additional four parenting skills training sessions offered in the HL+P group. This suggests that the addition of these sessions was not burdensome to parents.

Satisfaction

High ratings of program quality and satisfaction were reported by parents which did not differ significantly between groups or sites (Table 4.10). The majority reported it assisted them to make changes to their child's eating/activity behaviours (98%) and their own parenting style/strategies (83%). Almost 100% of parents stated that they would recommend the program to others.

As discussed in Section 1.3.3.4, there is a distinct lack of such process evaluation indicators reported in the literature. Only one of the 12 interventions reviewed in that section reported post-intervention process evaluation findings which took the form of interviews with parents of children enrolled in the study and brief questions to the children and intervention staff (188). Whilst valuable learnings were gleaned from this process, the thorough assessment of satisfaction undertaken by the PEACH study provided a much larger volume of information to inform future interventions. The most common suggestions provided to make such improvements to the PEACH program were i) more resources, ii) more contact, and iii) involve the child.

The strong request for more resources perhaps reflects a belief amongst parents/the community that more knowledge/resources are required to address health issues such as child weight management. This belief may be reflective of the personal responsibility that individuals feel they have to take to address such as issue. It ignores the need for environmental change and policy action that is widely recognised as necessary to address what is essentially a public health issue, but is an attitude often promoted by governments and the food industry (325). Furthermore, the recommendation for more resources by parents may illustrate a false belief that the acquisition

of more knowledge will assist with the management of their child's weight. Knowledge alone will not address the issue to which behavioural management is essential. Preventive public health interventions have demonstrated limited success in promoting long term maintenance by focussing on increasing individual knowledge through education strategies (326). The development and maintenance of practical skills and strategies (often requiring more personal effort than the gathering of knowledge) will be more effective to manage overweight and the environment in which it is promoted.

The second most requested improvement to the program was increased contact, which highlights the need for a long-term management approach to what is best defined as a chronic condition. The need for on-going support is discussed in more detail in Section 6.7.2.

Thirdly, parents requested that the program involve children more in the delivery of content. This recommendation may reflect the parental perception that the child needs to be targeted throughout management and that they are part of the problem. It also highlights the attitude of personal responsibility even towards children who have very little, if any control over the influences on their food and activity behaviours. Involvement of older children in child weight management programs may be appropriate at a time when they have control over such tasks as food purchasing, and this is worth considering if long term support is to be provided as suggested above. However, children aged 5-9 years old, as represented by the PEACH study sample, should not be responsible for making such decisions or negotiating home and society environments.

Significantly more parents in HL+P group reported making changes to parenting style/strategies than parents in the HL group ($p=0.04$). This is something that was not detected by the parenting questionnaires, which may reflect the individual nature of the perception of change and/or the definition of parenting style/strategies. The more common examples of change fell

under two key parenting strategies promoted by the Triple P[®]– managing misbehaviour and encouraging desirable behaviour.

The most common reasons given for not attending sessions or using program resources between sessions were related to lack of time and family and work commitments. This may illustrate the difficulties families experience in engaging in “extra-curricular activities” as a result of the demands of contemporary family life (75). In order to maximise the effectiveness of interventions such as PEACH, study design should recognise these difficulties. Exploration of more time efficient modes of delivery, such as web-based programs, needs to be undertaken. Additionally, a deeper examination of the real factors causing time limitations should be undertaken to determine their true cause. They could result from logistical issues such as travel distances, timing of program sessions or session frequency that could be addressed in future intervention planning.

Maintenance of program integrity

The integrity between intervention sessions was upheld across both sites. This was a result of strict protocols being provided to facilitators including sessions notes and checklists that included recommended timing of session components and delivery style (Section 2.4.5.3).

The audit of session integrity provided reassurance that the program session protocol was adhered to between groups and also across sites, thus increasing the generalisability of the study across multiple sites and settings. This is a unique addition to the process evaluation of the PEACH study and one that is not reported elsewhere. Incorporation of such protocols provides a quality assurance mechanism, strengthening the robustness of the study design and evaluation.

4.3 Conclusion: Impact and process evaluation

This chapter presented the impact and process evaluation findings of the PEACH study. These broad evaluation indicators were included in the study design so as to provide high quality and thorough evidence regarding the effectiveness of the intervention.

The improvements observed in the impact evaluation indicators demonstrate that the PEACH program was successful at improving targeted behaviours related to healthy lifestyle and healthy weight. It was effective in not only reducing degree of overweight, but also successful at changing key behaviours that influence weight, necessary for long-term maintenance of change.

Lack of statistical significance for the effect of group on these impact indicators may be in part due to the fact that the study was not powered to detect group differences for these outcomes, lack of sensitive tools and also as a result of the use of ITT analysis which provides a conservative estimate of effect.

Examination of process evaluation indicators showed that program was well accepted and generally well attended by participants. Factors external to the program were most commonly cited as preventing attendance to sessions and application of program materials at home. Program session integrity was maintained across sites, providing assurance that the program can be consistently delivered across settings.

Inclusion of these broad indicators of program effect by the PEACH study addresses key weaknesses regarding the design and evaluation of interventions for the family management of childhood overweight (Table 2.5).

Chapter Five: Facilitators and barriers to the achievement of program goals

This chapter reports on the analysis of 95 semi-structured interviews conducted with PEACH parents at the 12 month time point (Section 2.4.6.13). During the interviews, parents were asked to identify factors external to the program that supported or inhibited their attempts to initiate and maintain the healthy family lifestyle behaviours promoted throughout the PEACH program. The qualitative research method of thematic analysis was undertaken to identify these factors (Section 2.5.5).

As is common practice in qualitative research, the findings of this analysis are presented in partnership with an interpretation of their meaning (in contrast to the previous two quantitatively-focussed chapters, which included a discussion sub-section following presentation of the results). The purpose of including the discussion throughout the qualitative findings is to make them more meaningful and is critical for ensuring reader clarity (257).

5.1 Facilitators and barriers – initial codes

Thematic analysis of the ninety-five semi-structured interviews (50 from Adelaide, 45 from Sydney) identified 155 initial codes (62 for facilitators and 93 for barriers). Table 5.1 presents these initial codes along with how many interviewees referred to each one (sources) and the number of times each one was referenced across all the 95 interviews (references). The number of references and sources may vary as some sources may have referenced an initial code more than once, resulting in a higher number of references than sources. There were 375 references made to factors that facilitated achievement of program goals, and 433 references to barriers of goal achievement.

Table 5.1: Results of phase two of the thematic analysis¹ of 95 semi-structured interviews conducted with PEACH study parents at the 12 month time point listing the initial codes describing barriers and facilitators to achievement of program lifestyle goals and the number of times they were sourced (S) and referenced (R)

Barriers			Facilitators		
Initial codes	S	R	Initial codes	S	R
After-school care food	1	1	“Go for 2 and 5” promotion	4	4
Baby or pregnancy limiting PA ²	3	4	After-school care food	4	5
Birthday parties	5	5	After-school care sport	1	1
Bullying	4	5	Childs age – older	2	3
Change in routine	1	1	Childs awareness of healthy eating	19	25
Child fussy eater	1	1	Childs interest in PA ²	7	8
Child maturing	3	5	Childs positive outlook	6	7
Child not interested in canteen	1	1	Childs preference for water	1	1
Child not interested in PA ²	1	1	Consistency	2	2
Child not motivated due to young age	1	1	Daylight saving	1	1
Child skipping meals	1	1	Extended family support	9	9
Child stubborn	7	7	Extracurricular sport	15	15
Child’s appetite	5	5	Family modelling PA ²	13	26
Child’s aversion to PA ²	2	2	Family support	29	32
Child’s medical condition	5	5	Be Active ad	1	1
Conflicting messages from role models	2	3	Getting results	4	4
Cost of healthy food	2	2	Giving attention	1	1
Cost of PA ²	1	1	Goal setting or planning	7	9
Different nutritional needs of other family members	14	15	Having written information	3	3
Eating at friends house	5	5	Healthy choices by child	3	4
Eating on holidays	1	1	Healthy food from friends	1	1
Emotional eating	5	5	Healthy home food supply	13	14
End of term party food	1	1	Healthy parties	1	1
Family cultural beliefs	3	3	Holidays – more time	1	1
Fathers lack of experience with girls activity	1	1	Hygienic lunchbox	1	1
Fear of eating disorder	3	3	Increased awareness of healthy eating	18	20
Food emotions	2	2	Increased food variety	1	1
Fundraisers	1	1	Increased incidental exercise	3	5
Healthy home food supply not available or accessible	1	2	Involving child in healthy choices	2	2
Holidays	6	9	Mother on diet	3	3
Inactive home environment	1	1	Motivated parent	3	4
Inactive parent	1	1	No canteen at school	2	2
Inconsistency with friends rules	1	1	Non-food rewards	1	1
Inconsistent parenting	13	14	Nutrition information panel	6	7
Lack of commitment to goals	7	11	Old enough for sport	1	1
Lack of family support	14	16	Parent with new partner	1	1
Lack of knowledge	1	1	Parent working at home	1	1
Lack of motivation	9	11	Parental control of food	4	5
Lack of parental supervision due to work	5	5	Parental modelling of healthy eating	2	2
Lack of preparation	5	5	Peers modelling healthy behaviours	4	4
Lack of routine due to work	1	3	Persistence	2	2
Lack of support from social network	5	5	Planned ignoring	1	1
Lack of time	11	14	Readiness to change	2	2
Lack of time due to fathers work	1	1	Reduced take aways	3	3
			Removing junk food from house	3	5
			Removing pressure from child	1	1

Lack of time due to work	12	12	Retention strategies	6	6
Lack of time to be active	9	10	Rules and limit setting	7	7
Lack of time to prepare healthy snacks or meals	9	9	School – structured routine and environment	10	10
Large family with different food preferences	1	2	School canteen	17	18
Laziness	3	3	School canteen limits	2	2
Limited choice	1	1	School curriculum	5	6
Location	6	8	School PE	21	23
Lunchbox limitations	2	3	Sibling or friend to play with	2	2
Maintenance once program complete	10	12	Small family	2	4
Making excuses	1	1	Social support	8	8
Marketing of fast food	10	11	Summer – warm weather	13	14
Mothers dislike of cooking	1	1	Support – health professional	2	2
Mothers medical condition	1	1	TV or TV advertising	5	5
No neighbours to play with	1	1	Weather	11	11
No siblings to play with	2	2	Whole of family approach	13	14
Parents with new partner	1	1	Work life balance	1	1
Parental interference	1	1			
Parental overeating	2	2			
Parental overweight	1	1			
Parents not interested in PA ²	1	1			
Parties	2	2			
Peer pressure	6	6			
Peer pressure at school	10	10			
Peer role modelling	5	5			
Physical inactivity due to fathers work commitments	2	2			
Physical inactivity due to mothers physical disability	1	1			
Pilfering food	1	1			
Playstation	2	2			
Poor weight loss outcomes	1	1			
Responsibility on 1 family member	3	3			
School	3	3			
School canteen	12	14			
School vending machines	1	1			
Sibling rivalry around PA ²	1	1			
Socializing	14	16			
Sole parent	1	2			
Sole parent – children unsupervised	1	1			
Special occasions	2	2			
Swapping food at school	10	10			
Time	4	4			
Too tired for PA ² due to work	1	1			
Too young for sport	2	2			
Treats from extended family	10	10			
TV	3	3			
TV food advertising	8	10			
Weather	19	22			
Wet weather	4	4			
Winter - cold weather	13	17			
Work commitments	6	6			
Total	387	433	Total	338	375

¹ As described in (270) ² PA=Physical activity

Coding of initial codes was intentionally specific so as to avoid discarding data that may contribute to theme development in the subsequent phases of analysis. This process was audited by an external coder who coded 10% of transcripts which were compared to the codes identified by the candidate. Both coders coded for facilitators and barriers consistently.

As described in Section 2.5.5, initial codes were arranged into “theme-piles” to identify first level themes (phase three of thematic analysis). Again, care was taken not to over-generalise initial codes into themes, in order to present the meaning of the data accurately. Therefore, due to the large number of initial codes, the number of first level themes identified was substantial (12 for facilitators and 18 for barriers). Themes were numbered using the system described in Section 2.5.5. Table 5.2 presents the first level themes and the initial codes underpinning them.

In phase four of the analysis, themes were reviewed and refined to ensure they accurately captured the meaning of the data. At this point, some first level themes were discarded due to lack of supportive data; illustrated with strikethrough font in Table 5.2. For example, the nodes initially grouped under the level one facilitator theme “Miscellaneous” were discarded at this point.

The final phase of the analysis involved defining and naming the resultant second level themes. The first level themes were examined to identify if any could be further grouped together as second level themes. This refinement of themes provided a more general representation of the facilitators and barriers to achievement of program goals. Many of these consisted of level-one themes, whilst some level-one themes remained as second-level themes in their own right. For example, the first-level theme “Inconsistencies/Lack of support” was retained as a second-level barrier theme. This final phase of the thematic analysis resulted in three second-level facilitator themes and six second-level barrier themes. Figures 5.1 and 5.2 illustrate the level one and level two themes that summarise the facilitators and barriers to program goal achievement reported by study participants.

Table 5.2: Results of phase three of the thematic analysis¹ of 95 semi-structured interviews conducted with PEACH study parents at the 12 month time point listing level one themes describing barriers and facilitators to PEACH families' achievement of program lifestyle goals and the initial codes that underpin them

Barriers	Facilitators
B1.1: Food provided at school (27)	F1.1: Consistent messages/support (129)
After-school care food (1) Fundraisers (1) Swapping food at school (10) School canteen (14) School vending machines (1)	"Go for 2 and 5" promotion (4) Consistency (2) Extended family support (9) Family modelling PA ¹ (16) Family support (32) Be Active ad (1) Healthy food from friends (1) Healthy home food supply (14) Healthy parties (1) Nutrition information panel (7) Social support (8) Support – health professional (2) TV or TV advertising (5) Having written information (3) Getting results (4) Peers modelling healthy behaviours (4) Retention strategies (6) School – structured routine and environment (10)
B1.2: Maintenance (12)	F1.2: School promoting/provided healthy lifestyle choices (55)
Maintenance once program complete (12)	After-school care food (5) After-school care sport (1) No canteen at school (2) School canteen (18) School curriculum (6) School physical education (23)
B1.3: Social outings/Special occasions (41)	F1.3: PEACH strategies/principles (45)
Birthday parties (5) Eating at friends house (5) Eating on holidays (1) End of term party food (1) Holidays (9) Socializing (16) Special occasions (2) Parties (2)	Giving attention (1) Goal setting or planning (9) Involving child in healthy choices (2) Non-food rewards (1) Parental control of food (5) Parental modelling of healthy eating (2) Planned ignoring (1) Removing pressure from child (1) School canteen limits (2) Whole of family approach (14) Rules and limit setting (7)
B1.4: Peers (30)	F1.4: Child's age (4)
Bullying (5) No neighbours to play with (1) No siblings to play with (2) Peer pressure (6) Peer pressure at school (10) Peer role modelling (5) Sibling rivalry around PA ² (1)	Old enough for sport (1) Childs age – older (3)
B1.5: Miscellaneous (37)	F1.5: Child's attitude (40)
Change in routine (1)	Childs awareness of healthy eating (25)

<p><i>Child's medical condition (5) – RETAINED AS A SECOND LEVEL THEME</i></p> <p>Baby or pregnancy limiting PA² (4)</p> <p>Family cultural beliefs (3)</p> <p>Fathers lack of experience with girls PA² (1)</p> <p>School (3)</p> <p>Location (8)</p> <p>Lunchbox limitations (3)</p> <p>Mothers dislike of cooking (1)</p> <p>Mothers medical condition (1)</p> <p>Parents with new partner (1)</p> <p>Parental interference (1)</p> <p>Parental overeating (2)</p> <p>Parental overweight (1)</p> <p>Poor weight loss outcomes (1)</p> <p>Physical inactivity due to mothers physical disability (1)</p>	<p>Childs interest in PA² (8)</p> <p>Childs positive outlook (7)</p>
B1.6: Child's food/eating habits or style (14)	F1.6: Child's food/eating habits or style (5)
<p>Child fussy eater (1)</p> <p>Child skipping meals (1)</p> <p>Child's appetite (5)</p> <p>Emotional eating (5)</p> <p>Pilfering food (1)</p> <p>Limited choice (1)</p>	<p>Childs preference for water (1)</p> <p>Healthy choices by child (4)</p>
B1.7: Child's age (8)	F1.7: Miscellaneous (13)
<p>Child maturing (5)</p> <p>Child not motivated due to young age (1)</p> <p>Too young for sport (2)</p>	<p>Daylight saving (1)</p> <p>Parent with new partner (1)</p> <p>Holidays – more time (1)</p> <p>Hygienic lunchbox (1)</p> <p>Mother on diet (3)</p> <p>Sibling or friend to play with (2)</p> <p>Small family (4)</p>
B1.8: Lack of interest from child (4)	F1.8: Improved home food supply (9)
<p>Child not interested in canteen (1)</p> <p>Child not interested in PA² (1)</p> <p>Child's aversion to PA² (2)</p>	<p>Increased food variety (1)</p> <p>Reduced take aways (3)</p> <p>Removing junk food from house (5)</p>
B1.9: Child's temperament (7)	F1.9: Increased physical activity (20)
<p>Child stubborn (7)</p>	<p>Extracurricular sport (15)</p> <p>Increased incidental exercise (5)</p>
B1.10: Inconsistent messages/Lack of support (82)	F1.10: Flexible working arrangements (2)
<p>Conflicting messages from role models (3)</p> <p>Different nutritional needs of other family members (15)</p> <p>Inconsistency with friends rules (1)</p> <p>Inconsistent parenting (14)</p> <p>Healthy home food supply not available or accessible (2)</p> <p>Inactive home environment (1)</p> <p>Inactive parent (1)</p> <p>Lack of family support (16)</p> <p>Lack of support from social network (5)</p> <p>Large family with varied food preferences (2)</p> <p>Treats from extended family (10)</p> <p>Parents not interested in PA² (1)</p> <p>Marketing of fast food (11)</p>	<p>Work life balance (1)</p> <p>Parent working at home (1)</p>
B1.11: Financial (3)	F1.11: Pleasant weather (25)
<p>Cost of healthy food (2)</p> <p>Cost of PA (1)</p>	<p>Summer – warm weather (14)</p> <p>Weather (11)</p>

