



FAMILY-FOCUSED MANAGEMENT  
OF OVERWEIGHT IN  
PRE-PUBERTAL CHILDREN –  
A RANDOMISED CONTROLLED TRIAL



The Healthy Eating and Lifestyle  
through Positive Parenting (HELPP)  
study

Volume One



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Submitted in fulfilment of the requirements  
for the degree of Doctor of Philosophy

December 2005

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## **Thesis Summary**

Over a quarter of children and two thirds of adults in Australia are overweight, with these estimates reflecting global trends. The literature review in Chapter 1 highlights that treatment of childhood overweight is an important part of the public health approach required to address the obesity epidemic. Energy moderation, behaviour modification and family support are the cornerstones of treatment of childhood overweight. However the evidence to guide best practice is limited, with a call being made for well designed studies to inform age-appropriate effective, long term child weight management. Studies are needed in a range of populations and to assess a range of health outcomes. This thesis tested the hypothesis that, pre-pubertal children whose parents participate in a parent-led, family-focused child weight management intervention comprising parent skills training and intensive lifestyle education will have adiposity, metabolic profiles and indicators of physical and psychosocial functioning after 12 months that are a) improved compared to children wait listed for intervention and b) no different to children whose parents participate in parenting skills training alone (without intensive lifestyle education).

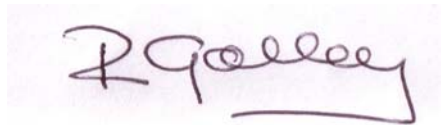
Methods of the randomised controlled trial undertaken with 111 overweight, pre-pubertal 6-9 year olds to test this hypothesis are detailed in Chapter 2. Parents were defined as the agents of change, responsible for attending intervention sessions and implementing family-focused lifestyle change to support child weight management. Two interventions, both utilising parenting skills training, but differing in the presence or absence of intensive lifestyle education were compared to a group waitlisted for intervention with a brief pamphlet. Program effectiveness was defined in terms of adiposity together with broader health and evaluation outcomes.

Chapter 3 describes the study population, their flow through the study, the primary outcome BMI z score and waist circumference z score. With parenting plus intensive lifestyle education there was a 10% reduction in BMI z score over 12 months. However this was not statistically different to the 5% reduction observed with parenting alone or intervention waitlisting. There was a significant reduction in waist circumference between baseline and 12 months with parenting alone and parenting plus lifestyle education, but not waitlisting. There was a group, time and gender interaction, with boys receiving intervention having greater reductions in adiposity. In determining intervention effectiveness, growth, metabolic profile and psychosocial outcomes are presented in Chapter 4. While there were limited improvements in metabolic profile and body dissatisfaction, significant improvements were observed in parent-perceived HR-QOL relating to psychosocial and family functioning. Improvements were confined to the intervention groups, parenting plus lifestyle education more than parenting alone. Chapter 5 presents the study process and impact evaluation. Parents were satisfied with the program and reported that it provided the type of help they wanted. Personal, rather than program factors such as work and family commitments limited intervention attendance to 60%. Child health behaviours and parental weight status show positive change in all groups, but favour intervention. Chapter 6 highlights key findings, study strengths/limitations and areas for further research. In conclusion, a parent-led family-focused intervention utilising parenting skills training and healthy family lifestyle is a promising intervention for young overweight children.



## Declaration

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

A handwritten signature in purple ink that reads "R Golley". The signature is written in a cursive style with a horizontal line underneath the name.

Rebecca K Golley

December 2005

The conception and design of the RCT reported in the thesis was undertaken before I commenced my PhD candidature, as part of a funding proposal for a multi-site RCT. Partial funding was secured from the Australian Health Management Group Assistance to Health and Medical Research Fund which enabled the RCT to be undertaken in Adelaide only as a PhD project. I adapted the study design to delivery at one site, developed the nutrition component of the study interventions, adapted the parenting component of the study interventions, assisted with obtaining ethical approval, developed study protocols and procedures, recruited subjects, co-ordinated subject eligibility screening, delivered the study interventions (apart from physical activity component) and co-ordinated outcome measurements by a blinded assessor. In consultation with my supervisors and a statistician I developed the study analysis plan and I performed the data entry and analysis. I designed and performed the secondary analysis of the National Nutrition Survey data and developed the evidence-based food-based recommendations underpinning the study interventions (chapter 2, appendix 6). I designed and performed the baseline analysis for the purposes of Metabolic Syndrome definition comparison (chapter 2, appendix 6). I took a leadership role in the preparation of all manuscripts arising from the study. The thesis study (HELPP) also formed the pilot work for a successful National Health and Medical Research Council grant for a multi-site study (PEACH) undertaken in Sydney and Adelaide from 2003.'

## **Acknowledgements**

Assoc Prof Lynne Daniels and Dr Anthea Magarey conceived the original study idea, and I thank them for the opportunity to undertake my thesis in this challenging area. I have appreciated the faith, independence and collegueship you both have extended me, blended perfectly with endless expertise and nurturing guidance. This unique blend of supervision qualities has facilitated my growth in research, dietetic and academic life. Special thanks to Professor Louise Baur, Assoc Prof Kate Steinbeck and Dr Nicola Spurrier for their support, advice and collegueship during my candidature.

Many thanks to the staff of the Flinders Medical Centre (FMC) Paediatric Unit for their support and assistance with the study; Dr David Everett for supporting the study, the unit paediatricians for donating their time to screen subjects and to Kylie Bailey and Tina Owers their kindness, friendship, professionalism and making me feel welcome in the paediatric unit.

I need to make special mention of the contributions of the following groups and individuals without which HELPP could not have succeeded. Thanks to; the FMC media unit for promoting media coverage of the study; Jane Bowen, Rochelle Kuhn and Kate Wood assistance with recruitment of cohorts 3 and 4, and conducting the dietary assessment tool validation; to Dr David Lyons, Dr David Everett, Dr Nicola Spurrier, Dr Brian Coppin and Dr David Thomas for screening subjects; Michelle Howard and Kevin Duffy for enabling us to conduct the study at the Women's Children's Hospital (WCH); I am indebted to Dr Anthea Magarey for all the (early morning) subject measurements to maintain assessor blinding and to Heather Garreffa and Judy Beltess for their expertise in collecting paediatric blood samples; the Division of Laboratory Medicine, WCH, Adelaide and Diagnostic Laboratory, Department of Endocrinology Royal Prince Alfred Hospital, Sydney for blood analysis; Ms Sarah Garnett and Ms Margie Gruca, The Children's Hospital at Westmead for access to their waist circumference z-score calculation program;

Professor Kevin Norton and Max Martin for the development of the physical activity program and Ross Bament, Tara Gehling, Stella Petrone and Adam Bishop for facilitating the physical activity program at various stages during the study; Gizelle Wilson and Fiona Curnow for their assistance with questionnaire entry and scoring when really needed; and my deepest thanks to Kylie Lange for her knowledge, expertise and patience in provision of critical statistical advice and support.

Funding for the study was provided by the Australian Health Management Group Assistance to Health and Medical Research Fund and through an Australian National Health and Medical Research Council Postgraduate Research Scholarship. The Positive Parenting Program resources which I adapted for the study interventions were purchased through the Parenting and Family Support Centre, Queensland and facilitator training was undertaken through Parenting Victoria.

Thank you to my colleagues and friends in the Department of Nutrition and Dietetics, Flinders University. I have felt a welcome and valued member of the department and have appreciated your support. I also need to acknowledge the friendship and support of my fellow PhD candidates, Michelle Miller, Rebecca Haigh, Jane Bowen - it was always reassuring to know I wasn't alone.

To my friends, family and husband. Thank you for your support in this endeavour and for helping maintain a life outside a thesis. I consider the way I was raised by my family and my relationship with you Matt has played a huge role in giving me the confidence to believe I can achieve anything and the support to pursue my dreams. I hope I can repay this in the future.

Last but not least, to the 111 'HELPP' families, without whom none of this could have been possible. Credit must be given for your dedication to your child's health and willingness to try a new family-focused approach and participate in research. Many thanks for your early morning attendance to measurement sessions and children's braveness in providing a blood sample. I wish you all the best in the years ahead.

## Abbreviations

AGHE	Australian Guide to Healthy Eating
BF	Body fat
BM	Body mass
BMI	Body mass index
BT	Behaviour therapy (behaviour modification)
BW	Body weight
C	Child
CBIS	Child body image scale
CHQ	Child health questionnaire
CI	Confidence interval
CONSORT	CONsolidated Statement Of Reporting Trials
CVD	Cardiovascular disease
EGIR	European Group for the Study of Insulin Resistance
FFM	Fat free mass
FMC	Flinders Medical Centre
FMS	Fundamental Movement skills
GI	Glycaemic index
HDL-C	High density lipoprotein cholesterol
HELPP	Health Eating and Lifestyle through Positive Parenting
HR-QOL	Health related quality of life
HT	Hypertension
IOTF	International obesity task force
LCD	Low calorie diet
LDL-C	Low density lipoprotein cholesterol
LFD	Low fat diet
MS	Metabolic Syndrome
NCEP	National Cholesterol Education Program
NHANES	National Health, Nutrition and Exercise Survey
NHMRC	National Health and Medical Research Council
NR	Non-restricted
NS	Not statistically significant
OR	Odds ratio
P	Parent

P+DA	Parenting skills training plus intensive lifestyle education
P	Parenting skills training alone
PAR™	Planned activities routine
PS	Problem solving
PSMF	Protein sparing modified fast
PSOC	Parents sense of competency
R	Restricted
RCT	Randomised controlled trial
S/D-BP	Systolic/Diastolic blood pressure
SD	Standard deviation
SEIFA	Socio-Economic Index for Areas
SES	Socioeconomic status
SPSS	Statistical Package for the Social Sciences
TC	Total cholesterol
TG	Triglycerides
TLD	Traffic light diet
Triple P <sup>®</sup>	Positive Parenting Program <sup>®</sup>
UK	United Kingdom
US	United States of America
VLCD	Very low calorie diet
WCH	Women's and Children's Hospital
WHO	World Health Organisation
WLC	12 month wait listed control
%O'WT	Percent overweight

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# Chapter 1 Weight management in children under ten years of age – a review of the evidence

## 1.1 Introduction

The obesity epidemic is a public health crisis that may see parents outliving their children, and reversal of the public health gains achieved from improved hygiene and nutrition (1-3). Australia, the United States of America (US) and the United Kingdom (UK) are leading in prevalence rates for overweight (4). The most recent nationally representative Australian data shows over 60% of adults and 20% of children are overweight or obese with prevalence rates having doubled and trebled respectively over the last 20 years (5, 6). Excess body weight, synergistically with its associated lifestyle patterns, poor diet and inactivity, are key risk factors for the non-communicable diseases currently burdening the health system (1, 2, 7). Therefore, addressing the epidemic of overweight is crucial to addressing the increasing prevalence and significant health burden of non-communicable diseases (1, 2).

The cause of overweight, energy intake in excess of requirements is a relatively simple concept. However the processes driving accumulation and maintenance of excess weight are “so numerous and so basic that they are inseparable from the way we live”, highlighting that reversing the epidemic of overweight is likely to be extremely difficult (1, 8). The underlying causes of overweight, energy dense diets and inactivity, are the “unintended consequence[s]...related to technologic and social change...” that have occurred over the last 20 years (8). Many factors influence food choice at the individual level. However this is within a context of environmental features (eg convenience of food or affordability of labour saving devices) promoting inactivity and ready access to a cheap energy dense food supply (9, 10).

Four interdependent levels have been identified for an effective and coordinated approach to addressing the obesity epidemic (Figure 1.1) (1). While prevention of overweight needs to be a primary focus, effective treatment is important to facilitate efficient use of limited health resources.

Treatment of overweight in childhood also provides a unique opportunity for secondary prevention of obesity and primary prevention of adult overweight (1). Effective treatment options for childhood overweight are urgently required given that 1) this epidemic already affects one in five Australian children (~10% globally) (6), 2) overweight children become overweight and obese adults (11) and 3) there are significant health consequences of childhood overweight (12) that persist into adult life (13). With children of overweight parents more likely to be overweight (14), treatment of child overweight that involves their family may also assist in the treatment of adult overweight.

Addressing energy balance and utilising behaviour modification strategies and family support are the cornerstones for management of overweight in adults and children (1, 15, 16). However management of overweight in young (primary-school aged) children hold unique challenges and opportunities. These include 1) meeting the needs of growth and development, 2) ability to utilise growth (height and lean body mass) with weight maintenance to reduce adiposity levels, 3) treating children as part of a family system, 4) facilitating lifestyle change may be easier due to the shorter exposure to an adverse environment and behavioural patterns are still developing (1, 17).

This review aims to evaluate child weight management literature to inform the development of an evidence-based, age-appropriate intervention for 6-9 year olds. The components or cornerstones important to incorporate in treatment programs for children are described. There is also a focus on highlighting potential strategies within these cornerstones that may improve the process and sustainability of weight management in children. Weight management effectiveness in terms of change in adiposity, broader health outcomes and quality of the evidence is considered.

## **1.2 Defining overweight and assessing adiposity change**

Overweight or obesity is defined as “a condition in which excess body fat (adiposity) has accumulated to an extent that health may be adversely affected. The underlying disease is an imbalance in the energy equation leading to weight gain” (1). The terms overweight and obesity are used interchangeably to refer to the point where health may be affected by weight gain. However they also indicate the degree of excessive weight accumulation, with obesity indicating greater fat accumulation and health risk than overweight (1). For the purposes of this review, the term overweight will be used to refer to the health condition encompassing overweight and obesity. Obesity will be used when reference to severity of overweight is pertinent.

### **1.2.1 Defining overweight and adiposity change in adults**

In adults there is a clear link between overall adiposity, assessed using body mass index (BMI,  $\text{kg/m}^2$ ) and mortality and morbidity (1). The association is J-shaped and continuous, with cut points identified where the risk of health consequences moves from minimal to moderate (overweight, BMI  $25\text{kg/m}^2$ ) and from moderate to high (obesity, BMI  $30\text{kg/m}^2$ ) (1). Thus the definition of overweight in adults is linked to adverse health outcomes. Fat location influences the risk of health consequences. Presence of excess abdominal fat, identified by waist circumference, confers a higher risk health consequences (1). In adults, BMI and waist circumference are also appropriate outcomes to measure changes in adiposity over time or in response to intervention (18).

### **1.2.2 Defining overweight and adiposity change in children**

Ideally, defining and tracking of overweight in children would use a method that adjusts for the height and body composition changes that occur with growth during childhood (19). BMI adjusted for height, age and gender (eg BMI for age centiles, BMI for age z-scores, BMI cut points derived from adult definition of overweight) meets this first requirement (19). Secondly, the ideal definition of adiposity in children would be linked to health outcome.



BMI for age centiles describes where the BMI of an individual is compared to the BMI distribution in a reference population (eg the 50<sup>th</sup> percentile is the median BMI of the reference population, the 75<sup>th</sup> percentile indicates only 25% of the reference populations BMI are greater than this etc...). BMI for age z-scores extend this concept further by describing how far the BMI of an individual lies from the median of a reference population (eg a BMI for age z-score of 0 is the median BMI of the population, equivalent to the 50<sup>th</sup> percentile). However the definitions of overweight and obesity in children using BMI for age centiles or BMI for age z-scores are limited as the cut points used (for example in the US 85<sup>th</sup> for overweight, 95<sup>th</sup> for obese) are arbitrary. They are based on the percent of the population lying above this cut point (eg prevalence of overweight 10-15%). This approach to defining overweight or obesity in children does not reflect any known medical or health risk that exists above these arbitrary cut points (19, 20).

There is no prospective, longitudinal data in children linking adiposity with health outcome, primarily due to the long delay between exposure (overweight) and health consequences in children (19, 20). However the recently proposed international definition for overweight in childhood moves a step closer to linking the definition of childhood overweight to health outcomes. This is albeit indirect, using the tracking of weight and its consequences from childhood into adult life. BMI for age z-scores are still calculated from a reference population and can be used to describe how far an individual lies from the median BMI of this population. However, the cut points for overweight and obesity in children are extrapolated from the adult definitions (ie cut points in children equivalent to BMI  $\geq 25$  or  $30\text{kg/m}^2$  at age 18, not an arbitrary cut point) (20). However the validity of these cut points across populations, agreement with the common alternative (BMI centile with arbitrary cut points defining overweight and obesity) and appropriateness for use in epidemiological and clinical settings remains controversial (20, 21).

Raw weight or BMI have been used to assess changes in adiposity over time or following intervention in children. However, age and gender adjusted BMI (already adjusted for height) is preferred to methods adjusting raw weight, as use of weight for height measures only weakly correlate with weight and strongly correlate with height (19, 22). There are a number of ways to express age, height and gender-specific BMI (eg BMI z-score/centile or percent overweight; the actual-mean/median BMI difference).

The number of ways used to express adiposity in children makes it difficult to compare studies, and use of different reference populations adds to the complexity. There is no consensus about which method is most suitable (19, 20, 23). Recently in 3-6 year olds it was found that all methods were highly correlated (all  $r > 0.9$ ) (23). However there may be some advantage, in terms of stability over time and use across the weight spectrum, in using percent BMI (over median BMI for gender and age) or BMI z score to assess adiposity change in children (23).

The methods for analysing adiposity outcomes (eg use of actual values versus change scores), management of baseline imbalances and values tending to show regression to the mean over time are additional considerations in analysing adiposity change. These issues are best managed by analysing actual values at each time point rather than change scores (24, 25).

Finally, defining and tracking overweight over time using measures of truncal adiposity is poorly researched in children. Inclusion of outcomes assessing changes in fat distribution are urgently needed given that waist circumference may be a better predictor of obesity-related health risk in children than BMI (26). Waist circumference also varies by gender and age and recently data have become available to determine waist circumference z scores against a UK population (27, 28). However the prospective association between truncal overweight and poor health outcomes remains unclear and no meaningful definitions or cut points for truncal overweight are currently available (27-29).

### **1.3 Prevalence and trends of childhood overweight**

There has been limited national monitoring of weight and growth in Australian children over the last 30 years, with the most recent national survey now over a decade old (30). Using the standard international definitions for childhood overweight (20) applied to the most recent nationally representative data from the National Nutrition Survey 1995 (5, 30), overweight is estimated to affect approximately 1 in every 5 Australian children aged 2-17 years (Figure 1.2) (6). For 7-11 year olds 12% of boys and 17% of girls are estimated to be overweight, with an additional 4% and 6% of boys and girls respectively classified as obese (6). Overweight is being established early in life. A South Australian survey using data collected from routine health checks covering 70-80% of birth cohorts, found 17% of four year olds were overweight in 2002 (31).

It is difficult to assess trends in prevalence of overweight over time due to a lack of consistent longitudinal data. The limited number of Australian surveys conducted over the last 30 years differ in their methodology, definition of overweight and age brackets (32). Prevalence rates of overweight and obesity were comparatively stable before the 1980s (32). However, they have risen rapidly in the decades since, with the risk of overweight in Australian children almost doubling (odds ratio, OR 1.8 confidence interval, CI 1.6; 2.0,  $p < 0.001$ ) between 1985 and 1995 with the risk of obesity tripling (OR 3.3 CI 2.5;4.3,  $p < 0.001$ ) (Figure 1.2) (6). Small, locally representative surveys indicate prevalence rates of childhood overweight have continued to rise since 1995. A cross sectional survey ( $n=268$ , 7-11 year olds, rural East Coast Australia) estimated prevalence of overweight to be 26% (includes 10% who are obese) in boys and 28% (7% obese) for girls (33). A longitudinal Victorian school survey (1997-2000/01,  $n=1438$  5-10 year olds) estimated the prevalence of overweight to be 25% (5% obese) (34). In this study there were 164 incident cases of overweight (12% of the cohort), with only 4% of the cohort resolving from overweight over this time (34).

The prevalence of overweight is increasing globally, with Australia, along with the United States, having the highest prevalence rates (Figure 1.2) (4, 6, 35, 36). While the prevalence rates of overweight are lower in developing countries, rates are increasing in many countries (4). This often results in added burden on countries experiencing subgroups of their population with under nutrition, in addition to, groups with over nutrition (4).

In summary, overweight affects a significant number of children globally, particularly in developed countries. There is a paucity of longitudinal studies and a number of definitions used to define and track adiposity in children, limiting study comparisons. However, in Australia, current prevalence rates of childhood overweight are estimated to be 20-25% (5-10% obese). The risk of childhood overweight has doubled between 1985 and 1995 and is likely to have worsened in the decade since. The number of children affected from an early age, the trend for prevalence and severity of overweight to continue to increase and low resolution rate, highlight the fact that effective management of overweight is required for children at all ages.

## **1.4 The consequences of childhood overweight**

### **1.4.1 Introduction**

Overweight in childhood is commonly considered by parents and health professionals as benign and a normal part of growth in children (eg 'puppy fat'). It is perceived to have limited health implications and likely to spontaneously resolve as children 'grow into their weight' (37-40). This may result in limited concern about child overweight and may have implications for treatment services (eg lack of services or services targeted at very obese children with obvious co-morbidities) (37-40). There is some hesitation to treat overweight children, with perceived potential harm from 'dieting' (eg triggering eating disorders, lowered self esteem, impaired growth and development) outweighing possible benefits, despite limited research in this area (15). However, the consequences of overweight are not confined to adulthood or the severely obese child. Overweight in childhood impacts on nearly every organ system, early in life including the endocrine, hepatic, orthopaedic, respiratory, cardiovascular and reproductive systems, as well as psychosocial well being, across the spectrum of overweight (Table 1.1) (1).

Overweight tracks from childhood to adult life, with childhood overweight and risk factors such as elevated lipids independently contributing to risk of adult disease and mortality (13).

#### **1.4.2 Persistence into adulthood**

Persistence of overweight and associated health consequences into adult life is perhaps the most striking, long term consequence of excess weight in childhood. Reilly and colleagues identified 7 high quality observational studies which indicated that 40-70% of obese pre-pubertal children are likely to become obese adults (41). These estimates are likely to be conservative as the cohorts were established prior to the rapid increase in obesity prevalence (41). The range in estimates arises from variation between studies but also variation by age, degree of overweight and parental weight status. Persistence of overweight into adulthood increases with late onset of obesity and increasing severity of obesity (eg 60% of obese 6-9 year olds versus >70% of obese 10-14 year olds are likely to become obese adults) (1, 13).

The consequences of overweight observed in childhood also track into adult life. A study with 20 year longitudinal data found that a BMI  $\geq 25\text{kg/m}^2$  significantly increased mortality in adult life (relative risk (RR) for mortality at 32 versus 19 years of age was 1.95) (41). A large body of evidence from the Bogalusa Heart Study indicates that cardiovascular risk is established in childhood and tracks into adult life. The Bogalusa Heart Study was a series of cross-sectional studies carried out in a bi-racial, semi-rural population in Southern United States in the mid-1970s to late 1980s. The children (5-14 year olds at baseline) from this survey were followed up in the late-1980s (42). Over a 15 year period, elevated lipids were observed in children aged 5-14 years, with risk of adult dyslipidaemia increasing if risk factors were present in childhood, especially for overweight subjects (42). Therefore childhood overweight is not only an independent risk factor for adult overweight, but is also an independent risk for adult morbidity such as cardiovascular disease (CVD) and the metabolic syndrome (dyslipidaemia, hypertension, obesity and diabetes) (42-44).

### 1.4.3 Metabolic consequences and the metabolic syndrome

Chronic disease is responsible for ~43% of the Australian health burden, defined as loss of healthy life years to poor health or disability and premature mortality (7). Mortality from cardiovascular-related conditions is the number one cause of death in Australia (19% all deaths in 2002), accounting for ~12% of the overall health burden (7). Type 2 diabetes and its related consequences is also one of the top 10 causes of death in Australia affecting at least 7% of the population in 1999-2000 compared with 3% in 1981 (7). Once considered 'adult onset' diabetes, the number of incident cases of type 2 diabetes in US adolescents has risen from 4 to 16% (15). Excess weight, together with its causes of poor diet and inactivity, are independent risk factors for the majority of chronic diseases burdening the health system including CVD and diabetes. In addition, overweight also influences key risk factors for chronic diseases such as hyperlipidemia, hypertension and insulin resistance (7).

Risk factors for CVD and diabetes such as hyperlipidemia, elevated blood pressure and hyperinsulinaemia are well-documented in children and adolescents (45-47). Mortality from CVD in childhood is rare but the process of atherosclerosis originates early in life. Autopsy data from 204, 2-39 year olds in the Bogalusa Heart Study showed 50% of 2-15 year olds had fatty streaks in the coronary arteries (45). In 93, 2-30 year olds the presence of atherosclerotic markers correlated with age, but also pre-autopsy BMI ( $r=0.48$ ,  $p<0.001$ ) and presence of childhood cardiovascular risk factors, particularly raised systolic blood pressure (SBP,  $r=0.55$ ,  $p<0.001$ ), triglycerides (TG,  $r=0.5$ ,  $p<0.01$ ) and low density lipoprotein cholesterol (LDL-C,  $r=0.43$ ,  $p<0.05$ ) (45). Insulin resistance is predictive of developing diabetes and is also a risk factor for CVD with hyperinsulinaemia, a marker of insulin resistance observed in young children (48, 49).

The presence of metabolic risk factors and the clustering of multiple risk factors increase across the weight spectrum. In 9167, 5-7 year olds from the Bogalusa Heart Study, race and sex-adjusted OR for metabolic risk factors ranged from 2 (CI 2.0;3.0) for total cholesterol to 13 (CI 10;16) for insulin. All risk factors were significantly higher in obese children (defined as BMI  $>95^{\text{th}}$

US centile) compared to all other children with an OR in obese children for presence of  $\geq 3$  risk factors of 44 (no CI provided) (49). This association between metabolic health and overweight is linked to overall adiposity as well as abdominal fat distribution which is independently (and synergistically) correlated with adverse metabolic outcomes (49-51). Insulin is believed to play an independent aetiological role in addition to adiposity in this association (48).

The Metabolic Syndrome (MS) describes a cluster of measurable abnormalities and physiological variables which include truncal obesity, CVD (raised triglycerides and/or low high density lipoprotein cholesterol, elevated blood pressure) and diabetes (hyperinsulinaemia, impaired glucose tolerance) (52). Prevalence of MS in adults and children is summarised in Table 1.2, increasing with age from 4-14% in children and adolescents to 24% in adults (53-55).

The prevalence of MS in all studies increases with severity of overweight. However the nature of the relationship between MS and overweight remains controversial and does not appear to be strictly linear (54-59). The estimated prevalence of MS varies between studies. Some of this variation is likely to reflect increases over time, but is also likely to be due to the population studied (eg US versus Canada) (54, 55). In addition there is variation in the definition and cut point criteria used, especially in children, where a consistent workable definition remains elusive (56, 57). Despite these limitations, metabolic risk factors for adult diseases are observed in childhood, appearing with increasing frequency and tending to cluster across the weight spectrum. While the prevalence of metabolic risk factors and associated diseases (eg CVD, diabetes and MS) are poorly described in pre-pubertal children, it is estimated that between 4-14% of overweight children would be classified as having MS (Table 1.2).

#### **1.4.4 Psychosocial consequences**

Negative stereotyping (60), social isolation (61, 62) and discrimination (62) are peer responses to the overweight child, which persist regardless of a medical explanation for the presence of obesity (62, 63). Social marginalisation of overweight children and the resultant negative psychosocial effects have been documented in children as young as 6-8 years. The psychosocial effects strengthen with age and while affecting both genders, may have a greater impact on girls (60). The psychosocial impact of childhood overweight carries into adult life. Adults who reported that they were obese in adolescence were found to have lower educational attainment and income levels and were less likely to have married than those who were thin as children (64). A causal association between 1) childhood overweight, 2) a social environment characterised by negative stereotyping and discrimination and 3) health and economic outcomes such as life opportunity, self-esteem (in particular body esteem), depression and eating behaviours is likely (65) but not confirmed (66).

Self esteem encompasses concepts such as academic and athletic performance, body appearance/esteem, extent of social networks and behavioural conduct (66). French and colleagues reviewed 35 studies conducted between 1967 and 1994 examining the relationship between self-esteem and childhood overweight (66). While highlighting many methodological flaws limiting the ability to draw firm conclusions, they concluded that “the relationship between obesity and self-esteem is present but weak” (66). Twelve of 25 cross-sectional studies they reviewed found overweight was associated with lower self esteem. Six of 8 intervention studies found treatment of overweight improved self esteem. However, these improvements were not predictive of or associated with degree of weight loss (66). Reilly and colleagues concluded in a systematic review (9 studies )that “obese children are more likely to experience psychological problems...[with] low self-esteem and behavioural problems particularly common” (41).



A 3-year longitudinal study published in 2004 (n=1157 5-10 year olds from Victoria, Australia) examined the causal direction of the relationship between overweight and self esteem assessed using the parent-reported Child Health Questionnaire (65). This study confirmed that overweight was associated with lower self esteem, and found after adjusting for baseline self-esteem, a higher BMI z score at baseline predicted poorer self esteem at follow up (OR 1.8 CI 1.2;2.6 p<0.001). This relationship was not observed between baseline self esteem and follow up weight status, suggesting the casual direction is overweight is causing the reductions in self esteem (65).

Self-esteem is influenced by many factors and includes perception of body appearance/satisfaction or body esteem. Six studies reviewed by French and colleagues assessed body esteem (66). Five showed a negative association between body esteem and overweight (size of effect not given) (66). An Australian cross sectional study (n=379) found that overweight 9 year olds had the lowest body esteem, with the discrepancy between perceived and preferred body shape increasing by weight category (and gender) (p<0.003) (67). Similar results are seen in other populations of similar age (68, 69) and in children as young as 5 years (70).

While there are few studies in this area, childhood overweight may also have psychosocial consequences for parents and families. In a qualitative study of 40 parents who were concerned about the weight of their 4-15 year olds, the presence of an overweight child impacted on family lifestyle habits, maternal concerns about child expectations due to older appearance, conflict about child's clothing and disturbed family member relationships (71). In a study of parents of 75 9-11 year olds, parents perceived criticism about not 'controlling' their child's overweight and they reported their own feelings of guilt and self-doubt in relation to their child's weight (62).

In summary, the psychosocial effects of child overweight are short and long term. The social environment of stereotyping and marginalising of overweight individuals is a likely but unconfirmed aetiological factor. Self esteem, in particular body esteem or body satisfaction, are key concepts affected by overweight, with some evidence suggesting overweight leads to low self esteem. In children, the psychosocial impact of overweight also appears to involve family or parental factors. Psychosocial outcomes are rarely included in observational or treatment studies. Given the potential beneficial or negative impact of weight management on children's psychosocial health, inclusion of these outcomes in studies is a priority.

#### **1.4.5 Health-related quality of life**

Health-related quality of life (HR-QOL) measures the impact of a medical condition (including its treatment) on overall health, including physical, mental, emotional and social wellbeing (72). It is therefore a measure of the overall impact of a condition on a range of health outcomes, including psychosocial concepts and family functioning. HR-QOL has been assessed in Australian (39) and American (73-75) non-overweight, overweight and obese children in both community (39, 73, 76) and clinical settings (74, 75). Overweight children and their parents consistently report lower HR-QOL compared to their non-overweight counterparts (39, 73, 74, 76). One study found that the HR-QOL reported from obese children was similar to that measured in children undergoing cancer treatment (74).

Domains of HR-QOL that are consistently lower in overweight compared to non-overweight children were physical (39, 73, 74, 76), social (74, 76), emotional and psychosocial (73, 74) functioning, self-esteem (39) and parent wellbeing (39, 73). Children undergoing weight management programs have significantly lower HR-QOL scores than overweight children sampled from the wider community (75). The type of treatment is also associated with differences in HR-QOL with children undergoing gastric bypass having lower HR-QOL than inpatient or outpatient treatment programs (75). However, the causal direction of these associations remains unclear. Given the physical, psychological and social consequences of overweight, HR-QOL is likely to be a good measure of the overall health impact of child overweight and any changes that result with intervention.

#### **1.4.6 Other consequences of overweight and obesity**

The consequences discussed above occur with increasing prevalence across the spectrum of overweight and obesity (1, 77). As the severity of overweight increases and/or children move into adolescence, additional health consequences arise affecting the orthopaedic, respiratory, reproductive and gastro-intestinal systems (15). These include; sleep-related disordered breathing (hypopnoea and apnoea), asthma, fatty liver disease (non-alcoholic steatohepatitis), cholelithiasis, early menarche, Blounts disease (slipped capital femoral epiphysis), physical discomfort and reflux (Table 1.1) (15). These consequences highlight the need for prevention and early treatment (eg overweight not just obese children) to prevent the development of these immediately life threatening, costly and debilitating health consequences.

#### **1.4.7 Summary - the health consequences of overweight in childhood**

The health consequences of excess weight are public health priorities in terms of quality of life, disease burden and health system cost (78). Childhood overweight impacts on many domains of child health, including indicators of psychosocial wellbeing such as self esteem, body satisfaction and family functioning. It is an independent risk factor for adult conditions such CVD, diabetes and associated risk factors, which appear earlier and at higher rates in overweight children.

The most significant consequence of childhood overweight is its persistence into adulthood such that the majority of overweight children (particularly adolescents) will become overweight adults. The increasing prevalence of childhood overweight (and improved medical assessment) has contributed to rising prevalence rates of its associated consequences. This highlights the urgent need to develop strategies that prevent childhood and adolescent overweight and the associated health consequences. Developing effective treatment programs for young children is one such strategy which may contribute to the prevention of adult overweight and its health consequences.

## **1.5 The aetiology of childhood overweight**

### **1.5.1 Introduction**

The cause of overweight, positive energy balance is a relatively simple concept. However the processes promoting food intake in excess of energy expenditure are complex and poorly understood. Aetiological factors are interwoven, individual- or population-specific, difficult to measure (particularly simultaneously) and vary depending whether an individual is pre-obese/obese static or in the process of weight gain (1). Any degree of positive energy balance will lead to weight gain. This may occur as a small net positive balance over weeks, months or years, together with/or as weight gain spurts linked to critical life phases such as pregnancy, menopause or festive seasons (1). The aetiological model for overweight has moved beyond simple 'balance scales' which tended to focus on the genetic or physiological causes of overweight (1). Rather, a model has been proposed that acknowledges the complexity of weight gain, including consideration of how genes, physiology, an individuals behaviour and environments interact to impact on food intake and activity levels (Figure 1.3) (79).

### **1.5.2 Genes**

Family, twin and adoption studies consistently show a familial component to overweight (15, 80). The US 10-state Nutrition study (1968-1970) found the relative overweight of children increased, almost in a dose response manner, from two lean to two obese parents. A child was found to have a 40% chance of being obese if their sibling was obese (cited in (4, 15)). The heritability of BMI is between 40 and 70%. The discrepancy between mono- and zygotic twins raised together or apart (consistent with the degree of shared genome) and individual (rather than shared) environmental differences explains the remaining variation (80-82). However, prevalence rates of overweight have risen over a relatively short period of time. This together with the observed obesity patterns in migrant populations which share genes but have different environments, suggest that genotypes indicate 'risk or susceptibility' of overweight. This genetic 'risk' is only translated to overweight phenotypes under optimal environmental conditions (8).

That is, the 70+ genes associated with overweight (involved in appetite regulation, metabolism, fuel utilisation etc...) increase individual or family susceptibility to weight gain but they don't cause overweight (1, 83).

### **1.5.3 Behavioural and environmental influences on childhood overweight**

During the period that the obesity epidemic has emerged, many behavioural, environmental and social changes have occurred which have changed the way individuals and populations eat, live, work and play (84). Economic and technological development has resulted in advances in motorised transport and labour saving devices reducing the need for physical activity (8, 84). There is also improved food security resulting in ready access to an abundant, energy dense food supply (84).

#### *1.5.3.1 Energy intake 1985-1995*

Over the last 20 years the energy intake of populations and individuals has increased (84). In Australia, daily energy intake assessed as part of nationally representative surveys in 1985 and 1995, has significantly increased by ~350kJ for adults, 1400kJ for boys (15%) and 900kJ for girls (11%) aged 10-15 years (85). For children, this is equivalent to an additional muesli bar and 25g of crisps each day. The factors promoting increased energy intake are multifactorial and inter-linked involving changes in macronutrient pattern and/or food volume (Figure 1.4).

#### *1.5.3.2 Food and macronutrients patterns*

There have been changes in food and nutrient intake, shifting towards a macronutrient pattern that is high in fat and/or (refined) carbohydrate foods (Figure 1.5) (85). The increase in consumption by 150-200ml per day, of non-alcoholic beverages (eg fruit juice, sports drinks, cordial and carbonated drinks) is especially concerning, as energy intake derived from fluids may occur without compensatory down-regulation of energy intake from food (86). High fat, highly refined sugar-containing foods and beverages are displacing intake of core (low energy density) foods such as vegetables and fruit, with 23 and 44% of 8-11 year olds consuming no vegetables or fruit respectively on the day prior to the 1995 National Nutrition Survey (85, 87).

Children aged 5-12 are of particular concern as they are consuming significantly more daily energy intake from non-core foods (42%) and beverages (31%) than any other age group (88). There is little evidence to suggest that these patterns have improved in the decade since the last nationally representative food survey. A food pattern that is high in fat and refined sugar places individuals at risk of passive over-consumption of energy due to its high energy density, palatability and low satiety value (89-91). This may be especially important within a context of reduced energy expenditure (1).

#### *1.5.3.3 Portion sizes and meal patterns*

Data on food portion size changes are not available in Australia. However trends from countries such as the US with similar prevalence rates of overweight are likely to reflect local trends to some degree. Portion sizes of food in the US have increased, particularly for non-core foods such as chocolate bars, snack and fast food and soft drinks (92). The increases in portion sizes have occurred for foods eaten at and outside the home (92). This is concerning given that in a study of 30 children, exposure to portions larger than the average intake for age influenced their ability to consume appropriate portions (93). The larger portion sizes resulted in an increased intake, both for grams of food (25%) and energy intake (15%) (93). The authors suggest this is the result of increased bite size, non-hungry eating and reduced sensitivity to fullness (93). The influence of portion size on intake is observed in children as young as 4, strengthening with age (93, 94).

While portion size is associated with higher energy intake levels in children (93), no association between portion size and weight status has been observed, probably due to a lack of sufficient length of observation time. However in 19 weight gaining and 19 weight stable adults, larger meal size (and high carbohydrate intake) explained the 1645KJ/day difference (7 day non-weighed diary) between the groups (95).

Meal patterns such as snacking, eating in front of the TV, skipping breakfast, eating at night, frequent or irregular eating have been proposed to promote weight gain (1, 4). Maffeis and colleagues, observed a weak relationship between child adiposity and the proportion of energy eaten at dinner (n=530 7-11 year olds,  $r=0.1$ ,  $p<0.05$ ) (96). However a prospective study (n=15 000 9-14 year olds) found snacking (serves per day assessed using sum of 25-snack item food frequencies questionnaire, FFQ) was not associated with 3 year change in BMI z score (97). The number of eating episodes or their regularity can impact on energy intake, particularly in those who are overweight (98). Further research is needed to tease out the association between meal patterns, nutrient and food intake and weight status.

Food and nutrient patterns, are influenced by individual choices or habits, as well as broader environmental factors (79). Trends to food consumption away from home (home energy intake decreased from 77 to 65% of total energy 1970s-1990s) is supported by systems and structures facilitating easy access to restaurants or fast food outlets (increased by 147%, 1970s-1990's) (92, 99). Likewise, increases in portion sizes are influenced by marketing techniques to sell more product through 'King' or 'Upsizing' (99).

#### *1.5.3.4 The family eating environment*

The behavioural and environmental influences on food behaviours summarised in Figure 1.4 applies to adults and children (79). However for children, parents or family units, the media and peers, are key influences shaping eating patterns (100-103). Parents play a key role in defining what, when and how children eat, through shaping the home food supply, parental modelling and child-feeding practices (Figure 1.6) (100, 104, 105).

Parents of young children are key food providers shaping the food supply through food purchasing and preparation (106). This is demonstrated eloquently by Davis (described by Birch (106)), where young children in a series of self-selection studies were offered a variety of 10-12 foods over days or months. The children appeared to have an innate ability to select an appropriate mix of foods to support appropriate growth and development without adult guidance. However in these studies, foods offered were only

nutritious, prepared without sugar or salt, and presented under the supervision (but not guidance) of nurses (107). When the available food supply consists of both nutritious and less nutritious items, children make poor food choices, particularly in the absence of parental supervision (106, 107). The number of times a food is presented also influences children's food choice, requiring exposure to a new item 10-15 times before reducing the innate neophobic response (106). Thus, the composition and variety of the family food supply influences children's food choice, with healthy eating promoted when nutritious foods are offered in the presence of parents.

Child development theories such as social learning theory (describing the way children learn by observing) has been widely used to explain the variability in children's eating patterns (102). Mothers' and children's food intakes correlate (108), with parental modelling exerting a stronger influence than innate taste preferences (109). The influence of parental modelling extends to food practices, attitudes, values, beliefs and health motivations in addition to food intake (102). So an approach that uses positive parental role modelling in terms of 'do as I do not as I say' may be effective in shaping positive eating habits in children (102).

Feeding strategies and practices (eg food rewards, contingencies or restriction) employed by parents to encourage children's intake of healthy foods also influence children's short and long term food choices, preferences and ability to self regulate intake (106). Using dessert to reward vegetable intake has been associated with decreased vegetable preference and increased preference for desserts, and restricting children's intake or access to foods can lead to children overeating all or particular foods (106).

Brown and Ogden (2004) analysed 112 parent-child (9-13 years) pairs, finding a correlation between parent and child intakes ( $r=0.39$  healthy eating,  $r=0.32$  unhealthy eating, both  $p<0.01$ ). They also found that children whose parents employed strategies to control their child's intake had higher intakes of both healthy and unhealthy snacks (102). Overall, the evidence suggests the best way to facilitate children's capacity for self control is for parents to provide healthy food choices but allow children to control how much they consume (110).



Parental factors such as home food supply, modelling and child feeding practices influence the development of overweight in children (110-112). This may be via 1) impairing children's ability to self-regulate which has been found to correlate with level of adiposity in children (110), 2) promotion of poor body satisfaction or disordered feeding practices or 3) promotion of family preferences for high energy high fat foods (112). In 428, 4-5 year olds whose parents were either lean or overweight, maternal-reported child food preferences differed by parental weight status, with children from 'obese' families preferring higher fat foods ( $p=0.06$ ), and having a lower liking for vegetables ( $p=0.02$ ) (112). Predictors of negative parental role modelling or use of restrictive child feeding practices include parental overweight, parental weight history, dieting practices and concern for child's adiposity (113).

In summary, the family eating environment impacts on children's eating patterns and food preferences which are established early in childhood and track into adult life. Working at the level of the family food supply, parental role modelling and child feeding practices provide further modification points for the prevention and management of overweight in childhood. Promoting a healthy food supply, neutral feeding practices and most importantly positive parental role modelling are likely to be key strategies in minimising the impact of the family environment on the development of overweight in children. However interventions in this area remain untested with the evidence base largely theoretical and laboratory based.

#### *1.5.3.5 Physical activity patterns*

Metabolic processes, the thermic effect of food and growth contribute over three quarters of total energy expenditure (15). However these are relatively unmodifiable, genetically driven and after adjusting for differences in body composition, do not differ between lean and overweight individuals (15). The thermic effect of exercise, or physical activity, can be increased and is the target to change energy balance through increasing energy expenditure. Physical activity can be in the form of occupational, incidental (activities of daily living, chores, moving around), leisure (exercise and play in children) or spontaneous movement (1, 15). Inactivity is the use of sedentary means for

these components of physical activity or engagement in sedentary activities (eg use of small screen devices) which limit opportunities to be active (1).

Industrialisation and urbanisation have changed the way in which society is active (8). There has been a decrease in occupational activity and increases in time spent in sedentary activities during leisure time. Advances in technology, especially transport and labour saving devices, and changes in neighbourhood structures have increased opportunities to be inactive in nearly every aspect of life (4, 114). The changes in the environmental structures and systems which increasingly support inactivity, interact with individuals' habitual activity patterns, experiences and preferences to shape their physical activity levels (115). For children, their confidence, perceived efficacy, (parental) role models and movement skills impact on their engagement in physical activity (116). These factors track and influence activity patterns in adulthood. Additionally, there is a trend for physical activity levels to decrease as children age, with physical activity levels falling substantially during adolescence, especially in females (15).

Lack of monitoring surveys, reliance on parental reports of activity for children under age of 11 (due to cognitive capacity of children to self report) and a focus on fitness rather than activity levels, limit the evidence to describe the physical activity trends in children (115). However equating fitness with physical activity levels and using indirect measures such as engagement in active transport, physical activity levels in children do appear to have decreased over the period of increasing obesity prevalence (15). The WHO energy requirements for children were recently estimated to be overestimating current requirements. This may reflect improvements in measuring energy balance using doubly-labelled water and indirect calorimetry, but may also reflect real changes in energy balance (1).

Cross-sectional data using accelerometers show overweight children to be less physically active and have lower fundamental movement skills than their lean counterparts (1, 117, 118). However the causal direction of this association remains unclear. Overweight children may be less active and less skilled leading to weight gain or they may be less active and less skilled

as a consequence of their weight (1, 15) The decrease in physical activity levels indicate susceptibility to weight gain in the context of stable or increased energy intake from food.

#### *1.5.3.6 The role of sedentary activity*

Sedentary activity is used as a proxy for risk of low physical activity levels or to highlight potential barriers to being physically active. Prevalence of overweight has rapidly increased during the time when (multiple) television ownership has increased and personal computers and video game units have become commonplace in the home. At least 7 cross sectional and longitudinal studies demonstrate a dose-dependent association between television use and increased risk of obesity (4). In a 4 year study of 700, 10-15 year olds, children watching over 5 hours/day of television were 5 times more likely to be overweight than children watching fewer than 2 hours/day, after adjustment for child and maternal weight status, SES and other potential confounders (119).

This association may be mediated through several mechanisms including; 1) competing with opportunities for physical activity, 2) reinforcement of sedentary behaviour, 3) increasing energy intake through exposure to food advertisements and 4) snacking of high-energy foods and drinks while watching television (4). While it is suggested that similar associations should exist for other screen devices, there are conflicting findings regarding the associations between computers, video games and overweight (15).

#### **1.5.4 Risk factors for childhood overweight**

In addition to the risk factors of a readily available, energy dense food supply and sedentary lifestyle outlined so far in section 1.5, other risk factors for childhood overweight have been identified.

#### *1.5.4.1 Parental weight status*

Parental obesity is the single biggest determinant of childhood risk of overweight. If both parents are overweight, the odds ratio for child overweight is 10 (CI 5;21) (14). The influence of parental weight status on risk of childhood overweight is likely to be due to both shared genetics and environment (refer to sections 1.5.2, 1.5.3.5) (14, 101, 103, 120). The risk of childhood overweight secondary to family weight status highlights an important opportunity for prevention and management of childhood overweight. Focusing on family energy balance, the family food supply, activity patterns and parental modelling may be a modifiable risk factor with wide reaching effect. This will be discussed further in section 1.6.

#### *1.5.4.2 Other risk factors*

Reilly and colleagues (14) provide longitudinal evidence for potential risk factors for childhood overweight using data from 7758, 7 year olds. In their final model (21 risk factors assessed) significant risk factors for overweight in addition to parental weight status included; very early 'adiposity' rebound (OR 15 CI 5;42); catch up growth (OR 3 CI 1;6) and weight at 18 months (OR 3 CI 1;7) (14). In this study limited or early cessation of breastfeeding was not associated with risk of overweight after adjustment for maternal education (as a measure of socioeconomic status), although other studies have observed this association (4).

Particular ethnicities (Pima Indian, Pacific Islander, indigenous Australian, African-American) and certain childhood conditions or medications (acute lymphatic leukaemia, glucocorticoids, antipsychotics, some anti-epileptics) have also been associated with increased risk of childhood overweight (15). Low socioeconomic status (maternal education, (121)) and rural living (121) have also been associated with increased risk of overweight. However the strength of these relationships, particularly in Australian children and the determinants mediating a likely social health gradient remains unclear.

### **1.5.5 Summary – the aetiology of childhood overweight**

Positive energy balance results from food intake in excess of energy requirements and leads to weight gain. Excess weight is maintained via complex interactions between genetic or physiological susceptibility and behavioural, social and environmental factors influencing dietary and activity patterns (79). Positive energy balance needs only small, sustained increases in intake and/or decreases in expenditure. Both of these are difficult to measure validly, with wide inter/intra subject variation, limiting the ability to demonstrate a statistically significant change over time. In addition intake and expenditure are rarely assessed simultaneously. However evidence does indicate a change in both intake and expenditure of biological (if not statistical) significance (84). This is creating chronic positive energy balance and increasing weight status over time in individuals and populations.

The main causes of overweight at the environmental level appear to be an abundant food supply (availability, portion size) that is energy dense (high in fat/refined sugar) with many opportunities for consumption (snacking/grazing, eating away from home, eating in front of the television). This eating environment is occurring within a physical activity environment promoting decreases in energy expenditure (sedentary occupations, motorised transport, labour saving devices, sedentary leisure activities). Children and their membership in families deserve special attention in addressing childhood overweight. Parental weight status is a significant risk factor for child overweight. In addition, parents are the main influence of children's eating and activity environment, which influences children's food patterns and preferences through the food supply, modelling and feeding practices.

## **1.6 Management of childhood overweight**

### **1.6.1 Introduction**

Addressing the environmental factors influencing eating and activity patterns is likely to have the greatest impact in reversing the obesity epidemic (Figure 1.1). Therefore a focus is required on public health prevention strategies (1, 122).

However, treatment of childhood overweight has an important role, providing a unique opportunity for secondary prevention of childhood obesity and primary prevention of adult overweight (1). Treatment of overweight early in childhood may offer advantages and better outcomes than treatment of adolescent and adult obesity by 1) utilising growth (height and lean body mass) with weight maintenance to reduce adiposity levels, 2) easier facilitation of lifestyle change due to the shorter exposure to an adverse environment during a time when behavioural patterns are still developing (1, 17) and 3) the potential to manage adult overweight by targeting family lifestyle change, which is also a child weight maintenance strategy given the parental influence on children's lifestyle patterns (102, 104).

## **1.6.2 Lessons from adult weight management**

Approaches to the management of overweight in children have been informed by the treatment cornerstones developed for management of overweight in adults. These are introduced below with a brief overview of their effectiveness in adult weight management using recent reviews.

### *1.6.2.1 Nutrition component*

Central to the effectiveness of any dietary or nutrition component for the treatment of overweight is its ability to lower energy intake over a period of time and facilitate weight loss. Equally important is the ability of the nutrition component to support weight maintenance by maintaining a new energy balance. Effectiveness of dietary components for weight loss may not lie solely with its potential to reduce energy intake or induce a particular rate of weight loss. The ability to facilitate an individual to understand, easily implement and comply with the approach and support treatment and long term maintenance is equally important. This latter aspect appears to be the greatest challenge and is also most neglected in the literature (123).

Table 1.3 summarises three systematic reviews evaluating studies which have assessed the effectiveness of common dietary weight loss approaches in adults. They compare 1) any dietary weight management approach to a control group (124), 2) low fat diets to other dietary weight loss strategies (125) and 3) low glycaemic index (GI) diets to high GI/control diets (126).

Weight loss (weighted mean differences) at 12 months ranged from -13.4kg (very low calorie diet compared to no treatment), to +1.1 kg (non-significant) when low fat diets were compared with low energy or low carbohydrate/low energy diets (Table 1.3). However after 12 months follow up, the weight change for any dietary approach or compared to no treatment was not significant and weight had returned to baseline levels (Table 1.3). These conclusions are consistent the Australian NHMRC Clinical Practice Guidelines for the Management of Overweight and Obesity in Adults (18) and other reviews in this area (127, 128). There may be a role for low fat diets in the prevention of weight gain, particularly when activity levels are low (127), although this has not been evaluated against other dietary approaches (124).

The studies used in the systematic reviews summarised in Table 1.3 have several, consistent methodological limitations. Seventeen of the 26 studies reviewed by Avenell and colleagues (124) were based in US with few studies that included severe obesity (1 study included BMI>40kg/m<sup>2</sup>, 6 had mean BMI 35kg/m<sup>2</sup>). Only two studies in this review reported concealed randomisation and only one study had blinded outcome assessment. Ten of the 26 studies had follow up to 12 months (longest 60 months) with drop out rates of 20-50%. Only nine studies used intention to treat analysis and sample sizes were generally inadequate with no sample size or power calculations.

Finally, studies looking at the effectiveness of diet for weight management in adults have generally included limited assessment of broader health outcomes. However there does appear to be benefit in terms of cardiovascular and endocrine health, respiratory function, quality of life (124). The majority of the literature examining the non-weight health benefits of dietary approaches as part of adult weight management has focused on cardiovascular profile, but only to 12 months and in relation to use of low fat diets (124). Therefore it remains unknown if low fat diets are better than other dietary approaches in terms of cardiovascular outcome.

In summary, weight loss in adults is possible using any of the dietary approaches highlighted in table 1.3 but this is based on limited evidence with little reporting of the broader health outcomes. In the short term greater energy restriction yields greater weight loss, but weight regain is observed consistently across all approaches. In the long term no one method is better than any other, probably due to poor adherence. Overall, evidence for the role of diet in management of adult overweight is limited as there are 1) very few (quality) studies in this area, 2) comparisons between studies are limited by the substantial heterogeneity of the types of intervention (eg different levels of fat restriction, dietetic versus medical education, variable activity or behavioural strategies, poorly described interventions etc...) and 3) focus is on treatment rather than maintenance diets.

#### *1.6.2.2 Physical activity component*

A systematic review evaluated 13 randomised controlled trials (minimum of 4 months follow up) examining the effectiveness of aerobic activity for treatment of adult overweight (129). The review concluded that increasing expenditure by 12600-14700kJ/ week (~ 45-60min intense walking most days) with no change in diet resulted in average weight loss of 2kg after 6 months (129). In 9 of 10 studies in this review which compared activity alone to a diet alone group, in the short term diet alone (9-13kg weight loss) was more effective in terms of weight loss after 6 months than activity alone (2kg weight loss (129)). However long term comparisons are not available.

#### *1.6.2.3 Combining diet and physical activity*

Dietary and activity components are commonly used in conjunction. Glenny et al (128) concluded that (1 study, small sample size, high attrition) without a behavioural component, use of diet and activity together was no more effective than either diet or activity components alone after a minimum of 12 months of follow up. This contrasts with the systematic review described in 1.6.1.2 above which included 15 studies that used a combined diet and physical activity intervention (129). Here it was concluded that physical activity used in conjunction with diet improved outcome (+2kg versus diet alone and +5 kg versus activity alone).



So while decreasing energy intake and increasing expenditure are theoretically equivalent components of treatment of overweight, in reality diet appears to be the more effective component for treatment of overweight. However the best long term outcome is still achieved when diet and physical activity strategies are used together. This may be due to the role that physical activity plays in preventing weight (re)gain (18).

#### *1.6.2.4 Behaviour modification component*

There are many factors that shape and reinforce eating and activity patterns beyond the physiological need to meet energy requirements (Figure 1.4) (79, 130). Lifestyle patterns are established early in life, reflect patterns of those around us (eg spouses or parents) and may track into adult life (131, 132). Therefore it is likely that strategies, in addition to those focused on changing diet and activity are required to support successful and sustained behaviour change to promote long term weight management (18, 133).

In the context of obesity treatment, behaviour modification has been defined as any strategy used to generate a change in eating habits or lifestyle (Table 1.4) (123). Strategies may encompass the way information is presented (model of education) and external (environment) or internal (individual behaviours, attitudes and values) influences on eating and activity patterns. Behaviour modification is best utilised when underpinned by a psychological framework conceptualised from theory about how behaviours are initiated and maintained (133-135).

Mulvihill and Quigley (123) summarised 3 systematic reviews (64 studies, sample sizes not given, with 4 to 24 months follow up) which examined the effectiveness of any behaviour modification approach (single or combination, details not given) as an adjunct therapy in adult weight management programs. "There is evidence that a combination of behavioural techniques used in conjunction with [diet and exercise] is effective for the treatment of adult obesity" (123). Weight outcome was 10% loss in 4-12 months. Effectiveness was only maintained with ongoing use of behavioural strategies and therapist contact (123). No one behavioural method was superior, although there is some evidence for those based on cognitive therapy (123).

### 1.6.2.5 *Family support component*

Family support can refer to 1) attendance at treatment sessions, 2) sole or joint responsibility for program adherence, 3) involvement in patient or family goal setting or 4) a combination of these strategies with varying levels of emphasis, focus and skill development (123, 136). Reciprocal role modelling, social support, motivation and positive reinforcement between spouse or family members and the ability to address the shared family food and activity environment are other possible mechanisms highlighting the role family support may play in management of overweight (100, 123).

McLean et al (136) identified 8 randomised trials in adults (n=421, intervention 9 to 20 weeks, with 1 to 4 year follow up, the drop out rate was reported to be 0-40% in 5/8 studies) where spouses were targeted or contracted for spousal support, weight or lifestyle change. Five studies favoured treating spouses together (-0.3-+6.1kg weight change versus +3kg if spouses alone,  $p<0.05$ ), while 3 studies favoured overweight treatment without spouse involvement (1.3 to 5.9kg weight change versus 1kg spouses alone,  $p<0.05$ ) (136). Involvement of spouses, particularly treating couples, in adult weight management appears to improve effectiveness. However the evidence is not consistent, with interventions and study quality varying widely and the preferred model of family support during adult weight management remaining unclear.

### 1.6.2.6 *Summary – the cornerstones of weight management*

Treatment of overweight requires a negative energy balance to promote weight loss. Addressing either side of the energy balance equation, alone or in combination will achieve weight loss. However sustaining an appropriate energy balance to prevent weight regain is crucial for long term maintenance. Ways to achieve and support weight maintenance is currently lacking in the literature. Given the strong multifactorial behavioural and environmental influences on energy balance, achieving long term weight loss using diet and activity is in reality difficult. Use of behaviour modification strategies and family support appear to enhance or facilitate the lifestyle changes. Therefore diet, increasing activity, behaviour modification, combined with family support are the assumed weight management cornerstones (1, 15, 18).

### **1.6.3 The evidence-base for management of overweight in children**

#### *1.6.3.1 Introduction*

The components for child weight management are the same as for adults (15, 18). However, it is imperative that the strategies used within each component also support normal physical and psychosocial growth and development (137). In children, there is the opportunity to use vertical growth to change weight trajectory whilst maintaining weight (137). However, growth and changes in body composition also present unique challenge for monitoring changes in adiposity in children (as discussed in section 1.2.2).

Children have changing developmental needs, from reliance on family in early childhood, the transition of adolescence, until reaching the independence of adulthood. Therefore during weight management, the child's developmental phase and most importantly, membership in a family system must be considered. Childhood also presents a time in life that has had less exposure to a overweight promoting environment and behavioural patterns are still developing. This may mean that lifestyle patterns may be more amenable to modification in childhood versus later in life (137). The question then is how to structure and combine the components of weight management for children in an age-appropriate manner, to be effective, sustainable and maintain optimal growth and development?

#### *1.6.3.2 Family-based child weight management - the work of Epstein*

The evidence base for management of childhood overweight has been extensively influenced by a large body of literature from a single research group. The Epstein group have developed, evaluated and evolved a family behavioural program implemented through a child weight control clinic at the University of Pittsburgh in the US (138, 139). The multi-component program (Table 1.5), evolved from 22 studies, with over 40 papers publishing primary outcomes, follow up data, health and economic consequences and reviews (15, 138-140). There is difficulty in distinguishing separate cohorts and interventions. This body of work provide the only 10 year outcome data from RCTs in the area of child weight management (141). However, the original interventions were conducted in the 1970/1980s, with substantial program changes and environmental context in the decades since.

### 1.6.3.3 *The current evidence-base – summary of outcomes and limitations*

A systematic review by Summerbell and colleagues published in 2003 (140) provides the most recent assessment of studies examining treatment of overweight in children and adolescents (6-18 years). It draws similar conclusions to a 1997 review by Glenny and colleagues examining management of overweight in children and adults (128). Included are 18 randomised controlled trials (n=852/1025, 13 with children, 5 with adolescents) examined the effectiveness of dietary (all), activity (5 studies, n=245), family (9 studies, n=399) and behavioural (4 studies, n=331, cognitive behaviour therapy (BT), problem solving, multi-component BT) components in childhood overweight (140).

While outcomes were assessor measured and study groups were equivalent at baseline, no studies fulfilled all the Cochrane quality criteria (140). Twelve studies were US-based, conducted when obesity prevalence rates were rapidly increasing and in relatively homogenous populations (white, middleclass, obese, older children). Fifteen studies had less than 23 subjects per group, with no sample size or power calculations reported. Drop out rates were variable ranging between less than 20% (9 studies) to 41%. Allocation concealment was unclear or not reported. No studies used intention to treat analysis, performed gender, age or weight sub-analysis or examined secondary or adverse outcomes such as metabolic profile or psychosocial wellbeing. The longest follow up period was 10 years (1 study) with the other ranging from 6-24 months (mean 14 months) (140). There was substantial variation between studies in the intervention focus, component combination and mode of delivery. Few studies share a component or combination of components, limiting study comparisons or meta-analysis. Treatment duration also varied between 2-18 months (mean 6 months) (140).

Comparison is further limited as weight outcomes are expressed in a variety of ways. This is both in terms of the method used (eg percent overweight calculated using weight for height or mean/median BMI, BMI, raw weight, plus/minus adjustment for age, gender, height) and how these are calculated (eg reference population used, use of 50<sup>th</sup> percentile versus z scores) (140).

Twelve of 18 studies using percent overweight showed a reduction of 8-26% points, but reversal towards baseline levels by 12 months (140). Children receiving treatment significantly reduced their percent overweight compared to no treatment, but remained overweight (140). Similar trends were observed using other outcomes (eg BMI, BMI% change, raw weight).