B1.12: Parental concern over restriction(5)	F1.12: Increased self-efficacy (28)
Fear of eating disorder (3) Food emotions (2)	Increased awareness of healthy eating (20) Motivated parent (4) Persistence (2) Readiness to change (2)
B1.13: Screen-based leisure time (15)	
Playstation (2) TV (3) TV food advertising (10)	
B1.14: Inclement weather (43)	
Weather (22) Wet weather (4) Winter - cold weather (17)	
B1.15: Work (30)	
Lack of parental supervision due to work (5) Lack of routine due to work (3) Lack of time due to fathers work (1) Lack of time due to work (12) Too tired for PA ² due to work (1) Work commitments (6) Physical inactivity due to fathers work commitments (2)	
B1.16: Lack of time/preparation (42)	
Lack of preparation (5) Lack of time (14) Lack of time to be active (10) Lack of time to prepare healthy snacks or meals (9) Time (4)	
B1.17: Low self-efficacy (27)	
Lack of knowledge (1) Lack of motivation (11) Lack of commitment to goals (11) Laziness (3) Making excuses (1)	
B1.18: Burden of responsibility (6)	
Responsibility on 1 family member (3) Sole parent (2) Sole parent – children unsupervised (1)	

¹ As described in (270) ² PA=Physical activity

Figure 5.1: Thematic mind map illustrating level one and level two themes describing facilitators to the achievement of program goals following the thematic analysis of 95 semi-structured interviews conducted with PEACH study parents at the 12 month time point

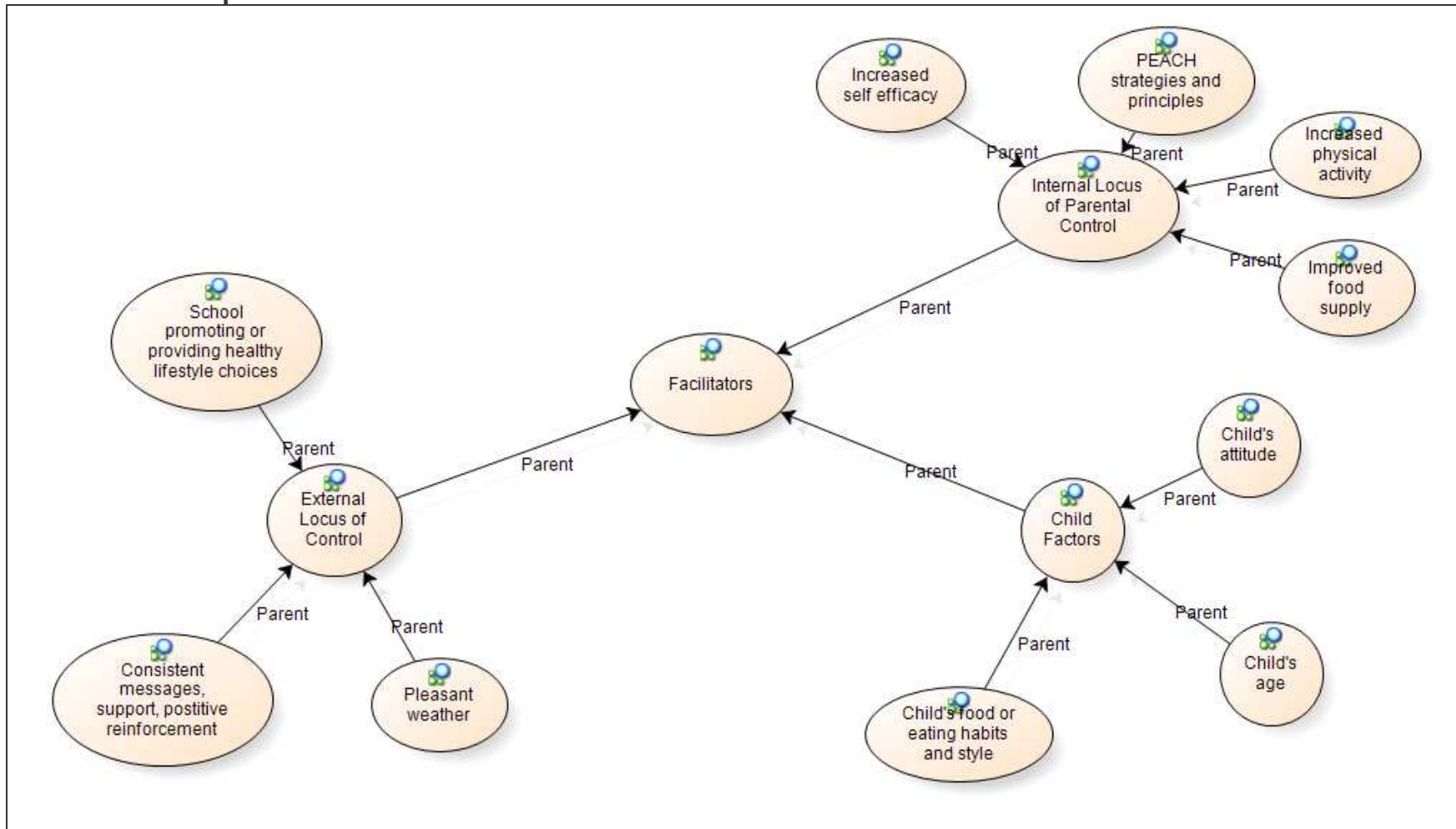
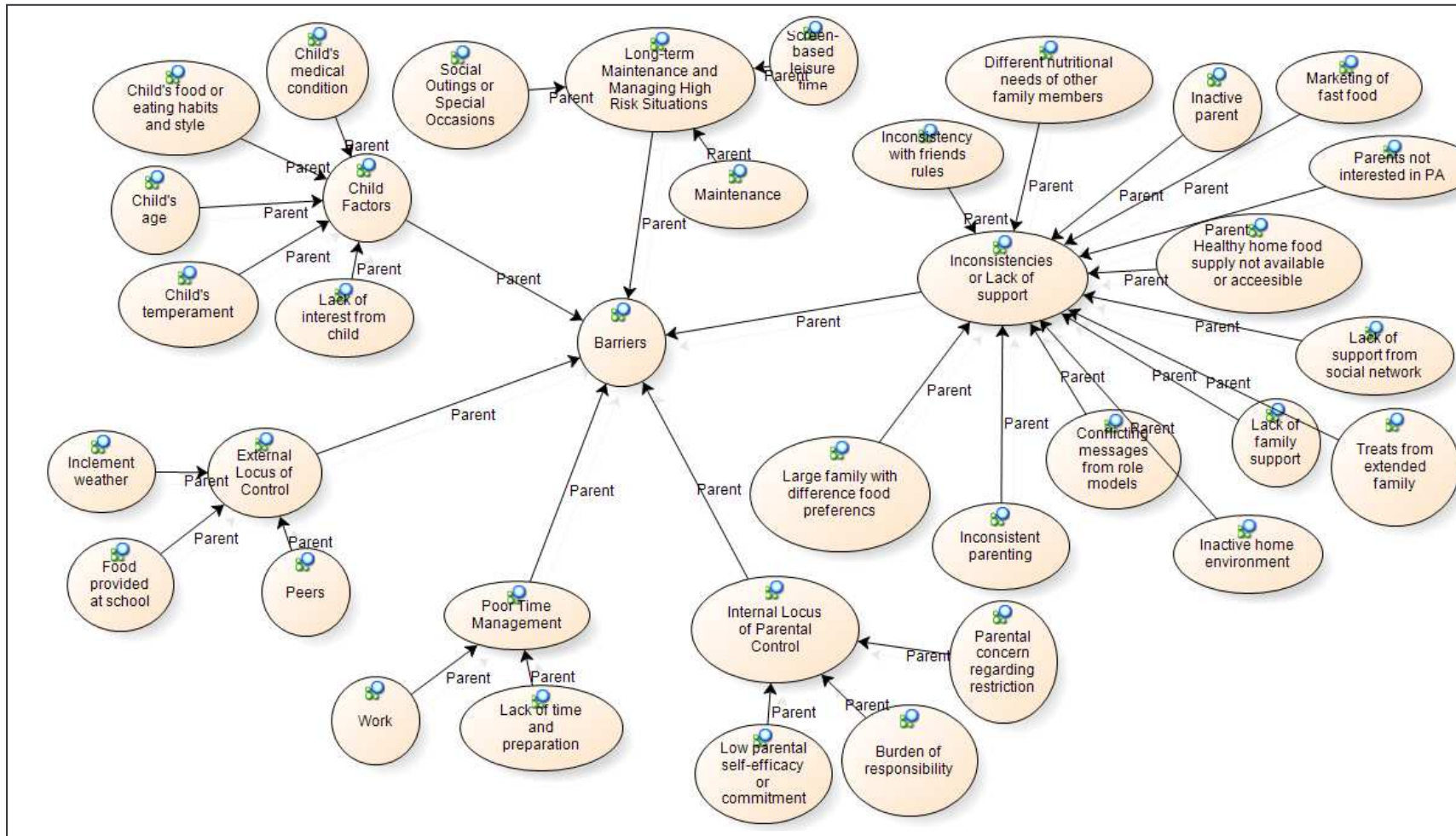


Figure 5.2: Thematic mind map illustrating level one and level two themes describing barriers to the achievement of program goals following the thematic analysis of 95 semi-structured interviews conducted with PEACH study parents at the 12 month time point



The following sections describe the level two themes for the two questions the interviews sought to answer i) “What factors external to the PEACH study made it *easier* for you to achieve the healthy lifestyle goals you set for your family?” and ii) “What factors external to the PEACH study made it *harder* for you to achieve the healthy lifestyle goals you set for your family?”. Each theme is described in detail and supported by direct quotations from selected interviews and discussed in relation to evidence from the existing literature.

5.2 Facilitators – Second-level themes

Three second-level themes representing factors that supported parents/families in achieving their program goals were identified. These were:

- factors under the control of parents (“internal locus of parental control”),
- factors beyond the control of parents (“external locus of parental control”),
and
- factors specific to the child (“child factors”)

Table 5.3 explodes these second-level themes to illustrate which first-level themes fell under them and how commonly each was referenced.

This section describes each of the second-level facilitator themes illustrated by direct quotations from interviews conducted with parents at the 12 month time point. Quotations have been selected to support a sample of the first-level themes underpinning the second-level themes, which are then discussed relative to the existing literature.

Table 5.3: Summary of second- and first-level facilitator themes and the number of initial codes (C) and references (R) supporting them identified through the thematic analysis¹ of 95 semi-structured interviews conducted with PEACH study parents at the 12 month time point

Second-level themes	First-level themes	C	R
Internal locus of parental control*	PEACH strategies and principles	11	45
	Increased physical activity	2	20
	Improved home food supply	3	9
	Increased self-efficacy	4	28
External locus of parental control*	School promoting/providing healthy lifestyle choices	6	55
	Consistent messages/support/positive reinforcement	18	129
	Pleasant weather	2	25
Child factors	Child's food or eating habits and style	2	5
	Child's attitude	3	40
	Child's age	2	4
Discarded	Miscellaneous	7	13
	Flexible working arrangements	2	2
Total		62	375

¹ As described in (270)

* Locus of control is a concept in between psychology and sociology related to where individuals conceptually place responsibility and choice for events in their life – either internal or external to themselves (327). The terms are used to define an individual as “internals” or “externals” and refers to the amount of control individuals believe they have over their lives (328). For the purposes of reporting the themes identified in the interviews for this thesis, these terms have been adapted to categorise the amount of control (internal = a lot, external = minimal) parents felt they had over factors that either supported or inhibited their ability to achieve healthy lifestyle goals promoted within the PEACH program.

Second-level facilitator theme: Internal locus of parental control

This second level theme groups first level themes that were deemed to be under parental control - PEACH strategies/principles, increased physical activity, improved home food supply and increased self-efficacy.

PEACH strategies/principles

Examples of “PEACH strategies/principles” that facilitated achievement of program goals included aspects underpinning both arms of the intervention (eg. whole of family approach, removing pressure from child) and also parenting practices that were promoted in the HL+P arm (eg. rule and limit setting, planned ignoring).

“Doing it as a family, like making sure that the whole family is involved, not just saying Thomas is doing this. We’ve brought the papers home and like everyone’s looked at them.”

“He loves his Playstation and all that but we have the rule, he gets half an hour a day, that’s it.”

Increased self-efficacy

The first level theme “increased self-efficacy” encompassed factors such as knowledge, awareness and attitudes that increased parents’ confidence in their ability to achieve their goals.

“But you know, that’s just something that now I can say, no I’m not going to be involved in that (selling chocolates as a fundraising event) , I will give you a donation but I’m not going to do that, because that’s easier. But it’s still hard.”

“I think the PEACH study has actually made me more aware of like types of foods and things to look for in packaged food, to get those healthy food choices..... I think it’s just that, what do you call it, sort of like a recognition that you know, you need to do something.”

Increased physical activity and improved home food supply

Parents also reported that assuming responsibility for the promotion of physical activity and ensuring a healthy food supply at home assisted with achieving the goals they had set for their family.

“And um just sorta eliminating in our family, our immediate family as in our home um, removing foods was not too hard because I do the shopping mainly so it was just whatever I bought was in the house and I just kinda eliminated chips and stuff like that”

Discussion of the second-level facilitator theme “internal locus of parental control”

Recommendations regarding healthy eating and activity behaviours promoted by the PEACH program (Table 2.4) are reflected by the above quotations eg. “...we have the rule he gets half an hour a day...”. The addition of the Triple P[®] component to the HL+P group aimed to “enhance the knowledge, skills, confidence, self-sufficiency and resourcefulness of parents” (241). The PEACH program included group activities, role plays and group discussions to enhance the opportunity for parents to implement the knowledge and skills promoted in the program.

It is possible that the promotion of the PEACH strategies and principles and the style in which they were delivered assisted in the development of self-efficacy, another theme identified as supporting parents to achieve healthy family lifestyle goals.

Self-efficacy is a term used to describe an individual's confidence in their own ability to make specific changes in behaviour and eventually assume responsibility for the treatment outcome (328). It is related to locus of control (see footnote in Table 5.3) and is described by Bandura as the most important prerequisite for behaviour change (329). The development of knowledge and skills, especially through role play and repetition, strongly promote the development of self-efficacy.

Self-efficacy is specific to both behaviour and environment (329). For example, a parent who is confident about serving appropriate serve sizes to their child at home may be less confident when dining with the family at an all-you-can-eat buffet restaurant. Understanding the way in which the physical and social environments act to provide incentives or disincentives for different behaviours assists the construction of interventions to manage such environments to further support healthy behaviours. The establishment of a supportive home environment through the provision of healthy food and activity choices appeared to assist parents to achieve their healthy lifestyle goals. This is also reflected in child weight-control strategies most commonly reported by a group of Australian parents of 5-6 and 10-12 year old children (282). The three most commonly reported strategies were promoting healthy eating (49% and 37% respectively), promoting exercise (33% and 35%, respectively) and reducing "junk" food (32 and 28%, respectively) (282). Interestingly, focus groups conducted in the UK with parents of 7-12 year old children from low (n=14) and high (n=27) SES groups found that parents from high SES families were more likely to enforce food rules in the home than parents from low SES families (330).

Second-level facilitator theme: External locus of parental control

Factors contributing to the second level theme of “external locus of control” were: pleasant weather, consistent messages/support and school promoting/providing healthy lifestyle choices. These were all factors which positively influenced children’s behaviours, but which parents had little, if any control over.

Consistent messages/support

The “consistent messages/support” theme contained the most initial codes (129) and represents a wide range of factors at the program, family and societal level.

“I think family support has definitely made it easier.”

“Well it was easy sorta talking to my extended family my mum and that and getting them to make some changes down their end. So wherever we went it was sorta healthy food.”

“some of the adverts that are on tv that are coming out at the moment, I mean there’s not that many, but ones, the goods ones, you know to do with the five foods groups or um there’s that eat well play well one on at the moment we sort of point those out to her”

School promoting/providing healthy lifestyle choices

Parents also reported the promotion/provision of healthy lifestyle choices at school supported the achievement of their family’s goals. These included the school curriculum, after-school care, the canteen and physical education.

“The external factors, the school is very good, the canteen has a very good healthy eating policy and out of school care that I use occasionally have very good eating policies, so that’s helped.”

“At school and the Institute of Fitness Program and every morning they do fitness with all the children. I think it’s like 10 or 15 minutes, but it’s obviously a help.”

Discussion of the second-level facilitator theme “external locus of parental control”

Previous public health initiatives, such as the tobacco control movement, identify the importance of including education strategies in a comprehensive multi-message, multi-channel program to guide social change (311). Management

interventions ideally need to be supported by mass media campaigns that will help to promote a climate supportive of program and policy efforts. Findings from interviews conducted by Economos et al with key informants from successful public health campaigns highlighted that “messages must be framed positively, be supported by consensus among scientists, be repeated in a variety of venues, and go beyond building awareness or conveying information” (331).

Furthermore, evidence suggests that with regards to tobacco, counter-marketing campaigns that challenged pro-tobacco messages helped to “de-normalise” smoking (311). The possibility of such an approach being applied to the promotion of non-core foods illustrates a further possible strategy beyond the direct control of parents that would help them and others to support parents/individuals to manage an overwhelmingly obesogenic environment.

The mass media is crucial to reach all social groups and influences society’s attitudes, beliefs and values to help shape common culture (331). Therefore, the dissemination of constant and consistent healthy lifestyle messages via numerous channels will assist to increase community-wide awareness of healthy practices.

Over the past 50 years, school health promotion has evolved alongside health promotion in other settings (332). The Health Promoting Schools initiative is a multifactorial approach that covers teaching health knowledge and skills in the classroom, changing the social and physical environment of the school, and creating links with the wider community (333). A review of the evidence of different types of school-based programs to promote child health and wellbeing found programs that promote healthy eating and physical activity to be amongst the most effective (332). Given this success and the importance of this as identified in the interviews, the use of such a model to promote healthy lifestyle behaviours to students and potentially families is extremely valuable and worth promoting.

Second-level facilitator theme: Child factors

Some factors relating to the children enrolled in the PEACH study made it easier for the parent's to achieve the healthy lifestyle goals they had set for their family. Specifically, these related to the child's age, their attitude and their food/eating habits or style.

Child's age

Some parents found that as children became older, their awareness of the need to make healthy lifestyle choices increased, as did their eligibility to participate in club sports.

"And because she's that little bit older I think she understands that a little bit more as well, so that's probably helped her more than anything, well both of us."