Studies reviewed by Summerbell and colleagues (140) tended to favour use of diet, activity and behavioural components in a multi-component program. There was also some evidence supporting use of lifestyle activity, reducing sedentary activity and involving parents in treatment. The remainder of section 1.6 will explore this further, looking at what strategies to use within each component and how to approach multi-component child weight management. Overall the evidence for sustained, long term management for childhood overweight is limited in scope and quality. Studies included in the most recent systematic review indicate that it is possible to reduce but not normalise childhood overweight and regain is common (140). The Australian Clinical Practice Guidelines summarised in table 1.6, highlight that evidence-based child weight management is limited by a lack of quality studies (15).

#### **1.6.4 What is the best strategy to reduce energy intake during child weight management?**

As with adults, the role of the dietary component of weight management programs is to reduce energy intake. It is important that this is achieved whilst meeting macro- and micro- nutrient requirements for normal growth and development. In children, consideration of who is the most suited target for nutrition education, the child, parent or both is also needed. Strategies used in the dietary component of child weight management are outlined in table 1.7. While progress has been made in the areas of useful family and behavioural strategies in treatment of child overweight, core aspects such as diet have not been rigorously evaluated. There are no RCTs of at least 6 months intervention and/or follow up assessing the effectiveness of dietary strategies for management of child overweight (140). Only one study in children has compared dietary strategies whilst keeping other components constant. Studies using different dietary strategies are difficult to compare due to variation in other components used and inadequate dietary intervention descriptions.

#### 1.6.4.1 Specified energy intake – quantitative

Amador et al (142) compared two levels of energy restriction in 94 pubertal 11-13 year olds (Table 1.8a). Strategies to achieve the specified energy intake and adherence were not detailed. Both interventions achieved weight reduction at 6 (treatment end) and 12 months (Table 1.8a). At both time points the mean group weight was lower with greater energy restriction (mean group difference, 3kg boys, 6kg girls, significance not reported). However, when the two levels of energy restriction were compared using an 'efficiency index', the 'cost' of fat reduction, in terms of lean body mass loss, was lower in the less restricted energy group (142).

Four other studies specified a set level of energy intake (3400-5000 kJ/day) using dietary prescriptions or meal plans and compared adiposity pre- and post- treatment, with a diet plus activity group (143-145) or with and without behaviour therapy (146) (Table 1.8a). Two studies (144, 145) assessed outcomes at end of treatment only (6 or 12 weeks) and saw no change in weight and BMI, but a reduction using height, age and gender adjusted BMI z score (145) (Table 1.8a). At 8 or 24 months after baseline, the reduction in percent overweight (weight for height) varied between 15 to 20% points using meal plans prescribing 3400-9000 kJ/d (Table 1.8a) (143, 146).

Two studies (144, 146) assessed dietary change (3-4 day records) and found significant reductions in fat intake ( $\downarrow$ 5% to 20% of energy as fat;  $\downarrow$ 22g). In both studies energy intake was reduced by 1000kJ/day ( $p>0.05$ ) that brought intake in line with the dietary prescription. The addition of exercise or behaviour therapy to diet did not improve outcomes (Table 1.8a, (143-145)). Overall energy restriction using diet alone can be achieved in children, leading to changes in adiposity proportional to the degree of energy restriction in the short term. A prescribed energy restriction of 3400 to 9000kJ/day ( $\sim\downarrow$ 1000kJ/day from current intake) using dietary prescription or meal plans will reduce adiposity by 15-20% points over 12-24 months without impairing growth (see section 1.6.10). However, regain or slowed weight change is likely over time, probably with reduced adherence, although initial and ongoing intake is rarely assessed.

#### 1.6.4.2 *Specified energy intake - semi-quantitative*

An alternative approach to specifying a set energy intake level using dietary prescription or meal plans sees children using a points or food exchange system to facilitate energy intake moderation. The Traffic light diet (TLD) is an example of a set energy intake food exchange system. It was developed by Epstein and colleagues as the dietary component of the multi-component Family Behavioural Weight Management Program (Table 1.5). The TLD has been used extensively in the child weight management literature (8/18 studies in a 2003 systematic review) (138-140). It has never been evaluated against other dietary strategies or outside an intensive behavioural/family therapy framework.

Parents and children are treated together with at least one parent overweight (eg high risk families). The TLD education and implementation is directed at children with parents acting as assistants. The TLD groups foods by energy content with subjects allocated food exchanges to achieve a defined energy limit (Table 1.9) (138). Education focuses on the types and portion size of foods and the authors claim this approach teaches children and families about the energy content of food and healthy eating (139). Refinements to the TLD have been made over the 3 decades of its evaluation, increasing the red foods limit (4 to 15 serves/week) and the energy restriction used (900-1500kcal/d) (147, 148).

Four studies in 8-17 year olds evaluate the TLD within a family behavioral framework compared to no intervention (141, 149), dietary information (150), a multi-component program including activity (141, 149, 151) or pre/post intervention (152) (Table 1.8b). Twelve months after baseline (treatment 4-6 months) percent overweight (weight for height or %ideal body weight) was reduced by 11-20% points. Treatment is better than no intervention (+4% points in 6 months) (141, 149) or dietary information only (-10-0% points after 6-60 months) (150) (Table 1.8b). Similar results are seen in severely obese children (152). Outcomes are not improved by adding an activity component to the TLD/behavioural program (141, 149, 151). Percent overweight is reduced by 6-30% points after 5 years (141, 150) and 8% points 10 years post baseline, with 20% of children non-overweight (141).

Adherence to the TLD has only been reported in one study (149). In children the mean intake of red foods was  $3\pm 2$  serves per week during the 8 week treatment phase. However the goal of less than 4 serves of red foods per week was only achieved for  $6\pm 1$  weeks. Adherence to the calorie limit was achieved for  $5\pm 2$  weeks. These results suggest that actual energy restriction is likely to have been less than prescribed and that adherence to the prescribed diet failed relatively quickly. Children's adherence was better than their parents who were instructed to follow the same diet (149).

Overall, use of the TLD to educate about calorie and fat content and appropriate portion sizes to promote a specified calorie restriction achieves short to medium term weight management in children when used within a behaviour modification framework (10-30% point reduction in percent weight for height over 12-60 months) (Table 1.8b). However, these studies have only assessed the efficacy not effectiveness of the TLD as none have performed intention to treat analysis. There are no data assessing the ease of implementing the TLD, particularly at the family level. Its use across changing child development phases has also not been assessed. Limited adherence data indicate that a key issue is sustainability of the TLD, which may not be sustained over the period for which treatment and maintenance is required.

#### *1.6.4.3 Lower energy density - macronutrient manipulation*

Manipulating fat and carbohydrate intake is an effective means of reducing energy intake and weight in adults (section 1.6.2.1) (125, 153). Focusing on manipulating macronutrient intake may offer advantages to setting a specified energy intake. Education can occur at the food level (eg use reduced fat milk) which may be easier to adopt and follow long term. However, fat or carbohydrate intake manipulation has not been evaluated against no treatment or other dietary strategies in child weight management, tending to be used as one strategy within a comprehensive nutrition component (eg TLD or 'healthy eating') (146, 148, 154, 155).



One non-randomised retrospective study of 107 children (68 girls, mean age 10±4 years) compared the use of a reduced fat diet (energy intake 55-60% carbohydrate, 25-30% fat, 15-20% protein) with a low glycaemic index (GI) diet (energy intake 45-50% carbohydrate [changed GI load and profile], 30-35% fat, 20-25% protein) (156). Children attended a multi-disciplinary outpatient program (~3.5 visits over 4 months) which provided equivalent family support, activity and behaviour modification advice and nutrition education using a food pyramid between the groups.

After adjustment for age, gender, ethnicity and baseline BMI, the reduction in BMI was greater in the low GI group (-1.1 [CI 1.69:0.60] kg/m<sup>2</sup>) than in the reduced fat group (+0.03 [-0.51: +0.57] kg/m<sup>2</sup>, p<0.001). While BMI trajectory had shifted in both groups the effect on relative adiposity is unknown as no appropriate measure was used. It is important to note that the fat intake in the low GI group is likely to have reduced from baseline levels and that more children in the low GI group received more behavioural input than in the reduced fat group.

Overall, the use of strategies to change fat or carbohydrate intake are integrated into multi-strategy dietary components of child weight management programs. The variation and combination of other treatment components limit any meaningful assessment from the available literature regarding the effectiveness of macronutrient manipulation for child weight management. This is a significant gap in the current literature (15). It is likely that use of strategies that manipulate macronutrient intake will need to consider overall macronutrient profile, not just fat or carbohydrate intake alone. This is highlighted by the increasing availability of low fat products. While such products are low in fat, many tend to be high in refined carbohydrates and equivalent in energy density to their regular fat counterparts (86). This may undermine the effectiveness of focusing on fat intake if there is no net energy intake reduction (18). Adequate micronutrient intake is important for long term health. It is likely that macronutrient manipulation for weight management is best utilised within a framework that also considers portion size and overall nutrient intake (eg fat, simple sugars, calcium, iron) (157).

#### 1.6.4.4 *Lower energy and increased nutrient density – ‘healthy eating’*

In clinical practice, dietary management of childhood overweight centres around promoting ‘healthy eating’ in line with the dietary guidelines (15, 158). Messages focus on lowering fat and sugar intake and encouraging fruit and vegetable intake to reduce energy density (159, 160). The emphasis is on changing food choice and addressing food quantity and quality.

A healthy eating approach may have advantages to strategies discussed in 1.6.4.1 and 1.6.4.2 in terms of 1) its use in both treatment and prevention of overweight (or regain), 2) management of co-morbidities and prevention of adult chronic disease and 3) ability to implement at the family level using parent- rather than child-focused education (discussed in section 1.6.6). The effectiveness of a ‘healthy eating’ approach in treating childhood overweight has not been evaluated against no treatment, other dietary strategies or without adjunctive behavioural, family support or physical activity components.

Studies from Israel, the US and Belgium have used ‘healthy eating’ as the dietary component of comprehensive child weight management programs (Table 1.8c). In these studies the ‘healthy eating’ message was directed at either the child (155) or the family (148, 161, 162). In the family-focused studies, parent(s) were targeted for intervention education. Two studies are evaluating treatment programs (155, 161, 162) while the other is an obesity prevention study focusing on high risk families where at least one parent is overweight (148). The studies compare two approaches to healthy eating (148), healthy eating with child-centred prescribed specified energy diet (161) or a control group of children from a nearby school (155) (Table 1.8c). The ‘healthy eating’ approach discourages calorie counting and focuses on making gradual change from existing habits. High fat/sugar foods are allowed but strategies to moderate intake are provided.

Use of multi-component programs that included healthy eating as the dietary component achieved stability of adiposity levels in 30 6-11 year olds from high risk families (148), a 12 month 5-10% point reduction in percent overweight (weight for height) when child focused and 15% point reduction (using percent >50<sup>th</sup> centile for age/gender) when family focused. With no intervention or using a meal plan for the child, the change in percent overweight was +4 and -8% point respectively (Table 1.8c). Eight years after baseline, participation in parent-led, family-focused healthy eating achieved a reduction of 29% points, compared to 20% points when treatment was targeted at the child ( $p<0.05$ ) (161, 162).

The study by Golan and colleagues assessed changes in food intake and the home environment. In the family-focused intervention, there was a reduction in food stimuli (eg visibility of snacks) in the home (mean 4 items,  $p<0.05$ ) and an increased frequency of children seeking permission to access food (154). Reduction in energy intake (7 day food records validated against a 24 hour recall) was 26% ( $p<0.05$ ). This correlated with reduced food stimuli ( $r=0.43$ ,  $p<0.01$ ) and improved eating behaviour (eg eating in front of TV) ( $r=0.32$ ,  $p<0.05$ ) (154). In the obesity prevention study the target for high fat/sugar foods was 15 serves/week (148). Intake of 'red foods' reduced by 5-9 serves, but remained above the target at 5-8 serves/day (163).

Overall promoting 'healthy eating' without a specified energy intake, can achieve similar or better reductions in percent overweight compared to specified energy approaches, especially long term (29% points at 8 years versus 10-20% points at 10 years follow up). Promoting 'healthy eating' at the family level, with the responsibility for implementation resting with parents appears particularly promising (see section 1.6.6). These conclusions are only valid within the context of a multi-component program including behavioural, family support and physical activity. There are no efficacy studies for a healthy eating approach or process evaluation in terms of ease of education, adherence or sustainability.

#### *1.6.4.5 Other dietary strategies*

Many of the dietary strategies used in child weight management have not been evaluated (Table 1.7). Their effectiveness and relative contribution within a multi-component framework is unclear. This includes 1) management of appetite (food volume, macronutrient satiety, psychological and appetite controls) (146), 2) reducing portion size, 3) improving diet quality, 4) changing food preferences (164), 5) the family food environment (165), 6) child feeding practices (165) or 7) general nutrition skills (eg label reading) (165). Effective nutrition education tools that support long term dietary change is also unknown. The role of meal plans, use of points system or food pyramids, grocery lists, cue avoidance and high risk situation planning have limited evidence of effectiveness in adults (123), but have not been assessed with children.

Finally, multi-component inpatient (166) or camp-based (155, 167) programs (food provided, 6300-7500kJ/day, 2-10 month treatment) and protein-sparing modified fasts (PSMF, 3500kJ/d, 2g protein/kg, 20-25g CHO 20 weeks, 5000kJ/d 30% fat 12 month treatment) (163) are other dietary approaches used in child weight management. Reduction in percent overweight after 12 months are similar (25% point PSMF n=106, 7-17 year olds,  $p<0.01$ ) or greater (51% points inpatient program versus +6% control group, n=76, 10-17 year olds,  $p<0.01$ ) compared to other approaches (eg -20% point with TLD) (141). However use of a PSMF has not been evaluated against no treatment, other strategies or beyond the 12 month treatment (163). Two year follow up of inpatient programs show 20% point regain (166). While still below baseline levels, these results suggest that long term adherence to these somewhat artificial dietary approaches may limit their usefulness.

#### *1.6.4.6 Conclusion – a way forward for the dietary component of child weight management programs*

There are a variety of ways in which energy intake can be moderated to facilitate weight loss in children. In the short to medium term (up to 12 month post baseline) change in percent overweight ranges between 5-50% points, (more commonly 15-20% points) (140, 155, 161, 162). More structured approaches generally have greater initial reductions.

Left untreated, adiposity levels tend to increase (4-6% points in 6-12 months) (149, 155). In the medium to long term (24-120 months follow up) percent overweight is reduced by 10-30% points (no control data available). The 30% point reduction in overweight was achieved using a parent-led, family focused multi-component program promoting healthy eating (161). The outcomes from this program exceed other approaches but this is yet to be replicated in other populations. In all studies, the majority of children in treatment arms have reduced their adiposity level but remain overweight.

While an effort has been made here to assess the effectiveness of dietary components in child weight management, results must be interpreted with caution. Dietary components have rarely been evaluated in the absence of other management components such as behaviour modification or family support. Outcomes are most commonly expressed in terms of percent overweight, but use of different calculation methods and reference populations limits direct comparison. While the dietary prescription is described, the actual intake trends and dietary adherence are rarely assessed. While this is somewhat understandable given the difficulty in accurately assessing dietary intake, the lack of data limits assessment of whether the dietary strategies are facilitating achievement of the dietary goals. Reductions between 1000 (non-significant, (144, 146)) to 2500 ( $p < 0.05$ , (154)) kJ/d have been observed as part of effective multi-component programs. The broader health effects (eg biochemical, psychosocial, growth parameters) should be considered in determining the most effective dietary strategies for child weight management, but data is limited (see 1.6.10).

Finally, it is important to consider children within their environmental and developmental contexts. Children exist within family systems. Parent weight status is a key risk factor for child overweight (14). Parents are also the key providers of food, role models and influences on eating preferences and behaviours (104). These considerations will influence which dietary strategy is most appropriate, all else being equal. The most appropriate dietary strategy for use with parents and families of overweight children remains an area for further research. Ways to support maintenance of weight loss or to change long term eating behaviours is also lacking in the literature.

### **1.6.5 What is the best strategy to increase energy expenditure during child weight management?**

The use of appropriate physical activity strategies needs to take into account that the developmental stage and daily routine of adults and children are different. Children tend to be physically active through play and structured sport and their physical activity occurs in many short bursts over the course of a day (15, 168). Engagement in physical activity in childhood also decreases with age and is influenced by motor skill level (15, 169, 170).

#### *1.6.5.1 Increasing physical activity - facility-based exercise sessions*

A meta-analysis of 30 studies ( $n \geq 6$ /group, at least pre-post design, up to 6 months of treatment and/or follow up) evaluated the role of facility-based aerobic and/or resistance training in changing body composition (body mass, BM; body fat, BF and fat free mass, FFM) ( $n=945$ , 5-17 years; 92 study groups) (171). Programs ran for 3-30 weeks (mean  $13 \pm 6$ ), 1-7 sessions/week ( $4 \pm 2$ ) for 20-60 minutes ( $38 \pm 18$ ) with 90-100% attendance rates. The mean difference between experimental and control groups (favouring treatment, adjusted for SD) was 0.7kg (CI 0.2; 1.1) BF, 0.5kg (CI 0.0; 0.6) FFM and  $0.8 \text{ kg/m}^2$  (CI 0.2; 1.7) for BMI. Stepwise linear regression found 30-55% of the variance in body composition was explained by baseline percent BF, exercise intensity (60-65% versus  $\geq 71\%$   $\text{VO}_2\text{max}$ ,  $p < 0.01$ ), mode (aerobic plus resistance training) and intervention (exercise within a family behavioural program). Session duration ( $>30$  minutes) but not program length ( $\leq 10$  week versus  $>10$  weeks) also improved body composition.

This review concluded that aerobic facility-based training for treatment of childhood overweight improves a range of body composition outcomes. Use of aerobic ( $\pm$  resistance training, with diet and behaviour modification) at low intensity for a long duration appear optimal. However conclusions need to be interpreted with caution as individual studies had small samples sizes, follow up was only to end of treatment and poorly described, and heterogenous intervention groups were combined for meta-analysis.

### *1.6.5.2 Increasing physical activity – prescribed home-based or ‘lifestyle’ activity*

Facility-based aerobic activity sessions require travel to a gym, trained facilitators and costly equipment, with limited flexibility to manage variety, preference and skill level. There is also the problem of supporting physical activity once programs cease. Focusing on home-based or ‘lifestyle’ activity that can be done anywhere and doesn’t require specialist staff or equipment is an alternative approach.

This approach still uses low intensity, long duration (>30 minutes) activity (see section 1.6.5.1) but offers a wider choice of activities. There is more opportunity to accumulate physical activity using daily activity (eg walk, chores, using stairs, active leisure activities, structured sport). ‘Lifestyle’ activity also allows program language to focus on ‘play’ rather than ‘exercise’ or ‘gym work’ which is developmentally appropriate (168) and can engage all family members, not just the overweight child.

Three studies (n=23-76, age 8-12 years, male 0-32%, conducted 1985-2000) evaluate use of lifestyle physical activity in conjunction with diet and behaviour therapy (151, 172, 173). Lifestyle physical activity is compared to diet and behaviour therapy alone (151, 172), diet, behaviour therapy and aerobic facility-based activity (151) or different levels of lifestyle activity (173). After 12 months the reductions in percent overweight in the lifestyle groups ranged from 16-26% points. This did not differ from the reductions observed using aerobic activity (16% points), diet and behaviour therapy alone (17-19% points) or using longer (32 versus 16km walking/week) activity duration (reduction of 26% points for walking 16 or 32km per week).

Two studies provide 10 year follow up data. One study found lifestyle activity to have double the 10 year effect compared to aerobic or diet alone (20 versus 10% point reduction). However the other study saw no difference between lifestyle activity and diet alone (10% point reduction) after 10 years (140). Use of lifestyle activity is as or more effective than aerobic exercise for management of childhood overweight when used in conjunction with diet and behaviour therapy.

### *1.6.5.3 Increasing physical activity – supporting motor skill development*

Participation in sports or physical activity in childhood can be influenced by preference, skill level, confidence and parental activity patterns (115, 116). Childhood activity patterns influence engagement in physical activity in later life (115, 116). Ability to engage in physical activity is influenced by the level of fundamental motor skills (FMS) such as eye-hand coordination, kinaesthetic and spatial awareness patterning, timing and spatial judgement (174).

Overweight children have lower levels of FMS compared to their non-overweight peers (170). This may be as either a cause or consequence of overweight, but is a potential barrier to participation in sport or to leading an active lifestyle (170). In theory, facility-based FMS practice or training during child weight management may improve long term (beyond treatment) enjoyment, confidence and capacity for physical activity using age-appropriate 'games' or 'play' (168). This theory is supported by short term pilot studies and prevention trials but has not been substantiated by long term treatment trials (117, 175, 176). However it provides a promising means of using facility-based sessions to complement home-based physical activity programs during treatment of child overweight.

### *1.6.5.4 Increasing physical activity - role of reducing sedentary behaviour*

Available time or opportunity to be active may impact on physical activity levels with technology such as motorised transport and small screen devices competing with opportunities to be active. Small screen use may also influence food intake and promote passive over-consumption of energy (177). Two randomised controlled trials (n=61-76, 8-12 years, 30% boys) with follow up to 12 months have assessed the effectiveness of reducing time spent in sedentary behaviours for child weight management (173, 178). Percent overweight (weight for height) was reduced by 22 and 27% points when time in sedentary behaviour was limited to 10 or 20 hours per week respectively (groups not significantly different). Focusing on reducing sedentary behaviour has a greater reduction in percent overweight than aerobic exercise alone (10% points,  $p<0.05$ ) or focusing on addressing sedentary and physical activity together (10% points,  $p<0.05$ ) (173, 178).



The quality and consistency of these two recent studies evaluating the role of reducing sedentary behaviour in management of overweight may reflect the strategy's effectiveness. However the results may also reflect improved design, implementation and/or reporting of studies which were conducted in the mid to late 1990s. These are the only two studies that provide evidence on the role of reducing sedentary behaviour in child weight management. Both are based in the US (same research groups) and follow up past 12 months is not available (140, 173, 178).

The studies also compare decreasing sedentary versus increasing physical activity (with a dietary and behavioural framework) and have not compared with no intervention or without dietary and behavioural strategies. However, as summarised in two systematic reviews, "data from these trials favour a reduction in sedentary behaviour" (140) with "reduction of sedentary behaviour appear[ing] to be the most effective intervention for achieving ... weight loss" in childhood (128).

#### *1.6.5.5 Conclusion - physical activity and child weight management, variety may be the key*

Activity is an effective cornerstone for child weight management. It has a modest impact on body composition variables, with the most suitable format being low intensity, long duration lifestyle activity (171). There is benefit in addressing both children's physical activity levels and the time they spend in sedentary activities (eg limiting small screen use to 10-20 hours/week). Reducing small screen use, and giving children choice in how they redistribute this additional time may be more effective than focusing on increasing activity or addressing physical and sedentary activity (173, 177, 178). However these conclusions are based on a limited number of studies by same research group and require replication in other populations.

Based on current evidence, using lifestyle- and play-based approaches to increasing physical activity and reducing sedentary activity, is likely to offer advantages over aerobic-focused facility-based exercise programs. However use of structured sessions focusing on improving children's movement skills level may be a way in which child weight management programs can incorporate structured activity sessions, supporting increases in home-based or lifestyle activity levels which will have benefits beyond the program itself.

### **1.6.6 What is the best strategy to facilitate achievement of energy moderating during child weight management?**

#### *1.6.6.1 Use of behaviour modification or problem solving in the management of childhood overweight*

The two most common behavioural approaches used in child weight management are behavioural therapy based on cognitive behaviour theory and problem-solving based on the theory of stimulus control (179, 180). Six studies (n=17-87, 5-13 years, majority girls, follow up 6-24 months) have compared either behaviour therapy (all 6 studies) or problem-solving (2 studies) with usual care (the traffic light diet and aerobic activity) (181-183), no treatment (172, 184) or to each other (181, 185). Behaviour therapy significantly reduced percent overweight (9-18% points in 6 months, 26% points in 12 months) as did use of problem-solving (24% points in 6 months) in conjunction with dietary and activity strategies. This was compared to a 10% point reduction with no treatment or diet alone. Significance levels favoured use of adjunctive behaviour therapy or problem solving in five of the six studies. While the dietary and activity components were similar between studies, result variability may be due to the relative emphasis placed on family support which differed between studies. One study with 24 month follow up found only a 1 unit increase in BMI using behaviour therapy compared to an increase of 3 BMI units with no treatment (184). Thus use of behaviour therapy or problem solving is an effective adjunct to dietary and activity measures. However which of these behavioural strategies are superior remains unknown.

### *1.6.6.2 Developmentally appropriate family support – child or shared responsibility versus parental leadership*

Given the clustering of overweight in families, family support is likely to be critical in the management of overweight in children (15, 128, 140) (Table 1.6). Identification of parental overweight as a key risk factor for childhood overweight lead to research examining whether the effectiveness of treating overweight children could be improved by simultaneously targeting weight or lifestyle change in their overweight parent(s) (186-188).

Ten years after randomisation, 55 of an original 76 6-12 year olds were followed up (now aged 13-22 years) (Table 1.10) (189). Children in the study group in which the child and parent were targeted for weight loss had a 10 % point reduction in percent overweight (weight for height) compared to when the target for weight loss was the child alone (+2% points) or the target was not specified (+12% points) ( $p < 0.01$ ) (189). While the study groups had similar 12 month outcomes (Table 1.10), long term weight maintenance was better when the overweight family rather than the child was targeted for change.

The importance of family support in managing childhood overweight extends beyond the shared family environment or parental weight as a key risk factor. The developmental stage or capability of children and therefore the role parents play is also an important consideration in appropriately delivering child weight management (188). As highlighted in section 1.5.3.5, parents play a key role in determining what children eat through food provision, parental role modelling and feeding practices (100, 105, 188). It is therefore parents that implement lifestyle change for child weight management.

Targeting parent's lifestyle patterns may also influence children's behaviours and intake pattern. If eating and activity behaviour is considered within a broader context of child behaviour, it is parents' responsibility to develop and manage these behaviours through parenting (165, 190). Finally while 987, 10-17 year olds reported that they expect poor eating habits to impact on their health in the next 6 months, factors such as taste and immediate physiological effects were found to have more influence than long term health benefits on food choice. Therefore health, nutrition or behaviour modification messages targeted at young children may be inappropriate and beyond their developmental capacity (103).

In adults, better weight outcomes are achieved using a family support model which involves shared responsibility for learning and implementing a program that targets both spouses, if both overweight (136). In adolescence, a time of transition, rebellion, increasing responsibilities and independence, weight management is again most effective when parents and the adolescent share responsibility for weight management. However in this model, outcomes are improved by delivering the program to family members separately, tailored for their role and stage of development (136). In younger children, research into effective management of chronic conditions such as diabetes, asthma, cystic fibrosis (191) and prevention of cardiovascular disease (192) indicate that the best model of family support at this stage of development may differ from adults and adolescents.

Eight studies have looked at the effectiveness of child weight management with varying degrees of family support (Table 1.10). Placing responsibility for lifestyle change with the child (161, 186, 193) or shared between the child and parent (181, 185-187, 193, 194) resulted in similar reductions in percent overweight (1-8% points,  $p < 0.05$  time,  $p > 0.05$  group) (Table 1.10). Apart from one study (185), the child outcomes did not vary according to who attended sessions, whether parent and child attended separately or together, or towards whom education and responsibility was focused. Eliakim et al (195) varied the education mode based on what was considered developmentally appropriate at different ages. No differences in outcome by age group were found, supporting age-appropriate treatment tailored for a child's stage of development (Table 1.10).

A unique study conducted in Israel by Golan and colleagues (Table 1.10) compared placing responsibility for program attendance and implementation with either the parent or child (161). In the 'child alone' group, children attended the program, were prescribed an individual, child-focused diet and lifestyle plan and were responsible for adhering to this. In the 'parent alone' group, the child did not attend any sessions and the responsibility for implementing the lifestyle recommendations rested solely with the parent.

The program in the 'parent alone' differed from that in the 'child alone' group, focusing on nutrition skills and the family eating environment (ie no 'diet' per se) (165). So, intervention arms differed in the diet approach used, the mode of family support and also the structure for the behavioural component. The 'child alone' group used individual behaviour therapy strategies while 'parent alone' group utilised parenting skills training, promoting parent self-efficacy and problem-solving (165). The intervention duration in both groups was 12 months. However the frequency of therapist contact and use of group versus individual family sessions differed between the 2 groups (table 1.10, parent-alone 14 hours group sessions, 1.5 hours individual contact; versus child alone 30 hours therapist contact all group sessions).

Baseline, 12 month (intervention end), 3 and 8 year post-baseline results are presented in 2 papers, with long term analysis performed by 'intention to treat' (161, 162). The 'parent alone' group had a significantly greater percentage point reduction from baseline compared to the 'child alone' group at each time point (Table 1.10). Eight years after baseline (average child age  $16 \pm 0.5$  years), 60% of the children in the 'parent alone' group were non-obese compared to 31% of children in the 'child alone' group. The 8 year reductions in percent overweight in the 'parent alone' (29% points) and 'child alone' (20% points) are remarkable in comparison to other literature in this area (eg 10 year reductions achieved by Epstein and colleagues of 8-10% points) (141, 162). The differences between these results may reflect superior effectiveness of the Golan program, but also population- and cultural-specific circumstances. The 8 year follow up period includes a proportion (not specified) of children spending time in compulsory military service.

Overall, these studies support parental involvement in child weight management. In programs which are child-focused, it is not necessarily parental session attendance that improves child outcomes. Rather, family support that promotes parent engagement in program implementation or co-treating family overweight is important. A study from Israel suggests weight management can be improved by having the parent rather than the child responsible for managing the child's weight. In this model, parents are solely responsible for attending sessions and initiating and maintaining lifestyle change at home. This approach is developmentally appropriate and was more effective than targeting the child alone. However this study requires replication in other populations.

#### *1.6.6.3 Supporting parent-led management of childhood overweight*

If parent involvement, and in fact parent leadership, is crucial for improving the effectiveness of management of childhood overweight, the question then becomes how to support parents in this role. In adult and child-focused weight management studies, use of behaviour modification strategies improves effectiveness (123). In these scenarios, it is the subject modifying their own behaviour, so individual behaviour modification strategies are appropriate (eg self-monitoring, contracting rewards for individuals' outcomes). However in parent-led child weight management, the situation arises where it is parents facilitating child behaviour modification. Therefore different behaviour modification strategies may be required and may be best considered within the broader parenting context.

Family and parent-child interactions are one of the most persuasive influences on all aspects of children's health and development (196). Families and parents provide care for children (including nutrition), are teachers (parent-child interactions, cognitions, modelling, expectations, reinforcement) and gatekeepers (limits and boundaries) (196). Family relationships, resources, parenting style and competency influence children's behaviour and development, yet parents are rarely trained or prepared for the parenting role (190, 196).

Supporting parents in their parenting role can prevent a range of psychological problems in children and can also be an effective means of modifying child behaviour (190). Improving parental competence and parenting skills is one way to support parents to modify children's behaviour (190). This is applicable in all areas of children's behaviour and is likely to be very important in establishing, monitoring and reinforcing appropriate eating and activity behaviours.