Child's attitude

Parents also reported that children's attitudes towards healthy lifestyle choices such as interest in healthy eating and/or physical activity and an overall positive outlook assisted with the achievement of program goals.

"And she's sort of, she's trying to make a conscious decision to make, to make healthy choices. You know, like, it's sort of like, oh I really like that but that wouldn't be as good for me."

"He like to play sport, he's very active, he got a lot of energy, is made me easy you know.... he's going to eat because he play everyday something so he want to eat health foods."

Discussion of the second-level facilitator theme "child factors"

Of the 49 references made to facilitators of healthy lifestyle change that fell under the second-level theme of "child factors", 25 referred to "child's awareness of healthy eating" (Tables 5.2 and 5.3). Similarly, focus groups conducted with Australian children aged 7-8 years and 10-11years found that children were aware of the health value of different foods eg. "*it makes your bones stronger*" as a consequence of eating healthy foods, whilst unhealthy foods "*make your arteries block*" (334). Children in this sample were also able to identify the health benefits of being physically active. The provision of opportunities for children to

translate this awareness and knowledge into practice is essential for the development of healthy behaviours.

Furthermore, food preferences may be influenced by temperament and personality (291) and parents found that children who enjoyed healthy foods, or were willing to try them, supported their efforts to make healthy changes to the family food/eating style. A Canadian study has found that children and adolescents who have a healthy diet generally do so because they like the food they are eating (335) – usually a factor that parents may influence, but is central to the child. The same may be said for activity preferences.

Although not as frequently referenced as the other two second-level themes of “internal”, and “external loci of parental control” (49 vs. 102 and 209, respectively), “child factors” have a meaningful influence on parents/families ability to achieve healthy family lifestyle goals and illustrate the importance and value of total family involvement in such an undertaking.

5.3 Barriers – Second-level themes

Six second-level themes were identified that summarised factors that inhibited parents/families achievement of program goals. Three of these were the same as the second level facilitator themes of:

- “internal locus of parental control”,
- “external locus of control” and
- “child factors”

and three were unique to barriers:

- “long term maintenance and managing high risk situations”
- “poor time management”
- “inconsistencies/lack of support”

Table 5.4 explodes these second-level themes to illustrate which first-level themes fell under them and how commonly each was referenced.

Table 5.4: Summary of second- and first-level barrier themes and the number of initial codes (C) and references (R) supporting them identified through the thematic analysis¹ of 95 semi-structured interviews conducted with PEACH study parents at the 12 month time point

Second-level themes	First-level themes	C	R
Internal locus of parental control*	Low parental self-efficacy or commitment	5	27
	Burden of responsibility	3	6
	Parental concern regarding restriction	2	5
External locus of parental control*	Peers	7	30
	Food provided at school	5	27
	Inclement weather	3	43
Child factors	Lack of interest from child	3	4
	Child's temperament	1	7
	Child's age	3	8
	Child's food or eating habits and style	6	14
	Child's medical condition	1	5
Maintenance & managing high risk situations	Maintenance	1	12
	Social outings or special occasions	8	41
	Screen-based leisure time	3	15
Poor time management	Work	7	30
	Lack of time and preparation	5	42
Inconsistencies or lack of support (first-level theme retained as a second-level theme)		13	82
Discarded	Miscellaneous	15	32
	Financial	2	3
Total		93	433

¹ As described in (270)

* Locus of control is a concept in between psychology and sociology related to where individuals conceptually place responsibility and choice for events in their life – either internal or external to themselves (327). The terms are used to define an individual as “internals” or “externals” and refers to the amount of control individuals believe they have over their lives (328). For the purposes of reporting the themes identified in the interviews for this thesis, these terms have been adapted to categorise the amount of control (internal = a lot, external = minimal) parents felt they had over factors that either supported or inhibited their ability to achieve healthy lifestyle goals promoted within the PEACH program.

This section describes each of the second-level barrier themes illustrated by direct quotations from interviews conducted with parents at the 12 month time point. Quotations have been selected to support a sample of the first-level themes underpinning the second-level themes, which are then discussed relative to the existing literature.

Second-level barrier theme: Internal locus of parental control

As for facilitators, the second-level theme “internal locus of parental control” summarised barriers to the achievement of healthy lifestyle goals that were considered to be under direct parental control. This second-level theme consists of the first-level themes of “burden of responsibility”, “low self-efficacy or commitment” and “parental concern regarding restriction”.

Burden of responsibility

The theme “burden of responsibility” was used to group together points expressed by parents who had the sole responsibility for making lifestyle changes within their family or who were the sole carer of their child ie. single-parents.

“I think that’s my biggest challenge. I’m doing it as a sole parent, it’s harder because I just have to think of everything.” (MOTHER)

“I find a lot of it falls on me, I’ve got to like watch what everyone is like. Like my husband was going to attack some food last night and I just said, stop... I’ll get called the food nazi now.” (MOTHER)

Low parental self-efficacy or commitment

The theme “low parental self-efficacy or commitment” reflected a perceived lack of knowledge, motivation and commitment by parents that made it harder for families to achieve their healthy lifestyle goals.

“I think my own mood at times can also contribute to that. Whether or not I can be bothered myself being active or showing the right example that way.”

“Now, the other thing which is actually is the commitment of all members in the family to actually lose weight and sort of stick to the PEACH Program and I guess there’s a commitment on myself too to actually do it and I guess I haven’t been committed to that.”

Parental concern regarding restriction

The third theme identified as falling under internal locus of parental control is “parental concern regarding restriction”. This theme refers to parents’ concerns about the potential adverse effects (for the child and/or parent) of limiting their child’s consumption of unhealthy foods.

“...because you don’t want to end up creating an eating disorder in your child and then saying well you can’t have any more, and then you know, you feel like if people are saying that to her all the time, she’s going to start feeling that she wants to eat when she doesn’t want to, set up this psychological thing, so, that whole psychological aspect of it is the one thing that I feel has been the issue with her.”

“The eating side of thing, it does get, it’s awful sometimes and she’ll say, you know, can I have something to eat? And I say, oh you know, you’ve had enough. And she’ll say, you just think I’m a pig don’t you. And it hurts me.”

Discussion of second-level barrier theme “internal locus of parental control”

Some of this “burden” is a result of work-life stresses, social gender roles or family structure. A recent analysis of data collected in the first wave of the Longitudinal Study of Australian Children (LSAC) examined the detrimental effects work can have on family life (336). The authors found that parents who felt they had more support from their partner (in raising children) felt more competent as parents (336). Work-family stress was increased for mothers having a child with a long-term health condition, suggestive of the greater caring role assumed by mothers than fathers.

Mothers also tend to assume the role of food provider and preparer. Much of the responsibility of this was experienced by mothers in the sample as illustrated by the second quote above. Despite changes to women’s education, employment and childbearing years exerting pressure on traditional gender roles, women continue to assume responsibility for domestic tasks in most households (337).

As discussed previously, self-efficacy, or the belief in one's ability to successfully perform a behaviour, is important for the achievement of behaviour change (329). Related to this is commitment or motivation to maintain new behaviours. In a study conducted in the US, low caregiver motivation was identified as a barrier to physical activity via semi-structured interviews conducted with 11 dyads (female child (n=12) and caregiver (n=8 mothers, n=3 grandmothers): *"I'm the one who is lazy and I can't make her run outside...while I...watch TV"* (338). Parents generally control the type and amount of food available to their young children (285), they help shape the attitudes and behaviours children develop in relation to food, and they construct the family mealtime environment (339) (197). In addition, when asked to indicate who they were most likely to learn from and believe regarding knowledge about food, a sample of 11-16 year old children from four European countries (n=1079) ranked parents highest, indicating the importance of role modeling (340). Therefore, modeling of unhealthy behaviours by parents may translate to similar behaviours in children.

Reluctance to limit food consumption was also elicited from focus groups held with (low-income) mothers of overweight children in the US (3 focus group, with 6 mothers in each, children's ages ranged from 26-56 months) (341). Mothers found it emotionally difficult to deny children additional food and especially struggled with children whose appetites appeared limitless: *"If they ask for something, I'm not going to tell them no. I don't want to deny my child something."* The authors of this study suggested that reluctance to limit a child's eating may have been related to the use of food as a reward, however this was not identified in the PEACH sample and was a practice explicitly discouraged in both intervention arms. However, parental concern regarding restriction of food was referenced five times as a barrier to the achievement of healthy lifestyle goals by the PEACH parents. Similarly, focus groups conducted with predominantly Hispanic mothers of 2-5 year old obese children found that at least one third of mothers had difficulty setting limits around food consumption (342).

Fear of inciting eating disorders has also been identified in other parent groups (330), however involvement in a professional child weight management intervention affords minimal risk of this (343). This is discussed further in Section 6.7.4.

Second-level barrier theme: External locus of control

Similar again to the second level themes identified for facilitators of change, the barrier theme “external locus of control” represented factors which influence children’s behaviours, but which parents had little, if any control over. This second level theme incorporated the first-level themes of “peers”, “food provided at school” and “inclement weather”.

Peers

There were a number of initial codes falling under the theme of “peers” that hindered achievement of healthy lifestyle goals for families. Some of the more frequently cited ones were peer pressure, peer role-modelling and bullying.

“Um, and then again, there’s at school there’s a lot of peer group you know, oh, why are you eating that, you know, why aren’t you having a sandwich or chips, where she’s taking salads and fruit, you know.”

“the fact that other kids can go to McDonalds and KFC, I mean, just the last, I’ve noticed more in the last 2 weeks, when I ask her what she wants for dinner, it’s oh, KFC or McDonalds, and it’s just been constant, every single night, she’s wanted takeaway.”

“...very recently at school he’s sorta been teased, just by one person, but like his class bully about his weight and he felt really bad last week, like really upset and sad and that’s happened to him last year and well same sort of thing, but that’s sorta set him back with his self image.”

Food provided at school

Food provided outside the home was another barrier identified by parents that fell outside their control. This included food provided at school from canteens and vending machines, fundraisers, after-school care and also children swapping food at school.

"I think the school having a canteen that only really supplies junk food was the hardest because the kids always want to have a school lunch and sometimes you want to use that as a reward and you don't think you can use it as a reward if they've got just hot dogs and all that sort of rubbish, like pies, pasties, pizzas and all that sort of stuff."

"Um, I guess influence of kids at school.... I know that they do swapsy's out of their lunch box and stuff and he'll often say "Oh, I swapped my banana for a..... because it looked better.""

Inclement weather

The final theme grouped under "external locus of control" was inclement weather. Wet weather, cold weather, and just weather in general were referred to as making it harder for families to achieve their healthy lifestyle goals.

"...a lot of the time around winter time, so not only is activity decreased because of weather I guess, but she's eating I guess a little more unhealthier than she would be through summer."

"Okay. Um well weather's always a factor. Like when you're trying to get out there and do your activity and stuff and, oh it's too hot, it's too cold, it's too wet."

Discussion of second-level barrier theme "external locus of parental control"

Peer pressure was also acknowledged by parents (n=17) to be a major barrier to healthy lifestyle choices for children (aged 7-11 years) in a previous Australian school sample (334) and a UK sample (n=40 mothers, child age: 7-12 years) (330). A recent report from the UK stated that peer pressure and advertising has a greater effect on determining children's food choices at school and home than teachers and parents (344).

Parents of 7-11 year old Australian children cited unhealthy options in school canteens as a major obstacle to healthy eating for their children: *"The issue is that kids buy stuff at the canteen.....they still get the [unhealthy] food"* (334). In addition, this sample also reported that many foods that children are taught are unhealthy are available at the canteen, leading to children believing that these foods were in fact healthy.

Currently in Australia, the state Departments of Education and Health are introducing healthy eating guidelines to public school canteens. They will provide general directions regarding foods and beverages suitable for every day purchase by students and ultimately reduce the barriers currently experienced by parents regarding food provided at school.

Regardless of the season, weather was consistently listed as a barrier to the achievement of program goals that was beyond the control of parents. Weather was also recognised as a barrier to physical activity for parents of both low and high SES families in the UK (n=41 mothers, child age: 7-12 years) (330).

Second-level barrier theme: Child factors

The second level theme “child factors” represented a number of factors relating to children that hindered the achievement of program goals for families. These were related to the child’s age, their eating habits and their temperament. The initial code “child’s medical condition” was also included under this second level theme.

Child’s eating habits

Children’s food/eating style or habits, particularly emotional eating and an insatiable appetite, were other “child factors” reported by parents that made goal achievement difficult.

“Since the day she was born, she has just loved food and um, she’s actually..... she’s just always had an incredibly healthy appetite.”

“The only thing I probably find with (child) is that when she gets a little bit emotional she likes to eat, I suppose it’s like with a lot of us. You know, turns to food for comfort.”

Child's temperament

A number of parents indicated their child's temperament or lack of interest in program goals made it difficult for them to bring about changes to lifestyle habits.

"Because she gets a bit bored and she's quite easily to say, "Oh, I'm just tired" or "I don't want to do that anymore" and she's quite strong-minded so she is really set sometimes. Trying to convince her is a bit difficult and you know."

Child's medical condition

A range of medical conditions were reported as hindering achievement of program goals.

"(Child) is also asthmatic so you know that's a little bit of a yeah, and its only when a cold comes on and I guess we're a little bit guarded with her like going out to do things when its cold in case she gets a cold and it brings on the asthma."

"He's been sick lately, so we have been going easy on the sport, and also relaxed the eating side of things because he is not feeling well."

Discussion of second-level barrier theme "child factors"

A child's capacity to self-regulate intake in response to internal hunger and satiety cues is innate, but easily overridden by social and emotional cues from adults (345). Explicit use of food as a reward or comfort has been shown to be ineffective and probably counterproductive to strategies for improving food intake and variety (81). Satter argues for a feeding approach based on a division of responsibility around food and eating (291). In this situation, the parent is responsible for choosing safe and nutritious food and ensuring it is available and accessible, and the child is responsible for deciding how much is eaten. This is an approach that she applies to children of all ages and for weight management (292).

In contrast to this philosophy, a group of parents of 7-12 year old children in the UK viewed food preferences as fixed and resistant to change, identifying such

traits as barriers to healthy behaviours (330). In addition, parental use of food to satisfy children's emotional needs has been linked to a tendency towards childhood obesity (346). Another factor parents may perceive as being related to their child that plays a role in the development of overweight is "a love of eating" which has been identified through in-depth conversations with Australian mothers (n=11, child age: 14months-15 years): *"If there's food around she can't not eat it (mother of 12 year old girl)"* (347).

It is commonly reported in the literature that overweight in childhood is not perceived by parents as a health concern. Usually, it is not until the child's weight prevents them from keeping up with peers physically and socially that it is considered an issue (348). This suggests that being overweight is not regarded as a high health priority and that for example, the risk of physical activity aggravating asthma is perceived to be a greater concern than the risk of no physical activity increasing the degree of overweight.

Second-level barrier theme: Long term maintenance and managing high risk situations

Difficulties associated with long-term maintenance of change and the management of high risk situations (refer to Section 2.2.1) was a second level barrier theme. This second-level theme included the first-level themes of "maintenance" in general, managing "social outings/special occasions" and managing "screen-based leisure activities", as illustrated by the selection of quotations below.

Maintenance

"But yeah, I mean it hasn't been easy outside the PEACH program. Once you sort of get away from the sessions and the constant, you know, you do forget things and (child) forgets things."

Social outings and special occasions

"And when we are at a socialising event, it's hard to control because they get upset if you tell them anything in front of other kids, so I've got to be mindful of that. And that's where sometimes there's a slippage in terms of them sneaking a few extra cups of soft drink because they're on the table. And it's like oh, mum's not watching, I can have it. That sort of thing."

“Yeah, holidays is an absolute nightmare, yeah one day we had McDonalds for breakfast, Hungry Jacks for lunch and fish and chips for dinner because of the people that we were meeting on that day, we had different things on and that was, was an appalling nutritional day but it was a good fun day, you know and it’s, that was not something we would do during the year, like during the term time so but yeah more and more parties and things to go to.”

Screen-based leisure time

“Externally for us too would [be] at home, things like the Play Station and the internet are a challenge because they encourage him to be sitting down not doing anything. So that sort of stuff makes it a little bit harder.”

Discussion of second-level barrier theme “long term maintenance and managing high risk situations

Previous research has found that parents feel they had a high level of control over what their children eat at home, but not necessarily so for eating episodes in other environments (330). This finding is consistent with some of the opinions expressed by PEACH parents, as expressed above, and may jeopardise the long-term maintenance of healthy behaviour changes. Such scenarios are termed “high risk situations” in the Triple P program and can be managed by application of the “planned activities routine” (Section 2.2.1). Using such a tool can assist with the identification of barriers to maintenance and planning of strategies to overcome these.

The identification of “high risk situations” by parents in this study highlights the challenges faced by parents undertaking family health behaviour change. It emphasises the need for a behaviour management approach to child weight management that empowers parents with the skills and confidence to plan, implement and maintain behaviour change (240).

Second-level barrier theme: Poor time management

“Work” and “lack of time/preparation” were two first-level themes captured under the second-level barrier theme of “poor time management”. These represented a

significant number of references (30 and 42 respectively) to various ways that a perceived lack of time inhibited the achievement of program goals.

Work

"Probably working full time made it hard because sometimes things just go up in smoke and you can't control it so you just have to change them, I'm just trying to think, time constraints again because of the work for both of us, that's all I can think now.

"Obviously you know, I mean it's extremely hard, you know, you work 5 days a week, sometimes 7, it makes it hard, as I'm sure you guys are aware. Doing more hours in the day than you, in a perfect world you'd have more hours in the day and less time to spend at work and more with family. It doesn't happen that way."

Lack of time

"It's the time of finding the vegies all this, and then the time of preparing it, and you know, and you do, and you run out of time, and that's probably you know, if you weren't quite so busy, you'd probably do a better job at that. That's life."

"I spose lack of time is a big ah, the big negative. Like um I get home at about six oclock at night so your looking for things to cook which makes it hard. Um. Also to with activity too so by the time we get home by the time you try to encourage a bit of activity it just lack of time."

Discussion of second-level barrier theme "poor time management"

Lack of time has been cited by samples of other Australian parents (n=17) as a major barrier to children participating in organised sport (334) and a barrier to the provision of healthy food/meals by UK parents (n=41 mothers, child age: 7-12 years) (330). The misconception that healthy food needs to be home prepared or fresh ie "finding the vegies", "looking for things to cook", potentially contributes to the perception of lack of time for healthy food and signals the need for education around quick, convenient and healthy meal options.

The three most common reasons given for not attending sessions or not using resources at home were lack of time, family and work commitments (Section 4.2.2). These responses support these interview findings, both of which illustrate the increasing challenges parents face to achieve a satisfactory work/life/family balance (75). Providing parents with strategies to manage their time and obtain and prepare healthy meals and provide activity opportunities for their children will assist in overcoming such time demands.

Second-level barrier theme: Inconsistencies/lack of support

This final theme relating to barriers was a first-level theme that was retained as a second-level theme as it included 82 references to a large number of initial codes. This theme reflects inconsistencies between program principles and the home environment, wider family, friends and society in general that were unsupportive of the achievement of program goals. In particular, comments relating to “inconsistent parenting”, “lack of family support” and “marketing of fast food” were commonly quoted and some examples are presented below.

“And her Dad is sort of, has a bit of a different way of thinking to me. Like, “Oh she’s only a kid you know” or “Let her have that, she’s alright, she does enough exercise”..... So that can be hard you know. Yeah, about his, or letting her sneak something, “Oh don’t tell Mum.” You know, if I’m at work and he buys her something. Or hiding things, which I think is a bit deceitful.”

“Mainly my wife, I suppose. My wife’s not really focussed on this sort of thing, but just tends to get on with things and keep everyone happy. And she tends to allow (child) to overeat.”

“Well, lots of things, yeah, um, I guess family has been very difficult. My husband has absolutely refused to co-operate, and if anything, gone more extreme, just deliberately to make it more difficult.”

“The other thing when you visit family, extended family and they invariably want to give the children treats, you know the chips or the baking, that I found was a little hard.”

“Like society in that whilst there is like this all-pervading healthiness everywhere, there is also amongst that, ads on TV every second for McDonalds and that sort of thing. So I guess those sorts of external factors made it harder, because (child) has got this glamorised view of McDonalds, and I don’t know what it is about the place, but she just finds the whole notion of going to McDonalds as terribly exciting.”

“Supermarkets. Yeah, the way they set up. You know, they strategically put everything at eye level that they want to sell. There’s not a huge amount that you can easily access, there’s more of the junk than there is the healthier. So that’s challenging, especially when you know you have a whole section that’s snack foods for kids and if you actually look at it all there’s very little that you can pull out of there.”

Discussion of second-level barrier theme “inconsistencies/lack of support”

Lack of support from other family members, most commonly by fathers and grandparents, has been reported elsewhere in the literature (341). This work was conducted with mothers only however, and some mothers indicated support from fathers, so it is difficult to conclude that fathers are always undermining

rules set by mothers. The PEACH study included interviews with mothers and fathers and references were made to both being unsupportive of healthy eating at times.

A recent cross-sectional survey (n=315, 36% men) undertaken at an Australian supermarket exploring the public's perception of the causes of obesity among primary school children found 50% of adults viewed the media's promotion of unhealthy foods as an extremely important causative factor (349). The need for clear and consistent messages around healthy lifestyle choices across settings is crucial for obesity management and prevention. This need was also identified by Australian parents (n=17) and children (n=119, 7-11 years old) participating in focus groups to explore perceptions around healthy eating, physical activity and obesity prevention (334).

Similarly, focus groups conducted with parents of 7-12 year old children in the UK reported "widespread scepticism of current information with the media, food manufacturers.....as sources of potentially biased information" (330). The World Health Organisation considers the marketing of fast foods a key factor in the worsening diets of populations, with children particularly affected by advertisements (344).

The findings from the PEACH study and others highlight the need for support for healthy lifestyle choices from *all levels of society* – from family and friends to organisations and governments – at the individual and population level. This will help to ensure that action regarding the management of overweight occurs simultaneously along the prevention – treatment continuum.

5.4 Conclusion: Facilitators and barriers to the achievement of program goals

This section reported the findings from the thematic analysis of interviews conducted with study parents to describe in detail the factors external to the PEACH program that facilitated or inhibited families in achieving their healthy lifestyle goals. The aim of thematic analysis is not to develop a theory (as for grounded theory), but to describe in detail the opinions and realities experienced by a target group (258) (Section 2.5.5).

Parents identified more barriers to the achievement of healthy lifestyle goals than they did facilitators. Many of these were beyond the scope of the study and also perceived to be outside the internal control of parents. This was similar to a group of British parents who found it more difficult to verbalise facilitators than barriers to healthy behaviours in primary school children (330).

The social and environmental barriers and time pressures identified by parents are a common feature of Western family life such that many parents are raising families in stressful situations (347). Therefore it is important that health care providers and interventions are considerate of these issues.

Limited research has been conducted to examine the factors that support or inhibit parents' efforts to achieve healthy lifestyle goals for their families (334), particularly the experiences of parents participating in a child weight management program. The few studies identified as having explored this area focussed mainly only on barriers to healthy lifestyle behaviours, commonly identifying:

- Limited facilities for physical activity (334) (330) (338)
- Lack of time (334) (330)
- Peer pressure/inconsistent or contradictory role modelling (334) (330) (338)

as preventing healthy lifestyle choices. Many of these themes are consistent with the findings of the present study and emphasise the need to view childhood overweight as a public health issue that has many societal and environmental influences (Figure 1.3). These findings place a “real-life” lens over the intervention allowing consideration of factors influencing its effectiveness. They identify the importance of environmental and social determinants of behaviours that result in weight gain, highlighting the need for extended support for individuals, families and populations to ensure that healthy choices are easy choices.

These findings provide an insight into the context within which families live and the influences they must manage whilst modifying their lifestyle choices. Recognition of this complex milieu illustrates the importance of considering factors external to a program and inherent to its participants during program design and delivery in order to maximise intervention effectiveness.

Supporting parents during an intervention to increase their control over situations that have been shown to jeopardise goal achievement may also be worth considering. Similarly, raising parents’ awareness of barriers identified by previous participants may help to alert them to possible pitfalls, thus stimulating action to prevent or avoid them. Identification of issues associated with maintenance will assist in the design of programs that provide adequate support during this crucial time.

Aspects that were relevant to both facilitators and barriers were factors internal and external to parental control. Parents need to be encouraged to initially address those barriers which they have direct control over (eg. skills and knowledge). This may lead to increased self-efficacy and a belief that those barriers outside their control (eg. obesogenic environment) are also manageable, for example via advocacy or lobbying. Such external factors may

be out of the reach of an intervention, but are important to keep in mind during intervention delivery.

Interventions and families exist within an environment in which the healthy choice is not always supported. Ideally, interventions should aim to advocate for supportive environments for participants in order to maximise the likelihood of success. This may be through discussions with schools regarding the promotion and provision of healthy lifestyle choices, lobbying against TV food advertising or advocating for healthful urban planning and development.

Understanding the “real-life” experiences of a target populations is necessary to design and implement weight management interventions in an increasingly obesogenic environment. The insights provided by the qualitative research findings described in this chapter provide an important understanding of these experiences. The implication of these findings on practice and future research is discussed in the conclusion of the following chapter.

Chapter Six: Overall Discussion

This final chapter reiterates the main findings of this thesis study and outlines how this work has contributed to the evidence regarding effective management of overweight in pre-pubescent 5-9 year old children. Study strengths and limitations are also identified and discussed. Finally, the implications of the study findings on child weight management practice are outlined and areas warranting further research are considered.

6.1 Reiteration of key findings

6.1.1 Outcome evaluation

The key findings of the outcome evaluation were: i) unsuccessful maintenance of the significant group difference observed for the primary outcome of BMI z-score at the six month time point, ii) significant reductions in BMI and WC z-score were successfully maintained by both groups to 12 months and iii) indicators of psychosocial health and growth were maintained or improved. These findings were discussed in relation to the literature in Section 3.2.3 and are briefly summarised below.

Unsuccessful maintenance of the significant group difference observed for the primary outcome of BMI z-score at the six month time point

A group difference was observed only for BMI z-score at the six month time point ($p < 0.005$), indicating that the addition of a parenting skills training program improves the short term effectiveness of a parent-led family focussed healthy lifestyle intervention for the management of overweight in 5-9 year old children. However, the addition of a parenting skills training program made no difference to the long term effect and the possible reasons for this were presented in Section 3.2.3. The finding necessitates the need for the acceptance of the null hypothesis (Section 1.4.3).

Significant reduction in BMI and WC z-score successfully maintained by both groups to 12 months

The long term effect of the intervention on the primary study outcomes (BMI z-score and WC z-score) showed that the reductions achieved over the intervention period were maintained for the following six months equally for both groups without any further program contact. As presented in Sections 3.2.1 and 3.2.2, both groups demonstrated significant decreases in BMI z-score and WC z-score from 0-6months and 0-12months ($p < 0.001$ for all).

Boys responded significantly better than girls for both of these anthropometric indicators over both the intervention and maintenance periods. This gender effect was confirmed and discussed in Section 3.2.3. It may be explained by the boys' significantly greater BMI and WC z-scores at baseline and/or physiological, environmental or societal gender differences. Varying effects of gender have been reported elsewhere in the literature (296) (215, 295) (294) (304) signalling that this characteristic should be considered in future study design, implementation and analysis.

Maintenance or improvement of indicators of psychosocial health and growth

In addition, indicators of psychosocial health as reported by children and parents were either maintained or significantly improved over time, respectively (Table 3.10). Indicators of HRQoL and body size dissatisfaction did not change for the children over time. Parents reported significant improvements in how they perceived their child's HRQoL for all three domains examined (0-6mth: $p < 0.01$, 0-12mth: $p < 0.001$). Children's linear growth was not negatively impacted upon but showed the potential to normalise. Height increased significantly over time (0-12mth: $p < 0.001$), whilst height z-score values significantly decreased (0-12mth: $p < 0.001$).

Summary of outcome evaluation findings

These findings demonstrate that a parent-led, family focussed child weight management intervention can result in successful reduction in overweight that is maintained during a period of no further program contact. However, the addition of a parenting skills training program did not improve the long-term effectiveness of the healthy lifestyle program included in this intervention.

Anthropometrically, boys responded better to the intervention than girls and there was no evidence of negative impacts upon the psychosocial health of children of either gender. The possibility of increased reductions following on-going support is an area that holds immense potential and requires further investigation.

It is important to consider that the improvements in the sample's anthropometric outcomes were seen in a sample self-selected from a population where prevalence rates of childhood overweight increase by 1% annually (1). In the absence of nationally-representative longitudinal data, this annual increase in population prevalence of overweight implies a temporal increase in individuals. If this is the case, the real effect of the intervention may be greater than the documented decrease in BMI z-score from baseline due to the prevention of potential increases in degree of overweight that may have occurred in the absence of the intervention. As discussed in Section 2.3.1, the study did not include a control group for a number of ethical reasons. Comparison to an age- and gender-matched community cohort may have been a useful "quasi-control" group to extend the interpretation of the significance of the study results.

Analysis of the secondary outcomes provided reassurance that involvement in the PEACH study did not cause any unintended harm. Rather than being negatively affected, psychosocial health was seen to be at least maintained, and for some aspects improved. Linear growth was not retarded, instead it was observed to align more closely with normal age- and gender-specific growth

patterns and hence accelerated growth associated with overweight was moderated.

The maintenance of group reductions in measures of adiposity potentially reflects the initiation and maintenance of beneficial lifestyle changes which was the principle aim of the study (for both intervention arms). These outcomes were analysed through the evaluation of the study's impact evaluation indicators which are discussed below.

6.1.2 Impact evaluation

The key findings of the impact evaluation were: i) children's dietary and activity behaviours significantly improved and were maintained by both groups to 12 months and ii) indicators of parenting skills were maintained or displayed improvement. These findings were discussed in relation to the literature in Section 4.1.1.3 and 4.1.2.3 and are briefly summarised below.

Children's dietary and activity behaviours significantly improved and were maintained by both groups to 12 months

There was an absence of group difference in the impact indicators of children's dietary and activity behaviours. This was not unexpected given that there were few group differences in the outcome indicators and the study was not powered to detect differences in such indicators. However, improvements in both children's lifestyle behaviours were observed in both groups over the intervention period that were maintained in the following six months without any further program contact. The improvement in dietary behaviours reflected changes towards program and national healthy eating recommendations. The number of children achieving the recommended scores for each of the dietary subscales increased over time and remained above baseline levels, despite a reduction in sample size. The time children spent being physically active per day showed a non-significant increase over time. This was coupled with a significant decrease in the amount of time spent engaged in small screen entertainment

per day to produce a large discrepancy between the measures that reversed and increased over time.

Indicators of parenting were maintained or displayed improvement

There was an absence of group differences according to both measures of parenting. The sample as a whole demonstrated significant improvement in satisfaction, efficacy and total parenting competence score. The constructs of parenting consistently showed significant effects of child gender for the “monitoring and supervision”, “involvement” and “positive parenting” scores. Significant improvements were seen for the full sample over both time periods for the “inconsistent discipline” and “corporal punishment” scores. When change over time was examined by group, the only difference was for the “monitoring and supervision” score, with improvement seen at 12 months only for the HL+P group. The possible reasons for this were discussed in Section 4.1.2.3.

Parental anthropometry data needed to be interpreted with caution due to low response rates and a heavy reliance on self-reporting, especially for fathers (39% and 44% respectively at 12 months). These indicators appeared to remain constant for both mothers and fathers, suggesting maintenance of weight status amongst a sample that exhibited a 70-90% prevalence rate of overweight/obesity at baseline.

6.1.3 Process evaluation

The key findings of the process evaluation were discussed in relation to the literature in Section 4.2.4 and are briefly summarised below.

Well attended and accepted

There were no group differences regarding attendance to sessions or satisfaction with sessions. Attendance rates correlated with the level experienced by the pilot study but were lower than reports from other studies. The main reasons for not attending sessions or applying program principles at

home were related to factors external to the program associated with work/family commitments and general lack of time. Parents rated the program highly in regards to quality and satisfaction.

The most common suggestions for program improvement were i) more resources, ii) more contact, and iii) involvement of the child. A possible rationale for these suggestions was outlined in Section 4.2.4.

Maintenance of program integrity

Assessment of the maintenance of session integrity confirmed that differences in sessions were maintained, assuring that the program was delivered consistently across two sites by multiple facilitators.

6.1.4 Facilitators and barriers to the achievement of program goals

The key findings of the examination of factors affecting intervention effect were discussed in relation to the literature in Sections 5.2 and 5.3, and are briefly summarised below.

More barriers identified than facilitators

Thematic analysis of 95 interviews conducted with parents at the 12 month time point identified more reference to prohibitive than supportive factors external to the PEACH program that influenced participant success (433 vs. 375 respectively). Grouping of these references into themes resulted in barriers having twice the number of themes than facilitators. The three facilitator themes summarised factors under the control of parents (“internal locus of parental control”), factors outside of parental control (“external locus of control”) and factors specific to the child (“child factors”). The six barriers themes identified included three identical to the facilitator themes, along with “long term

maintenance and managing high risk situations”, “poor time management” and “inconsistencies/lack of support”.

Identification of the contextual nature of the issue

The identification of many different factors external to the program that either supported or inhibited parental ability to achieve healthy lifestyle goals recognises the contextual nature of family-based interventions and weight management strategies. These influences must be considered in program design, delivery and evaluation.

6.2 Contribution to the evidence

Investigation of the role of parenting

The benefit of targeting only parents for the management of childhood overweight has previously been established by a single research group (190). This study has extended the work of Golan et al and demonstrated the generalisability of their recommendations.

The type of support to offer parents, however, is yet to be determined. This thesis study addressed this issue by examining the importance of general parenting skills in the parent-led, family management of childhood overweight.

Assessment of broad health outcomes

As discussed in Section 1.3.2.2, there is a need to include broad health outcomes (beyond change in degree of overweight) in the assessment of the effectiveness of child weight management interventions. This study included primary and secondary outcomes that assessed measures of anthropometric indicators of weight status and also psychosocial indicators of health.

Inclusion of impact and process evaluation indicators

In addition to the assessment of outcome evaluation indicators, this thesis study reported impact and process evaluation indicators – a further need identified by numerous reviews and recommended by program evaluation literature. The collection of impact evaluation data monitors whether intervention actions result in the intended outcomes as anticipated. Recording of process evaluation indicators provides a quality assurance mechanism for the intervention and also increases the program's generalisability.

Consideration of environmental influences and assessment of parental perspective

In recognition of the contextual nature of the development and subsequent management of overweight in childhood, a greater understanding of the factors external to the intervention that affected parents' abilities to achieve healthy lifestyle goals was sought through the use of qualitative research methodology. A greater understanding of social phenomena can be achieved through the simultaneous use of quantitative and qualitative approaches (350). This design aspect provides a further contribution to the evidence via the use of high quality methodology.

Provision of long-term follow-up

Finally, the 12 month results reported represent the long-term follow-up of a six month parent-led, family-focussed child weight management intervention following a six month period of no further program contact. Analysis of this maintenance effect addresses yet another evidence gap in the literature and contributes to greater understanding of the need to consider childhood overweight as a chronic condition (discussed further in Section 6.7.2).

6.3 Study strengths

The five main strengths of this thesis study are:

- i) study design and protocol,
- ii) inclusion of broad evaluation indicators,
- iii) inclusion of qualitative research methodology,
- iv) analytical technique, and
- v) incorporation of national recommendations.

The first three strengths directly address study design and evaluation issues as identified by Section 1 of the literature review and summarised in Table 2.5. The details of each of these strengths are presented below.

Study design and protocol

Randomised controlled trials are considered the “gold standard” for treatment and intervention studies (215) (216). The PEACH study was prospective and randomised with a “usual care” control – a significant design strength. In addition, randomisation was stratified by gender, cohort and site – reducing the risk of confounding due to these factors. Examination of key characteristics and potential confounders at baseline found no significant group differences, indicating that the randomisation process was successful. Assessors were blinded to group allocation and sample size was calculated based on national reference data.

Furthermore, a number of additional design features contributed to enhanced generalisability of the study. The use of an internationally recognised measure of childhood overweight to assess effectiveness facilitates comparison across regions, resulting in consistent and meaningful reporting of outcomes (11). Where possible validated tools were used to measure outcomes so as to improve the accuracy and relevance of reporting. Importantly, a standardised protocol was used to deliver the intervention (including program delivery and measurements) across sites. This resulted in the program being delivered

successfully and consistently across two sites and by multiple facilitators. This design feature enables direct replication of the intervention in other settings, further increasing its generalisability.