Three studies provide some evidence for a role for parenting skills training in child weight management (161, 181, 185) (Table 1.10). However none are intended or designed to primarily address the question of how best to support parents during child weight management. The types of parental support for child weight management examined include use of parenting skills training and problem solving, which are utilised within a dietary, activity and behavioural framework that differed substantially between studies, making comparisons and conclusions difficult. Parenting skills training supported a reduction in child percent overweight 8 years after baseline of 29% (161). Use of parental problem solving training in a US study produced significantly greater reductions in percent overweight compared to the standard program (no parent problem solving training) after 12 months (25 versus 9% point) (181). However use of parenting skills is not supported by 2 small, short term studies (187, 194) and 1 study found no additional benefits for parent training or problem solving in addition to a comprehensive behaviour program (185). The target of change (parent versus child), relative focus on parenting skills training and the other strategies used may explain the conflicting results.

#### *1.6.6.4 Conclusion – supporting parents for the role of child behaviour modification*

Behaviour modification (either behaviour therapy or problem solving) used in conjunction with diet and activity strategies enhances short to medium term effectiveness of child weight management programs. Family support is important. This may be through targeting all overweight family members, or perhaps more importantly, utilising the role parents play in shaping the child's and family's eating environment and wider child development.

There is some evidence that placing the responsibility for management of childhood overweight solely with parents, supported by parenting skills training and addressing the family environment is a promising approach with long term effectiveness demonstrated in one population. This approach, supported by child development theory, is a common approach utilised in clinical practice despite limited evaluation or evidence base. Overall use of parents as 'sole agents of change' and how to best support parents in their ability to initiate and maintain family change to facilitate changes in child adiposity remains an area for further research.

### **1.6.7 Does the format of and frequency of contact during of child weight management influence effectiveness?**

Outcomes of weight management or health promotion programs may be influenced by factors such as the treatment setting; type of professional delivering the program; the format of the program (eg individual versus group treatment); frequency of professional contact and program duration; and the educational or theoretical models underpinning the programs. However, very few studies have investigated these aspects of child weight management programs in relation to weight or other outcomes such as participant satisfaction or cost/resource effectiveness.

#### *1.6.7.1 Program Format: Individual versus group education*

Comparison of the effectiveness of group versus individually delivered programs is difficult as early studies tended to be individually based while recent studies have tended to be group- or group plus individual-based. Braet and colleagues (155) in Belgium (n=259, 162 girls, 7-16 year olds, 14 sessions over 11 months bi-monthly or monthly) and Nuutinen (146) in Finland (n=32, 74% boys, 6-16 year olds, 7 sessions in 12 months) found that group therapy (~105 minutes therapist contact/child) and individual therapy (~150-300 minutes therapist contact/child) utilising diet, activity and BT, both significantly reduced percent overweight at 12-24 months (10-16% point reduction in percent overweight,  $p < 0.05$  time, NS group).



Equivalent reductions in weight outcomes were also found in a US study (n=31, 8-12 year olds) with children treated either via group therapy only or group plus individual therapy (mean decrease in BMI z score was  $0.59\pm 0.49$  and  $0.64\pm 0.63$  at 6 and 12 months respectively for groups combined,  $p<0.001$  from baseline, NS group) (147). Group only treatment was less expensive than group plus individual treatment due to differences in salary costs (cost/family \$491 versus \$1390,  $p<0.05$ ) with group therapy resulting in larger reductions in BMI z score per treatment dollar spent (0.014 versus 0.005,  $p<0.01$ ) (147).

#### *1.6.7.2 Number and Frequency of Sessions*

Weight management programs involve delivery of dietary and activity information which needs to be learnt, incorporated and maintained into family behaviours. The capacity to implement the required behaviour change is influenced by provision of feedback and reinforcement, sustained behaviour modification therapy and possibly the number of and timing between sessions (123, 134). Treatment programs tend to commence with weekly sessions to equip families with information and strategies to initiate change, tapering off to fortnightly, monthly or booster sessions to support maintenance of change.

Only one study has directly addressed whether the frequency and number of sessions impacts on outcome during a child weight management program (182). The same number of group treatment sessions delivered either rapidly over 8 weeks or gradually over 6 months resulted in similar outcomes initially, but by 26 weeks, the gradually delivered program produced double the reduction in child percent overweight (20% versus 10%). However due to a small sample size (n=18 at 26 weeks) and thus insufficient power, this difference was not statistically significant.

### 1.6.7.3 Conclusion

Group therapy is as effective as individual- or group plus individual-counselling, but may be more cost effective by reducing therapist salary costs. Group therapy may offer additional benefits including; improving attendance and motivation, fostering social support (encouragement, positive reinforcement, modelling) and participant independence but these mechanisms are only based on theoretical evidence (197). One study in children (182) supports findings in adults and adolescents suggesting that increasing duration and intensity of treatment results in greater weight loss, but the optimal number and sequencing of contact remains unknown (18, 123, 128). Tapering the amount of therapy from intense contact to less frequent may enable longer program duration whilst limiting resource costs. This approach may also promote participant independence, but this remains theoretical or informed from other health programs (190, 198).

Child weight management outcome variation by program setting or therapist profession is unknown and whether different theoretical frameworks influence child weight outcomes has not been evaluated. However research in other nutrition and health related conditions suggest that programs with a theoretical framework will perform better than one without a theoretical underpinning (130).

### 1.6.8 Use of medication and surgery in child weight management

In adults adjunctive therapies using medication (appetite suppressants or fat absorption inhibitors) and surgical procedures (reversible or non-reversible stomach reduction) have produced the best outcomes in terms of absolute weight loss, long term sustainability and of that weight loss and management of co-morbidities (18). Diet, activity and BT remain the key components of adult weight management, but medication and surgical strategies are viable adjunctive therapies, especially in severely obese adults with multiple co-morbidities (18).

Ten pharmacotherapeutic agents have been trialled in adolescence for assisting with weight management. Only four are recommended for use in adolescents with extreme obesity and comorbidity (silbutramine, orlistat, octreotide, metformin) (15). Six drugs have been trialled in children, but none are currently recommended for use, due to the lack of knowledge in terms of benefit and harm. Recommendations are that surgical procedures for obesity in children should only be used in similar circumstances (15).

#### **1.6.9 Broader health outcomes and program evaluation of child weight management programs**

Excess adipose tissue affects many body systems, with reduction of adiposity ameliorating the consequences of overweight. In adults, studies are limited, but improvements in metabolic health, chronic disease prevalence reduction and reproductive function have been achieved with ~5-10% weight change and are sustained long term (10 years) (1, 124). These benefits outweigh negative effects (gall bladder disease, reduced bone density) which are rare and generally associated with very rapid weight loss (1, 124). In children and adolescents it is recommended that “outcome indicators of success additional to weight change should be part of any weight-management program” (15). However evidence to define these non-weight outcome indicators is derived from level III-2 evidence (199), with the majority of short term studies assessing metabolic health and focusing on adolescent populations. No RCT with  $\geq 12$  months follow up in children examines non-weight outcomes (15, 140).

The broader health and evaluation outcomes of weight management programs in children are summarised in Table 1.11. There are no studies assessing the most common consequence of overweight, tracking of weight and associated consequences into adult life. There is some evidence of improved metabolic function (reduced TC, TG, prevalence of hyperinsulinaemia and increased HDL-C) with weight change in childhood and that growth is only adversely affected with severe energy restriction (protein sparing modified fast,  $<0.17\text{MJ/kg}$ ) and only during treatment (15, 139).

Treatment of overweight has been associated with both improvements and reductions in measures of psychosocial health in a limited number of studies. Generally, the changes in psychosocial health are independent of weight changes observed. Seven of 8 treatment studies in 7-18 year olds have shown improved self esteem (66). One study has reported increased HR-QOL after treatment for overweight in an inpatient setting (200). The only study to have assessed changes in disordered eating symptoms during family-based treatment of 67, 8-12 year olds, found no changes from baseline levels (201). However, decreased self esteem following treatment for overweight (202) and increased use of inappropriate/adverse dieting behaviours in boys who were encouraged by their mothers to diet (203) has also been reported. Overall it is very difficult to draw conclusions regarding the impact of treatment of overweight on psychosocial health due to the variety of treatment methods used and lack of assessment of psychosocial outcomes (140). Finally, retention rates are poor (up to 50% drop out) and studies to date show limited medium to long term success for reducing adiposity. However, no consideration is given to process factors such as program implementation and adherence and the role they may play in limiting successful outcomes, beyond the treatment approach itself (140, 204).

Overall there is a need for assessment of secondary outcomes as part of child weight management studies, particularly metabolic health and psychosocial outcomes such as self esteem and body satisfaction. Overall health-related quality of life can also measure the impact of overweight and its treatment on physical, psychosocial and family functioning. Evaluation of program processes are also urgently required to determine whether the outcomes of child weight management are due to program approach or are influenced by other factors such as program adherence, participant characteristics or program implementation (15, 140). Broader health outcomes, program satisfaction and whether treatment suits child/family characteristics are important indicators of effectiveness in addition to adiposity outcomes. This broader exploration of program effectiveness is non-existent in the current literature base and is an area for further research, which is urgently required.

## **1.7 Child weight management – areas for further research**

Genetic susceptibility has seen significant proportions of populations expressing an obese phenotype within the current behavioural, social and structural ‘obesity-promoting’ environments (79). The magnitude of the obesity epidemic in adults and children and its short and long term health implications highlights an urgent need for effective treatment strategies. Management of overweight in early childhood is an important strategy as part of a comprehensive approach to the prevention and management of this health crisis (4). However it is an area that health professionals’ and families are currently grappling with and support and guidance are urgently needed.

### **1.7.1 Evidence-based, age-appropriate child weight management**

The necessary and available treatment components for child weight management are clear. A change in weight gain trajectory by moderating energy balance (decreasing energy intake, increasing physical activity and decreasing sedentary activity) is possible. This requires behaviour modification with adiposity change enhanced via the use of behaviour modification skills and family support (1, 15). It is crucial to use all available components as they are all likely to contribute to effective management but their relative effectiveness or potential synergistic effects between components is currently unknown (15).

However, even a multi-component program may expect to reduce, but not normalise, childhood overweight (10-30% points in 12-120 months) (140). For any treatment approach, some children do not change in their adiposity status and reversal over time to baseline levels is common. This may be due to the limited inclusion of strategies to support long term maintenance. Additionally, there are a range of developmental needs and phases covered in managing child overweight and this may impact on how treatment needs to be approached. The best way to approach and combine the component of child weight management in an age-appropriate manner to support effective and sustained weight management remains a central area for further research. The remainder of 1.7.1 highlights ‘best guesses’ in terms of how to approach each component to support age-appropriate child weight management in young children.

Little research has investigated the best dietary approach for child weight management in terms of adiposity, age-appropriateness, long term sustainability and impact on broader outcomes such as growth, cardiovascular, endocrine and psychosocial health. Parents and the family environment play an important role in shaping children's eating behaviours through modelling and as the decision-makers in terms of when, what and how children eat (100, 104). Focusing on family rather than child eating patterns may be the most age-appropriate approach to addressing children's eating patterns.

This may also have the greatest potential to influence long term food choices. There are also potential advantages in terms of ability to influence 'family overweight', with the majority of overweight children likely to have at least one overweight parent. Aiming to maintain or improve child dietary adequacy whilst moderating energy intake through promoting family eating patterns consistent with the Dietary Guidelines for Children and Adolescents using food selection guides such as the Food pyramid or The Australian Guide to Healthy Eating shows considerable promise (15, 158-160, 205). However use of family-focused healthy eating in child weight management has not been formally evaluated and is based on clinical experience with limited supporting experimental (155, 165) and theoretical evidence (157).

Effective child weight management utilising an increase in energy expenditure should combine an increase in low intensity, long duration physical activity together with promotion of opportunities to be active by limiting time spent in sedentary behaviours (140, 171). There is some evidence suggesting that the first target of treatment using activity should be management of small screen use to less than 10-20 hours per week (140). Treatment should aim to increase activity above current levels using a variety of opportunities in daily life, including promotion of active play in children (15). Improving children's fundamental motor skills may be an important way to support this aim, though further research is needed in this area (170). Using facility-based exercise or 'play' sessions as part of a child weight management can allow children to practice and refine their movement skills, in order to support increases in overall lifestyle activity patterns.

There is some evidence to support parental leadership as an age-appropriate behaviour modification and family support component for weight management in young children (161, 165). Changing eating and activity behaviours to moderate energy balance requires translation of knowledge into new behaviours and behaviour reinforcement to maintain these long term. Behaviour modification and family support are important components supporting this process. In children there is evidence that this may be best managed within the family context as part of the broader parenting role.

One study has shown better adiposity outcomes, family behaviours and less family conflict during weight management with parent-led, family focused treatment. While these findings require replication in other populations, support for a 'parent leadership' model can also be derived from the child development and management of child chronic disease management literature (191). While the evidence to support involving parents in the role of leadership and child behaviour modification, the best way to support parents in this role is unknown.

Parenting ability or competence to facilitate child behaviour modification is likely to influence the child and family's ability to establish, monitor and reinforce changes in dietary intake or physical activity (190). Therefore ways to support parents in the role of child behaviour management is likely to improve program effectiveness, and is perhaps as or more important as the nutrition or lifestyle components. Theories underpinning behaviour modification highlight that the mode of knowledge and skill education may be important, with strategies promoting parent independence, capacity and competence facilitating transferable skills and enhancing the maintenance effect after a program has finished (135, 190). These aspects need to be explored as a potential way to improve the process and sustainability of weight management and maintenance in children.

Finally, development of parental capacity and competence may be influenced by how a program is delivered and their satisfaction with the program. Group versus individual or mixed sessions appear equally as effective, with some advantages in terms of cost effectiveness and other outcome such as social support. Tapering session frequency also provides a means of extending treatment programs without increasing resource use and may also facilitate a focus on treatment to maintenance and also transfer leadership and responsibility from facilitator to parent.

### **1.7.2 Improving the evidence base**

The limited evidence base informing effective child weight management is highlighted in two systematic reviews as well as in the Australian NHMRC Clinical Practice Guidelines for Management of Overweight and Obesity in Children and Adolescents (15, 128, 140). The NHMRC recommendations highlight that much of clinical practice is not supported by literature as the appropriate studies have not been done (Table 1.6) (15). The child weight management literature overall is limited in number, scope and quality, with few Australian studies. The limitations of the current evidence base relating to the design and quality of studies highlighted in this review include;

- Only relatively homogenous populations have been studied with little research in overweight or mildly obese non-clinical populations, and limited research outside the US-based Epstein group (only 1 study from Australia)
- Generally a wide age-range of children has been studied together without consideration of needs of different age groups. For example the specific needs of young (<10 years) children whose parents remain a key influence on lifestyle patterns, may be difference to that of older children entering adolescence (>10 years)
- The relative focus, combination, structure and delivery of program components vary substantially between studies limiting meaningful comparisons, with intervention often poorly described
- There is a lack of evidence from gold standard study design, randomised controlled trials (particularly with 'no intervention' controls) and studies often have poorly described study designs



- Majority of studies have sample sizes resulting in power issues at follow up (although sample size or power calculations not reported).
- Analysis is not conducted using principles of intention to treat therefore limited generalisability to 'real life' situation.
- Finally, there are issues regarding the scope and appropriateness of study outcomes. A range of inadequate weight outcomes are used making comparisons between studies. Broader non-weight outcomes assessing harm or benefit are rarely assessed and follow up is only sufficient to explore short or medium term effectiveness.

## **1.8 Thesis aims and hypothesis**

### **1.8.1 Thesis research question(s) and general aim**

The literature reviewed here suggests that in the absence of evidence to suggest that any one component used in child weight management is more effective, it is prudent to include all the cornerstones – diet, activity, behaviour modification and family support. This review has identified strategies within each of these components that warrant further investigation of their use within a multi-component program (refer to 1.7.1). Given the important role that parents and families play in providing age-appropriate family support and child behaviour modification during child weight management, identification of methods to support parents in these roles is a key area lacking in the available literature.

Therefore this thesis aims to address the research question; 'Is an evidence-based, age-appropriate (parent-led family-focussed) child weight management program utilising parenting skills training an effective way to manage overweight in young children'? A second aim is to examine the common, but mistaken belief that parents know what to feed their child but just require some behaviour skill development to translate knowledge into practice (135, 206). Little attention has been given to exploring effective lifestyle (in particular dietary) approaches and education strategies, tending to focus on family involvement and behaviour modification (140).

### **1.8.2 Specific thesis aims**

The study undertaken in this thesis aims to;

- 1) Develop an evidence-based, parent-led weight management program for 6-9 year olds, utilising parenting skills training to support parent capacity to initiate and maintain healthy family lifestyle behaviours. To address the secondary thesis aim, two variations of the program will be developed. They will have equivalent parenting skills training but will be with and without intensive lifestyle education.

This is to examine the relative role of behaviour modification/family support versus lifestyle education in management of overweight in young children.

- 2) To examine, using a RCT, the 12 month effectiveness of these program in terms of a broad range of outcomes including overall adiposity, truncal adiposity, growth, metabolic and psychosocial health
- 3) To evaluate the programs in terms of a) parent attendance and satisfaction (process evaluation) and b) changes in child lifestyle behaviours and parental competence and weight status (impact evaluation)

### **1.8.3 Thesis hypothesis**

The study aims will test the hypothesis that;

Pre-pubertal children whose parents participate in a parent-led family-focused child weight management program comprising parent skills training and intensive lifestyle education will have BMI and waist circumference z scores, metabolic profiles and indicators of health-related quality of life and body satisfaction after 12 months that are

- a) improved compared to children who are wait listed for intervention for 12 months, and
- b) no different to children whose parents participate in a parent-led, family focused intervention utilising parenting skills training alone (without intensive lifestyle education).

## Chapter 2 Study Methodology

### 2.1 Introduction

This chapter describes the methodology of the randomised controlled trial (RCT) assessing the effectiveness of utilising parenting skills training as the behaviour modification/family support component in parent-led, family focused management of overweight in 6-9 year olds. Use of parenting skills training alone and parenting skills training in conjunction with intensive lifestyle education were compared 1) to one another and 2) to no intervention (see section 1.8). Short term (12 month post baseline) effectiveness is assessed. Program effectiveness is defined in terms of adiposity as well as broader metabolic, psychosocial and general health indicators and program evaluation. The study was conducted between July 2002 and August 2004 at two teaching hospitals in the Adelaide metropolitan area. Subjects were recruited through the media, health professionals and school newsletters. The study was approved by the Flinders Clinical Research and the Women's and Children's Hospital's ethics committees.

### 2.2 Overview of the intervention programs

Development of the study interventions was informed by current evidence. The literature review presented in chapter 1 was used to 1) confirm the components of child weight management, 2) inform what strategies might be most appropriate within each component and 3) identify gaps between available literature and clinical practice recommendations. The intervention goals, objectives, strategies and content is summarised in Table 2.1/2.2. The behaviour modification and family support component (eg parenting skills training) and mode of delivery were identical between the two interventions. However the delivery and emphasis placed on lifestyle (diet and activity) education was different (Table 2.1 and 2.2). This resulted in a difference of 7 therapist contacts between the two interventions, but the total intervention period was equivalent running over 6 months. The components of the interventions are outlined below, with details on the actual delivery of the interventions detailed in section 2.4.5.

## **2.2.1 Child behaviour modification and family support component**

### *2.2.1.1 Role of parents*

In both interventions parents were defined as the 'agent of change'. This meant that parents had sole responsibility for attending and participating in education sessions, implementing the lifestyle changes at the family level and monitoring progress. Children were not involved in any of these processes. Parenting skills training was used to facilitate and support parental capacity as the sole agent of change. This component was identical between the two intervention groups.

### *2.2.1.2 Parenting skills training*

The Positive Parenting Program (Triple P<sup>®</sup>) is a standardised, evaluated, commercially available program. Triple P<sup>®</sup> was developed by the Parenting and Family Support Centre, based within the School of Psychology at The University of Queensland, headed by child psychologist, Professor Matthew Sanders. Triple P<sup>®</sup> is underpinned by a theoretical framework informed by child development theory, family systems theory and social learning principles (190). The primary aim of Triple P<sup>®</sup> is to promote parental competence and independence to manage child behaviour (190, 207). This is facilitated by delivery of content as well as an education approach which is process as well as content-focused (190). A self-regulatory framework fosters parent's independent problem-solving ability and enables parents to tailor the program to their individual needs rather than a 'one size fits all' approach (190).

While Triple P<sup>®</sup> is an established and commercially available program, the context in which it was used in this study was novel. Linking Triple P<sup>®</sup> to lifestyle education and application to weight-related behaviours for child weight management has not previously been undertaken. Triple P<sup>®</sup> is widely used in Australia for general child behaviour management with accredited 3-day training courses available for a range of health professionals. Established Triple P<sup>®</sup> resource materials were purchased and utilised in the study interventions.

However, the standard Triple P<sup>®</sup> examples were adapted by the thesis candidate to reflect dietary and activity behaviours (eg parenting strategy of rule setting discussed within context of TV viewing time or access to the refrigerator between meals; incidental teaching strategy applied to talking with children about fruit and vegetables; demonstration of application of praise strategy to child practicing ball throwing skills or helping with food preparation; setting a good example for role modelling of healthy eating).

Triple P<sup>®</sup> is taught using 5 'parenting principles' (Table 2.1) which are applied using a practical framework titled the Planned Activities Routine (PAR)<sup>™</sup> (207). The PAR<sup>™</sup> is a planning tool that is designed to give parents the confidence to manage their child's behaviour and problem-solve situations or barriers that could jeopardise achievement of family goals (207). The PAR<sup>™</sup> is applied to situations that are termed "high risk situations" and include examples such as birthday parties, long car trips, lack of family support for the program or making healthy eating appealing to children (207). Table 2.3 illustrates use of the PAR<sup>™</sup> in identifying a potential high risk situation, preparing to manage the situation, setting rules, and having consequences for times of less than ideal behaviour. Behaviour change is promoted by reinforcing positive behaviour (190).

## **2.2.2 Nutrition component**

### *2.2.2.1 The Australian Guide to Healthy Eating*

The Australian Guide to Healthy Eating (AGHE) is used nationally to support implementation of the Australian dietary guidelines for adults and children (153, 158, 205). It is the food selection guide used to promote adequate nutrition and prevent nutrition-related diseases such as obesity, cardiovascular disease and diabetes (Figure 2.1). The AGHE is semi-quantitative, providing recommendations on the volume and type of foods to consume both within and between food groups. Modelling indicates eating in line with the AGHE will achieve recommended daily intakes of energy, macro- and micronutrient requirements (205). Food-based messages outlining appropriate daily serves of each food group (with serve sizes provided) are used and there is no counting of calories or fat.

The AGHE is commonly used in Australian clinical practice for child weight management and is the recommended nutrition education tool in the NHRMC Clinical Practice Guidelines for Management of Overweight and Obesity in Children and Adolescence (15). It can be used across the ages of 2-18 years and provides a means to promote gradual, sustained (lifelong), individually-tailored dietary change during the active treatment phase of weight management. However it can also be adjusted to support long term maintenance of appropriate energy balance against a background of changing child nutritional needs. Child weight management can also be facilitated at the family level with all members of the family following the AGHE. This may assist with development of healthy family eating preferences.

There is limited evidence for and evaluation of the AGHE as an appropriate weight management tool in children (15). Therefore, dietary modelling was undertaken by the thesis candidate during intervention development to assess whether the AGHE used in conjunction with simple, food-based messages targeting fat and refined sugar intake would facilitate lowering of energy in children diets (157, 208) (appendix 6). Briefly, using data from the 1995 National Nutrition Survey (NNS95) the energy, nutrient and food intake of children consuming 35-45% energy as fat (n=280) was compared to children consuming 23-27% energy as fat (n=85). A 3-day dietary model was developed (SERVE<sup>®</sup> nutritional management system, M&H Williams Pty, NSW, version 3.99, 1999) reflecting the dietary intake of children consuming the high fat diet. A series of food modifications were implemented on the dietary model, with the accumulative effect on energy and nutrient intake assessed. The series of food modifications was based on 1) foods which were found to make a significantly higher contribution to total food or energy intake in the NNS95 analysis, 2) focusing on 'non-core' foods according to by the Australian Guide to Healthy Eating, and 3) increasing the intake of particular foods which would improve nutrient intake.

Food-based recommendations found to be most effective for reducing energy and fat intake included; changing to reduced fat milk, reducing intake of cereal-based and snack foods and replacing water for juice or soft drink. These changes, together with avoiding adding fat to vegetables and using sources of lean meat, reduced energy intake by ~10%, total fat intake by ~30% and saturated fat intake by 53%. This suggests that the AGHE is appropriate for use in child weight management for children and family members over the age of 2 years.

#### *2.2.2.2 Nutrition Skills and the family eating environment*

Nutrition knowledge influences eating behaviours and dietary intake. Knowledge relating to what foods are good for health (declarative knowledge) and procedural aspects of food choice (eg decreasing fat and sugar intake or increasing vegetables in recipes; label reading to identify 'extras' foods) are important in shaping healthy eating behaviours (135). Therefore the ability to use the declarative knowledge provided in the AGHE may be increased through additional procedural content focused on nutrition skills such as label reading and recipe modification (Table 2.1).

Section 1.5.3.4 highlighted the role that families, and in particular parents play in determining what and when children eat. This section also highlighted how the available food supply, parental modelling and child feeding practices influences children's intake, dietary preferences and risk of obesity (100, 101). This may be of particular importance in families with a history of overweight and in families with overweight children (110-112). Provision of a healthy food supply, positive parental role modelling and neutral feeding practices may support development of children's preferences for healthy foods and their ability to self-regulate intake (105). These strategies may improve a children's ability to consume adequate amounts of appropriate foods (105). Therefore it is appropriate to discuss the family eating environment as part of a child weight management program involving intensive lifestyle education (Table 2.1, 2.2, appendix 1).

In summary the AGHE formed the basic nutrition recommendations in both intervention groups. In the parenting plus intensive lifestyle education, detailed information and monitoring in line with the AGHE was also undertaken. Use of the AGHE was supported by nutrition education skills and education on the role of the family environment and children's lifestyle patterns in the intensive intervention only.

### **2.2.3 Physical activity component**

#### *2.2.3.1 'Being active in a variety of ways'*

The program physical activity recommendations (Table 2.1) were delivered using a physical activity pyramid (Figure 2.2) (209). At the time of intervention development the Australian physical activity guidelines for children (recommending 60 minutes of daily vigorous-intensity physical activity and to limit screen time to 2 hours per day) were not published (210). However the intervention physical activity recommendations were similar to the national guidelines. The screen time recommendation was 7-10 hours per week based on aetiological evidence showing the lowest risk of obesity is associated with screen time of less than 2 hours per day (119). The exercise recommendation was 30 minutes per day. This was coupled with the recommendation to 'be active in a variety of ways' (eg active transport, play at school, active family leisure time and chores). Parents were responsible for setting and monitoring family activity goals in line with these recommendations.

#### *2.2.3.2 Structured skill-based sessions*

In the parenting plus intensive lifestyle education group, the overall aim of 'being active in a variety of ways' was supported by the children attending structured, supervised activity sessions developed by physical activity experts (appendix 3). The sessions consisted of fun, non-competitive games designed around aerobic activity and development of fundamental motor skills. Sessions were designed as 'play' rather than 'exercise' sessions. The sessions were designed to require minimal equipment, be delivered by non-expert staff (eg parents, teachers, human movement students) and be easily applicable to the home environment.



## **2.3 Study Design**

### **2.3.1 Design**

A single-blinded randomised controlled trial (RCT) design was used to assess the effectiveness of the two child weight management interventions (parenting alone, P, and parenting plus intensive lifestyle education, P+DA) described in section 2.2.

Program effectiveness was compared between the two interventions and to no intervention. No intervention subjects were waitlisted for intervention for 12 months (wait-listed control, WLC). This design can be summarised as;

- (1) P: Parenting skills training alone
- (2) P+DA: Parenting skills training + intensive lifestyle (diet-activity) education
- (3) WLC: 12 month wait list control

A wait-listed approach enabled comparison to a control group recruited and monitored at the same time as the intervention groups (eg concurrent control). It also provided incentive for study participation and retention. Given the high likelihood that weight status in control subject would remain stable or increase over 12 months with potential health consequences (34), ethically it was felt appropriate to provide the WLC group with a brief healthy lifestyle pamphlet (appendix 2).

### **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 and 2) the intervention programs would be appropriate for the child's developmental stage. Pubertal staging was important given the prevalence of early maturation in the target population and the impact of puberty on growth and insulin resistance (12, 211). Given the shared family environment, enrolling multiple members of the same family would reduce the sample variability and increase sample size requirements.

### 2.3.2.2 *Study inclusion criteria*

Children were eligible for the study if they were aged between 6 and 9 years (up to 10<sup>th</sup> birthday), were pre-pubertal (Tanner stage 1, (212)) and overweight or obese based on the standard international definition for children (20).

### 2.3.2.3 *Study exclusion criteria*

Children were excluded from participating in the study if they 1) were severely obese (BMI z score >3.5, (15)), 2) had syndromal obesity, 3) had physical or developmental problems preventing ability to engage in the physical activity or dietary intervention, 4) were on weight-influencing medications or 5) had a sibling enrolled in the study. Families unable to indicate that at least one parent/caregiver competent with written and spoken English would be able to attend all sessions were also ineligible.

## 2.3.3 **Overview of study outcomes**

### 2.3.3.1 *Definition of intervention 'effectiveness'*

Management of overweight in childhood represents a unique opportunity to utilize the impact of vertical growth on BMI. An increase in weight over one year of only 0-50% of that expected if a child was to maintain their degree of overweight while increasing in height will result in a fall in BMI and is considered clinically a realistic outcome during child weight management (15). However, there are many consequences associated with child overweight which should reverse with treatment and be part of the definition of intervention effectiveness (see section 1.4). Along with persistence of overweight into adult life, metabolic and psychosocial consequences are two of the highly prevalent health consequences observed in childhood overweight (Table 1.1). Clustering of metabolic risk factors (ie the Metabolic syndrome) is of particular clinical and public health interest, given the health burden of CVD and diabetes. The impact of overweight on overall health, self esteem and body dissatisfaction are also of interest and somewhat controversial. While a limited number of studies have shown improvements in these outcomes following child weight management, some studies suggest treatment itself may lower rather than improve indicators of psychosocial health. Further research is urgently needed to address this controversy.

Finally, weight management programs are often effective in the short term (ie during active treatment) with medium to longer term effectiveness either poor or not assessed (140). However, the chronic nature of overweight suggests that it may be the longer term effectiveness that is central ie the ability to sustain weight change rather than whether weight change can be initially achieved. Therefore the effectiveness of the program was assessed both at end of treatment and after a period of no intervention.

For the purposes of this study, program effectiveness was defined as a decrease in adiposity (BMI z score) equivalent to weight gain of 50% expected with normal growth over 12 months with maintained or improved metabolic profile and psychosocial health. For the interventions to be considered 'effective', they also needed to be favourable in terms of participant program satisfaction. The remainder of section 2.3 outlines why each study outcome was included and the justification for assessment tool selection. Data collection methods are provided in section 2.4.6.