Generalisability is further addressed by the program design being suitable for inclusion in current treatment service delivery models within the Australian public health system. The group delivery method would provide improved service efficiency over the current routine practice of one-on-one individual counselling for weight management (351).

Both intervention arms were feasible with reasonable attendance rates (75% of sessions attended by almost half of participants in each group). The 12 month attrition rate of 27% was less than the anticipated rate of 33% (see sample size calculation in Section 2.5.1) and lower than the 10-50% reported elsewhere (140).

Inclusion of broad evaluation indicators

The effectiveness of the study was evaluated against a broad range of indicators and measured using a mixture quantitative and qualitative research methods.

A strength of the study is the inclusion of outcomes beyond anthropometric indicators. The inclusion of psychosocial indicators of health and lifestyle behaviours that contribute to weight status are essential to provide a more accurate understanding of the mechanisms contributing to weight management. Further, the assessment of study processes provided information on program acceptability and aspects for further improvement. Appreciation of these aspects is fundamental to a client-centred approach – the preferred approach for chronic disease management- and is critical for the translation of research to practice and indication of study generalisability. The inclusion of such broader evaluation outcomes has been identified as a research need and recognition of this is a further strength of this study (140).

Inclusion of qualitative research methodology

Inclusion of qualitative research methods within interventions was another research recommendation made by the Cochrane review of interventions for treating obesity in children (140). Qualitative research methods provide a means of exploring contextual issues and understanding intervention effects that conventional theories have difficulty explaining (352). When combined with quantitative methods they provide compelling evidence for the effectiveness of behavioural interventions (216). They allow an insight into the lived experience of study participants – an aspect that is crucial when examining a condition so deeply contextual as the family management of childhood overweight. Clinicians are trained in deductive reasoning and naturally lean towards deductive quantitative research that best answers the “whether” and “how much” questions (353). However, as the obesity epidemic is increasingly being recognised as a societal issue, quantitative methods alone will not help answer the questions that influence the behaviours of individuals and populations. Systematic and qualitative research methods are required to interpret such environmental interactions (353).

The environmental and societal influences on lifestyle behaviours and weight change are often discussed anecdotally. This study moved beyond such “armchair hypothesising” to incorporate rigorous qualitative research methods within a strong quantitative framework (353). This coupling of methods has resulted in findings that are broader in scope and richer in meaning than if only one of the approaches were used. The qualitative findings, whilst not providing answers, have potentially generated a greater conceptual understanding of the challenges faced by parents managing their families health in what has been described as a “toxic” environment (344).

Analytical technique

Utilisation of the ANCOVA statistical technique facilitated adjustment for potential confounders at the six and 12 month time points. In addition, the use of intention to treat (ITT) analysis resulted in all subjects with available data being included in each statistical model, regardless of attendance to sessions (used as a proxy for adherence). Despite ITT analysis being the most appropriate method for assessing intervention effectiveness (205) it is rarely reported.

The rigor of the qualitative analysis was ensured by following systematic processes as outlined by Braun and Clarke and incorporating auditing of analysis (270).

Incorporation of national recommendations in program content

The lifestyle behaviours promoted in the program are reflective of national eating and activity guidelines and concur with clinical practice guidelines for the management of overweight in children and adolescents.

The nutrition component of the intervention was underpinned by the Australian Guide to Healthy Eating (AGHE) – the national food selection guide (242). Dietary modelling has shown that an eating patterns consistent with the AGHE and linked to nutrition recommendations promoted by the program result in a reduction in the amount of saturated fat and energy in Australian children's diets (244). The physical activity and sedentary behaviour recommendations promoted within the program reflect physical activity guidelines endorsed by the Australian federal government (104). In addition, inclusion of the cornerstones of management as outlined in the National Health and Medical Research Council's Clinical Practice Guidelines ensures that the program is directly applicable to the clinic setting, providing an evidence based approach to practice (12).

6.4 Study limitations

There are four main limitations of this intervention and interestingly, some appeared as strengths in the previous section. The limitations of the study have been identified as:

- i) study design,
- ii) limitations of generalisability,
- iii) limited long-term follow-up and
- iv) limited power.

The details of each of these limitations are discussed below.

Study design

Despite the widely acknowledged strengths of the randomised controlled study design, this model may have limited the effectiveness of this intervention. This possibility is recognised by the 2003 Cochrane review which highlighted the usefulness of rigorously evaluated, innovative non-RCT interventions to provide evidence regarding the most effective management of childhood overweight (140).

Overweight is a chronic condition, the management of which requires a participatory, client-centred approach (discussed more in Section 6.7.2). The requirements of the RCT protocol such as the need to ensure consistency across cohorts and sites and also the maintenance of differences between groups limited the ability to tailor the program to client needs. This may have impeded the success that families could possibly achieve, thus limiting the achievement of maximum program potential.

The involvement of participants and practitioners in the delivery of individualised care is more likely to result in satisfactory treatment outcomes than the delivery of a standardised program (217). The tailoring of interventions to subjects however is difficult within the boundaries of a randomised clinical trial and this may be a significant limitation of the study.

Limitations of generalisability

A limitation of the study is its inability to be generalised to all families of overweight children. The families who enrolled in the PEACH study were self-selected and aware of their child being overweight. As discussed in Section 3.1.7, the vast majority of the population do not identify overweight in their children and/or do not feel concerned by it/motivated to take action. The importance of individual readiness to initiate behaviour change for program success can be explained by the transtheoretical model, which identifies the “action” stage as the point at which an individual is motivated to undertake behaviour change (354). This model is applied widely to weight loss interventions and illustrates the importance of engaging individuals in an intervention when they are motivated to take action (329).

Also, the study sample represented a middle-class, predominantly Caucasian population so its usefulness in other groups is unknown. The prevalence of ethnic diversity is increasing amongst populations and an Australian government report estimates that climate change alone could result in up to 200 million climate change refugees worldwide, many from low-lying islands in the South Pacific (355). Immigrants, especially children, are particularly susceptible to the obesogenic environment of industrialised countries (356). The prevalence of chronic diseases associated with obesity increases with time amongst immigrants living in an industrialised host country (357). These points reinforce the importance of programs that are acceptable to culturally diverse groups and highlight an area worth investigating within the current PEACH program.

Limited long-term follow-up

It was beyond the scope of this thesis to report findings beyond the six month post-intervention end time point. While 12 month follow-up may be considered long-term maintenance in comparison to many of the other studies providing evidence in this field, longer term follow-up is required. The PEACH study will continue following families six monthly to two years and then yearly to 5 years

post baseline. Initial analyses of this longer term follow-up data indicate that the patterns observed over the first 12 months are being maintained beyond this time point, with the reduction in degree of overweight being maintained over time equally for both groups.

Limited power

Despite achievement of the calculated sample size, it is likely that the study was underpowered to detect a group effect at the 12 month time point. As described in Section 2.5.1, the sample size calculation was based a reduction in BMI z-score of 10% and 30% from baseline to the 12 month time point for the HL and HL+P groups respectively. The actual reduction achieved was 9% and 11%, suggesting that the power calculation gave an accurate estimate of the likely effect of the intervention for the HL group, but overestimated this for the HL+P group. A reverse power calculation conducted with the actual group differences achieved and the actual baseline BMI z-scores produced a required sample size of 1 939 subjects per group to achieve 80% power at the 0.05 significance level.

The study was testing the effectiveness of the intervention – that is, the effect of the intervention is a real life setting. For example, subjects were purposefully not provided with regular reminders to attend session, or given structured meal plans as the aim of the intervention was for self-management and competence. This is in contrast to an examination of intervention efficacy, which would test the effect of the intervention in an ideal setting. In this scenario, families could be provided with weekly shopping lists and recipes in addition to regular session reminders. Given that the intervention was occurring in an obesogenic environment and families identified more barriers than facilitators to the achievement of program goals, the full potential of the intervention may not have been realised. This is a possible reason for a lack of statistical significance by group, however provides a more accurate picture of results that could be expected in the real-life setting of a public health care service.

6.5 Potential bias

The possibility of selection bias due to participants' level of motivation and demographic characteristics impacting upon study generalisability has been presented in the previous section.

Potential bias was successfully managed by randomisation that was stratified by gender and generated for each cohort in each site resulting in even distribution of potential confounders between groups across sites. There was a tendency for i) obese children over eight years of age, of middle-class overweight families to enrol in the study and ii) boys to perform better than girls with respect to reduction in adiposity. These factors may have implications for generalisability as acceptability of the program to socio-economically disadvantaged families is unknown. However, its suitability to overweight parents is important given the high genetic and environmental risk this places on their children.

During the delivery of the intervention and collection of data, other potential sources of bias associated with site and cohort were minimised by the use of standardised protocols and data collection tools. Adherence to these protocols and hence the maintenance of program integrity was assured by the auditing process outlined in Section 2.4.6.12. Nevertheless, the possibility of intervention bias existed due to variations in adherence across groups. Using attendance to sessions as a proxy for adherence however, this variation appeared similar across groups, indicating the minimisation of intervention bias.

The use of standardised protocols, consistent equipment and available validated tools minimised the risk of measurement or misclassification bias. Reporting bias, common when parents report on behalf of children, may have affected the accuracy of data collected in this study (358). Socially desirable reporting may have also been another source of bias in both groups. In addition, the reporting of the subjective measures (particularly the secondary outcomes and impact evaluation indicators) may have led to bias in favour of treatment. However if

present, such bias would have resulted in a bias of the estimates of effects towards no group effect. This may have potentially reduced the ability of the intervention to detect a group difference.

Retention rates were 80% at six months and 73% at 12 months and drop outs were evenly distributed between the two study arms, indicating a low likelihood of follow-up bias.

As described by Braun and Clarke, the themes identified in the data during the process of thematic analysis were actively identified by the researcher, rather than passively “emerging” from the data. This assumes that the researcher actively identified the themes because they were of interest and relevance (270). This process introduces potential researcher bias, however is unavoidable. The use of an auditing process and thorough documentation of all data collection and organisation helped to reduce this and increase the validity and reliability of the interpretation.

6.6 Clinical relevance

Despite the absence of a statistically significant group effect at the 12 month time point, the maintenance of significant reduction in degree of overweight for both groups over the six month period following the intervention end without further program contact represents a clinically relevant achievement. In the adult literature, a reduction of 10% in body weight is defined as clinically significant (359) and this was achieved for waist circumference z-score for both intervention arms and BMI z-score for the HL+P arm to the 12 month time point (Table 3.6).

A previous study by Reinehr et al (360) showed that a weight loss of between 0.25 and 0.5 z-scores in BMI over one year is associated with a significant reduction in LDL cholesterol in a sample of 40 children aged 4-15 years. The

children in the HL+P arm of this thesis study demonstrated a reduction in BMI z-score within this range (-0.31 over 12 months), suggesting that the weight loss observed may have accorded significant reduction in cardiovascular disease risk. Children in the HL arm of the study however did not reach this threshold. Mean baseline BMI z-scores were similar in the Reinehr group and the HL+P and HL arms of the thesis study (2.5, 2.8 and 2.7 respectively).

In addition, the maintenance and improvement of indicators of child psychosocial health as reported by children and parents respectively demonstrates a clinically relevant outcome of the intervention. Improvement and maintenance of child lifestyle indicators over the short and long term also represent clinically and practically relevant achievements in behaviours that directly contribute to improvements in both weight and health.

6.7 Implications for practice

6.7.1 A need for effective treatment

There is a need to provide treatment services to address childhood overweight, however the research into effective management options is diminishing as the emphasis on primary prevention increases. Despite this, the evidence for prevention is even less robust than that for treatment (361), the outcomes of which will not be experienced for at least another generation.

The current funding and research activity focussing on the prevention of childhood overweight could potentially result in neglect of furthered understanding of effective treatment of the condition. Choosing between prevention and treatment is a potentially unproductive way to dichotomise the issue of childhood overweight, particularly as at least 20% of children are currently overweight, with this rate increasing annually and the condition and its

attendant co-morbidities persisting into adulthood in at least 40% of children (57).

The results of this study demonstrate that a parent-led, family focussed approach to child weight management can produce effective long term results, counteracting the argument for minimal funding to this area due to lack of evidence of effectiveness.

A balance needs to be struck between the effective prevention and treatment of this persistent and increasingly omnipresent condition. Previous successes experienced by other public health issues (such as smoking) stress the importance of a balance of strategies offering treatment, prevention and support (311). The management of established childhood overweight must be considered as treatment of a childhood condition and also secondary prevention of adult overweight and in this way offers intervention along all points of the prevention - treatment continuum (4).

6.7.2 Recognition that overweight is a chronic condition

There is a need to recognise that childhood overweight is a chronic condition resulting from rapid societal and environmental change. As discussed above, effective management requires action at both the population/public health level and early intervention/secondary prevention level (357).

The long term effect of the intervention on the primary outcomes (BMI- and WC-z-scores) of the study showed that the reductions achieved by both groups over the intervention period were maintained for the following six months without any further program contact. This potentially reflects the initiation and maintenance of beneficial lifestyle changes which was the principle aim of the study (for both intervention arms). However, in both groups the rate of decrease in BMI z-score diminished over the second “non-contact” six month period. This pattern was

also reported by a recent intervention conducted in Finland (215). In addition, the mean BMI z-score of both groups indicated that the samples remained overweight.

These patterns highlight the need for continued monitoring or low level support to maintain initial successful behaviour change in order to sustain a continued reduction in the degree of overweight over time. The delivery of a four month post-weight loss treatment maintenance strategy to a group of 150 7-12 year olds in the US has recently been demonstrated to significantly improve child weight control when compared to a no contact control group (362). This requires the application of a long-term chronic disease management approach to the management of childhood overweight, as is delivered in the adult weight loss field (362) (363). A recent review of interventions to reduce obesity and chronic disease risk in children identified a lack of long term follow up and called for implementation of this to determine sustainability of program impacts and maintenance of weight management (357).

Management of other chronic conditions in childhood (such as cystic fibrosis, asthma and diabetes) provide valuable lessons. Group programs are key to providing long term management of asthma and diabetes (364) (365). Communication technology (eg. text messaging, email and telephone) is an effective adjunct to health service delivery (366) (367). Short-term delivery of weight management sessions via the internet has been successfully trialled with adolescent African American girls (11-15 years old) and confirmed this delivery format as an effective means of transmitting program material over six months (368).

Important considerations for the provision of long-term chronic disease management for young people are i) that it is age- and developmentally-appropriate (discussed further in Section 6.7.4), ii) that there is an effective

transition from paediatric to adult care (369) (370) and iii) that psychosocial aspects of life with a chronic illness are considered (371).

6.7.3 Appropriateness of weight change as a primary outcome

Despite its use in adult weight management programs, the use of weight change as a primary indicator of effectiveness in child weight management programs may be inappropriate (140). Rather, the monitoring of lifestyle behaviours that translate to improvements in weight and health and changes in psychosocial health may be more meaningful.

The rationale for monitoring change in weight is underpinned by the association between overweight in childhood and adult risk of overweight and its comorbidities. When targeting children who are overweight, but not morbidly obese, these complications are often not experienced until adulthood and if present in childhood, are not experienced physically. This means that the determination of long term effectiveness is difficult and may take more than 20 years to report. Furthermore, if these clinical endpoints are not experienced by the child and/or parent, the motivation to initiate and maintain behaviour change is likely to be lower. In addition, parental ambivalence to childhood overweight as a health concern is widely reported (284) (282) (52), suggesting that a change in degree of overweight (especially when defined as BMI z-score) may be an irrelevant client outcome and unlikely to maximise engagement.

Conversely, psychosocial morbidity resulting from overweight in childhood is a symptom directly experienced/perceived by both child and parent. Anecdotally, parents reported positive outcomes relating to child's happiness, socialisation at school, willingness to participate in sport and joy at being able to fit into department store jeans as a result of successful weight management. As for the tracking of overweight into adulthood, weight management in childhood can positively affect psychosocial health in adulthood to provide a long term

monitoring indicator. Consideration of such outcomes as an alternative to weight based outcomes still provide clinical relevance but also meaning to participants (children and parents) that may assist with engagement and retention in a child weight management program.

However, selection of such behavioural and psychosocial indicators as primary outcomes requires the use of validated and reliable tools. As highlighted in Section 3 of the literature review, such indicators and tools are rarely reported or used. In addition, the implication on sample size calculations would undoubtedly mean that a much greater number of subjects would be required to generate statistically significant effects, exacerbating difficulties in securing funding (discussed further in Section 6.7.4).

Alternatively, if indicators of weight change are to remain as primary outcomes, more sensitive measures of change in *adiposity* are required. McCarthy et al have recently produced sex-specific centile curves for body fat for Caucasian children aged 5-18 years (n=1 985) (372). Body fat was measured using bio-impedence and the centile curves developed are broadly consistent with the International Obesity Taskforce body mass index definitions of overweight, obesity and underweight (11). Unlike the BMI centile curves, the body fat centile curves reflect more accurately the post-pubertal gender dimorphism that occurs with regards to body fat percentage. The body fat curves therefore illustrate the normal anatomical differences not distinguished by the BMI curves, improving accuracy and sensitivity in reporting. The centile curves are available from the Child Growth Foundation (available from Harlow Printing, email: sales@harlowprinting.co.uk), software for z-score calculation is accessible via the internet (available at: <http://shop.healthforallchildren.co.uk/pro.epl?DO=PRODUCT&WAY=ONFO&ID=185>) and bio-impedence is relatively inexpensive and convenient to administer. These features make change in body fat a readily accessible alternate/additional measure of effectiveness of child weight management interventions.

6.7.4 Recognition of the challenges of research in this field

Undertaking research with humans in a free-living environment has many recognised challenges. Four challenges specific to child weight management experienced by the author are discussed below. They are i) subject recruitment, ii) subject retention, iii) changing child development stage, iv) concern regarding the development of eating disorders and v) allocation of adequate funding.

Subject recruitment

The recruitment of families into child weight management interventions is often arduous (273) and was a challenge experienced by the present study. On average, two and half families were contacted for every one recruited and recruitment of the 169 families across two sites took 12 months. Given that the sample consisted of volunteers from the community, enquiry generally relied on parental identification of overweight in the child. It is likely that poor parental perception of and concern regarding childhood overweight reported elsewhere (52) (284) (283) (282) were present in the target populations and contributed to the low levels of enquiry regarding the study.