#### 2.3.3.2 *Primary outcome - BMI z-score*

BMI is an internationally accepted proxy for overall adiposity in children. It is non-invasive, easily collected, (relatively) reliable when measured by a trained observer and valid against measures of body density (19, 213). BMI in children varies by gender and age and therefore needs to be adjusted for these factors to enable comparisons across time and gender (23). BMI-for-gender and age reference charts for the Australian population are not available. However age-adjusted BMI charts established prior to the increase in obesity prevalence are available for other generalisable, western, Caucasian populations in the US (214) and UK (215). BMI z score is an age and gender-adjusted expression of BMI which compares an individual BMI with the reference population (20, 23, 158).

#### 2.3.3.3 *Waist circumference*

Truncal fat measured using skin fold measurements, circumferences and imaging techniques have been shown to have independent and synergistic health consequences to that of overall adiposity (26, 50). Truncal and in particular visceral fat is strongly associated with the health consequences of obesity and is considered the best predictor of obesity-related health risk (26). Imaging techniques, whilst being the most accurate and detailed, are expensive and invasive (19). Skin fold and waist circumference measurements are less invasive but require trained and accurate measurements otherwise they may not predict obesity-related health consequences any better than BMI (19). Measurement of waist circumference is less invasive, more reliable and valid measure of fat distribution in children than skin fold measurements (19).

While truncal adiposity predicts health risk there is limited gender and age-adjusted reference population data available for waist circumferences in children. In addition, as with BMI, cut points for truncal adiposity in children are not currently reflective of health consequences (19). Some of this information is currently emerging (29) and UK reference charts for waist circumference are available from the UK (27).

#### 2.3.3.4 *Growth*

Children require adequate nutrition for appropriate growth and development. With appropriate nutrition, growth or height tracks through childhood (216). Weight reduction is promoted by inducing an energy deficit which also has the potential to retard growth. Assessing height adjusted for gender and age against a reference population can assess the impact of a weight management intervention on height potential or tracking of height.

#### 2.3.3.5 *Metabolic health*

Presence of individual metabolic risk factors such as dyslipidaemia, elevated blood pressure, glucose and insulin have been observed in childhood (45). There is also a tendency for these risk factors to cluster with overweight, which potentially indicates a higher overall risk and therefore clinical importance, than presence of individual risk factors (49, 50, 217, 218). This clustering of overweight, hyperinsulinaemia, dyslipidaemia and hypertension has been termed the Metabolic Syndrome (MS) (52). However the specific mix of risk factors and cut points to consistently and accurately define MS in children has been problematic. As highlighted in Appendix 6, there is currently no systematic definition of MS for children and estimates of MS prevalence vary significantly by which definition is used (52, 219, 220). However use of a definition based on recent publications would allow direct comparison with other studies.

#### 2.3.3.6 *Body size dissatisfaction*

Body size acceptance represents one component of body image or esteem. Studies have consistently shown impaired body esteem and body size dissatisfaction as a consequence of overweight, even in children as young as five years (70). Body size dissatisfaction may be one of the mechanisms resulting in lower self-esteem in overweight individuals and may also be a risk factor for disordered eating (70). Assessment of body size satisfaction before and after child weight management can be an indicator of whether improvements in body satisfaction are seen with treatment of overweight in children. Improvements in body dissatisfaction or body esteem with child weight management may be valuable regardless of adiposity changes.

#### 2.3.3.7 *Health-related quality of life*

Health-related quality of life (HR-QOL) is a subjective, comprehensive, multi-dimensional measure of an individual's perception of the impact of their health condition or health treatment on their physical, mental, emotional and social wellbeing (1, 221). Therefore assessment of HR-QOL before and after a child weight management intervention is a means of assessing how overweight affects children's overall health and whether overall health is improved following weight management.

The key developmental influences on HR-QOL vary between children and adults. Therefore parent-completed, child specific HR-QOL tools have been developed. These tools also consider how parents perceive themselves to be affected by their child's health (222). Child-specific HR-QOL tools that are appropriate for use by a range of professionals, in many settings and for varying purposes (eg clinical care, population health assessment and evaluation of interventions) are available. This enables comparison of HR-QOL between conditions, populations or within individual or groups of children over time, using a single tool (222). HR-QOL can be generic, reflecting daily living without the presence of a specific medical condition, or specific to provide additional information assessing the impact of a specific disease or treatment aspects on HR-QOL (222). While there is currently no obesity-specific measures of HR-QOL, some of the psychosocial domains believed to be important in obesity and obesity management (eg self-esteem (66), family functioning) are covered in generic HR-QOL tools.

#### *2.3.3.8 Program evaluation*

The goals of a child weight management intervention, as with any health program, are influenced by whether its objectives are fulfilled (204). Achieving program objectives is influenced by whether 1) an intervention is delivered as intended, 2) participants attended and engaged in the intervention, 3) participants are satisfied with an intervention and 4) an intervention was able to facilitate sustained change in factors along the causal pathway (204). Evaluation of such influences also unravels or explains the changes in outcomes following intervention and can help describe who did and did not benefit from an intervention.

Process evaluation measures the activities of an intervention, its quality and who the intervention is reaching (204). Impact evaluation measures the immediate effects of an intervention and whether a program achieved its objectives eg change in dietary habits, reduced screen time or improved parenting competency (204). Program evaluation is an important part of both assessing the feasibility and generalisability of child weight management interventions for service delivery and the process of translating evidence into practice (123, 140).

## **2.4 Study procedures**

### **2.4.1 Recruitment**

Subjects were recruited between July 2002 and August 2003 via print, radio and television media avenues, health professional referral and school newsletters. Suburbs within a 10km radius of the two Adelaide metropolitan teaching hospitals where the study was conducted were targeted. Subjects were recruited in four cohorts of 21-38 families to minimize waiting times between recruitment and intervention delivery and to ensure workable group sizes. The intervention programs were run twice at each study site. Cohorts 1 and 3 were recruited to and received the intervention at Flinders Medical Centre, Bedford Pard. Cohorts 2 and 4 participated in the study at the Women's and Children's Hospital, North Adelaide.

### **2.4.2 Eligibility screening**

A standardized form was used to assess study eligibility, document study referral source and subject contact details (appendix 5.1). Eligibility screening was initially conducted via telephone when parents enquired about the study. If a child appeared eligible and parents were interested in enrolling in the study, a medical screen appointment was undertaken by either a paediatrician or a general practitioner to confirm eligibility, particularly BMI, pubertal staging and medical history. Families excluded from participating received verbal and written information of family lifestyle tips for child weight management and Adelaide Dietetic service options.

### **2.4.3 Consent**

Once eligibility was confirmed, the study details were discussed with both the parent and child using a standardised study information sheet. Particular attention was given to highlighting the possibility of allocation to the 12 month waitlisted group, frequency and timing of study sessions and the family's ability to attend and support the program. Parent capacity to read the information sheet and complete consent forms was observed for capacity with English. Written, informed consent was obtained from parents (for themselves and third party for child) and children who were eligible and desired to participate in the study.

#### **2.4.4 Randomisation**

Separate allocation schedules were developed for each of the four recruitment cohorts. A computer generated randomization sequence was generated using a 3 block design, stratified for gender to ensure equal numbers of each gender were allocated across intervention groups. Sealed, opaque allocations envelopes were developed from this sequence. Upon completion of baseline measures, the next allocation envelope was opened and group allocation recorded. The thesis candidate was responsible for subject recruitment and intervention delivery and therefore was not involved in the development of the randomization schedules or allocation envelopes. To enable blinded outcome assessment, the thesis candidate co-ordinated the data collection sessions, but measurements were performed by a single, trained assessor who was blinded to subject group allocation.

#### **2.4.5 Delivery of the interventions**

##### *2.4.5.1 Intervention groups – parenting alone and parenting plus intensive lifestyle education*

The two study intervention programs outlined in section 2.2 used a combination of face to face group and individual telephone call sessions which were delivered with decreasing frequency over 6 months (Table 2.2). Groups in both interventions were conducted with approximately 8-14 families depending on the size of the cohort. Only parents or caregivers attended program education sessions (Table 2.2). Parenting sessions were conducted in the evening to assist with parent work commitments and childcare arrangements. If parents from either intervention group missed group sessions a letter detailing session content, session handouts and a reminder about the next sessions was sent.

For the individual phone call sessions, the facilitator called at a pre-arranged time and parents have 20 minutes to work through a structured process to facilitate parent-led problem solving (207). Parents could re-schedule telephone sessions and were provided 2 calls over 10 minutes at the scheduled time to utilise the phone sessions.



In the P+DA group, participants attended an additional 7 group sessions over 6 months which focused on intensive lifestyle education (Table 2.2). Detailed written lifestyle resources were developed for these sessions by the thesis candidate. This was provided at each session covering the session content and outlining homework tasks. In the P+DA group, children and siblings attended physical activity sessions while parents were in the lifestyle sessions. The lifestyle education sessions were conducted during the after school period (4.30-5.30pm). The children's activity sessions were facilitated by physical activity or education students.

#### *2.4.5.2 Wait-listed control*

At the time of group allocation, the waitlisted group was provided with the same written material developed for the parenting alone group (appendix 2). Parents in this group were contacted by phone 3-4 times in 12 months for ~5 minutes. Their continued participation in the study was discussed including any dissatisfaction with allocation to the wait-listed control group. The length of time until there were eligible to participate in a child weight management program was highlighted and general wellbeing of the child discussed. Researcher contact with the waitlisted control families was minimized to avoid potential placebo effect secondary to therapist contact.

#### *2.4.5.3 Quality assurance*

Parenting, lifestyle and telephone sessions for all cohorts were delivered by the same facilitator (thesis candidate) who had undertaken accredited Triple P<sup>®</sup> training through Parenting Victoria. The thesis candidate also developed all parent lifestyle education material and adapted the standard Triple P<sup>®</sup> material so that parenting examples reflected possible nutrition and physical activity behaviours. Intervention content and delivery occurred in a standardised, consistent manner between cohorts using facilitator session checklists and specific, structured guidelines for both group and telephone sessions (appendix 1). Families were provided with standardised handouts of all program materials to refer to during and in between sessions. To avoid contamination between P and P+DA, which both received the parenting program parenting sessions but had varying focus on the lifestyle material, the parenting sessions were delivered separately.

## **2.4.6 Data Collection**

Baseline data collection occurred prior to randomisation with outcome measures assessed at intervention completion (6 months) for subjects in the study intervention groups and at 12 months after baseline for all subjects. At each data collection point, children and parents attended a 60 to 90 minute measurement session between 7.00 and 8.30am.

Parents were instructed that children were to consume no food or fluids (except water) from midnight the previous night with fasting status confirmed on arrival. The same procedure was followed at all data collection points using a standardised form (appendix 5.2). Data collection was performed by the same trained assessor (100% baseline and 6 months, 93% 12 months) who was blinded to group allocation. Flexible appointment times (eg an afternoon appointment without blood collection), home visits and parent-measured packs (2 packs posted and 1-2 reminder calls made) were utilised to maximise follow up at 12 months focusing on anthropometric and questionnaire data. Parents received a letter summarizing their child's blood and anthropometric results and change in weight status at 6 and 12 months. Reference ranges and/or relevant study aims were also highlighted.

### *2.4.6.1 Demographic information*

At baseline an 18-item demographic questionnaire was completed as part of the Child Health Questionnaire (appendix 5.3, refer to section 2.4.6.9). Items covered parent characteristics (gender, age, ethnicity, relationship to child and health status), family structure (marital status, number of children in the family), child health issues and postcode. Additional child demographic characteristics were collected as part of the information required to determine BMI z score (child age and gender).

Socioeconomic status (SES) was assessed using the Socio Economic Index for Areas (SEIFA) indices for postcode (223). SEIFA indices are validated measures of geographical SES derived using principle component analysis from the 2001 census of population and housing (223). The SEIFA indices consist of 4 related domains; advantage (high scores indicate, high income, skilled labour); disadvantage (low scores indicate; low income, education,

high unemployment and unskilled labour); economic resources (high scores indicate high income, family expenditure, wealth); and education (high scores indicate high education and skilled occupation structures) (223). Indices are standardised to have a mean of  $1000 \pm 100$ , with 95% of index scores falling between 800 and 1200 (223). SEIFA indices are an appropriate population measure of SES but should not be used at the individual level (223).

#### 2.4.6.2 *BMI z score*

Height and weight were measured with children lightly clothed and without shoes. Height to the nearest millimetre was measured with a Trumeter™ stadiometer (Manchester, UK) and weight to the nearest 0.1kg with SECA™ (Hamberg, Germany) or AND™ FV-150K electronic scales (Thebarton, South Australia). BMI ( $\text{kg/m}^2$ ) was calculated as weight in kilograms divided by height in metres squared and the subject's gender and decimal age BMI z-score calculated using UK reference data provided as a computer program (Child Growth Foundation, London UK) (215). For categorical analysis, subjects were classified as non-overweight, overweight, obese or severely obese using BMI age and gender specific cut-points recommended by Cole and colleagues (2000) based on BMI z score equivalent to a BMI of  $<25$ ,  $\geq 25$ ,  $\geq 30 \text{kg/m}^2$  or  $\geq 40$  at age 18 respectively (1, 20).

#### 2.4.6.3 *Waist circumference z score*

Waist circumference was measured against the skin or over light clothing with subjects in a standing position, midway between the tenth rib and the iliac crest using a non-elastic flexible tape and recorded to the nearest millimetre (224). Waist circumference was converted to a gender and age-specific z score using UK reference data (27). For categorical analysis, subjects were classified as centrally overweight or obese if their waist measurement exceeded the 91st or 98th percentile (waist circumference z scores 1.33 or 2.00) respectively (28).

#### 2.4.6.4 *Height z score*

The impact of the interventions on growth was assessed. Height in centimetres was converted to a gender-specific height-for age z score using EpiInfo™ (Version 3.2.2, CDC, Atlanta, United States). The CDC 2000 growth chart reference population was used which is nationally representative data from the 1977-1994 US national health surveys (214).

#### 2.4.6.5 *Blood collection and analysis*

Five to 10ml of blood was collected via venipuncture using standard procedures and aliquots placed into vacuette tubes as per laboratory protocol (FE Sodium Fluoride/EDTA K3 coated for glucose analysis, LH Lithium Heparin coated for lipid analysis, Z serum clot activator coated followed by plasma extraction for insulin analysis preparation).

Blood analysis occurred within 6-8 hours except for insulin, where plasma samples were stored at minus 70°C for up to eight months prior to transfer and batch analysis (within 48 hours) in Sydney. Blood lipid, glucose and insulin analyses were undertaken in laboratories participating in the RCPA-AACB chemical pathology quality assurance program. Fasting glucose, total cholesterol (TC), high density lipoprotein (HDL-C) and triglyceride (TG) were determined using a Synchron CX5 Pro analyser (Beckman Coulter Inc, Fullerton, USA) in the Division of Laboratory Medicine, Women's and Children's Hospital, Adelaide. Low density lipoprotein (LDL) was calculated using the Friedewald equation as  $\text{Cholesterol} - (\text{HDL-C} + \text{TG}/2.2)$  (225). Fasting serum insulin was measured in the Department of Endocrinology Royal Prince Alfred Hospital, Sydney by radio-immunoassay using the Linco Human Insulin Specific Assay Kit (Linco Research Inc, Missouri USA).

#### 2.4.6.6 *Blood pressure*

Blood pressure was measured on the right arm using a Dinamap™ automated blood pressure monitor (GE Healthcare UK). A variety of cuff-sizes was used (most commonly small-adult) to ensure that the length of the bladder completely encircled the arm and the width was at least two-thirds the length of the upper arm (226). A single measurement was taken after supine rest for 10 minutes following collection of the blood sample (226).

#### 2.4.6.7 *Defining metabolic syndrome*

Biochemical parameters and blood pressure were converted to categorical variables to determine prevalence of cardiovascular risk factors (Table 2.4). Metabolic syndrome was defined as the presence of insulin resistance, indicated by fasting hyperinsulinaemia and at least two other abnormal variables for waist circumference, raised TG, low HDL-C or raised SBP.

#### 2.4.6.8 *Body dissatisfaction*

The Children's Body Image Scale (CBIS) was developed by Truby and colleagues in Australia to assess body size perception and body size satisfaction in pre-pubertal 7-12 year olds (227). Children choose a photo image representing their perceived body figure and their desired body figure (appendix 5.4). Body dissatisfaction is calculated as the discrepancy between perceived and desired body figure. CBIS validation with 153 7-12 year old Victorian children (range of BMI) showed high construct validity ( $r=0.47$  girls  $p<0.001$  and  $r=0.51$  boys,  $p<0.001$  perceived body figure;  $r=-0.64$  girls,  $r=-0.56$  boys  $p<0.001$  desired body figure). There was a moderate negative correlation between body dissatisfaction and a validated measure of body esteem ( $r=-0.20$  to  $-0.86$ , all  $p<0.05$ ) and for girls above 8 years of age the CBIS negatively correlated with measures of disordered eating ( $r=-0.35$  to  $-0.45$ ,  $p<0.05$ ) (227).

Advantages of the CBIS tool to assess body dissatisfaction include, 1) it uses a figure rating scale previously shown to be valid and reliable for assessment of body image in older children and adolescents, 2) it correlates with tools assessing disordered eating and actual BMI, 3) it uses actual photos of known BMI across normal variation of BMI in Australia, 4) it is administered in a developmentally appropriate manner via an interview process minimising reliance on verbal fluency and 5) it consists of only 3 items making it quick and simple to administer. Limitations of the CBIS tool include 1) repeatability for this tool has not been assessed (although repeatability has been established in similar tools), 2) while the distances between scores are equal, these do not equate to equivalent distances between BMI percentiles and 3) the CBIS presents a range of BMIs but those at the extremes and therefore the BMIs for an overweight population are not extensively represented.

This may result in an under-estimation of body dissatisfaction. However no tool assessing body dissatisfaction has been developed or validated specifically for use with overweight children.

#### Validation for use of the CBIS tool in overweight children

When the CBIS tool was developed by Truby and colleagues, 2 single-items (Do you think your body is too thin/too fat? and Would you like to be a little thinner/much fatter?) were used to assess the construct validity of the CBIS tool in a community sample (227). These 2 items were included in the CBIS interview in the present study at baseline measurements. This provided a means of assessing the construct validity of the CBIS tool in an overweight sample. Construct validity was assessed using Pearson's correlation to compare the CBIS figure scale discrepancy measure of body dissatisfaction with the 2 verbal items asking about perceived and desired body image. Differences in tool validity by gender and for children less than 8 compared to  $\geq 8$  years as performed by Truby et al were also examined (227). Given that the actual BMI of the CBIS figures are known, it was also possible to assess the ability to use the CBIS tool for overweight children to estimate or report their BMI or body size. This was examined using Pearson's correlation to compare perceived body size (eg chosen CBIS figure when asked which their body most looked like) and actual body size (ie measured BMI converted to the percentile range given).

#### Administration and scoring

Children completed the CBIS via a standardised interview process (227). Questions were read to children individually in a quiet room without parents present. The interview was structured such that children could clarify questions and built in prompts were used to check children understood the task and that their answers accurately reflected their feelings. Following adequate time and repeating the question children were able to not answer. Children were asked to identify the body figure most like their own (perceived body figure) and which figure they would most like to have (desired body figure) with the discrepancy between these calculated (perceived-desired discrepancy). As is convention, the nominal data were treated as scale data presenting means and standard deviations and parametric statistics were used (227).

#### 2.4.6.9 *Health-related quality of life*

##### Child Health Questionnaire

The Child Health Questionnaire (CHQ) measuring child HR-QOL was developed as part of the Child Health Assessment Project conducted in the United States (222). The CHQ includes 13 child-specific health concepts derived from the literature, focus groups and interviews with parents and children (222). It has been established as a reliable, valid and discriminative tool in population and clinical samples of children in multiple countries, including overweight populations (222). For children aged 6 to 9 years, the CHQ is completed by parents as children are not able to accurately self-report at this age (appendix 5.3).

At the time of instrument choice, the CHQ was the only measure of child HR-QOL that had been adapted and validated for use in the Australian setting with normative population data available. The Authorised Australian Adaptation CHQ is a 50-item parent report survey (CHQ PF50) with responses measured on 4-6-point Likert scales (222). The CHQ assesses parents' perception of child health, impact on parents and family functioning. There are 2 single item scales and 11 multi-item scales (Table 2.5).

Validation in the Australian setting shows high four to six week test-retest (ICC 0.47-0.82) and item internal consistency (>88% multi-item scales Cronbach alpha greater than 0.4). The tool shows excellent discriminate validity (8/11 multi-item scales correlating perfectly with their own rather than other scales) (72, 222, 228). Tool limitations include 1) significant ceiling effects, 2) the summary scores are not valid in the Australian setting and 3) it is only a measure of parent perception of child HR-QOL which may vary from the child's perception (72, 222, 228).

## Administration and scoring

Parents completed the CHQ PF50 as part of a batch of written questionnaires completed by parents at each data collection point (appendix 5). Parents were provided with verbal and written instructions for standardised completion of the CHQ PF50 with questionnaires checked for missing items. Questionnaires were coded (including recoding and recalibration) and scored as per the CHQ Australian Authorised Adapted interpretation guide (222). Raw scores for the 13 scales were transformed to range between 0-100 with a higher score indicating better health and functioning (Table 2.5) (222). Summary scores (psychosocial and physical) were not calculated as these have been shown to be unreliable and invalid in the Australian setting (222). As proposed by Sawyer and colleagues some of the CHQ scales were altered to better reflect the items comprising each scale, with similar scale items grouped under sub-headings 'physical functioning', 'psychological functioning' and 'impact on parents and family' (229).

### 2.4.6.10 *Process evaluation - attendance*

Parents were asked to check off their names upon arrival at sessions with the facilitator verifying participant numbers. For the P group there were a total of 11 sessions with the P+DA group total number of sessions being 18 due to the 7 additional sessions they attended for lifestyle education and support (Table 2.2). Program attendance is a rough measure of the dose or intensity of exposure to the program. Attendance may impact on outcomes but is also a measure of program acceptability.

Program attendance was arbitrarily categorised to be good if 75% or more of sessions were attended, fair if 50-74% of session attended and poor if participants attended less than 50% of sessions. Good attendance at 75% attendance was chosen to have enough people in the group to perform the per protocol analysis and allowing for real life situation that over 6 months it is likely a few sessions would be missed. Attendance was compared between the 2 intervention programs.



#### *2.4.6.11 Process evaluation - satisfaction*

Parent satisfaction with the study groups was assessed using an anonymous 16 item satisfaction questionnaire adapted from Sanders and colleagues (appendix 7.5) which has high internal consistency ( $\alpha=0.96$ ), item total correlation ( $r= 0.66$ ) and inter-item correlations ( $r=0.30$  to  $0.87$ ) (230). Adaptations for the current study included relating questions to a child weight management study rather than a general child behaviour management program and the addition of questions relating to lifestyle change and perceived barriers to program attendance and implementation. Parents in the two intervention groups completed the same questionnaire with parents in the wait-listed control group completing an adapted version focusing on satisfaction with study allocation and lifestyle changes made during the wait list period. Likert scale, yes/no and multiple choice responses were entered into SPSS and summarised as frequencies. Open-ended questions were coded under appropriate themes and summarised as frequencies.

#### *2.4.6.12 Impact evaluation – health behaviours*

Changing energy balance or weight via a reduction in energy intake and/or increased energy expenditure requires a change in the intermediate health behaviours; food intake and physical/sedentary activity. It is therefore important to assess whether changes in health behaviours occurred in line with intervention objectives or recommendations, and if so to what degree. Food behaviours were assessed using a 54-item parent completed FFQ questionnaire developed for this study (appendix 5.3). It was based on assessing intake compared to the intervention objectives (Table 2.1). Parents directly estimated intake of the 5 core AGHE food groups (section 2). Intake of extras was estimated from the FFQ items in section 1.

Validation of this tool assessing children's intake according to the AGHE core food groups is detailed in appendix 4. In summary there was a weak-moderate correlation between serves of the core food groups (apart from vegetables) assessed using the questionnaire or via 4 24 hour food record. However parents tended to overestimate food group intake using the questionnaire compared to the food records.

Activity health behaviours were assessed using a parent report 20-item questionnaire with questions relating to both physical and sedentary activity (appendix 5.4). The focus was on key areas covered in the interventions eg child's use and frequency of 'screen' appliances such as television and computer games, mode of transport to school and how their child spends their time after school (Table 2.1). The activity inventory is not a validated tool and aimed to describe how parents perceived they implemented the program goals and objectives rather than estimating energy expenditure.

#### *2.4.6.13 Impact evaluation – parental competency*

Promoting parenting competency, or a parents capacity and confidence to be responsible and independent in managing their child's behaviour is a key objective of Triple P used in the study intervention programs (190, 198). The 16-item 'Parenting sense of competency scale' (PSOC, appendix 7.3) was used to assess parents' views of their competence as parents on two dimensions; 1) parenting satisfaction (extent of parental frustration, anxiety and motivation); and 2) parenting efficacy (problem solving ability and capability in the parenting role) (231). The total score shows a satisfactory level of internal consistency ( $\alpha=0.79$ ) (231). Normative data is available with the values from mothers of 7 to 9 year olds used as they most closely fit the profile of the study population (231).

#### *2.4.6.14 Impact evaluation – parental weight status*

Parental weight status was used as a proxy to assess if the intervention objective 'to take a family approach to child weight management' was achieved. This was based on the assumption that changes in family lifestyle behaviours could be expected to change energy balance in other overweight family members (154, 178, 232, 233).

Both parents were requested to attend data collection sessions. Measurement of parental height, weight and waist circumference was undertaken using the same equipment and protocol detailed for children in section 2.4.6.2 and 2.4.6.3. If a parent was unable to attend the sessions, instructions to measure these variables at home were provided. Parents' weight status was classified by recognized standards of  $BMI \geq 25 \text{kg/m}^2$  indicating overweight and  $\geq 30 \text{kg/m}^2$  classified as presence of obesity (1).

## **2.5 Data analysis**

### **2.5.1 Sample size calculation**

Sample size calculation was based on clinical relevance and the impact of reduced weight velocity with growth on adiposity levels (details in section 2.3.5). The fall in BMI z score reflecting a weight gain of only 50% of that expected over 12 months was estimated to be between 0.26 and 0.58 depending on age, initial degree of overweight and height (Anthea Magarey, 2002 personal communication). The standard deviation for BMI z score of overweight 6 to 9 year olds (BMI z score <3.0) in the National Nutrition Survey was 0.49 (208). A sample size of 28 per group would have 80% power to detect a difference in mean BMI z score from baseline of  $0.26 \pm 0.49$ , assuming no change in the waitlisted children, at two-sided significance level 0.05. Drop-out rates in previous child weight management studies have ranged between 10-50% (140). Therefore to accommodate a drop-out rate of up to one-third 42 children per study group were sought (N=126).

### **2.5.2 Data handling and management**

Data was recorded on standardized forms with subject identification numbers and checked for completion. Data sheets and personal information were stored separately in locked filing cabinets. Data entry and analysis were undertaken using SPSS for Windows version 11.5 (SPSS Inc, Chicago). Raw data was single input entered with data entry accuracy and outliers checked visually using frequency and extreme value analysis and cross checking with original data sheets. Calculation of BMI and BMI z score were performed twice. Computation of categorical variables and final questionnaire scores were performed in SPSS.

## 2.5.3 Data Preparation

### 2.5.3.1 *Data normality*

Baseline data was visually assessed for normality using frequency histograms. Anthropometric, biochemical, blood pressure and PSOC measures were considered normal therefore means and standard deviations were reported and parametric statistics employed. Parametric statistics were also used for CBIS nominal data as per convention (227). Health behaviour data (dietary and activity data) were not normally distributed, but examination of variable residuals found them to be normally distributed. Therefore median and interquartile ranges are given, however the normal residual distribution meant that the effects of group and time could be assessed using a parametric model (see section 2.5.4.2 below). Six of the 13 CHQ PF50 items were skewed to the left, therefore median and interquartile ranges were reported. CHQ item residuals were also not normally distributed and could not be made so through log transformation. Therefore non-parametric statistics used for analysis.

### 2.5.3.2 *Potential covariates*

Potential covariates were identified from the literature and were measured at baseline (weight status, growth, gender, parental weight status, ethnicity, age, socioeconomic status). Randomization was used to distribute potential covariates evenly between study groups. Stratification was undertaken by gender to ensure equal numbers of boys and girls in each group and by wave of recruitment to limit sampling bias. Management of covariates via randomisation was checked using two-way Analysis of Variance (study group and gender) or Chi Square to test for differences in baseline characteristics by treatment group. For weight change studies it is important to have baseline values of the dependent variable included in the statistical model as individual variation in response to treatment is influenced by the magnitude of weight change and baseline levels (eg initial BMI, BMI z score or height) (24). However as discussed in 2.5.4.2 below, individual variation is included in the model chosen for analysis, therefore it was not necessary to include baseline values for the dependent variable when testing for effects of group or time.

## 2.5.4 Primary analysis

### 2.5.4.1 *Intention to treat analysis*

Primary analysis was by intention to treat to minimise the risk of a type 1 error by maintaining randomisation and to maximise generalisability to the clinical or health service delivery setting (234, 235). All subjects were included in the analysis according to original group allocation, with no subjects excluded from analysis because of false inclusion, poor program attendance or missed follow up sessions (235). To assess potential follow up bias, the amount and pattern of missing data was explored using separate variance t tests comparing quantitative outcome variable means by presence or absence at follow up (235). Incomplete cases were included in order to minimise the risk of a type 1 error, and maintain data variability. Missing data was not imputed as imputed data or complete case analysis leads to underestimation of the data variability due to regression to the mean and often incorrectly assumes no change in control groups (25). Management of missing data was achieved through use of a statistical model which allowed subject data from baseline, 6 and 12 months to be included for analysis regardless of whether they attended follow up (see 2.5.4.2 below) (25).

### 2.5.4.2 *Linear mixed model analysis*

The method of analysis needed to cater for multiple measurements in the same individuals and be able to model time trends. Analysis of repeated measures data requires management of; missing data, unequal correlation between time points, baseline differences between groups and covariates. End point, change scores (ANOVA/ANCOVA) or RM ANOVA are commonly used to manage these issues, but all have limitations (Table 2.6) (236, 237). Linear mixed model analysis (mixed effects, random coefficients analysis) is a hierarchical (2-level) regression model that structures data in a way that considers subject and observational structures with the ability to handle both the between- and within- subject variability (238). In the 2-stage model, regression co-efficients are initially developed for each individual subject. These subject-specific regression co-efficients are then used as random outcome variables with estimation and testing for subject and observation effects performed using maximum likelihood inference (25, 237).

Linear mixed models allow inclusion of subjects with missing values at some time points and are preferable to simple imputation methods (eg last observation carried forward or complete case analysis). Linear mixed models have equivalent advantages to complex imputation methods, maintaining data variability and managing any type of missing data (25, 237). Time trends can be modelled (using range of shapes), covariates are managed and most importantly linear mixed modelling does not assume equal correlation between time points. Estimations are made on individual trends which are assumed to vary, producing an unbiased estimate of treatment effect. Therefore linear mixed modelling meets all the requirements for analysis of repeated measures data (Table 2.6) (25, 237). Non-normally distributed data can be analysed using linear mixed modelling, provided the residuals are normally distributed. Linear mixed modelling has also been found to have the best power to detect treatment differences (237).