In addition, the effectiveness of GPs as a recruitment channel was overestimated. Referrals from GPs provided only 5% of study enrolments, compared with media and school networks which sourced 90% of all enrolments. Poor adherence to recommendations made in the NHMRC Clinical Practice Guidelines for the Management of Overweight and Obesity in Children and Adolescents and a reluctance of GPs to raise the sensitive issue of childhood overweight weight with parents are likely reasons for poor identification and referral to weight management programs such as the PEACH study (276) (277).

In a parallel with tobacco control, some GPs choose not to question their patients about the tobacco use for fear of the personal nature of the topic. However, patients report greater satisfaction from GPs who do make such enquiries and also cite them as reasons for quitting and for better success in this endeavour (311). Transferring this response to the context of child weight management, it is possible that parents may welcome discussion about their child's weight initiated by their GP which may motivate action to address the issue.

These findings raise the issue of lack of parental awareness regarding their own child's overweight and limited capacity of GP's to engage families about the issue. Public awareness campaigns and professional development to assist with effective identification and management of this public health issue are essential for both prevention and treatment of the childhood obesity epidemic.

Subject retention

In recognition of the poor retention rates experienced by previous child weight management interventions, a number of strategies were implemented in the PEACH study to minimise attrition. These included i) the collection of contact details of two alternative informants should correspondence with the study family be disrupted, ii) the distribution of mailed quarterly newsletters to families and annual birthday and Christmas cards to children, iii) the provision of feedback to families following each six monthly measurement, iv) the availability of reduced assessment options for families who were reluctant to attend full measurement sessions ie. self report packs provided with a self-addressed, stamped envelope or home visits, and v) the provision of \$10 at measurement sessions to reimburse petrol and/or parking costs. These strategies resulted in a 27% attrition rate at 12 months, much less than the upper limit of 50% reported elsewhere (140).

The challenges of subject retention must be recognised and accepted by researchers and funders so that strategies to minimise attrition are included in

the logistical and financial planning of child weight management programs. The potential to include program aspects that specifically target certain family members, or are tailored to meet subject preferences may be an additional way to enhance subject retention. The opportunity to undertake such strategies may be limited within the constraints of an RCT, however the possibility of future examination of this option is discussed further in Section 6.8.3.

Changing child developmental stage

As discussed above, childhood overweight is a chronic condition and therefore must be managed accordingly. As the treatment of overweight in childhood must vary according to the child's age, the challenge is to provide a long-term program that is developmentally appropriate over time.

Examples provided by other chronic conditions such as cystic fibrosis, asthma and diabetes give some guidance, typically moving from parent-led to child focussed management as the child develops (373). Whilst a parent-led intervention is most appropriate for pre-pubertal/primary school aged-children seen in the PEACH study, practice needs to adapt delivery to focus on the child and acknowledge them as having increasing responsibility over their lifestyle choices and environmental quality.

Concern regarding the development of eating disorders

The possibility of the development of eating disorders following involvement in a child weight management intervention is a concern often raised by community members, service deliverers and reviewers of grant applications.

The likelihood of this occurring was examined in a research review undertaken by Butryn and Wadden in 2005 (343). They reviewed papers reporting on professionally administered weight loss programs that reported the measurement of eating-related behaviours or attitudes. They concluded that such programs pose minimal risk of precipitating eating disorders in overweight children and

adolescents. On the contrary, significant improvements in psychological status were observed along with weight loss in several of the included studies.

Properly organised and monitored long term child weight management interventions offer substantial medical and psychosocial benefits to participants (306) and their implementation should not be ceased for fear of causing eating disorders in subjects.

Allocation of adequate funding

Adequate funding is required to ensure that broad outcomes are evaluated over an adequate time frame (ie. to at least five years post baseline) in order to determine long-term effectiveness. Such time frames are often beyond the scope of most funding periods which are typically three years in duration. In addition, as discussed above, prevention and treatment interventions are competing for funding, creating a potentially unproductive dichotomy for research and practice activity. Recognition of the treatment of childhood overweight as simultaneously treating and preventing child and adult overweight respectively should assist with the allocation of adequate funding to the area.

In addition, the provision of financial support to multi-site interventions will minimise expense by relieving the pressure on one site to recruit the full sample. This will facilitate the recruitment of the required sample size over a shorter time frame, ensuring both time and cost efficiency. Multi-site trials also increase the generalisability of findings to demonstrate that the success of an intervention is not reliant on the site or facilitator in which or by whom it was delivered. These benefits are often difficult to justify to funding bodies who often view multi-site trials as creating additional cost.

Budget restraints may result in narrow evaluation of interventions given the expense associated with the inclusion of additional outcomes, particularly those concerned with qualitative evaluation. Therefore, funding bodies need to be

encouraged to appreciate the importance of broad and comprehensive evaluation of behavioural interventions and allocate appropriate funds to facilitate this. Furthermore, budgetary limitations potentially result in an overestimation of effect size in order to ensure sample sizes are viable within funding caps. In turn, this can result in the existence of type II error and the erroneous acceptance of the null hypothesis (358), quite possibly the case for this study.

The need for further examination of the cost-effectiveness of interventions is discussed in the following section.

6.8 Future research

6.8.1 Cost-effectiveness evaluation

The examination of the cost-effectiveness of obesity interventions has received little attention in the literature, with most studies focussing on establishing clinical effectiveness (374). Investigation of cost-effectiveness has been called for by a recent Cochrane review (140), and is also sought by funding bodies and governments seeking to invest in prevention and management programs (375).

A small amount of work in the area has been identified which has concluded that i) group interventions are more cost-effective than a mixture of group and individualised treatment (up to 12 months post baseline) (171) and ii) based on simulation-modelling techniques, family-based targeted programs for obese children are cost-effective and cost-saving, representing an overall cost saving of \$4.1 million and a reduction in 2 700 disability adjusted life years (375).

Cost-effectiveness of child weight management programs could be enhanced by including strategies and outcome measures that relate to more than one chronic disease associated with obesity (357) (376). By demonstrating that improved lifestyle behaviours and psychosocial health confer benefits beyond obesity

management, researchers can demonstrate improved cost-effectiveness thus strengthen the argument for funding.

6.8.2 Improved accessibility of the PEACH program

Enhancement of the accessibility of programs such as PEACH requires improved public awareness regarding the need to address the issue of childhood overweight.

In addition, the existing health care system that encourages multi-disciplinary management of chronic conditions needs to be strengthened. This could occur through the streamlining of referral pathways to government funded programs and the recognition of the management of childhood overweight as a condition eligible for such a program. Ideally this should be supported by an effective reimbursement system in recognition of the benefit of addressing the issue and as an incentive to seek treatment (377).

Furthermore, there is a need for programs to be developed that are relevant to minority groups. Mainstream programs will require adaptation to ensure cultural appropriateness for high risk groups such as ethnic minorities and the financially disadvantaged.

6.8.3 Tailored and targeted interventions

It is well established that parent-led, family-based treatments for childhood overweight are more successful than child-focussed interventions (197) (378), however a common barrier to this is parental attendance at sessions (368). Given that frequency of attendance to sessions is related to successful weight management (379), maximising attendance to session is desirable and designing interventions with a variety of delivery modes that better “fit” participants may be one way to achieve this.

Planners of health services need to be aware of the perceived barriers to and facilitators of behaviour change in order to enhance program attendance and effectiveness. To further this, screening questionnaires issued to participants prior to enrolment could enhance recognition of potential facilitators and barriers to change or the readiness of the individual to engage in behaviour change (329). Such a strategy was employed by Reinehr et al (295) (Table 3.8). They required parents to complete a questionnaire to “prove their motivation” in order to be admitted to their “Obeldicks” program. The use of such a screening tool to assess the subject stage of change could assist with the identification of subjects most likely to engage and consequently succeed in the program, ultimately improving its overall effectiveness.

This information could identify the suitability of a program for potential subjects, opportunities for tailoring of the program to suit individual participant needs or the usefulness of pre-intervention motivational strategies to progress individuals to a stage of action. Such a strategy could help to identify factors beyond the health sector that influence lifestyle behaviours. These are considerations which are largely unanswered by the literature (140) and also present major design and funding challenges if conducted in the context of an RCT.

In addition, the under-representation of fathers to both program and measurement sessions, and interview findings of a lack of support from extended family members highlight i) the difficulty in engaging all family members in an intervention and ii) the potential need to employ strategies to engage specific family members in an intervention. Such strategies may include offering specific sessions targeting for example, only fathers or grandparents. A recent report from a child weight management outpatient program indicated that there may be advantage in combining group sessions with individual appointments which could facilitate such targeted delivery (295).

6.8.4 Environments and societies supportive of parents and healthy lifestyle choices

Targeting parents as the primary agents of change recognises their responsibility for the health and wellbeing of their children. In order for them to fulfil this role however, it is essential that the environments in which their children spend their time are supportive of healthy lifestyle initiatives that may be occurring in the home. A supportive environment for healthful behaviours is a requisite component of individual action (380).

For example, supportive school environments that ensure a healthy food supply at the canteen and mandate inclusion of physical activity in the curriculum are essential to support healthy lifestyle choices driven by parents at home. Conversely, societies and employers that impose long working hours on employees can impact on the ability of parents to model desirable lifestyle behaviours at home. It is thought that more time spent at work is related to increased consumption of convenience foods and longer time spent watching television (75).

Time barriers and gender role conflicts were two key issues found in the analysis of the 12 month interviews and are likely to be two of the most important barriers to overcome when supporting parents to create healthful family environments (381). The time limitations created by our modern, nuclear family environment is experienced by researchers and parents alike, however there is no research available to support this phenomenon in order to provide impetus for societal change around this dynamic.

The increasing recognition of and need for environmental change to support healthy lifestyle choices is something that needs to be driven and supported by governments. There is an opportunity to create a *social policy* approach to healthy lifestyles rather than the current *health policy* approach (382). There is a need for research into how best to promote healthy lifestyle through the

development of such social policies and a recognition for involvement of all sectors beyond just health.

6.8.5 Policy research

There is an absence of evidence to inform the development of interventions that may tackle “up stream” population health issues. In their comprehensive and inclusive review of interventions to treat and prevent reduce obesity in children and youth, Flynn et al identified 147 high-scoring reports of which none dealt with population-wide policy-related issues (357). The majority of studies provided evidence for strategies undertaken in schools or clinics rather than researching the advantages of working in more upstream approaches as has been documented elsewhere (383).

Given that the “obesity epidemic” has occurred as a result of change on an environmental level and is now considered a public health issue, policy needs to be created to initiate societal change (384). Similar public health issues, such as tobacco control, drink driving and car seat belts have required such an approach and were initially dismissed as being unrealistic (385). It is likely that calls for similar action regarding obesity prevention/management will also receive such a response, however hindsight can impart some valuable lessons.

The successes of tobacco control lie in the development of a comprehensive approach that includes interventions and environments supportive of cessation and/or unsupportive of initiation, rather than relying solely on individual-level strategies such as education or counselling (311). The 2000 Surgeon General’s Report entitled “Reducing Tobacco Use” identified five key elements for tobacco control: i) clinical intervention and management ii) educational strategies iii) regulatory efforts iv) economic approaches v) the combination of all these into comprehensive programs with synergistic effects (386). Mercer et al note that the greatest gains in tobacco control were experienced through combining the

elements into a “comprehensive, multi-message, multi-channel approach, built on the foundation of policy-based interventions” (311). There is an urgent need for such co-ordinated and multi-level action to be conducted in the area of policy research regarding obesity control and there are valuable lessons to be learnt from prior public health campaigns.

6.9 Conclusion

The 12 month findings of this thesis study necessitate the need for the acceptance of the null hypothesis, indicating that the addition of a parenting skills training program does not increase the long-term effectiveness of a parent-led, family focussed healthy lifestyle intervention for the management of overweight in 5-9 year old children. However, there are a number of potential reasons for the lack of a significant group difference at the 12 month time point (discussed in Section 3.2.3) which must be taken into consideration during the planning of future studies.

Despite this, the PEACH study has provided further strength to the evidence-base for the effectiveness of a parent-led, family focussed healthy lifestyle approach for the management of overweight in 5-9 year old children. Both intervention groups demonstrated significant reductions in measures of degree of overweight and improvements in lifestyle behaviours affecting weight and health that were maintained six months following the completion of the six month tapered HL and HL+P interventions and with no further program contact.

The PEACH study has addressed a number of design weaknesses associated with child weight management interventions and made major contributions to the state of the evidence regarding such interventions (Section 6.2). Future study designs would be strengthened by the selection of a limited number of specific and sensitive outcome and impact evaluation indicators to result in a more clearly articulated definition of effectiveness. In addition, process indicators

should be routinely collected and reported to provide vital information to researchers and practitioners of the practical and logistical considerations that must be made to deliver an effective, accessible and well accepted intervention.

It is the intention of the PEACH research team to continue to collect anthropometric outcomes from study subjects up to the five year time point. In recognition of the chronic nature of childhood overweight, funding is currently being sought to investigate the most effective form of long-term management to provide children and families during changing child developmental stages. In addition, funding has being secured to develop and pilot a PEACH training package for health professionals to be offered through the existing public health system in order to increase families' access to such a service.

The World Health Organisation recently declared the prevalence of overweight to have “reached epidemic proportions globally” (387). Containment of this global public health issue will be possible only if effective and meaningful action is undertaken along all points of the prevention-treatment continuum by all stakeholders. The PEACH program provides a potential strategy for the treatment of childhood overweight and the secondary prevention of adult obesity, however is only one aspect of the required action plan. As highlighted in Sections 6.8.4 and 6.8.5, environments supported by healthy social policies must be established to foster the establishment and long term maintenance of healthy lifestyle behaviours that will initially halt and then reverse the current increasing rates of child (and adult) overweight observed worldwide.

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Appendix One: Search Strategy for Section Two of the Literature Review

Papers reporting on the role/effect of parents/parenting in the management of childhood overweight (published between 2000-2007)

1. Searched Medline using strategy:
 - #1 exp Obesity/
 - #2 exp Overweight/
 - #3 1 or 2
 - #4 limit 3 to (humans and English language)
 - #5 limit 4 to ("preschool child (2 to 5 years)" or "child (6 to 12 years)")
 - #6 limit 5 to yr="2000-2007"
 - #7 exp Parents/
 - #8 exp Parent-Child Relations/
 - #9 exp Parenting/
 - #10 7 or 8 or 9
 - #11 6 and 10
 (gave 321 hits)

2. Used same search strategy as basis for searching CINAHL and PsycINFO (having to adjust for different limit commands etc) CINAHL gave 187 hits and PsycINFO gave 28 hits.

3. Abstracts from each database were examined and articles that appeared relevant were sourced. Once read, articles were categorised as being either general background papers or reporting on an intervention. They are summarised in the table below:

General articles	Intervention articles
MEDLINE	
Ogden (2006) <i>Appetite</i> 47(1): 100-6 Stein (2005) <i>Obesity Research</i> 13(10): 1749-55 Ritchie (2005) <i>JADA</i> 105 (Suppl 5): S70-9 Golan (2004) <i>Nutr Rev</i> 62(1): 39-50 Benton (2004) <i>IJO</i> 28: 858-69 Golan (2001) <i>J Nutrition Education</i> 33(2): 102-7	Golan (2006) <i>Brit J Nutr</i> 95(5): 1008-15 Kirschenbaum (2005) <i>Obesity Research</i> 13(9): 1527-09 – after reading article, clear that it's focus is more on process eval and the role of behaviour change/self-monitoring in management Golan (2004) <i>Obesity Research</i> 12(2): 357-61 Beech (2003) <i>Ethnicity and Disease</i> 13(Suppl 1): S40-53
CINAHL	
Golan (2004) <i>Nutr Rev</i> 62(1): 39-50 – IDENTIFIED THROUGH MEDLINE Berry J (2004) <i>Family Nursing</i> 10(4): 429-49 St Jeor (2002) <i>JADA</i> 102: 640-4	
PsycINFO	
None	None

All papers were printed and saved

4. Primary intervention papers identified via the above searches were searched in Web of Science to identify where else they had been cited (conducted 7-3-07)

	Cited references	Times cited	Related records
Golan (2006) Brit J Nutr 95(5): 1008-15	32	0	323 (printed and searched) – references 301 onwards (ie. 23 papers) excluded as published in 2000 or earlier
Kirschenbaum (2005) Obesity Research 13(9): 1527-9	10	2	277 (printed and searched) – references 201 onwards (ie. 77 papers) excluded as published in 2000 or earlier
Golan (2004) Obesity Research 12(2): 357-61	29	14	1 788 (not printed or searched as relevant references would have been identified by the 2006 article and others most likely been published pre-2000)
Kleges (2003) Ethnicity and Disease 13(Suppl 1): S40-53	NOT IDENTIFIED IN WEB OF SCIENCE – PERHAPS BECAUSE A SUPPLEMENT??		

5. The references in which the above papers were cited (times cited) and the related records were then searched to identify any other primary intervention papers published between 2001 and 2007 that focused on the role of parents/parenting in the management of childhood overweight (conducted 9-3-07)

	Times cited	Related records
Golan (2006) Brit J Nutr 95(5): 1008-15	N/A	5/323 relevant, but all only general/review articles: Ogden (2006) Appetite 47(1): 100-06 – ALREADY SOURCED FROM MEDLINE Kitzmann (2006) J Family Psychol 20(2): 175-89 – PRINTED AND SAVED Stein (2005) Ob Res 13(10): 1749-55 - – ALREADY SOURCED FROM MEDLINE McLean (2003) IJO 27(9): 987-1005 – PRINTED AND SAVED St Jeor (2002) JADA 102(5): 640-44 – ALREADY SOURCED FROM CINAHL
Kirschenbaum (2005) Obesity Research 13(9): 1527-9	0/2 relevant	5/277 relevant, but both only general/review articles: Kitzmann (2006) J Family Psychol 20(2): 175-89– PRINTED AND SAVED Lindsay (2006) Future of Children 16(1): 169-86 – after reading article, focus is more on prevention and not relevant for this literature review
Golan (2004) Obesity Research 12(2): 357-61	1/14 relevant, and only a general/review article: Kitzmann (2006) J Family Psychol 20(2): 175-89– ALREADY SOURCED FROM SEARCH ABOVE	N/A

6. The Cochrane databases Clinical Trials (13 hits) and DARE (1 hit – printed out in full) were searched using the search term “obesity and parent” (conducted: 9-3-07)

COCHRANE Clinical Trials	COCHRANE DARE
2/13 hits relevant: Golan (2006) – ALREADY SOURCED FROM MEDLINE McGarvey (2004) Am J Pub Health 94(9): 1490-5 – PRINTED AND SAVED - prevention focus, not relevant to this review Beech (2003) – ALREADY SOURCED FROM MEDLINE	1 hit – Family-based interventions for childhood obesity – a review – ALREADY SOURCED PRIMARY PAPER (BY BERRY ET AL) FROM CINAHL - PRINTED OUT DARE SUMMARY AND FILED WITH PRIMARY PAPER

7. The final results of searches of MEDLINE, CINAHL, PSYCINFO, Web of Science and Cochrane (CENTRAL and DARE) seeking papers reporting on the role/effect of parents/parenting in the management of childhood overweight (published between 2000-2007):

INTERVENTION/PRIMARY PAPERS (3)	GENERAL/REVIEW PAPERS (10)
Golan (2006) Brit J Nutr 95(5): 1008-15 Golan (2004) Obesity Research 12(2): 357-61 Beech (2003) Ethnicity and Disease 13(Suppl 1): S40-53	Ogden (2006) Appetite 47(1): 100-6 Stein (2005) Obesity Research 13(10): 1749-55 Ritchie (2005) JADA 105 (Suppl 5): S70-9 Golan (2004) Nutr Rev 62(1): 39-50 Benton (2004) IJO 28: 858-69 Golan (2001) J Nutrition Education 33(2): 102-7 Berry J (2004) Family Nursing 10(4): 429-49 + DARE SUMMARY St Jeor (2002) JADA 102: 640-4 Kitzmann (2006) J Family Psychol 20(2): 175-89 McLean (2003) IJO 27(9): 987-1005

Appendix Two: Parent proxy- and child self-report forms of the PedsQL™4.0

ID# _____
 Date: _____

PedSQL™

Pediatric Quality of Life Inventory

Version 4.0

YOUNG CHILD REPORT (ages 5-7)

Instructions for interviewer:

I am going to ask you some questions about things that might be a problem for some children. I want to know how much of a problem any of these things might be for you.

Show the child the template and point to the responses as you read.

If it's not at all a problem for you, point to the smiling face

If it is sometimes a problem for you, point to the middle face

If it is a problem for you a lot, point to the frowning face

I will read each question. Point to the pictures to show me how much of a problem it is for you. Let's try a practice one first.

Is it hard for you to snap your fingers	Not at all	Sometimes	A lot
---	------------	-----------	-------

Ask the child to demonstrate snapping his or her fingers to determine whether or not the question was answered correctly. Repeat the question if the child demonstrates a response that is different from his or her action.

Think about how you have been doing for the last few weeks. Please listen carefully to each sentence and tell me how much of a problem this is for you.

After reading the item, gesture to the template. If the child hesitates or does not seem to understand how to answer, read the response options while pointing at the faces.

PHYSICAL FUNCTIONING (problems with...)	Not at all	Some-times	A lot
1. Is it hard for you to walk	0	2	4
2. Is it hard for you to run	0	2	4
3. Is it hard for you to play sports or exercise	0	2	4
4. Is it hard for you to pick up big things	0	2	4
5. Is it hard for you to take a bath or shower	0	2	4
6. Is it hard for you to do chores (like pick up your toys)	0	2	4
7. Do you have hurts or aches (Where? _____)	0	2	4
8. Do you ever feel too tired to play	0	2	4

Remember, tell me how much of a problem this has been for you for the last few weeks.

EMOTIONAL FUNCTIONING (problems with...)	Not at all	Some-times	A lot
1. Do you feel scared	0	2	4
2. Do you feel sad	0	2	4
3. Do you feel mad	0	2	4
4. Do you have trouble sleeping	0	2	4
5. Do you worry about what will happen to you	0	2	4

SOCIAL FUNCTIONING (problems with...)

SOCIAL FUNCTIONING (problems with...)	Not at all	Some-times	A lot
1. Is it hard for you to get along with other kids	0	2	4
2. Do other kids say they do not want to play with you	0	2	4
3. Do other kids tease you	0	2	4
4. Can other kids do things that you cannot do	0	2	4
5. Is it hard for you to keep up when you play with other kids	0	2	4

SCHOOL FUNCTIONING (problems with...)

SCHOOL FUNCTIONING (problems with...)	Not at all	Some-times	A lot
1. Is it hard for you to pay attention in school	0	2	4
2. Do you forget things	0	2	4
3. Is it hard to keep up with schoolwork	0	2	4
4. Do you miss school because of not feeling good	0	2	4
5. Do you miss school because you have to go to the doctor's or hospital	0	2	4

ID# _____

Date: _____

PedSQL 2

PedsQLTM

Pediatric Quality of Life Inventory

Version 4.0

PARENT REPORT for YOUNG CHILDREN (ages 5-7)

DIRECTIONS

On the following page is a list of things that might be a problem for your child. Please tell us **how much of a problem** each one has been for your child during the past **ONE month** by circling:

- 0 if it is **never** a problem
 1 if it is **almost never** a problem
 2 if it is **sometimes** a problem
 3 if it is **often** a problem
 4 if it is **almost always** a problem

There are no right or wrong answers.
 If you do not understand a question, please ask for help.

In the past **ONE month**, how much of a **problem** has your child had with ...

PHYSICAL FUNCTIONING (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0	1	2	3	4
1. Walking more than one block	0	1	2	3	4
2. Running	0	1	2	3	4
3. Participating in sports activity or exercise	0	1	2	3	4
4. Lifting something heavy	0	1	2	3	4
5. Taking a bath or shower by him or herself	0	1	2	3	4
6. Doing chores, like picking up his or her toys	0	1	2	3	4
7. Having hurts or aches	0	1	2	3	4
8. Low energy level	0	1	2	3	4

EMOTIONAL FUNCTIONING (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0	1	2	3	4
1. Feeling afraid or scared	0	1	2	3	4
2. Feeling sad or blue	0	1	2	3	4
3. Feeling angry	0	1	2	3	4
4. Trouble sleeping	0	1	2	3	4
5. Worrying about what will happen to him or her	0	1	2	3	4

SOCIAL FUNCTIONING (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0	1	2	3	4
1. Getting along with other children	0	1	2	3	4
2. Other kids not wanting to be his or her friend	0	1	2	3	4
3. Getting teased by other children	0	1	2	3	4
4. Not able to do things that other children his or her age can do	0	1	2	3	4
5. Keeping up when playing with other children	0	1	2	3	4

SCHOOL FUNCTIONING (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0	1	2	3	4
1. Paying attention in class	0	1	2	3	4
2. Forgetting things	0	1	2	3	4
3. Keeping up with school activities	0	1	2	3	4
4. Missing school because of not feeling well	0	1	2	3	4
5. Missing school to go to the doctor or hospital	0	1	2	3	4

ID# _____

Date: _____

PedsQL 2

In the past ONE month, how much of a problem has this been for you ...

PedsQL™

Pediatric Quality of Life Inventory

Version 4.0

CHILD REPORT (ages 8-12)

DIRECTIONS

On the following page is a list of things that might be a problem for you. Please tell us how much of a problem each one has been for you during the past **ONE** month by circling:

- 0 if it is **never** a problem
- 1 if it is **almost never** a problem
- 2 if it is **sometimes** a problem
- 3 if it is **often** a problem
- 4 if it is **almost always** a problem

There are no right or wrong answers. If you do not understand a question, please ask for help.

About My Health and Activities (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0	1	2	3	4
1. It is hard for me to walk more than one block	0	1	2	3	4
2. It is hard for me to run	0	1	2	3	4
3. It is hard for me to do sports activity or exercise	0	1	2	3	4
4. It is hard for me to lift something heavy	0	1	2	3	4
5. It is hard for me to take a bath or shower by myself	0	1	2	3	4
6. It is hard for me to do chores around the house	0	1	2	3	4
7. I hurt or ache	0	1	2	3	4
8. I have low energy	0	1	2	3	4

About My Feelings (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0 <th>1 <th>2 <th>3 <th>4 </th></th></th></th>	1 <th>2 <th>3 <th>4 </th></th></th>	2 <th>3 <th>4 </th></th>	3 <th>4 </th>	4
1. I feel afraid or scared	0	1	2	3	4
2. I feel sad or blue	0	1	2	3	4
3. I feel angry	0	1	2	3	4
4. I have trouble sleeping	0	1	2	3	4
5. I worry about what will happen to me	0	1	2	3	4

How I Get Along with Others (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0 <th>1 <th>2 <th>3 <th>4 </th></th></th></th>	1 <th>2 <th>3 <th>4 </th></th></th>	2 <th>3 <th>4 </th></th>	3 <th>4 </th>	4
1. I have trouble getting along with other kids	0	1	2	3	4
2. Other kids do not want to be my friend	0	1	2	3	4
3. Other kids tease me	0	1	2	3	4
4. I cannot do things that other kids my age can do	0	1	2	3	4
5. It is hard to keep up when I play with other kids	0	1	2	3	4

About School (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0 <th>1 <th>2 <th>3 <th>4 </th></th></th></th>	1 <th>2 <th>3 <th>4 </th></th></th>	2 <th>3 <th>4 </th></th>	3 <th>4 </th>	4
1. It is hard to pay attention in class	0	1	2	3	4
2. I forget things	0	1	2	3	4
3. I have trouble keeping up with my schoolwork	0	1	2	3	4
4. I miss school because of not feeling well	0	1	2	3	4
5. I miss school to go to the doctor or hospital	0	1	2	3	4

ID# _____

Date: _____

PedSQL™

Pediatric Quality of Life Inventory

Version 4.0

PARENT REPORT for CHILDREN (ages 8-12)

DIRECTIONS

On the following page is a list of things that might be a problem for your child. Please tell us how much of a problem each one has been for your child during the past **ONE month** by circling:

- 0 if it is never a problem
- 1 if it is almost never a problem
- 2 if it is sometimes a problem
- 3 if it is often a problem
- 4 if it is almost always a problem

There are no right or wrong answers. If you do not understand a question, please ask for help.

In the past ONE month, how much of a problem has your child had with ...

PedSQL 2

PHYSICAL FUNCTIONING (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0	1	2	3	4
1. Walking more than one block	0	1	2	3	4
2. Running	0	1	2	3	4
3. Participating in sports activity or exercise	0	1	2	3	4
4. Lifting something heavy	0	1	2	3	4
5. Taking a bath or shower by him or herself	0	1	2	3	4
6. Doing chores around the house	0	1	2	3	4
7. Having hurts or aches	0	1	2	3	4
8. Low energy level	0	1	2	3	4

EMOTIONAL FUNCTIONING (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0	1	2	3	4
1. Feeling afraid or scared	0	1	2	3	4
2. Feeling sad or blue	0	1	2	3	4
3. Feeling angry	0	1	2	3	4
4. Trouble sleeping	0	1	2	3	4
5. Worrying about what will happen to him or her	0	1	2	3	4

SOCIAL FUNCTIONING (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0	1	2	3	4
1. Getting along with other children	0	1	2	3	4
2. Other kids not wanting to be his or her friend	0	1	2	3	4
3. Getting teased by other children	0	1	2	3	4
4. Not able to do things that other children his or her age can do	0	1	2	3	4
5. Keeping up when playing with other children	0	1	2	3	4

SCHOOL FUNCTIONING (problems with...)	Never	Almost Never	Some-times	Often	Almost Always
	0	1	2	3	4
1. Paying attention in class	0	1	2	3	4
2. Forgetting things	0	1	2	3	4
3. Keeping up with schoolwork	0	1	2	3	4
4. Missing school because of not feeling well	0	1	2	3	4
5. Missing school to go to the doctor or hospital	0	1	2	3	4

Appendix Three: Child Body Image Scale

**Baseline
Child Body Image
Interview**



Interviewer questions in italics

Form completed by interviewer

We are asking children about how they feel about their body. I'm going to ask you some questions and get you to answer them by looking at these pictures. I will write your answers down.

1) *These are some pictures of children about your age, can you pick the child that you think your body is most like?* (perceived figure)

Code

2) *If you could choose a body, which of the pictures would you want your body to be like?*

Code

3) **Body Size dissatisfaction (perceived - ideal discrepancy)**

4) *Are you happy about the way your body looks?*

No
Yes

If yes go to question 7)

5) *What do you like about your body?*

6) *What don't you like about your body?*

7) *Are there any parts of your body you would like to change?*

No
Yes

If yes, what are they?

8) *Do you think your body is*

- Too thin
- A little too thin
- Just right
- A little too fat
- Too fat

9) *Would you like to be*

- A little thinner
- Stay the same
- A little fatter
- Much fatter

10) *Have you ever tried to lose weight?*

No
Yes

If yes, how did you do this?

11) *Have you ever tried to put on weight?*

No
Yes

If yes, how did you do this?

12) *Do other people think you are*

- Too Thin
- A little too thin
- Just right
- A little too fat
- Too fat

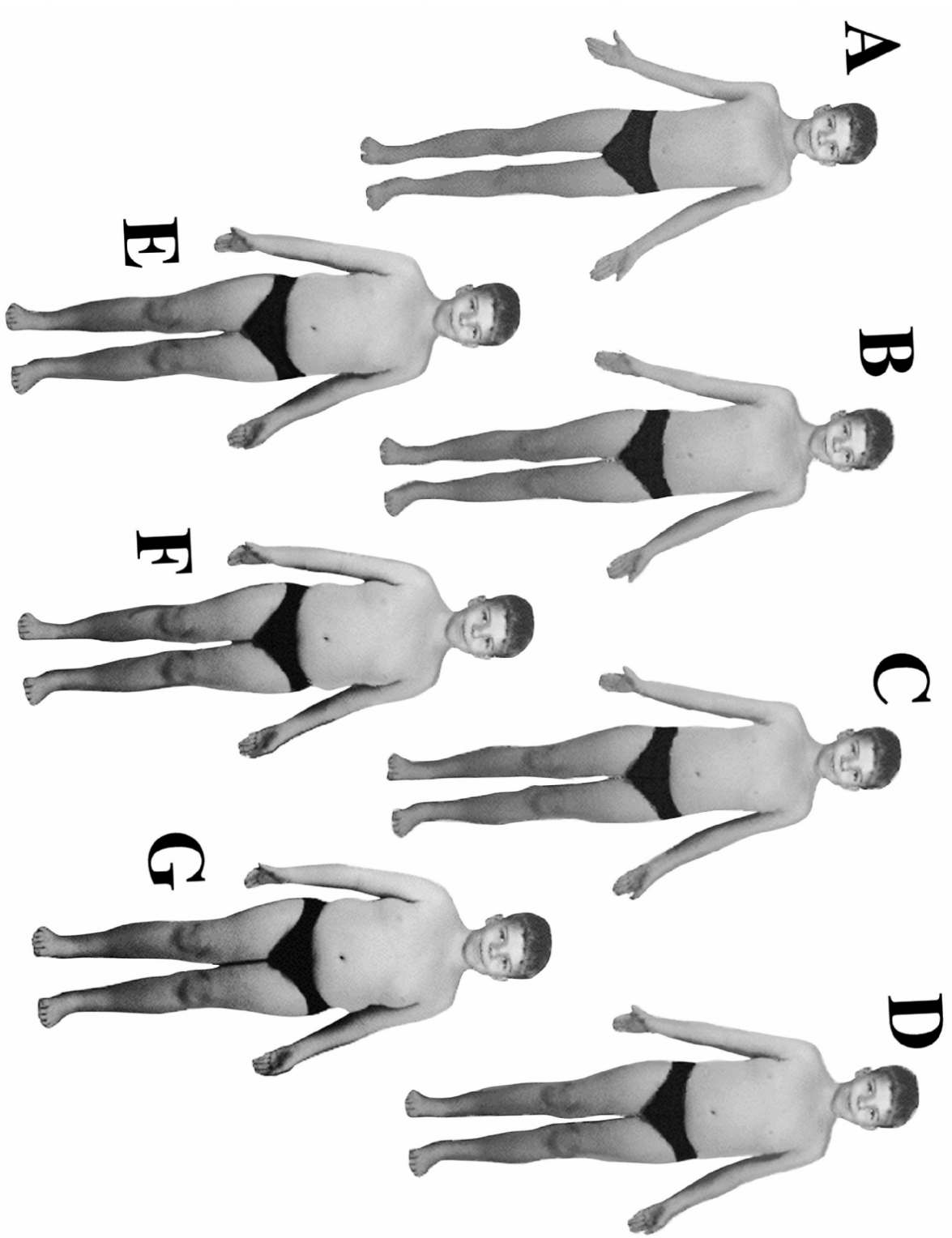
Interviewer confirms subject's body perceptions depending on interview responses

- 13) You are:
- a) *Happy with your body and don't want to change it*
 - b) *You think you are too thin and would like to be fatter*
 - c) *You think you are too fat and would like to be thinner*

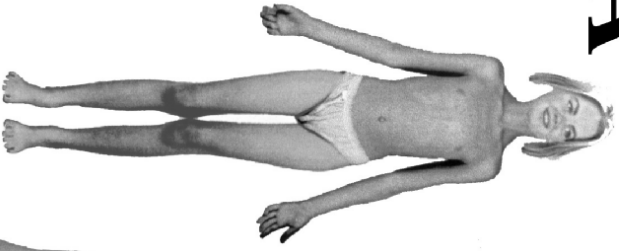
Subject agrees with interviewer comment:

Yes
No

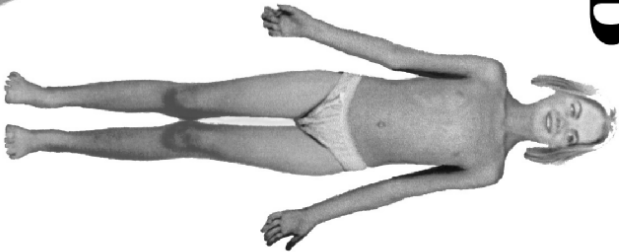
→ If no reconfirm responses



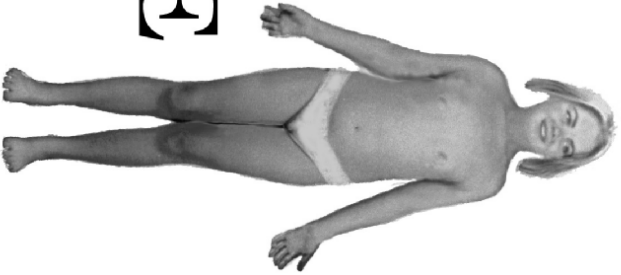
A



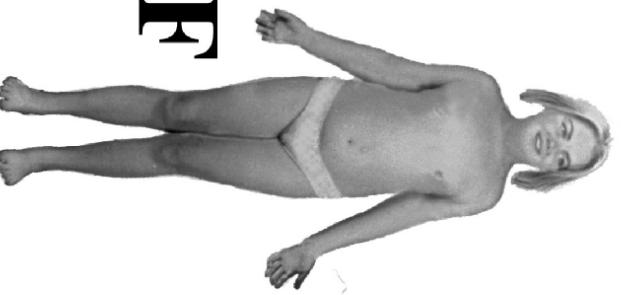
B



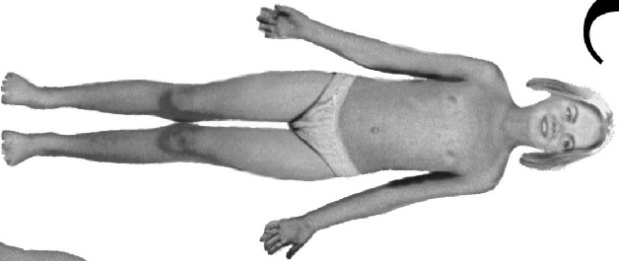
E



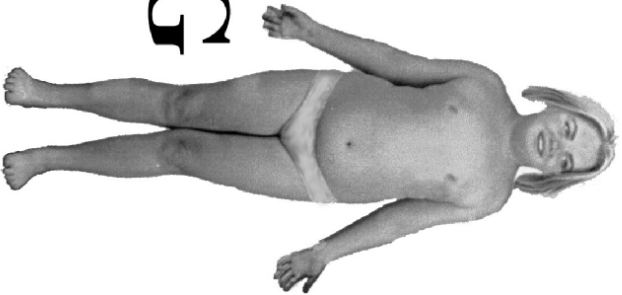
F



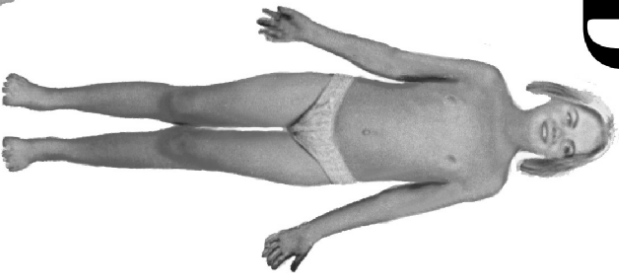
C



G



D



Appendix Four: Children's Dietary Questionnaire

CHILDREN'S DIETARY QUESTIONNAIRE



This questionnaire is asking you to report what your child eats and drinks on a daily or weekly basis. Please read the instructions at the start of sections A, B, C & D carefully as what you are asked to report changes between each section.