Potential limitations associated with linear mixed model analysis include 1) inclusion of unnecessary covariates may bias the tests and 2) due to complexity of the model, assumption violations are harder to assess which may lead to erroneous conclusions (238). Linear mixed model analysis is increasingly being used for analysis of repeated measures data. It was documented as the analysis method in 30% of papers analysing repeated measured data in the Journal of Psychology, 1999-2001 compared to 0% in 1989 (237).

All data (apart from CHQ items) were found to have normal distribution and equality of variance of residuals. No assumptions were made about the covariance pattern (unstructured). A (full factorial) linear mixed model including time, group and their interaction was used to determine whether there was a significant time by group effect at 6 and 12 months. When group by time interactions were non-significant, average intervention effects of the follow-up period were estimated. Post hoc analysis was performed on significant interaction or main effects terms using the Bonferroni method.

#### 2.5.4.3 *Non-parametric analysis, CHQ PF50*

No non-parametric equivalent was available which could manage missing data, therefore CHQ PF50 analysis was performed using complete cases only, n=91. Mann Whitney or Kruskal Wallis was used to compare continuous variables by gender and study group at baseline. Group effects were examined at 6 (Mann Whitney) and 12 (Kruskal-Wallis) months, with time effects assessed using multiple t tests stratified for group allocation (with Bonferroni corrections made for multiple testing with significant level set at  $p < 0.02$ ). The only exception was for the comparison with normative data which is presented as mean (SD) and compared via t test.

#### **2.5.5 Secondary analysis – per protocol**

Analysis using linear mixed modelling was also performed 'per protocol' to assess intervention efficacy rather than effectiveness. For the per protocol analysis attendance to program sessions was used as a proxy for intervention compliance. Thirty-seven subjects whose parents attended  $\geq 75\%$  program sessions (18 P, 19 P+DA) and the 36 subjects allocated to the wait-listed control group were included in this analysis (n=73).

## Chapter 3 Primary study results – changes in adiposity

This chapter describes the characteristics of study participants and their flow through the study using the Consolidated Standards of Reporting Trials (CONSORT) statement (239). The CONSORT statement was developed to facilitate transparent reporting of the design, conduct, analysis and interpretation of randomised controlled trials. The framework facilitates consideration of any strengths, weaknesses and potential bias in studies and reporting of how these are managed (239). The anthropometric outcomes from the study are then presented. These include the primary study outcome BMI z score as a measure of overall adiposity, and the secondary outcome waist z score as a measure of truncal adiposity. The interaction between group (P, P+DA, WLC) and time (0, 6, 12 months) is examined, with main effects of group and time examined when the interaction is not significant.

### 3.1 Flow of participants through the study

Forty-two percent of children whose parents enquired about the study, completed baseline assessment and underwent group allocation (Figure 3.1).

#### 3.1.1 Subject enrolment

Seventy-six of 111 families were recruited via local newspapers, school newsletters and television coverage (Table 3.1). One hundred and fifty-one children were excluded from participating in the study at either the phone or medical screen based on age (48), weight status (17), pubertal stage (3) and medication (1); or they declined to participate secondary to the program not being suitable (23), family being too busy (9), not attending baseline (4), unhappy with blood collection (2) or other/unknown reasons (44). There were no significant differences between children who did or did not enrol in the study by indicators of socioeconomic status (all SEIFA indices  $p > 0.05$ , data not shown), age (enrolled,  $n=111$   $8.3 \pm 1.2$  versus not enrolled,  $n=114/151$   $8.5 \pm 1.9$  years,  $p=0.36$ ) and BMI at screening ( $n=111$ ,  $24.3 \pm 2.6$  versus  $n=69/151$ ,  $25.3 \pm 4.6 \text{ kg/m}^2$ ,  $p=0.10$ ). Families who enquired about the study were less likely to enrol if their child was male (66/106) than if the child was female (43/112,  $p < 0.001$ ).



### **3.1.2 Group allocation**

Figure 3.1 shows the number of subjects allocated to each of the three study groups. Comparing subject characteristics at baseline with the study inclusion and exclusion criteria (see section 2.3.2), 15 false inclusions were identified (7 outside weight criteria; 3 over 10 years; 2 receiving medication influencing weight; 3 families failed to attend any intervention sessions). False inclusions were secondary to changes in subject characteristics between study screening and baseline.

### **3.1.3 Intervention session and follow up attendance**

Attendance at the intervention program sessions and follow up measurements 6 and 12 months after baseline is summarised in Figure 3.1 (Note. For simplicity tables and figures only provide total n values at each time point. Readers are referred back to Figure 3.1 for the number of subjects analysed at each time point by study group). Further details on program attendance are presented in section 5.2.1. Eleven families did not attend any follow up. Families were not seen at 6 month follow up due to; family too busy (5), research staff unable to contact (7), felt weight was not an issue (1), child did not wish to be weighed (3) or family found program irrelevant (2).

Twelve month measures were not completed as; program/study irrelevant (2), child did not wish to be weighed (3), unable to attend morning follow-up session (2), family being too busy (2), family moved interstate (2), researchers unable to contact (9). There were no significant differences between those who did and did not attend 12 month measurements by cohort ( $p=0.66$ ), group allocation ( $p=0.82$ ), gender ( $p=0.94$ ), mothers weight status ( $p=0.38$ ) and indicators of socioeconomic status (all SEIFA indices  $p>0.05$ ). Those who did not attend 12 month follow up were older at baseline ( $8.7\pm 0.9$  versus  $8.2\pm 1.2$  years,  $p=0.04$ ) and had a higher BMI z score ( $2.96\pm 0.44$  versus  $2.71\pm 0.53$ ,  $p=0.04$ ) and waist circumference z score ( $3.54\pm 0.64$  versus  $3.14\pm 0.64$ ,  $p=0.04$ ) than those who did attend.

## **3.2 Participant characteristics at baseline**

### **3.2.1 Family and sociodemographic characteristics**

The average age of the parent completing the study questionnaires at baseline (96% were mothers) was  $38.5 \pm 0.6$  years with 93/111 born in Australia. Eighteen parents were immigrants from the United Kingdom (9), other Caucasian populations (7) and Asia (2). Ten of the 18 parents who had migrated to Australia had lived in Australia for more than 20 years. Eighty-two/111 mothers (74%) and 64/76 (84%) fathers were classified as overweight ( $BMI \geq 25 \text{ kg/m}^2$ ) or obese ( $BMI \geq 30 \text{ kg/m}^2$ ).

Indicators of socioeconomic status and family structure are shown in Table 3.2. The mean values of study participants for SEIFA indices of economic advantage and resources were between the South Australian 50-75<sup>th</sup> percentiles, with the study population mean education index at the 75<sup>th</sup> percentile (223). The median size of study families was 2 (IQR 2; 3) children. Female subjects were more likely to come from single parent families (34% girls versus 15% boys,  $p=0.04$ ) but this did not differ by group allocation. There were no differences at baseline by child gender or study group for parental age, SEIFA indices or number of children per family.

### **3.2.2 Child characteristics**

Child characteristics and differences by gender at baseline are shown in Table 3.3. The majority of subjects were female, over eight years of age (75/111) and obese. There were no significant differences by group allocation for any baseline demographic characteristic or potential covariate by group allocation including age ( $p=0.33$ ), anthropometric variables (height z score  $p=0.08$ ; BMI z score  $p=0.62$ ; waist z score  $p=0.95$ ) and socioeconomic status (all SEIFA indices,  $p > 0.80$ ).

### **3.2.3 Characteristics by recruitment cohort and study site**

Subject recruitment and randomisation was conducted over 4 cohorts each with its own randomisation schedule. The intervention programs were run twice at each study site. Cohorts 1 and 3 were recruited to and received the intervention at Flinders Medical Centre. Cohorts 2 and 4 participated in the study at the Women's and Children's Hospital (details in section 2.4.1). Table 3.4 shows baseline anthropometry, socioeconomic status and family characteristics by study site. There was no significant difference in parents marital status by study site ( $p=0.18$ ).

There were no significant differences in children's age ( $p=0.44$ ), height z score ( $p=0.35$ ), BMI z score ( $p=0.17$ ), waist z score ( $p=0.61$ ) or parental BMI ( $p=0.09$  mother,  $p=0.26$  father) by study cohort. There were significant differences by cohort for parent's age (cohort 4  $34.3\pm 8.6$  years compared to cohort 1  $41.3\pm 4.1$  years,  $p<0.01$  and cohort 3  $39.1\pm 6.4$  years,  $p=0.02$ ). Indicators of socioeconomic status were significantly lower for families in cohort 2 versus cohort 3 (advantage  $971\pm 78$  versus  $1026\pm 73$ ,  $p=0.02$ ; disadvantage  $982\pm 94$  versus  $1042\pm 62$ ,  $p=0.02$ ; resources  $963\pm 62$  versus  $1004\pm 55$ ,  $p=0.03$ ; and education  $976\pm 81$  versus  $1031\pm 78$ ,  $p=0.02$ ). However as shown in sections 3.2.1 and 3.2.2, randomisation stratified for recruitment cohort resulted in no significant differences in baseline subject characteristics by study group.

## **3.3 Primary study outcome – overall adiposity**

### **3.3.1 BMI z score by intention to treat analysis**

Table 3.5 shows the mean $\pm$ SD for weight, BMI and BMI z scores by study group at baseline, 6 (end of intervention) and 12 months after commencing the study. Analysis for differences by group and over time were performed on BMI z score as a height, age and gender adjusted measure of overall adiposity (refer to section 1.2.2). Over 12 months the mean BMI z score reduced by 9% (range -85 to +18%) in the P+DA group, 6% (range -48 to +49%) in the parenting alone group and 5% (range -78 to 16%) in WLC group.

However the model for the group by time interaction was not significant ( $p=0.76$ ). This indicates that the reductions in BMI z score over time were not statistically significantly different between the study groups (Figure 3.2). The mean difference in BMI z score for all study subjects was lower at 6 (-0.14, CI -0.03;-0.25,  $p=0.01$ ) and 12 months (-0.18, CI -0.07;-0.29,  $p<0.01$ ) compared to baseline but not significantly different at 12 compared to 6 months (-0.03, CI -0.15 to +0.09,  $p=1.0$ ).

Forty-eight percent of children waitlisted for intervention (WLC) increased their BMI z score over 12 months compared with 24% and 19% in the P and P+DA groups respectively (Table 3.5,  $p=0.03$ ). Two children (1 each from P+DA and WLC) shifted from overweight to non-overweight over 12 months. There was a decrease in the percent of obese children but this was not significantly different between time points or study groups (Table 3.6).

### **3.3.2 BMI z score by gender**

There was a different pattern for BMI z score over time between boys and girls by group allocation (Figure 3.3). The interaction between time and group with gender as a covariate was significant ( $p=0.04$ ). However posthoc analysis of this significant interaction was not performed due to power limitations given there were less than 13 boys in each study group at 12 months follow up (Figure 3.1).

### **3.3.3 BMI z score by per protocol analysis**

Overall significance of the results obtained by intention to treat analysis (section 3.3.1) did not change when a completers or 'per protocol' criteria was used (ie families attending  $\geq 75\%$  of program sessions, Table 3.7, see section 2.5.5).

### **3.4 Truncal adiposity**

#### **3.4.1 Waist circumference z score by intention to treat analysis**

Table 3.8 shows mean waist circumference and waist circumference z scores at baseline, 6 months (end of intervention) and 12 months after commencing the study. Waist circumference z score was a secondary outcome and is an age and gender adjusted measure of truncal adiposity. Waist circumference z score was significantly different between boys and girls at baseline (Table 3.3), so gender was entered as a covariate. There was a significant interaction for group by time with gender ( $p=0.03$ , Figure 3.4) and for group by time ( $p=0.02$ ). The main effects of group, time and gender are not presented as post hoc analysis was performed on the significant interaction term group by time (without gender given the limited number of boys per group at 12 months).

Waist circumference z score was significantly lower at 12 months compared to baseline in both intervention groups (P+DA and P), but not WLC (Table 3.8). Waist circumference z score was also significantly lower at 12 versus 6 months for the P+DA group only (Table 3.8). At 12 months the mean difference in waist circumference z score was -0.32 (CI +0.12; -0.76) P+DA versus WLC, -0.19 (CI +0.24; -0.63) P versus WLC and -0.13 (+0.31; -0.57) P+DA versus P (all  $p>0.05$ ).

#### **3.4.2 Waist circumference and waist circumference z score by per protocol analysis**

Overall significance of the results obtained by intention to treat analysis (section 2.5.5) did not change when a completers or 'per protocol' criteria was used (ie families attending  $\geq 75\%$  of program sessions, Table 3.9).

### **3.5 Discussion**

This chapter described the study sample, their flow through the study and anthropometric results at baseline, 6 and 12 months. Subject's parents participated in one of two 6-month interventions (parenting alone or parenting plus intensive lifestyle education) or were waitlisted for intervention for 12 months. Both intervention programs were compared to waitlisting and a comparison between the two interventions was also undertaken. This was to determine the effectiveness of the family-focused child weight management interventions compared to no intervention, and to explore the relative importance (or interdependence of) lifestyle education versus parent-led child behaviour modification (see hypotheses section 1.8.3). The primary study outcome was BMI z score as an age, gender and height-adjusted measure of overall adiposity (19, 23). Waist circumference z score was a secondary outcome and is an age and gender-adjusted measure of truncal adiposity (19).

#### **3.5.1 Key findings**

BMI z score was lower in all study groups at both 6 and 12 months compared to baseline when analysed in an intention to treat analysis. The 12 month reduction in BMI z score was similar between the parenting alone and wait listed control groups (average ~5%). The parenting plus intensive lifestyle education group had an average 10% reduction in BMI z score over 12 months, but this was not statistically significant compared to the parenting alone or 12 month waitlisted groups. However significantly more children in both intervention groups maintained or reduced BMI z score (22% parenting alone, 25% parenting plus lifestyle education) over 12 months compared to subjects waitlisted for intervention (16%). There were no significant changes in BMI z score between 6 and 12 months in any study group. This suggests that the reductions achieved during treatment, while not improved, were sustained in the 6 months following treatment (ie therapist contact had ceased).

For truncal, rather than overall adiposity, there was a significant reduction between baseline and 12 months for the parenting alone and parenting plus lifestyle education groups. This was not observed in the waitlisted group. There was also a significant reduction in truncal adiposity in the parenting plus lifestyle education group between 6 and 12 months, which was not observed in either the parenting alone or waitlisted study groups. The reductions in truncal adiposity were greater than the reductions in overall adiposity and sustained beyond the 6 month treatment phase. The further reductions in waist circumference z score between 6 and 12 months in the parenting plus lifestyle education group indicates the potential of the program to have treatment or maintenance reach beyond its 6 month duration.

Clear interpretation of the results in order to accept or reject the study hypothesis is complicated by the lack of between group differences secondary to the reductions in the wait listed group. This was not expected and may have affected study power (discussed further in section 3.5.3). While not statistically significant, there does appear to be a consistent pattern in the overall, and particularly truncal, adiposity results suggesting that parenting plus lifestyle education is an effective child weight management intervention compared to waitlisting for intervention for 12 months ie no intervention. This conclusion is supported by the change in BMI z score observed in the parenting plus lifestyle education group ( $-0.24 \pm 0.43$ ) which was similar to the estimated change, reflecting a clinically relevant change in overall adiposity over 12 months (discussed further in section 3.5.3). Results also suggest that the parenting plus lifestyle education intervention may be more effective than the parenting alone intervention, which does not consistently appear to be more effective that waitlisting for intervention.

Child weight management studies to date have tended to use percent overweight (weight for height) to assess changes in overall adiposity and truncal adiposity is not assessed. However, expression of overall adiposity using BMI z score or %BMI (% difference from median BMI) are the preferred methods for assessing adiposity change as they are height, age, gender-adjusted and relatively stable over time (23). BMI z score was used as the measure of overall adiposity in this study and therefore only limited comparisons to the current literature can be drawn.

Two 12 month RCTs from the same group have evaluated a child-focused family behavioural therapy weight management intervention in 8-12 year olds (147, 185). Initial BMI z scores (calculated from a US not UK reference population) were similar to the sample in the present study ( $-2.7 \pm 0.9$ ) with the 12 month difference in BMI z score  $-0.6 \pm 0.6$  to  $-1.3$  (no SD given) (147, 185). Only one other study has used an intervention model similar to that in the present study ie parent-led and family focused (165). In this Israeli study, the 12 month change in percent overweight (percent over 50<sup>th</sup> centile for weight) in the parent-led group was 39% (15% points) (161). So while difficult to compare, the reductions in overall adiposity in the present study ( $0.12 \pm 0.47$ - $0.24 \pm 0.43$ , 5-10%) appear to be moderate compared to either child-focused or parent-led interventions used in other studies. However the present study was conducted 'intention to treat', reflecting 'real life' service delivery, whereas the literature discussed here was analysed 'complete cases' only (3-23% drop out), which may overestimate treatment effect (234).

Only one published study has assessed changes in truncal adiposity. Conducted in the UK (n=11, 7-11 year olds, no concurrent control), this study piloted a 3 month comprehensive (mind, exercise, nutrition and diet) weight management program (240). There was a significant reduction in waist circumference between baseline and 6 months follow up ( $3.4 \pm 2$ cm, paired t test  $p < 0.05$ ) (240). At baseline the waist circumference z score was 1.9 (range 0.4-3.0) which is lower than for children in the present study. However, no comparisons can be drawn between this and the present study as waist circumference z scores were not analysed at 6 months.



BMI and waist circumference z score results were not altered when analysis was performed 'per protocol' using  $\geq 75\%$  attendance to interventions sessions as the proxy adherence measure. There are two conclusions that may be drawn from the observed similarity between the adiposity reductions by the 'intention to treat' and 'per protocol'. Firstly, results seen may not be related to participation in the child weight management program, occurring by chance or external influences. Secondly the results (lack of a difference to no intervention) may be influenced by intervention bias (eg poor intervention adherence) which will be discussed further in chapter 5.

### **3.5.2 Gender differences**

For both BMI and waist circumference z score, there was a significant interaction between group, time and gender. This indicates that the pattern of adiposity change over time and/or between study groups was different for boys and girls. Boys appeared to have a greater reductions in both overall and truncal adiposity over time, with these reductions only observed in the intervention groups (parenting plus lifestyle education greater than parenting alone). For boys in the waitlisted group, BMI and waist circumference z scores were stable or increased over time. This was the pattern expected in the waitlisted group, and was used in the sample size calculation (refer to section 3.5.3). However, sample size calculations were not sufficient to adequately power sub-analysis by gender so no post-hoc analysis of this interaction between group, time and gender were performed.

The different pattern between boys and girls was not expected, primarily as sub-analysis by gender has not been reported in the current literature base until after children pass through puberty. Differences in body composition between boys and girls are managed through methods such as those used in this study, randomisation stratification for gender. Only one study could be identified that has examined gender differences (241). Fifty-six children were randomised to interventions which had equal dietary (TLD) and behavioural/family support components, but varied in their activity components focusing on increasing activity (15 boys, 14 girls), or increasing activity and decreasing sedentary activity (14 boys, 13 girls) (241).

Boys were observed to have better reductions in percent overweight than girls in the combined group (-16 versus -1% points respectively,  $p < 0.05$ ), but not the increased activity only group. The authors explained these differences by suggesting that boys were more motivated to undertake physical activity and greater family compliance in families of boys. The effect of gender was not found to independently predict outcome and the authors propose that this was due to the higher motivation and compliance in families of boys moderating the gender effect observed (241).

The gender differences observed in the present study may be due to environmental or compliance differences by gender. However physiological gender differences may also play a role. Boys had a higher degree of truncal adiposity than girls at baseline which may influence their response to intervention. Secondly, recent data suggest that the increase in truncal adiposity, in Australian children is increasing more rapidly for girls than boys (242). There may be gender differences in the response to environmental influences promoting overweight making it harder for girls to reverse this trend. Study power limitations and outcome sensitivity may have also played a role. Overall, these gender differences are a unique observation, largely unexplored in the current literature. It appears that as for adults, males and females respond differently to interventions, with analysis or even interventions needing to be tailored for these differences even prior to puberty in children.

### **3.5.3 Study power and clinical relevance**

The mean difference in BMI z score between 12 months and baseline for the parenting plus lifestyle intervention was  $0.24 \pm 0.43$ . This result is similar to the difference used in the study sample size calculation ( $0.26 \pm 0.49$ ) which was based on a clinically relevant change (a 50% increase in weight of that expected) (refer to section 2.5.1). While significance testing was not performed on raw weight (as it is unadjusted for height, age and gender), weight appeared stable at 6 months in the parenting plus lifestyle group and the 12 month increase tended to be lower than that observed in the parenting alone or waitlisted groups. This is of clinical relevance as they demonstrate

that the goals commonly used in the clinical setting for child weight management were achieved in the parenting plus lifestyle group (15).

The lack of a statistically significant difference between study groups may have a number of explanations. The interventions may be no more effective than no intervention and/or the proposed clinically relevant expectation of only 50% weight gain for child weight management may be inappropriate (under-estimated). Based on the current literature, effective treatment in overweight and obese children may be expected to achieve a 10-30% point reduction in percent overweight in 12 months (refer to chapter 1) (141, 162)). Therefore in obese children, weight maintenance, or even weight loss, may be necessary. While, adiposity changes using only a reduction in weight trajectory may be theoretically appropriate, it may be difficult to maintain this long term perhaps secondary to a limited window of opportunity for treatment.

A final explanation is that the sample size calculation did not account for the observed reduction in BMI z score in the control group indicating the possibility of a type II error. It was reasonable to anticipate no change or even an increase in adiposity in the wait listed group as previous studies using a wait listed control have observed a 4-6% point increase in percent overweight over 12 months (149, 155, 187). Additionally, longitudinal Australian data have shown only a 4% rate of spontaneous resolution of overweight (34). The reduction in adiposity in the control group in this study may be explained by 1) the lack of services for overweight in Adelaide, 2) increased media coverage of this child health issue during the course of the study, and/or 3) high motivation levels in study volunteers. These factors, together with provision of brief written lifestyle information may have been sufficient to facilitate a non-significant reduction in adiposity over 12 months. This highlights that the waitlisted group was not a true 'no intervention' control despite efforts to limit intervention and therapist contact in this group. The results of this study highlight the difficulty and ethical issues of having true a 'no intervention' group in this area of research with 82% of children in WLC increasing BMI z score over 12 months.

### **3.5.4 Potential bias**

Subjects were recruited via multiple state-wide, community (non-clinical)-focused methods. There were no differences between children who did or did not enrol in the study apart from gender. Perhaps not surprisingly, the majority of children were from 'high risk' families in terms of parental weight status. Nearly three-quarters of mothers and over 80% of fathers were classified as overweight or obese. Families were otherwise similar to the population from which they were drawn. The majority were Caucasian and middle-upper class, with study population indicators of socioeconomic status similar to the standardised means by postcode in South Australia. The 111 children who completed baseline measures were mainly female (63%), obese (79%) and over 8 years of age (68%). Girls were more likely to be enrolled into the study than boys, perhaps indicating a source of selection bias secondary to cultural gender body image attitudes. However potential selection bias was effectively managed via random group allocation.

Children were recruited into the study over a 12 month period, targeting various areas of Adelaide within 10 km of the 2 intervention sites. The type of family recruited into the study did not change over the course (cohort) of recruitment. Children who participated in the study at the Women's and Children's hospital had a higher BMI z score, younger parents and lower scores for SES indicators than children undertaking the study through Flinders Medical Centre. However, there were no other differences in child age, height, waist circumference z score or parental BMI between study sites at baseline. Potential site bias was effectively minimised at the study design rather than analysis stage through use of separate allocation schedules by recruitment cohort (and therefore study site).

At baseline, there were no differences in parental, family or SES characteristics by child gender, apart from girls who were more likely to come from single-parent families. Boys were older, taller and heavier than girls. However after adjustment for height, age and gender BMI z score did not differ by child gender. Boys did have a higher degree of truncal adiposity even after adjustment for age and gender. Gender differences were minimised through study group allocation stratified for gender. There were no significant differences between study groups for any child, parental or family characteristics indicating randomization (stratified for gender and recruitment cohort) was successful in distributing potential confounders evenly between study groups (no allocation bias).

Follow up rates were 76% at 6 months. Eighty-two percent of the original 111 children recruited into the study were measured at 12 months. Drop out was even between the study groups. Twelve month drop out (18%) lies in the mid-range of drop out rates (10-50%) observed in other 12 month duration RCTs in the area of treatment of child overweight (140). Older children with a higher BMI and waist circumference z score were more likely not to attend 12 month measurements. While there did not appear to be any follow up bias, the pattern of drop out may have implications for study generalisability.

As the number of children failing to attend follow up measurements did not differ by group allocation, any potential bias is consistent across study groups and would not have affected between group differences observed. However children dropping out of the study at 6 and 12 months follow up were more overweight than children attending follow up, regardless of study group (refer to section 3.1.3). This has implications when interpreting changes observed over time. It makes it difficult to differentiate whether outcomes changes within study groups over time are true effects, or whether it in part reflects the more overweight or obese children dropping out of the study. Therefore, study results should be interpreted with caution given that more overweight children dropped out of the study which may be one factor influencing the outcomes changes observed within study groups over time.

### **3.5.5 Conclusion**

Randomisation managed potential bias increasing the confidence of the study findings. There was a tendency for 1) overweight girls, children over 8 years of age and middle-class, overweight families to volunteer for the study, 2) older and heavier children to drop out of the study and 3) a difference in the results observed for boys and girls. This may have implications for study generalisability. Younger children, particularly boys, who are overweight rather than obese may find the parent-led, family focused child weight management program evaluated in this study most useful. The families in this study were generally medium to high SES and therefore generalisability of this approach to lower SES groups is unknown. However the program is applicable to use in families where parents are overweight, important given parental weight status is a significant risk factor for child weight status.

Based on the adiposity results, parenting plus intensive lifestyle education is an effective weight management intervention for pre-pubertal 6-9 year olds, particularly for boys. Changes approximated clinically relevant difference in overall adiposity and reductions in truncal adiposity were also favourable. Effectiveness appears better than waitlisting for intervention for 12 months (no intervention) and the parenting alone intervention which did not have consistent differences in results across outcomes. These results favour the thesis hypothesis and also suggest that lifestyle education enhances use of behaviour modification/family support delivered using parenting skills training. In chapter 4, the changes in metabolic health and psychosocial indicators following participation in a parent-led, family focused child weight management program are examined to broaden the definition of intervention effectiveness.

## Chapter 4      Secondary study results - growth, metabolic profile and psychosocial health

The study definition of program effectiveness encompassed reductions in adiposity **together with** normal growth and stable or improved metabolic, psychosocial and overall health (refer to section 2.3.3). This chapter presents these broader non-adiposity child health outcomes assessed prior to and following parent participation in the interventions (P or P+DA), or being wait listed for intervention for 12 months (WLC). Given the limited data in young children, the prevalence of each health consequence is described for this sample of overweight 6-9 year old pre-pubertal children, where possible drawing comparison with a non-overweight community sample. Height z score, metabolic risk factors, body dissatisfaction and health-related quality of life are examined. The interaction between group (P, P+DA, WLC) and time (0, 6, 12 months) is examined, with main effects of group and time examined when the interaction is not significant.

### 4.1      Growth

Table 4.1 shows children's height and height z score at baseline, 6 and 12 months after commencing the study. The average increase in height over 12 months for all subjects was  $6.5 \pm 1.3$ cm ( $p < 0.01$ ) and this was not significantly different between study groups ( $p = 0.84$ ). There was no significant group by time interaction ( $p = 0.39$ ) or main effect of group ( $p = 0.10$ ) for height z score. This indicates that the increase in height z score over time ( $p < 0.01$ ) did not differ between study groups.

Post hoc analysis of the main effect time (regardless of study group) indicates that the mean height of the study sample increased more than that of the US reference population. This was observed at both 6 months (mean increase in height z score from baseline 0.16, CI 0.01; 0.31,  $p = 0.03$ ) and 12 months (mean increase in height z score 0.08, CI 0.02; 0.14  $p < 0.01$ ). The decrease in height z score between 6 and 12 months was not significant (0.08, CI -0.24; +0.07,  $p = 0.62$ ).

## 4.2 Metabolic profile

### 4.2.1 Metabolic data available for analysis

Table 4.2 shows the number of subjects providing a blood sample and hence n values for metabolic outcomes at baseline, 6 and 12 months. For simplicity, tables and figures provide total n values at each time point. Readers are referred to table 4.2 for the number of subjects analysed by study group (ie analysis was not by intention to treat principles). The majority of missing data was due to non-attendance at measurement sessions (n=18 6 months, n=19 12 months). Other reasons for missing data were; declining blood collection/blood pressure measurement, unable to obtain fasting blood sample or complete analysis. Metabolic syndrome could only be assessed for the children with complete metabolic variable data (101/111 baseline, 50/57 6 months, 71/91 12 months).

### 4.2.2 Baseline metabolic profile

The mean $\pm$ SD and prevalence of elevated metabolic risk factors for all subjects at baseline are shown in Table 4.3. Thirty-nine/101 children (39%) were classified with Metabolic Syndrome at baseline (defined as the presence of fasting hyperinsulinaemia and at least 2 other metabolic risk factors, see section 2.4.6.7). HDL-C was the only metabolic variable that was different at baseline by gender (1.4 $\pm$ 0.2 boys versus 1.3 $\pm$ 0.2mmol/L girls, p<0.01. Other gender data not shown). There were no significant differences at baseline by study group for fasting TC (p=0.53), LDL-C (p=0.71), HDL-C (p=0.89), TG (p=0.14) glucose (p=0.75), insulin (p=0.94), SBP (p=0.12) or DBP (p=0.69).

### 4.2.3 Lipids over time by study group

Table 4.4 shows the changes in lipid profile by study group with no significant group by time interaction for any variable. There was a significant increase between baseline and 12 months baseline for TC (mean difference 0.16 CI 0.04: 0.28mmol/L, p<0.01), LDL-C (mean difference 0.20 CI 0.09; 0.32, p<0.01) and HDL-C (mean difference -0.06 CI -0.11; 0.00) (Table 4.4 and Figure 4.1). Assessment of the main effects found that TG levels did not change over time (p=0.98) or differ between study groups at any time point (p=0.74).



#### **4.2.4 Blood pressure over time by study group**

Table 4.5 shows the mean $\pm$ SD for systolic and diastolic blood pressure at baseline and 6 and 12 months after commencing the study by intervention group. DBP significantly increased between baseline and six months (Figure 4.2) but this was not significantly different between study groups (interaction group by time,  $p=0.82$ ).

#### **4.2.5 Endocrine outcomes over time by study group**

Table 4.6 shows the mean $\pm$ SD for fasting glucose and insulin at baseline and 6 and 12 months after commencing the study by intervention group. There was no group by time interaction for fasting glucose and fasting insulin, both of which did not change over time or differ between study groups.

#### **4.2.6 Prevalence of metabolic risk factors and metabolic syndrome 12 months after commencing the study**

Prevalence of metabolic risk factors for children 12 months after commencing a child weight management study are shown in Table 4.3. Thirty/71 children (42%) were classified as having metabolic syndrome at 12 month follow up. The number of children with metabolic risk factors or metabolic syndrome did not change significantly during the study or differ between study groups.