✓ Please tick the appropriate box

SECTION A

Please tick all of the listed foods your child has eaten over the past 7 days

1. Fruit (fresh, canned or stewed)

- | | | |
|---|---|--------------------------------------|
| <input type="checkbox"/> Fruit Salad | <input type="checkbox"/> Strawberries | <input type="checkbox"/> Orange |
| <input type="checkbox"/> Peach | <input type="checkbox"/> Mango | <input type="checkbox"/> Dried Fruit |
| <input type="checkbox"/> Banana | <input type="checkbox"/> Melons (Water, Rock) | <input type="checkbox"/> Apple |
| <input type="checkbox"/> Apricot | <input type="checkbox"/> Grapes | <input type="checkbox"/> Pineapple |
| <input type="checkbox"/> Pear | <input type="checkbox"/> Mandarin | <input type="checkbox"/> Pawpaw |
| <input type="checkbox"/> Nectarine/Peach/Plum | <input type="checkbox"/> Plum | <input type="checkbox"/> Other |
- 18

2. Vegetables (Cooked or Raw)

- | | | |
|---|---|---|
| <input type="checkbox"/> Pumpkin | <input type="checkbox"/> Carrot | <input type="checkbox"/> Cabbage |
| <input type="checkbox"/> Cauliflower | <input type="checkbox"/> Broccoli | <input type="checkbox"/> Brussel Sprouts |
| <input type="checkbox"/> Potato (Not hot chips) | <input type="checkbox"/> Corn | <input type="checkbox"/> Sweet Potato |
| <input type="checkbox"/> Peas & Beans | <input type="checkbox"/> Legumes (Chickpeas, Lentils, Kidney Beans) | <input type="checkbox"/> Spinach |
| <input type="checkbox"/> Lettuce | <input type="checkbox"/> Tomato | <input type="checkbox"/> Cucumber |
| <input type="checkbox"/> Celery | <input type="checkbox"/> Capsicum | <input type="checkbox"/> Mushroom |
| <input type="checkbox"/> Eggplant | <input type="checkbox"/> Zucchini | <input type="checkbox"/> Squash |
| <input type="checkbox"/> Vegetables in mixed dishes (soups & stews) | <input type="checkbox"/> Mixed frozen vegetables | <input type="checkbox"/> Other (eg Olives) Beetroot |
- 24

SECTION B

Please circle how often your child had each of the following food/drink items in the past 24 hours.



1. Fruit Juice/Fruit Drink

Nil Once Twice 3 times 4 times 5+ Times

2. Water

Nil Once Twice 3 times 4 times 5+ Times

3. Full Cream/Full Fat Milk (including flavoured milk) (as a drink or on cereal)

Nil Once Twice 3 times 4 times 5+ Times

4. Reduced Fat Milk (including flavoured milk) (as a drink or on cereal)

Nil Once Twice 3 times 4 times 5+ Times

5. Cheese and/or Cheese Spreads

Nil Once Twice 3 times 4 times 5+ Times

6. Regular Yoghurt/Custard

Nil Once Twice 3 times 4 times 5+ Times

7. Reduced Fat/Low Fat Yoghurt/Custard

Nil Once Twice 3 times 4 times 5+ Times

8. Vegetables (raw or cooked) (salad in sandwich and vegetables at evening meal = twice)

Nil Once Twice 3 times 4 times 5+ Times

9. Fruit (fresh, canned, stewed or dried) (juice at b'fast and AT, apple at lunch = 3 times)

Nil Once Twice 3 times 4 times 5+ Times

10. How many different vegetables (raw or cooked)

none One Two 3 4 5+

11. How many different fruits (fresh, canned, stewed or dried)

none One Two 3 4 5+



SECTION C
Please circle the number of times your child had the following food/drink items in the past 7 days

1. **Peanut Butter or nutella**
Nil Once Twice 3 times 4 times 5 times 6+ times
2. **Pre-sugared cereals (eg. Coco Pops, Fruit Loops) or sugar added to cereal**
Nil Once Twice 3 times 4 times 5 times 6+ times
3. **Sweet biscuits, cakes, muffins, doughnuts or fruit pies**
Nil Once Twice 3 times 4 times 5 times 6+ times
4. **Potato chips/crisps or savoury biscuits**
Nil Once Twice 3 times 4 times 5 times 6+ times
5. **Lollies, muesli or fruit bars**
Nil Once Twice 3 times 4 times 5 times 6+ times
6. **Chocolate (bar/block/coated biscuits)**
Nil Once Twice 3 times 4 times 5 times 6+ times
7. **Soft drink/cordial (not diet varieties)**
Nil Once Twice 3 times 4 times 5 times 6+ times
8. **Ice-cream/Ice-blocks**
Nil Once Twice 3 times 4 times 5 times 6+ times
9. **Pie, pastry or sausage roll**
Nil Once Twice 3 times 4 times 5 times 6+ times
10. **Pizza**
Nil Once Twice 3 times 4 times 5 times 6+ times
11. **Hot chips or French fries**
Nil Once Twice 3 times 4 times 5 times 6+ times



12. **Hot Dog/Fritz/processed meats**
Nil Once Twice 3 times 4 times 5 times 6+ times
13. **Takeaway (eg McDonalds, KFC, Fish n Chips/Chicken Shop)**
Nil Once Twice 3 times 4 times 5 times 6+ times
14. **How many days in the last week did your child have some vegetables (raw or cooked)**
None 1 2 3 4 5 6 every day
15. **How many days in the last week did your child have some fruit (fresh, canned, stewed, or dried, excluding juice)**
None 1 2 3 4 5 6 every day

SECTION D

Please circle the most appropriate answer

1. **How many times a week does your child eat breakfast?**
Nil Once Twice 3 times 4 times 5 times 6+ times
2. **How many times a week does your family sit at a dinner table to eat the evening meal?**
Nil Once Twice 3 times 4 times 5 times 6+ times
3. **How many times a week would your child eat a meal or snack in front of the TV?**
Nil Once Twice 3 times 4 times 5 times 6+ times
4. **How often do you encourage your child to finish everything that is served to him/her?**

Never- Rarely Sometimes Often Always



5. **How often does your child ask first before helping him/herself to food/drink?**
Never Rarely Sometimes Often Always
6. **Do you restrict your child's access to particular foods?**
Never Rarely Sometimes Often Always
7. **Is your child allowed to help him/herself to food?**
Never Rarely Sometimes Often Always
8. **Do you ask your child if he/she is hungry before you provide food/meals?**
Never Rarely Sometimes Often Always
9. **Does your child express hunger within 1 hour of eating a meal/snack?**
Never Rarely Sometimes Often Always
10. **Most of the time at main meals does your child**
Finish ahead of everyone else Finish at about the same time Finish behind everyone else
11. **Is your child's main meal the size of**
Half a bread and butter plate A bread and butter plate Half a dinner plate Three quarters of a dinner plate A dinner plate
12. **Does your child have second helpings?**
Never Rarely Sometimes Often Always

Thank you for your time

Appendix Five: Activity Inventory

PEACH CHILD ACTIVITY INVENTORY

On this questionnaire there are 8 questions asking you about your child's activity patterns. Please read each item carefully and tick Yes or No as appropriate to your child. For questions where you answer Yes, you will also be asked to estimate the time spent doing a particular activity.

1. Does your child watch television or videos before school?

No 1
Yes 2

If yes, on average for how long?

----- minutes

2. Does your child watch TV or videos after school or in the evening of school days?

1

No
Yes 2

If yes, on average for how long?

----- minutes

3. Does your child watch TV or videos on weekends?

No 1
Yes 2

If yes, on average for how long in total over the weekend?

----- minutes

4. Does your child play video games?

No 1
Yes 2

If yes, on average for how long - on weekdays?

----- minutes

- in total over the weekend?

----- minutes

5. How does your child get to school?

Walk 1
Bus/train 2
By car 3
Bicycle 4

6. How does your child get home from school?

Walk 1
Bus/train 2
By car 3
Bicycle 4

7. How much time (minutes) does your child engage in the following activities?

	On an average week day	On an average weekend day
Riding a bicycle		
Taking a walk		
Swimming		
Doing gymnastics or similar		
Dancing		
Playing team ball games		
Athletics		
Other active play (indoor or outdoor activities/playing, not involving sitting)		
- TOTAL		
(give 3 examples)		
-		
-		
-		

8. When your child is alone or not busy does he/she get bored (circle one)?

0 - never 1 - almost never 2 - sometimes 3 - frequently 4 - always

All Done! Thank you!

Please check that you have completed all questions in each questionnaire and return the questionnaire pack to PEACH staff.

**Appendix Six: Parenting Sense of Competence Scale
(The Being a Parent Questionnaire)**

Appendix Seven: Alabama Parenting Questionnaire

The University of New Orleans
Alabama Parenting Questionnaire (APQ)
(Parent Form)

ID# _____

Parent Completing Form (Circle One): Mother Father Other _____

Instructions: The following are a number of statements about your family. Please rate each item as to how often it TYPICALLY occurs in your home.

The possible answers are Never (1), Almost Never (2), Sometimes (3), Often (4), Always (5).

PLEASE ANSWER ALL ITEMS.

	Never	Almost never	Sometimes	Often	Always
1. You have a friendly talk with your child	1	2	3	4	5
2. You let your child know when he/she is doing a good job with something.	1	2	3	4	5
3. You threaten to punish your child and then do not actually punish him/her	1	2	3	4	5
4. You volunteer to help with special activities that your child is involved in (such as sports, boy/girl scouts, church youth groups).	1	2	3	4	5
5. You reward or give something extra to your child for obeying you or behaving well.	1	2	3	4	5
6. Your child fails to leave a note or to let you know where he/she is going.	1	2	3	4	5
7. You play games or do other fun things with your child.	1	2	3	4	5
8. Your child talks you out of being punished after he/she has done something wrong.	1	2	3	4	5
9. You ask your child about his/her day in school.	1	2	3	4	5
10. Your child stays out in the evening past the time he/she is supposed to be home	1	2	3	4	5
11. You help your child with his/her homework.	1	2	3	4	5
12. You feel that getting your child to obey you is more trouble than it's worth.	1	2	3	4	5
13. You compliment your child when he/she does something well.	1	2	3	4	5
14. You ask your child what his/her plans are for the coming day.	1	2	3	4	5
15. You drive your child to a special activity.	1	2	3	4	5
16. You praise your child if he/she behaves well.	1	2	3	4	5
17. Your child is out with friends you don't know.	1	2	3	4	5
18. You hug or kiss your child when he/she has done something well.	1	2	3	4	5
19. Your child goes out without a set time to be home.	1	2	3	4	5
20. You talk to your child about his/her friends.	1	2	3	4	5
21. Your child is out after dark without an adult with him/her.	1	2	3	4	5
22. You let your child out of a punishment early (like lift restrictions earlier than you originally said).	1	2	3	4	5

Appendix Eight: Triple P[®] Satisfaction Questionnaire

Program Satisfaction Questionnaire - PPP



This questionnaire will help us to evaluate and improve the Triple P sessions of the PEACH program. We are interested in your *honest opinions* about the services you have received, whether they are positive or negative. Please answer all the questions. Responses are anonymous.

1. How would you rate the quality of the service you and your child received during the program?
- | | | | | | | | |
|------|---|---|------|---|------|---|-----------|
| Poor | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | Fair | | Good | | Excellent |

2. How could we improve the quality of the service you received during Triple P?

3. What type of help were you seeking when enrolling into the PEACH program?

4. Did you receive this help from Triple P?

Yes No

5. How satisfied were you with the amount of help you received during the program?
- | | | | | | | |
|------------|---|---|------------|---|---|-----------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Not at all | | | Moderately | | | Extremely |

6. What extra help would have liked to receive from the Triple P sessions?

7. Please rate how useful you found the following aspects of the Triple P sessions:

	1	2	3	4	5	6	7
a. Triple P sessions							
b. Homework tasks							
c. Triple P manual							

Comments:

8. Please list anything in the Triple P sessions that you did not find useful.

9. Have the Triple P sessions helped you to make changes to your parenting style/strategies?

Yes
If yes, please describe:

No

10. Have the Triple P sessions helped you to make changes to your child's eating and activity patterns?

Yes
If yes, please describe:

No

11. Please circle any factors that prevented your attendance to Triple P sessions (may circle more than one)

- Transport	Family commitments	Work commitments
Sport commitments	Session times	Too many sessions
Illness	Sessions not meeting needs	
Other:		

12. Please circle factors preventing the use of the Triple P program materials between sessions
(may circle more than one)

- | | | |
|-------------------------|-----------------------|----------------------------------|
| Lack of time | Program too demanding | Program not meeting needs |
| Illness | Family commitments | Work commitments |
| Too many changes needed | | Not enough time between sessions |
- Other: _____

13. Would you recommend the Triple P program to others?

- Yes No

14. Since beginning the program, have you sought further assistance to manage your child's weight from any other source? If so, please describe.

- Yes No
If yes, please describe: _____

15. Since beginning the program, have you sought further assistance regarding parenting skills from any other source? If so, please describe.

- Yes No
If yes, please describe: _____

16. Do you have any other comments about the Triple P program?

Thank you for your feedback.

Appendix Nine: PEACH Satisfaction Questionnaire

Program Satisfaction Questionnaire



This questionnaire will help us to evaluate and improve the PEACH program. We are interested in your *honest opinions* about the services you have received, whether they are positive or negative. Please answer all the questions. Responses are anonymous.

- Please circle the program you were enrolled in:
- I attended the Healthy Eating and Activity Sessions
 - I attended the Triple P and Healthy Eating and Activity Sessions

1. How would you rate the quality of the service you and your child received during the program?

1	2	3	4	5	6	7
Poor		Fair		Good		Excellent

2. How could we improve the quality of the service you and your child received during the program?

3. What type of help were you seeking when enrolling into the PEACH program?

4. Did you receive this help from the PEACH program?

Yes No

5. How satisfied were you with the amount of help you and your child received during the program?

1	2	3	4	5	6	7
Not at all			Moderately			Extremely

6. What extra help would have liked to receive from the PEACH program?

7. Please rate how useful you found the following aspects of the PEACH program:

	Not at all useful	1	2	3	4	5	6	7	Extremely useful
a. Healthy eating and activity sessions for parents		1	2	3	4	5	6	7	
b. Parent session handouts		1	2	3	4	5	6	7	
c. Homework tasks		1	2	3	4	5	6	7	
d. Triple P group sessions (if applicable)		1	2	3	4	5	6	7	
e. Triple P manual		1	2	3	4	5	6	7	
f. Individual phone sessions		1	2	3	4	5	6	7	
g. Activity sessions for children		1	2	3	4	5	6	7	

Comments:

8. Please list anything in the PEACH program that you did not find useful.

9. Has the PEACH program helped you to make changes to your parenting style/strategies?

Yes No
If yes, please describe:

10. Has the PEACH program helped you to make changes to your child's eating and activity patterns?

Yes No
If yes, please describe:

11. Please circle any factors that prevented your attendance to PEACH program sessions (may circle more than one)

- | | | |
|-------------------|----------------------------|-------------------|
| Transport | Family commitments | Work commitments |
| Sport commitments | Session times | Too many sessions |
| Illness | Sessions not meeting needs | |

Other: _____

12. Please circle factors preventing the use of the PEACH program materials between sessions (may circle more than one)

- | | | |
|-------------------------|-----------------------|----------------------------------|
| Lack of time | Program too demanding | Program not meeting needs |
| Illness | Family commitments | Work commitments |
| Too many changes needed | | Not enough time between sessions |

Other: _____

13. Would you recommend the PEACH program to others?

- Yes No

14. Since beginning the program, have you sought further assistance for your child's weight from any other source? If so, please describe.

- Yes No
If yes, please describe:

15. Since beginning the program, what changes has your family made around eating and activity?

16. Do you have any other comments about the program?

Thank you for your feedback.