### **4.3 Body size dissatisfaction**

#### **4.3.1 Validation of the children's body image scale (CBIS) in overweight children**

The CBIS tool was developed in Australia for use in pre-pubertal 7-12 year olds as a tool to measure child-reported body size perception and body size dissatisfaction (see section 2.4.6.8). Children are asked to identify a gender-specific body figure (representing a known BMI category) which firstly looks like them (perceived body figure) and secondly represents what they wish to look like (desired body figure). The discrepancy between the two figures chosen ranges from zero (ie satisfied with body figure) to  $\pm 6$  (degree of body dissatisfaction). The CBIS tool was used to assess body size dissatisfaction, but given this was the first time the tool was used in an overweight sample, its overall validity in this population was examined.

#### 4.3.1.1 *Body size perception*

The correlation between measured and perceived body figure was  $r=0.20$  ( $p=0.04$ ). The correlation was stronger in girls ( $n=71$ ,  $r=0.25$ ,  $p=0.04$ ) than boys ( $n=40$ ,  $r=0.15$ ,  $p=0.35$ ). The discrepancy between measured and perceived body figure ranged from -2 to 4 (mean $\pm$ SD,  $1.2\pm 1.2$ ). This was lower in boys than girls ( $0.9\pm 1.2$  boys versus  $1.4\pm 1.2$  girls,  $p=0.01$ ) but did not differ between younger versus older children ( $p=0.84$ ).

#### 4.3.1.2 *Construct validity for body size dissatisfaction*

The CBIS body satisfaction item was positively correlated with a single item asking about perceived body image ( $r=0.29$ ,  $p\leq 0.01$ ) and negatively correlated with a single item asking about desired body image ( $r=-0.39$ ,  $p<0.01$ ). This indicates that as body dissatisfaction assessed using the CBIS tool increases, the perceived body image is heavier and the desired body image is thinner. Table 4.7 shows the correlation between the CBIS body satisfaction item and the two single body image validation items for boys and girls.

### **4.3.2 Body size dissatisfaction of study children at study baseline**

Table 4.8 shows perceived, desired and perceived-desired body figure discrepancy for boys and girls at baseline. Study children were significantly more dissatisfied with their body size than a community sample ( $n=310$ , 7-12 year old Victorian school students) (227). The study sample had a significantly higher perceived body figure compared to the community sample, in keeping with their weight status. However the mean desired body figure of study children was not significantly different to that of the community sample.

At baseline, 1 child indicated that their desired body figure was larger than, and 6 indicated their desired body figure was equal to their perceived body figure. The remaining 103 children (94%) indicated their desired body figure was lower than their perceived body figure. The mean discrepancy between perceived and desired body figure was  $2.5\pm 1.4$ . There was no difference in body size dissatisfaction at baseline by child gender (Table 4.8,  $p=0.86$ ) or study group (Table 4.9,  $p=0.92$ ).

Forty-eight/110 children (44%) indicated they were not happy with how their body looked at baseline. Their weight (18) and stomach (13) were the most commonly reported disliked body features. Seventy-eight children (71%) indicated that they had previously tried to lose weight. Forty-six reported using dietary means (16 'eating healthy', 12 'eating less' 10 'a diet') and 28 reporting using increased activity.

#### **4.3.3 Body size satisfaction by time and study intervention group**

Table 4.9 shows the mean $\pm$ SD body size dissatisfaction at 6 and 12 months of the study by group allocation. The reductions in body size dissatisfaction observed over time did not differ by study group (group by time interaction,  $p=0.45$ ). Study subjects were significantly less dissatisfied with their bodies at 12 months compared to baseline (mean difference -0.5,  $p<0.01$ ).

### **4.4 Parent reported health-related quality of life (HR-QOL)**

#### **4.4.1 Baseline HR-QOL**

Table 4.10 shows the mean $\pm$ SD for 12 domains of HR-QOL assessed at baseline using the parent-report Child Health Questionnaire (refer to section 2.4.6.9). For all HR-QOL domains a higher CHQ score (possible range of 0-100) indicates better parent perceived child HR-QOL (refer to table 2.5). Scores for all domains of HR-QOL were lower in the study sample compared to a representative Australian community sample ( $n=2406$  5-10 year olds from Victorian schools) (228). Children aged 6-7 years at baseline of the study scored significantly lower on 3 HR-QOL domains compared to a community sample (two under psychosocial functioning, one under family functioning, Table 4.10). Children aged 8-10 years scored significantly lower on 8 CHQ items (3 under psychosocial functioning, 3 under family functioning, 2 under physical functioning, Table 4.10). Self esteem was significantly lower in study subjects than the community sample in both age groups (Table 4.10).

There were few baseline differences in HR-QOL by gender with only 2/13 items significantly different between boys and girls. According to parent report, boys were perceived to have more behaviour problems than girls (median [IQR], 56 [48:79] boys versus 70 [64:81] girls,  $p < 0.01$ ) and more emotional problems (median [IQR], 50 [35:73] versus 67 [50:83],  $p < 0.01$ ). There were no significant differences at baseline between study groups for any of the 13 domains of HR-QOL (Table 4.11,  $p > 0.05$  for all items).

#### **4.4.2 HR-QOL between groups at 6 and 12 months**

Table 4.11 shows the median and interquartile range parent-reported HR-QOL items at 6 and 12 months by study group. At 6 months there were no significant differences for any indicator of HR-QOL between study groups. At 12 months self esteem was significantly higher in both intervention groups compared to the concurrent control group, but there was no difference between P+DA and P (Table 4.11). Parent perceived overall child health compared to one year ago was also significantly increased in both intervention groups (median [IQR], P+DA 75[50:75], P 50[50:75]) compared to no intervention (50 [50:50],  $p = 0.02$ ) but not compared to each other.

#### **4.4.3 HR-QOL over time**

Between baseline and 6 months, there were significant increases in scores for items relating to emotional problems ( $p = 0.001$ ), global health perceptions ( $p = 0.02$ ) and emotional impact on parents ( $p = 0.001$ ) for the P+DA group and emotional problems ( $p < 0.001$ ) and self esteem ( $p = 0.02$ ) for the P group (Table 4.11). There were no significant changes between baseline and 6 months for the waitlisted control group (Table 4.11).

At 12 months, all the items that were significantly higher at 6 months for the P+DA group were significantly higher at 12 months compared to baseline. Additionally, self esteem ( $p < 0.01$ ), role/social activities limited by physical health ( $p = 0.03$ ), role/social activities limited by emotional health ( $p = 0.03$ ), behaviour problems ( $p = 0.01$ ) and impact on family activities ( $p = 0.001$ ) and were significantly increased at 12 months compared to baseline (Table 4.11). Parent perceived child's health compared to 1 year ago was also significantly higher (50 50; 50 baseline; 50 75; 75 12 months,  $p < 0.02$ ).

The increase in scores for the P group relating to emotional problems and self esteem were statistically higher at 12 months compared to baseline, with emotional impact on parents ( $p<0.01$ ) and family cohesion ( $p=0.01$ ) also increased compared to baseline. For the WLC group the only significant change at any time point was an increase in the emotional problems item ( $p<0.01$ ) at 12 months compared to baseline.

## **4.5 Discussion**

Overweight, as defined by the WHO, is the accumulation of adipose tissue to the point where health is affected (1). Therefore, the effectiveness of a child weight management intervention should encompass not only a reduction in adiposity, but also a reversal of associated health consequences. Despite this, the improvements in health associated with, or independent of, adiposity changes following weight management in children are rarely assessed (140). This chapter presented the non-weight outcomes assessed to determine the broad effectiveness of a parent-led, family-focused weight management program for 6-9 year old pre-pubertal children. Two interventions (parenting with or without intensive lifestyle education) were compared to intervention waitlisting. The objective of either intervention was to facilitate improvements in metabolic, psychosocial and overall health, or at a minimum maintain baseline levels (ie do no harm).

### **4.5.1 Growth**

Height and height z score increased between baseline, 6 and 12 months in all groups. This indicates the pattern of growth for children in the study intervention groups (ie undergoing intervention aiming to moderate energy intake) was equivalent to that observed in overweight children waitlisted for intervention. Impaired growth has been documented in child weight management studies that use significant energy restriction ( $<40\text{kcal/kg/d}$ ) or non-conventional therapies such as protein sparing modified fasts (700-900kcal/day) (142, 163). However, when moderate restriction (900-1200kcal/day, (243)) or non-restricted ( $>65\text{kcal/kg/d}$ , (142)) energy moderation is used, growth rates are not impaired. Growth rates normalise once intervention ceases and reflect expected height percentiles long term (139, 189).

In agreement with the present study, positive growth velocity z scores have also been observed following treatment for child overweight (139). However the increases in height z score should be interpreted with caution as the growth of Australian overweight children was compared to a US reference population (no Australian data available) and may represent differences in growth patterns between these populations. In summary, the adiposity changes resulting from the parent-led, family focused weight management interventions trialled in this study did not negatively impact on the growth of 6-9 year olds. It is possible to facilitate a change in energy balance while maintaining normal growth and development during weight management in young children. Therefore, while growth should be monitored during treatment, concerns about negatively affecting growth should not be a reason for not treating overweight in children with moderate dietary changes.

#### **4.5.2 Metabolic health**

Risk factors associated with cardiovascular disease and diabetes were common in this sample of overweight pre-pubertal 6-9 year olds. The most frequent metabolic abnormality was hyperinsulinaemia (85%), followed by raised TC (46%), LDL-C (43%) and SBP (42%). Other metabolic disturbances associated with the metabolic syndrome were not frequently observed (prevalence of low HDL-C 4% and high TG 3%) and there were no cases of hyperglycaemia. This differs to observations from US population studies involving similar aged children where more than 10% of children had low HDL-C or high TG (49). There may be geographical specific influences, possibly relating to dietary patterns (eg corn syrup, trans or unsaturated fats), affecting metabolic profile in addition to weight status (244).

Using a definition of the metabolic syndrome reliant on the presence of hyperinsulinaemia and at least 2 other metabolic abnormalities or overweight, 39% of subjects were classified with metabolic syndrome at baseline. This reinforces that clustering of metabolic and endocrine risk factors in overweight children is common, even prior to puberty, and is consistent with estimates of the metabolic syndrome in other age groups of children in a range of countries (20-50%, Table 1.2).

As presented in chapter 3, there were modest but significant reductions in BMI z score in all 3 study groups between baseline and 12 months (5% P and WLC, 9% P+DA,  $p>0.05$  by group, refer to Table 3.5). Reductions in waist circumference z score were also observed in the intervention (but not control) groups (10-15%, refer to Figure 3.2 and Table 3.8). However in general, these reductions in overall and truncal adiposity were not associated with significant improvements in metabolic indicators, either as a reduction in mean values or reduced presence of elevated risk factors (Table 4.3, 4.4). In fact, all study groups had significant increases in TC, LDL-C and decreases in HDL-C between baseline and 12 months. There were no significant differences in triglycerides, glucose or insulin by study time or group.

The results from this study are different to that observed in the limited number of studies which have assessed metabolic outcomes following weight management intervention in children less than 10 years of age. Four studies (summarised in Table 1.11) with reductions in percent overweight of 15-25% points observed reductions in TC (0.3), TG (0.6) and increased HDL (0.2) at 12-60 months follow up (treatment duration 2-12 months) (15, 139). A 10-20% reduction in insulin levels has also been observed following child weight management that achieved a 15% point reduction in percent overweight (Table 1.11) (15, 139).

The exception to the metabolic profile findings was DBP, which was significantly reduced between baseline and 6 months (ie during treatment), but not 12 months. However the 12 months blood pressure results are favourable (ie no change from baseline), given the age-related 1-2mmHg increase in blood pressure over 12 months (245). This study represents the first reported study which has assessed blood pressure after treatment for overweight in pre-pubertal children. No difference by group or over time was observed for systolic blood pressure, which differs from studies in older children where both SBP and DBP are improved with weight management (139). However this may reflect power limitations of the present study increasing the risk of a type II error (discussed further below).

The discrepancy in the metabolic findings in the present study with available literature may be secondary to study design or outcome assessment limitations. Age-related changes are well documented for blood pressure in children (245). Similar age-related changes may exist for other metabolic or endocrine variables. Changes in cholesterol during childhood are not well documented unlike insulin increases from early puberty (Tanner 2), with these changes being independent of adiposity levels (246). While pre-pubertal stage (Tanner 1) was confirmed at baseline, it was not re-evaluated at 12 months (children now 7-11 years of age) with some children likely to have entered puberty. Interpretation of the metabolic results may be difficult without appropriate adjustment for age, although this was not required in previous positive studies. Blood was collected from 94% of children at baseline falling to 77% at 12 months (n=71-94). Study sample size calculations were based on the primary study outcome only, with power calculations suggesting that the sample size was insufficient to detect group or time differences in metabolic indicators.

Regardless of outcome or power limitations, the degree of weight change in the present study (5-10% change in BMI z score) was lower than the 10-25% points observed in other studies (Table 1.11). There may be a threshold level of adiposity change (greater than that observed in the present study) required before improvements in metabolic indicators are observed. Finally, the dietary approach used in the present study gave families more food choice than in previous studies which used strictly prescribed eating plans. It is possible that the food choices made by families negatively impacted on the ratio of unsaturated to saturated fat consumed by children. However the results of this study and the current literature provide no further explanation.

Overall, this study confirms that potentially adverse metabolic consequences are frequently observed in young overweight children. While improvements in DBP were observed with modest changes in overall and truncal adiposity, no improvements were observed in other indicators of metabolic and endocrine health. Firm conclusions are limited by the lack of age-adjusted metabolic data, study power limitations and limited assessment of dietary intake.



### **4.5.3 Body dissatisfaction**

Body dissatisfaction was reported by over 90% subjects, consistent with other cross-sectional studies in overweight pre-pubertal children (67). Children enrolled in this weight management study were more commonly dissatisfied with their bodies and to a greater degree compared to an Australian community population of 7-12 year olds (227). Interestingly, while the perceived body figure was higher in overweight children, they had a similar desired body figure to that of non-overweight children (Table 4.8). This explains the greater body size dissatisfaction and suggests that despite a higher actual and perceived body figure, overweight children want to achieve the wider population or culturally valued body figure.

The degree of body dissatisfaction in this group of overweight 6-9 year olds highlights a lack of body size acceptance, with overweight children having an ideal that is likely to be unachievable. Associations between body size dissatisfaction, body esteem and disordered eating practices have been observed (70, 247). Study results suggest that overweight children may be at risk of engaging in undesirable eating practices such as bingeing, purging or restricting intake. Over 40% of the sample reported previous weight loss attempts at baseline. However children verbalized this in terms of changing eating and activity patterns and disordered eating practices were not assessed. The results of this study support addressing the issues of body dissatisfaction and disordered eating practices in the assessment and management of overweight in children (247). This may take the form of discussing realistic treatment outcomes in terms of adiposity changes, promoting body size acceptance and avoiding dietary restriction strategies associated with disordered eating practices.

Over time (baseline and 12 months), significant reductions in body size dissatisfaction were observed in all study groups. All groups maintained higher body dissatisfaction levels compared with a community drawn sample (227). Two other studies have assessed body dissatisfaction during child weight management (201, 247).

Braet and colleagues developed a child-centred program which addressed realistic weight outcomes and used a non-dieting treatment approach (247). They found that in 109 children (80% of an original cohort of 7-17 year olds) 4.6 years after commencing treatment, disordered eating practices (bulimia) and body dissatisfaction stabilised (no statistical comparison pre-post) and there was an 11% point reduction in percent overweight (weight for height) (155). In comparison, 24 months after 47 8-12 year olds commenced a child-focused, prescriptive weight management program there was a  $13\pm 13\%$  point change in percent overweight (weight for height), reduced prevalence of bulimia but increased body dissatisfaction (1-item in Kids eating disorder survey,  $0.3\pm 1.7$ ,  $p>0.05$ ) (201).

The present study involved 6-9 year old children, compared to 8-12 and 7-17 year olds in the studies discussed above. There was also a difference in who was the focus of the intervention. In this study the intervention was parent-led and family focused, rather than centred on the child. Removal of the child from the process of implementing and monitoring lifestyle (dietary) change may in itself prevent development of disordered eating practices in children. However, given the difference (although not significant) between the P and P+DA interventions, the additional lifestyle education to parents (including discussion of realistic outcomes and ways to promote self-esteem and minimise teasing) may have also assisted with improvements observed in body dissatisfaction.

This study is the first reported use of the CBIS body size dissatisfaction tool in a sample of overweight children. The CBIS showed moderate, significant correlations in the appropriate direction with two single body image items (Table 4.7). The gender and age differences observed were similar to those found by Truby and colleagues in a sample of mostly non-overweight 7-12 year olds (227). The construct validity of the CBIS tool appears appropriate for assessing body size dissatisfaction in overweight 6-9 year olds. The strengths of this tool are outlined in section 2.4.6.8. Furthermore, the tool was developed in the Australian setting increasing its appropriateness. However its repeatability and sensitivity to detect change is not established.

In summary, there is controversy as to whether treatment of childhood overweight may have negative psychological consequences including disordered eating and body dissatisfaction. This study was not associated with any negative effects on body dissatisfaction and there may have been improvements in the parenting plus intensive lifestyle education intervention. The treatment approach, including parent-led rather than child-centred treatment, limited calorie counting and weight monitoring, realistic treatment outcomes and using a non-restrictive dietary approach (ie non-dieting or healthy eating) may be useful strategies to reduce body dissatisfaction in overweight children. Further investigation of body dissatisfaction pre-post child weight intervention in terms of both 'do no harm' and potential gain beyond weight change is warranted.

#### **4.5.4 Physical, psychosocial and family health**

Health-related quality of life measures the perceived impact of a health condition on a range of domains. For children, this includes psychosocial concepts and family functioning. It can therefore be used as a measure of the overall health impact of child overweight and any changes that result with intervention (72). The HR-QOL of this sample of overweight 6-9 year olds was lower across all CHQ items compared with a community-based sample (228). Younger overweight children were found to have significantly lower scores than the normative sample for 3 HR-QOL domains, increasing to 8 HR-QOL domains in the older children (Table 4.10). The difference between younger and older children may reflect a longer exposure to or awareness of overweight.

The domains of HR-QOL that were significantly lower in the study sample were in keeping with the health domains affected by overweight (eg emotional problems, self esteem, physical activities affected by physical health) (66, 74, 76). Similar to other studies, child overweight was found to have a significant impact on parents and families, particularly emotional impact on parents (66, 76, 221). The emotional impact on parents may be mediated through parents dealing with their childhood weight issues or feelings of guilt around weight, and family life balance (62, 71).

Over 6 months, significant improvements were observed in a number of HR-QOL domains in both intervention programs which were sustained at 12 months. At 12 months, the parenting only had significantly higher scores in 4/13 items and the parenting plus intensive lifestyle education intervention had significantly higher scores on 9/13 CHQ items (table 4.11). The WLC group had significant increases for only 1 CHQ item. In both intervention groups, improvements were observed in parent-perceived child self esteem (ie child is very satisfied with abilities, looks, family/peer relationships and life overall), emotional problems (ie child feels peaceful and happy all the time) and emotional impact of parents (ie parent doesn't experience feeling of emotional worry/concern as a result of children' physical and or psychosocial health). Parents in the parenting plus lifestyle education group also reported improved domains relating to physical health (ie child performs all types of physical activities without health limitation and parent believes child health is excellent) and impact on family activities (child's health never limits/interrupts family activities or is a source of family tension).

These results suggest that 1) improved parent-perceived HR-QOL (relating to psychosocial and family functioning) was only associated with parent-led, family focused child weight management intervention and that 2) additional improvements relating to physical functioning were observed when parenting skills training was used in conjunction with intensive parental lifestyle education (and child physical activity sessions). The domains in which improvements were observed were those considered consequences of overweight. These findings are consistent with the limited literature in this area. Improvements in self esteem have been observed in 3 other treatment studies in 7 to 12 year olds (66). A single recent study assessing HR-QOL post-treatment of childhood overweight using an inpatient program also saw improved global HR-QOL (200).

The Child Health Questionnaire is a widely recognized tool for assessing HR-QOL and has been used previously with overweight children. In this study, HR-QOL assessed using the CHQ showed median scores above 90 for most items. This is likely to be an artefact of the significant ceiling effects of this tool (222). This could potentially impact on the ability of the CHQ tool to detect improvements in HR-QOL over time or post-intervention. Non-parametric statistics were also used due to skewed distribution in favour of high CHQ scores. These factors indicate the analysis undertaken was conservative, likely to reflect true differences and changes over time.

One difference with previous use of the CHQ was the minimal differences in domains of parent perceived HR-QOL between boys and girls. In validation work of the CHQ in Australia, 1-3 point differences between boys and girls were observed across most domains. However this may reflect the large sample size (n=2406) and risk of type one error rather than real gender differences (228). As minimal differences were observed by gender at baseline in the sample of overweight children, primary analysis was performed for boys and girls combined. The CHQ is also a parent-perceived assessment of their child's HR-QOL, which may differ from the child's perception of their own HR-QOL. Tools are available which assess the child's own perception of their HR-QOL, but have not been validated in Australia.

In summary, this study confirms that being overweight in childhood negatively impacts on a range of health domains. Improvements were observed in a number of domains of HR-QOL with parent-led family focused child weight management, which were not observed in a waitlisted control group. This highlights that while some change in adiposity may have been achieved with no intervention, improvements in HR-QOL were only observed with intervention. Improvements were observed in both interventions groups highlighting the potential of the parenting skills training. However additional improvements were observed in the group receiving lifestyle education and child activity sessions, suggesting that different components of treatment may (synergistically) impact on HR-QOL.

#### **4.5.5 Conclusion**

This study used a broad definition of effective child weight management, inclusive of adiposity changes and reversal of weight-related health consequences. This is an important strength of the current study in comparison to the literature (1, 140). Other strengths relating to assessment of broader health outcomes include; use of reliable and valid tools and use when possible of tools validated for use with young (<10 years), pre-pubertal (Australian) children (see section 2.4.6). Randomization stratified for recruitment cohort and child gender resulted in no significant baseline differences in any metabolic, growth or psychosocial variable by study group. This indicates that potential covariates were evenly distributed between groups. One limitation of the study is that the study sample size considered only clinically relevant changes in overall adiposity. Therefore it is likely that the study was underpowered to detect group and time change in secondary outcomes, particularly metabolic outcomes.

As discussed in chapter 3, the adiposity outcomes observed following participation in the parent-led, family focused weight management interventions were modest (5-10% change in BMI z score, greater with intensive lifestyle education). However these intervention programs were not associated with a worsening of broader health indicators achieving, at a minimum, 'doing not harm'. While limited in terms of improvements in metabolic profile and body satisfaction, significant improvements were observed in multiple domains of HR-QOL as perceived by parents. Of particular interest was that the interventions, both of which involved parenting skills training, had significant improvements in self-esteem and also domains of family functioning. Greater improvements were found in the group that received additional lifestyle education, highlighting that both lifestyle education and behaviour modification/family support are important in terms of improving the overall health overweight children.

## Chapter 5 Study process and impact evaluation

### 5.1 Introduction

This chapter presents the study evaluation assessing the degree to which intervention goals and objectives were achieved (Table 2.1), and whether similar achievements were obtained without intervention. Evaluation of the child weight management study can help determine why or how an intervention is or is not effective. This can assist in explaining the observed changes in adiposity and broader health outcomes. Process evaluation assessed parent attendance to and satisfaction with the interventions. Satisfaction with the control waitlisting process was also examined. Impact evaluation specifically assessed the degree to which intervention objectives were achieved. This included changes in child nutrition and activity behaviours, parental sense of competency with parenting, and parental weight status. The interaction between group (P, P+DA, WLC) and time (0, 6, 12 months) is examined, with main effects of group and time examined when the interaction is not significant.

### 5.2 Process evaluation

#### 5.2.1 Program attendance

Parent attendance to either the P or P+DA intervention sessions is shown in Table 5.1. In the P study arm 4/37 parents attended all 11 sessions, with 5/37 attending no or only one session over 6 months. One parent in the P+DA group attended all 18 intervention sessions and 2/38 parents attended no or one session. There was no significant difference between the P and P+DA groups for the proportion of total sessions attended ( $57\pm 32\%$  versus  $59\pm 30\%$ ,  $p=0.85$ ). Similar proportions of parents attended more than three-quarters of program sessions (51% and 47% for P and P+DA respectively,  $p=0.73$ ). The parenting sessions were common between the two interventions (although delivered separately to each study arm) with 13/37 and 8/38 parents from the P and P+DA groups respectively attending all parenting sessions ( $p=0.80$ ).

## 5.2.2 Parent satisfaction

### 5.2.2.1 *Intervention program satisfaction*

Table 5.2 shows the number of program satisfaction questionnaires completed anonymously at 6 months (end of intervention) available for analysis. Indicators of parent satisfaction are presented in Table 5.3. Six of 10 P group parents and 20/26 P+DA group parents said they would repeat the intervention program they undertook if they were seeking assistance in managing child overweight again. There was limited use of weight management services outside the study interventions with only 7 parents from the intervention groups seeking additional assistance regarding child weight management. Information was sought from health professionals (2), internet or books (2), friends (1), physical education teacher (1) or a surf life saving club (1).

Parents were asked to circle one or more intervention resources which they found useful in assisting them to manage their child's weight (26 from P+DA group and 10 from P group). The parenting skills training resources (group parenting sessions 14 P+DA, 7P; parenting phone sessions 12 P+DA, 7P; parenting manual 10P+DA, 6P) were more commonly circled as being useful than the lifestyle education resources (lifestyle sessions 5 P+DA, not applicable for P; lifestyle written material 5 P+DA, 1 P). Parents were asked to circle factors that prevented them attending the intervention or implementing the intervention at home. Barriers associated with family or work commitments, family illness and perception of a lack of time were most frequent (Table 5.4).

Table 5.5 summarises parent responses when asked what they liked most and liked least about the interventions and what else should have been included in sessions.



Examples of parent responses were –

### **P group**

#### Liked most:

*“It [the program] focused on more than food. It focused on the behaviour behind the food and in general it has been a family not individual program”.*

*“Open discussions with other parents in similar situations”.*

#### Liked least:

*“The fact that the ‘positive parenting’ was the main focus...education on how to read food labels was the most important”.*

*“The lack of nutritional information”.*

*“I would like a more clear cut daily eating plan/snacks plan – information given regarding this was too broad”.*

### **P+DA group**

#### Liked most:

*“Group sessions where we learnt we weren’t alone. We learnt how other[s] approach similar problems. The phone calls kept us on our toes (good)”.*

*“Made the family think more about what we eat and what foods we buy”.*

*“I liked that you linked...parenting and eating as being associated”.*

*“Facilitators understanding of difficult situations and advice and support in order to deal with them”.*

#### Liked least:

*“Having to make changes was difficult but certainly got easier”*

*“Sometimes found it hard to keep up [with] homework tasks, reading etc... just because of busy lifestyle”.*

#### **5.2.2.2 Satisfaction with the 12 month wait listed control group**

Thirty-one of 36 parents whose child was allocated to the WLC group attended 12 month follow up. Twenty-one completed an adapted satisfaction questionnaire focusing on study group allocation and perceptions of family changes made whilst waitlisted for a child weight management program. Five of 21 parents indicated they were disappointed about their study allocation group, consistent with 6 parents who voluntarily expressed disappointment at the time of group allocation (researcher log).

## 5.3 Impact Evaluation

### 5.3.1 Parent reported lifestyle changes made during the study

#### 5.3.1.1 Perceived changes in the intervention groups baseline to 6 months

Parent responses when asked about their learning during the intervention and perceived changes made are summarised in Table 5.6. Examples of parent responses included -

#### **P group**

##### Learning

*“Good snacks, how to set rules, how to say no and mean it!!”*

*“To be very aware of exactly what is being eaten, that the whole family has to focus on healthy eating for it to be successful, to have specific TV viewing time, to encourage a wide variety of activities”.*

##### Changes made:

*“TV turned off after ½ hour after school, more outdoor fun games, no biscuits/cakes/muesli bars for snacks”.*

*“Healthier eating, exercising, parents working together as a team”.*

*“Less snacking and takeaway, more family meal times, more family time/activity”.*

#### **P+DA group**

##### Learning:

*“[About the] Australian Guide to Healthy Eating (AGHE), increase daily intake of vegetables, balance and variety of diet”.*

*“Better ways of making changes, being better prepared for situations, food [change] ideas”.*

*“Need more activity, less screen time”.*

##### Changes made:

*“[We] eat a range of foods from all food groups, lots of family activity”.*

*“Less tv overall, better food choices, being aware what is in foods”.*

*“Planning dinner and timing, talking about the foods more together”.*

*“We eat portion sizes and food suggested in the AGHE booklet, we exercise often and the children now walk to and from school”.*

*“Less snacks, more activities, more water less cordial”.*

Parents were asked to list what they perceived would help their family maintain lifestyle changes made during the intervention once sessions had ceased. Responses were coded as themes and related to; reviewing program resources (7 P+DA, 6P); utilising parenting skills training (5 P+DA, 1P); utilising health beliefs for motivation (4 P+DA, 0 P); being consistent/aware/motivated (7 P+DA, 8 P); and lifestyle influences (4 P+DA, 0P). Examples of parent responses are –

**P group**

*“Staying consistent, using the program resources. Knowing I can still get help if I need it”.*

*“Routine, planning”.*

**P+DA group**

*“Going back to resource material, family meeting[s], using PAR (planned activities routine) etc...when stuck”.*

*“We like our new lifestyle and our new found health keeps us motivated to continue healthy choices”.*

**5.3.1.2 Perceived changes in the waitlisted group baseline to 12 months**

Parents in the WLC group were asked to “list 3 changes (if any) to your child’s eating and activity patterns your family has made over the last 12 months”. Nineteen of 21 parents indicated they had made a least one change. The type and frequency of strategies were; 15 increased sport, 8 promoted healthy eating, 5 reduced fat and/or sugar intake, 5 monitored and or reduced portion size of meals, 3 reduced takeaway frequency, 2 increased water intake, 1 increased awareness around food/activity. Fourteen of 21 WLC parents indicated that the written material provided ‘hasn’t helped much’. The remaining seven indicated that it had ‘helped somewhat’ in managing child weight issues. During the 12 month wait-listed period 6/31 WLC families sought GP (3), allied health (2) or other (1) assistance for child weight management.

### 5.3.2 Child health behaviours

Table 5.2 shows the number of parents who completed evaluation measures.

#### 5.3.2.1 Food group intake

Table 5.7 shows the median daily serves of food groups assessed by parents using definitions given in the Australian Guide to Healthy Eating (AGHE, appendix 5.3) (205). There were no significant differences at baseline in the number of daily serves of food groups by gender, group allocation, weight status or parent attending  $\geq 75\%$  of program sessions (data not shown, all  $p > 0.05$ ). There was no significant group by time interaction for intake of breads and cereals, vegetables, fruit, dairy or meat and alternatives and the intake of these food groups did not change over time for any study group (Table 5.7, all  $p > 0.05$ ,  $p = 0.059$  for dairy intake).

There was a significant group by time interaction for intake of extras foods (Table 5.7,  $p = 0.02$ ). Post hoc analysis of the group by time interaction (using Bonferroni method) found that while there were no significant group differences ( $p > 0.05$  WLC versus P+DA or P, and P+DA versus P) at any time point, there was a significant reduction in the intake of extras for both intervention groups between 6 months and baseline (mean difference, P+DA 1.5 [CI 2;1]; P 1 [2;0.5]) and 12 months and baseline (mean difference P+DA 1 [CI 2;0.5]; P 1 [1.5;0]). There was no significant change in intake of extras between baseline and 12 months for the WLC group ( $p = 0.73$ ). There were no significant changes between 6 and 12 months for any study group.

#### 5.3.2.2 Small screen use and active play

The number of minutes per day parents reported children spent engaged in small screen activity or active play is shown in Table 5.8. At baseline boys spent more minutes per day than girls engaged in small screen activities (median (IQR), 340 (255:390) versus 245 (180:330) minutes per day,  $p < 0.01$ ). There were no differences at any time point by study group ( $p = 0.93$  screen time,  $p = 0.23$  active play).

Regardless of study group there were significant reductions over time in the reported time spent engaged in small screen activities ( $p < 0.01$ ) and an increase in the time spent in active play ( $p < 0.01$ ) (Table 5.8). The decreased small screen use and increased time spent in active play between both 6 and 12 months and baseline were significant ( $p < 0.01$ ). For active play there was no significant change between 6 and 12 months ( $p = 1.00$ ). However there was a further significant reduction in minutes per day spent using small screen devices between 6 and 12 months ( $p < 0.01$ ) (Table 5.8).

At baseline there were no significant differences by study groups for the number of children who had no access to small screen devices before school ( $p = 0.56$ ), no access to video games ( $p = 0.99$ ), or children taking active means of transport to ( $p = 0.09$ ) and from ( $p = 0.13$ ) school. There were no significant differences between study groups for these outcomes at 12 months (all  $p > 0.05$ ). All study groups decreased no access to TV before school (27/91, 29% baseline and 43/91 46% 12 months), and no access to video games (12/91, 13% baseline and 36/91, 40% 12 months). All study groups increased use of active transport to and from school (19/91, 21% baseline to 37/91, 41% 12 months). Children's access to TV after school and on weekends was over >98% and stable over time.

### **5.3.3 Parental perceived sense of competency**

Triple P was used in both study intervention groups for parenting skills training and aims to increase parental ability and confidence to manage parenting issues, termed parental competence (190, 230). In application of the Triple P program to child weight management, parent-led change in children's eating and activity behaviours were advocated. The Parent sense of competency (PSOC) scale is the standard tool used pre and post- Triple P to measure changes in parental competency (see section 2.4.6.13). PSOC is the sum of two sub-categories, PSOC-satisfaction PSOC-perceived efficacy. Higher scores indicate higher parental competency, parenting satisfaction and perceived parenting efficacy. Overall PSOC and its sub-categories were not significantly different between parents of boys or girls at baseline and scores were similar (higher for PSOC-perceived efficacy) to a community sample of Canadian mothers of 7-9 year olds (Table 5.9) (231).

There was no significant difference between study groups at baseline for PSOC ( $p=0.43$ ), PSOC-satisfaction ( $p=0.48$ ) or PSOC-perceived efficacy ( $p=0.60$ ). There were no significant group by time interactions (PSOC  $p=0.07$ , PSOC-satisfaction  $p=0.06$ , PSOC-perceived efficacy  $p=0.44$ ). However there was a main effect of time with all 3 PSOC items increasing between baseline and 12 months (Figure 5.1). While there was no significant differences between study groups at any time point, PSOC items tended to be higher at 6 and 12 months in the intervention groups that had received parenting skills training compared to waitlisting.

#### **5.3.4 Parental weight status**

Parental anthropometric measures were self-measured in 5%, 9% and 13% of mothers and 78%, 71% and 71% of fathers at baseline, 6 and 12-months respectively. At baseline, 84/111 mothers (74%) and 64/76 fathers (84%) were classified as either overweight (37 mothers, 27 fathers) or obese (45 mothers, 37 fathers). Sixteen mothers and 9 fathers were severely obese with a BMI  $>35\text{kg/m}^2$ . Table 5.10 shows the mean and standard deviation for mothers and fathers BMI and waist circumference. There was a pattern across the four variables for a (clinically relevant) decrease in BMI and waist circumference of parents in the intervention groups versus no change or an increase in parents wait listed for intervention. However there was only a significant group by time interaction for father's BMI ( $p=0.01$ , Table 5.10). Post hoc analysis of this interaction showed that while there were no significant differences between study groups at any time point, the only significant decrease in BMI over time (baseline versus 12 months) was for fathers in the P+DA group ( $1\text{kg/m}^2$  CI 2;0).

### **5.4 Discussion**

A recent systematic review of studies for treatment of childhood overweight made a call for studies to include study and intervention evaluation measures (140). This chapter presented the process and impact evaluation for the study child weight management interventions. Relevant aspects were also considered and evaluated in the concurrent control group.

Evaluation of whether a child weight management intervention was 1) delivered as intended, 2) was attended by participants, 3) met participant needs and 4) facilitated sustained change along the energy balance-health behaviour-weight status causal pathway (204), can assist in explaining subject outcomes and identify possible sources of bias. Evaluation of these aspects can also inform whether the intervention is appropriate for its intended purpose and define who did or did not benefit. These are important considerations in assessing the generalisability of the intervention or to highlight areas for intervention refinement and adjustment prior to use in future studies or health service delivery settings (140, 204).

#### **5.4.1 Process evaluation**

Mean attendance to intervention sessions was approximately 60%, with about 50% of parents attending >75% of intervention sessions. This was despite parents rating the intervention programs highly in terms of the quality of the service and over 70% of parents indicating they would repeat the intervention. Over 80% of parents completing the satisfaction questionnaire felt the interventions delivered the type and amount of help they wanted. This was particularly evident in terms of the parenting support provided. There were no differences in intervention attendance or satisfaction between the parenting only and parenting plus lifestyle interventions, apart from dissatisfaction with the level of lifestyle education in the parenting only group.

Intervention attendance in the present study was lower than that reported in five studies of multi-component child weight management interventions (3-12 month duration) which have included attendance data (mean attendance 70 to 82% of sessions) (144, 148, 152, 154, 240). In the study most similar to the present study (ie where parents were responsible for intervention attendance), the average session attendance was 70% and accounted for 13% of the variation in weight results (154). The differences between these parent-led interventions and the other studies was child-centred intervention delivery (144, 148, 152, 240) and a deposit-reimbursement for attendance system (154).

In the present study, the most common reasons parents gave in both intervention groups for missing sessions were individual factors (eg family and work commitments) rather than program factors (which is consistent with level of satisfaction with the interventions). The family-specific factors, along with lack of time, were also the most commonly reported barriers to implementing the program at home. This type of data in terms of reasons for poor attendance has not been reported in previous studies. This information may be useful in terms of defining who may benefit from an intervention and guiding intervention adjustments to account for these difficulties (eg pursuing more flexible intervention delivery systems such as self directed programs or use of technology such as the internet or e-mail).

Another aspect of process evaluation is to determine whether an intervention was delivered as intended (204). In this study, facilitator checklists were developed and used as a quality assurance strategy (Appendix 1). This was to ensure that intervention delivery occurred as intended and was consistent across the four cohorts of recruitment (ie the interventions were delivered 4 cohorts in each study arm). While analysis of the checklists is beyond the scope of this thesis, the checklists for each session were completed and no deviations from protocol were documented. Furthermore, the same facilitator delivered all the intervention sessions to each cohort and study arm, providing further intervention delivery consistency.

#### **5.4.2 Impact evaluation**

The child weight management approach used in both intervention arms of this study was unique in that it adapted a general parenting skills training program to child/family eating and activity behaviours. Qualitative responses from parents provided insight into how this approach was perceived and whether the message of 'parent-led, family-focused healthy lifestyle' child weight management was taken up by parents.



Responses suggest that the key intervention messages were received with parents using terms relating to 'healthy eating', 'increasing activity', and also referring to parenting skills and modifying behaviour. Parents did not appear to perceive the interventions to focus on a prescriptive child 'diet and activity plan' which was in line with the goals of the interventions (Table 2.1).

Assessment of energy and nutrient intake and activity levels is fraught with difficulties including; at best only moderate correlation with actual intake/activity, under- or over-reporting and high subject burden (248). Evaluation of health behaviours (eg eating behaviours, food group intake, small screen device use) is a simple, low burden alternative to assessment of actual dietary intake or activity levels. In this study the Australian Guide to Healthy Eating (AGHE) was used as the nutrition education. The AGHE uses population food group intake modelling to recommend a food pattern that would achieve nutrient and energy intake requirements and prevention of nutrition-related disease (205). Application of the AGHE has also been shown theoretically to reduce energy intake for the majority of Australian children (249). Therefore it was considered appropriate to compare children's intake against the AGHE recommendations as an assessment of whether the interventions achieved their objectives (Table 2.1).

However, as with other dietary assessment methods, use of the AGHE to assess children's food group intake may be limited by parents' ability to accurately recall and quantify their child's intake according to the AGHE food groups. Evaluation of the AGHE assessment tool (Appendix 5.3) against 4-6 24 hour diet records found that parents over estimated children's intake against the AGHE assessment tool (refer to appendix 4). Therefore the discussion below needs to be interpreted with the tool limitations in mind, which also includes that the repeatability and ability to detect real change has not been established for this tool.

Baseline food group intake of study children reflected an 'at risk' pattern, likely to be high in energy and of poor nutritional quality (205, 249). Median intake was low for vegetable and dairy intake and high for meat and extras compared to the AGHE recommendations (Table 5.7) (205). The results suggest an eating pattern that may be 'at risk' in terms of weight gain, although not dissimilar to the dietary and nutrient intake patterns of the wider population for this age group (85, 249). At 12 months, dietary objectives that were met were maintenance of dairy intake and overall nutritional quality (using a proxy of stable fruit and breads and cereals groups), although there was no increase in the low intake of vegetables. This was not different between study groups (eg intervention versus waitlisting). However, while not significant by group, intake of 'extras' (high energy/fat/sugar/salt) foods was reduced in both intervention groups at both 6 and 12 months compared to baseline, which was not observed in the waitlisted group. In the intervention groups, there were no changes in extras intake between 6 and 12 months, indicating that dietary change achieved during the treatment phase, was maintained in the following 6 months with no therapist contact.

Three other studies (summarised in Table 1.8b and 1.8c) have used a similar 'healthy eating' dietary approach and assessed dietary intake (148, 149, 154). The study by Golan and colleagues assessed changes in food intake and the home environment with reduction in energy intake (7 day food records validated against a 24 hour recall) of 26% ( $p < 0.05$ ). This correlated with reduced food stimuli ( $r = 0.43$ ,  $p < 0.01$ ) and improved eating behaviour (eg eating in front of TV) ( $r = 0.32$ ,  $p < 0.05$ ), which while interesting are not able to be compared with current findings (154). In the Epstein program (Table 1.5, 1.9) the dietary approach classifies high fat/sugar foods as 'red' foods, similar to the AGHE 'extras' foods. For weight management red foods are restricted to 4 per week, with adherence to this (average  $3 \pm 2$  serves per week) only lasting an average of  $6 \pm 1$  weeks (151). However in a weight gain prevention study, red food intake was recommended at 15 /week (similar to 2 serves/day of extras in present study), with red food intake reducing by 5-9 serves/day but remaining above the target at 5-8 serves of red foods per day (148).

Adherence to the recommendation of up to 2 serves of extras foods per day was more readily achieved than the red food recommendations used in these two studies. This may reflect the non-diet prescription approach used, allowing moderate intake of all types of foods daily and perhaps limiting the tendency for people to look for ways to 'cheat' associated with restricting dieting approaches (247). However this is speculation and dietary intake and behaviour patterns and ability to adhere to dietary recommendations is an area for further research. It would appear that from the present study that dietary change can be achieved by focusing on relatively few dietary changes. Focusing on decreasing intake of extras, increasing vegetable (but not fruit) intake, and promoting dairy intake of 1-2% milk and occasional use of cheese and ice cream may be most effective (249). Limiting and prioritising the number of food-based recommendations required to facilitate long term dietary behaviour change and weight management may be useful in achieving long term adherence (250).

Over time there were significant changes for both screen use (reduced) and active play (increased) highlighting that the intervention activity objectives were achieved (Table 2.1). However these objectives were achieved regardless of intervention (with or without activity sessions) or waitlisting for intervention. These observations are unlikely to reflect a type II error, but may be influenced by the non-validated tool used to assess activity behaviours (ie unknown association to real activity patterns, repeatability or ability to detect change). One explanation for these results may be that promotion of activity behaviours favouring weight management in children (eg less TV, more active play) may be more readily implemented without therapist support than the dietary changes required. However this is only speculation and an area for further research.

Parental weight status at baseline highlights that the sample of overweight children studied are from 'high risk' families with more than three quarters of mothers and fathers being overweight or obese at baseline. This is consistent with literature that shows a trend for familial pattern of overweight, with overweight children likely to have overweight parents (14, 251).

There was a significant reduction in fathers' BMI in the parenting plus intensive lifestyle education intervention between baseline and 12 months. While the changes in fathers' waist and mothers' anthropometric results were not significant, the pattern of change was similar to that observed for fathers' BMI. The parental anthropometric outcomes in the intervention groups tended to reduce over time while remaining stable or increasing in the wait listed control group. So there did appear to be some adoption of a family lifestyle conducive to reduction in family weight status. However the study may have been underpowered to detect the change, the effect was moderate and may have been influenced by the self-reporting of parental weight status (especially fathers' BMI).

Other parent outcomes indicated improved satisfaction with parenting and sense of parenting competency, but this was not specific to the groups receiving parenting skills training. The mean score in the parent sense of competency scale in the study sample was high at baseline and comparable to a normative sample (Table 5.9) (231). Therefore the ability to improve parental sense of competency may have been limited. There were increases over time in overall sense of competency and perceived parenting satisfaction and efficacy. This may explain current results to that evaluating the Triple P program where parents had children with behaviour problems (198). There may be more appropriate tools to assess parenting within the context of child weight management such as tools that measure actual parenting style or child feeding practices.

#### **5.4.3 Potential bias**

Program attendance did not differ between the two intervention groups indicating that this was not a source of intervention bias. However it is likely that intervention attendance results underestimate intervention effect. However, while the study may underestimate intervention efficacy, it is likely to reflect its use in a real life setting. If parents are not willing or able to attend a program, its effectiveness is likely to be limited in a health delivery service setting. The program was suitable for some families, suggesting the potential for screening strategies to match treatment to family characteristics and needs.

Attendance at an intervention can be used as a rough measure of parent adherence to an intervention or reflect the degree of intervention exposure. In the present study, using attendance as a proxy, adherence appears relatively poor (discussed above). However as a study retention strategy parents not attending sessions received a letter containing the written material from the session. Therefore regardless of attendance, program information was received by families and actual adherence was not assessed. The degree of adherence and factors influencing the ability to adhere to an intervention may uncover important family characteristics to predict outcomes. This could inform between study or intervention design and is an area for further research. This is highlighted by a study (discussed in section 3.5.2) which found family intervention adherence was associated with outcome differences between boys and girls (241).

True 'placebo' or 'no intervention' controls have only been used in two other child weight management studies and these used a wait listing approach to address recruitment, retention and ethical issues (149, 193). In general, 'usual care' or 'wait listed' controls provide a good alternative to 'no intervention' control groups and may be a better design to studies that compare two interventions (eg where effectiveness is only assessed using time changes not between group comparisons). Waitlisting is an underutilised design in child weight management studies, but the experience of families in control groups should be considered.

In this study, 25% of parents were disappointed with allocation to the wait listed control group that received a brief 'healthy family lifestyle' pamphlet. Although few reported this pamphlet being useful or that they accessed alternative assistance for child weight management, the majority of wait listed families reported changing their child's eating and activity patterns during the course of the study. This highlights that waitlisting in this study was not as such 'no intervention', possibly due to awareness of the issue of child overweight and readiness for change. However, while able to achieve some positive lifestyle and adiposity change, the broader health benefits associated with the intervention groups were not observed (see Chapter 4).

While the program satisfaction was measured by an anonymous questionnaire, strengthening ability to draw 'true' conclusions, only 48% of parents allocated to an intervention group completed the satisfaction questionnaire. This limits the generalisability of these findings to the whole sample. Those who did not attend measurements or complete the questionnaire may have had very different views about the program, than those who completed it.

#### **5.4.4 Conclusion**

Study evaluation is rarely undertaken in child weight management studies, with the data presented in this chapter attempting to address gaps in the current literature base (140). Exploration of intervention attendance and satisfaction, and changes in factors present on the energy balance-weight status causal pathway, also assists in explaining the anthropometric outcomes presented in chapter 3. Intervention attendance was relatively poor and may reflect low intervention adherence and (together with analysis by 'intention to treat') could be one possible factor explaining the modest changes in adiposity observed in the intervention groups compared to previous studies (refer to section 3.5.1). The limited capacity to show differences between the control and intervention groups is also influenced by the lifestyle changes, particularly activity behaviours, made by the waitlisted group during the study. The provision of a brief lifestyle pamphlet, but more importantly the motivation of the volunteers suggests they were not a true 'no intervention' control. There may have also been a Hawthorn effect, where just monitoring (eg study measurements) is sufficient to bring about change (although limited by only measuring at 12 months).

However, a number of results still support the interventions trialled in this study, particularly parenting skills training with intensive lifestyle support. In addition to trend for better adiposity outcomes (Chapter 3) and improved HR-QOL (Chapter 4), children in the intervention groups significantly reduced their intake of high fat/sugar/salt/energy foods (not observed in the control group) and parents were satisfied with the type and help received in the intervention program. However, while appreciating and valuing the parenting skills training, it would be better if linked to appropriate lifestyle education.

## Chapter 6      General Discussion

### 6.1      Overview

Diet, activity, behaviour modification and family support are the cornerstones of child weight management. However the best way to utilise them in an age-appropriate manner remains unknown (see section 1.7) (140). In young children, parent-led family focused treatment may be most appropriate (165). Parenting skills training may provide age-appropriate behaviour modification strategies to support parents' ability to facilitate lifestyle change in their child. The thesis hypothesis was that pre-pubertal children aged 6-9 years, whose parents participate in a 6 month parent-led family-focused child weight management program comprising parent skills training and intensive lifestyle education, will have BMI and waist circumference z scores, metabolic profiles and indicators of health-related quality of life and body satisfaction after 12 months that are, a) improved compared to children who are wait listed for intervention for 12 months, and b) no different to children whose parents participate in a parent-led, family focused intervention utilising parenting skills training alone (ie without intensive lifestyle education) (see section 1.8).

Intervention effectiveness was assessed against a criteria that was inclusive of reductions in overall and truncal adiposity, together with reversal of obesity-related health consequences (see section 2.3.3.1). In addition to examining adiposity and broader health indicators, the study addressed several study design and quality limitations frequent in the literature, as identified by recent systematic reviews (128, 140). This included use of a 'no intervention' control, reported sample size calculation, clear randomisation procedure, blinded outcome assessment, intention to treat analysis to assess effectiveness rather than efficacy, and a study end point of 12 months which spanned 6 months intervention and 6 months follow up. The CONSolidated Statement Of Reporting Trials statement was used to facilitate clear and transparent study reporting (239).

## 6.2 Key findings and interpreting the results

### 6.2.1 Key findings across outcomes

The adiposity outcomes are presented in chapter 3. BMI z score between baseline and 12 months was reduced by  $0.24\pm 0.43$  with parenting skills training plus intensive lifestyle education (P+DA),  $0.15\pm 0.47$  with parenting skills training alone (P) and  $0.13\pm 0.40$  with 12 month waitlisting for intervention (WLC). These 5-10% reductions in overall adiposity were significantly different over time, but not between study groups. However, significantly more children in both intervention groups reduced or maintained their BMI z score over 12 months compared to the control group. Interestingly, as discussed in section 3.5.2, the intervention response was different between boys and girls. While insufficient sample size limited formal gender sub-analysis, boys in both intervention groups had larger reductions in BMI and waist z score than girls. Adiposity levels for boys in the control group were also stable, rather than decreasing, over time. There was a significant group by time interaction for waist circumference z score, which was reduced after 12 months with either intervention, but not with waitlisting.

As discussed in section 3.5.1, the  $0.24\pm 0.43$  reduction in BMI z score in the parenting skills training plus intensive lifestyle education group, while clinically relevant, were modest compared to previous studies. The only other study which evaluated parent-led child weight management, found in Israeli 6-11 year olds, a 15% point reduction in percent overweight in 12 months (161). Child-focused studies in 8-12 year olds have achieved 10-15% point reductions in percent overweight and a  $0.6\pm 0.6$  to 1.3 (no SD) reduction in BMI z score (141, 147, 185). Reductions in BMI z score of this magnitude were only observed for boys in the present study (Figure 3.3). Promotion of gradual behaviour and adiposity change, modest intervention effectiveness, method of expression of adiposity, intention to treat analysis and sample characteristics are all possible explanations for the difference between the present and previous studies. No previous studies have reported waist circumference z scores, limiting comparison of these results with the literature (see section 3.5.1).



Chapters 3 and 4 present the broader health outcomes. There were no improvements in metabolic profile in any study group. The exception was diastolic blood pressure which significantly decreased in all groups between baseline and 6 (but not 12) months. Child-reported body dissatisfaction in all groups reduced over 12 months. In both intervention groups there were improvements over 12 months in multiple domains of parent-perceived HR-QOL. As presented in table 4.11, in the parenting skills training plus intensive lifestyle education group there were improvements in 2/4 domains relating to physical functioning, all 4 domains relating to psychosocial functioning, 2/4 domains relating to family functioning and improved overall child health compared to 1 year ago (refer to table 2.5). In the parenting skills training only group, improvements were observed in 2/4 domains relating to psychosocial functioning and 2/4 domains relating to family functioning. Only 1 domain of HR-QOL (emotional problems) had a higher score at 12 months compared to baseline in the waitlisted group. Self esteem, assessed as one of the domains of HR-QOL, was significantly higher at 12 months in both intervention groups compared to the waitlisted group (but not compared to each other). In the parenting skills training only group, no improvements were observed in any domains of physical functioning. This is in contrast to the improvements observed in physical functioning with parenting skills training in conjunction with intensive lifestyle education. In summary, improvements in HR-QOL were specific to study groups which received active intervention. Improvements in physical functioning were also specific to treatment that involved lifestyle support and child activity sessions.

### **6.2.2 Interpreting the outcomes: a consistent pattern**

Self esteem at 12 months and the proportion of children achieving stable or reduced BMI z score between baseline and 12 months, were statistically significantly higher in both intervention groups compared to waitlisting, but not compared to each other. These were the only two outcomes where statistical differences by study group were observed.

However, despite the lack of statistically significant group differences (including for the primary study outcome BMI z score), when 1) a broad criteria for assessment of intervention effectiveness is used (refer to section 6.1), 2) the direction and relative size of change over time between groups is considered, and 3) the statistically significant time trends within active intervention groups only are considered, consistent trends are observed.

Overall, the study results and consistent trends summarised in 6.2.1 support part a) of the thesis hypothesis (see section 6.1), suggesting that parenting skills training used in conjunction with intensive lifestyle education is an effective intervention for treatment of overweight in 6-9 year olds compared to intervention waitlisting. Parenting skills training with intensive lifestyle education resulted in a moderate, but clinically relevant reduction in adiposity, reductions in truncal adiposity and improvements in parent-reported HR-QOL across multiple domains of physical, psychosocial and family functioning. Whilst not significantly different by group, the significant changes over time tended to be either specific to subjects receiving active intervention and/or the size of the change over time was greater with this intervention compared to waitlisting. There were no improvements in metabolic profile observed in the P+DA intervention group and the reductions in body dissatisfaction were similar to that observed with waitlisting. So while no more effective than waitlisting the criteria to 'do no harm' was achieved.

The study results do not support the part b) of the thesis hypothesis (see section 6.1). Parenting skills training alone without intensive lifestyle education had a greater proportion of children reducing their BMI z score over 12 months, a significant reduction in waist circumference z score and some improvement in HR-QOL domains, which was not observed with waitlisting. However, the size of the reduction in BMI z score was no different to waitlisting. In addition, the reductions in overall and truncal adiposity and HR-QOL improvements in the parenting alone group were consistently less than that observed in the intervention with intensive lifestyle education. Parenting skills training, used in conjunction with intensive lifestyle education, may enhance treatment effectiveness.

In summary, the results suggest that both parenting skills training alone and in conjunction with intensive lifestyle education are more effective for managing childhood overweight than waitlisting for intervention. The results also indicate that intensive lifestyle education may enhance parents' ability to use a parent-led child behaviour modification component. This is supported by the differences in the results between the two intervention groups, together with intervention evaluation where parent feedback indicated that aspects of nutrition education (eg nutrition skills such as label reading, child feeding practices) may be important to facilitate parental ability to utilise the parenting skills within a child weight management context.

However without an intensive lifestyle education alone group, the relative role of parenting skills training and lifestyle education, or synergy between these treatment components remains unknown. Inclusion of a lifestyle education only group was considered in the design of this study, but was outside available resources. The parenting only, rather than lifestyle only, group was included to explore the belief that individuals have sufficient lifestyle knowledge but lack behaviour modification skills to support weight management (see section 1.8.1). The potential resource savings of the parenting skills training alone group, if effective, was also of interest.

The interpretation of this study is based on result trends using a broad criteria to assess intervention effectiveness. There were limited statistical differences between study groups, including the primary outcome. The unanticipated reductions observed in the control group, and a sample size calculation based only on the primary study outcome, may have limited study power contributing to risk of a type II error. In addition, intervention adherence and dilution of size of effect with intention to treat analysis, may also assist to explain why consistent trends favouring intervention did not convert to statistical significance. These factors may also explain why the results in the present study are moderate compared to previous studies (refer to sections 3.5.1, 6.2.1).

## **6.3 Study strengths and limitations**

### **6.3.1 Study strengths**

#### *6.3.1.1 Study design and implementation*

A randomised controlled design was used to evaluate the effectiveness of parent-led, family focused child weight management. The RCT design, including a concurrent 'no intervention' control group and random subject allocation stratified for gender and recruitment cohort, provided a strong design base and effective management of potential bias (see section 3.5.4) (252). A clear study population was defined to specify study generalisability. Additionally, the study was only the second to focus on a narrow age range, and young children (6-9 years) to ensure the intervention was age-appropriate (161). Previous studies have spanned developmental stages (143, 145, 146, 150) or focused on the range ~8-12 years (141, 181, 187, 194) which includes the transition between childhood and early adolescence.

This study addressed a number of design, implementation and/or reporting limitations present in the child weight management literature (128,(140)). These included 1) utilising recruitment and retention strategies to achieve the reported sample size calculation, and less than 20% drop out at 12 months, 2) blinded allocation and outcome assessment using validated tools, applicable to the age and weight status of the study sample, to minimise measurement bias, 3) intervention delivery using standard protocols and a single, trained facilitator to limit site bias and enhance internal study validity, 4) broad health outcome assessment (inclusive of adiposity and obesity-related health consequences) at 12 months which included a follow up period after treatment had ceased, and 5) performing primary analysis by 'intention to treat'.

The intention to treat analysis is of particular importance as it is the most appropriate method for assessing intervention effectiveness rather than efficacy (234). No studies in the child weight management literature have reported 'intention to treat' analysis. Therefore the literature reflects intervention efficacy, which often overestimates intervention effects and limits generalisability to the health care setting (140, 234). Intention to treat analysis using linear mixed modelling was used in this study. This is the most appropriate analysis method for unbalanced repeated measures data as it also manages the issue of missing data without reducing effect size or data variability (237).

#### *6.3.1.2 Age-appropriate, evidence-based intervention design*

The intervention development is another study strength. The interventions were based on recent evidence and aimed to replicate findings from a single previous study using parent-led child weight management (161, 165). The interventions focused on two areas of child weight management which may potentially improve long term effectiveness, 1) family-focussed management where parents are responsible for implementing change and monitoring progress and 2) a sustainable 'healthy lifestyle' rather than 'prescriptive' diet and activity component (see section 1.7.1).

Promoting parental skills to manage child lifestyle behaviours may increase the sustainability of a child weight management intervention and its application across changing phases of child growth and development. The interventions utilised a novel application of a previously validated general parenting skills training program to the area of child weight management. The parenting skills training program was chosen to maximise generalisability of study results, as it was designed for use in Australian children and facilitator training is widely available (198). The program was also chosen to utilise its self-regulatory framework, with parenting skills training conducted in a way to promote parental independence and efficacy. At early school age it is developmentally appropriate that parents hold the responsibility for managing their child's health and nutrition (161, 165, 191).

Behaviour modification frameworks based on self-management theory in adults and parent/shared-management theory in children have been found to be effective theory models in management of chronic conditions (191, 253, 254). However, the current study is the first in which a comprehensive behaviour modification model, based on parent-management and parental independence to initiate lifestyle changes has been utilised in child weight management (190, 207).

The dietary component used in conjunction with parenting skills training was in line with Australian recommendations and clinical practice (18) (159, 160, 255), theoretically achieves energy moderation in children (see appendix 6) (249), and promotes gradual, sustained family level dietary change. This may support maintenance, development of healthy food preferences and avoid development of restrictive eating practices (see also section 6.4.2.2). The physical activity component used in the parenting plus intensive lifestyle intervention promoted an 'active family lifestyle' using family-focused recommendations and fun, non-competitive child activity sessions. Multiple areas of physical activity including transport, play, exercise and time spent in sedentary pastimes were addressed. This may lead to increased confidence and child engagement in other opportunities for physical activity such as team sport and can impact on adult physical activity patterns (115, 116).

#### *6.3.1.3 Intervention evaluation*

Few studies to date have reported any intervention evaluation measures. This has been highlighted as an area for further research to explore study results, identifying factors leading to success or failure (140). Therefore the process and impact evaluation data presented in chapter 5 is a strength of this study. Process evaluation indicated that parents in both intervention groups were satisfied with the parent-led, family focused approach. They reported the intervention provided the type of help they wanted to assist with child weight management.

This suggests that interventions focusing on supporting parents to manage a child's eating and activity behaviour (for example through use of parenting skills training) are in line with parents' expectations. Impact evaluation also showed a trend for reductions in BMI and waist circumferences of mothers and fathers following active intervention. This suggests that family-focused intervention may benefit families of overweight children, important given the familial clustering of overweight (14). Interpretation of the study evaluation does warrant consideration of some of its limitations, which are discussed in section 6.3.2.2.

## **6.3.2 Study limitations**

### *6.3.2.1 Differences in therapist contact and intervention attendance*

In interpreting the study findings, some limitations in the intervention structure and implementation need to be considered. Varying the degree of lifestyle education between the two intervention groups and minimising potential Hawthorn effect secondary to contact with the wait listed control group resulted in differences in the level of therapist contact between the study groups (Table 2.2). This is a potential source of intervention bias, with the greater therapist contact a possible explanation for study trends favouring parenting skills training plus intensive lifestyle education.

Average attendance to the intervention sessions, while similar between the two interventions, was ~60%. The similar rates between the two interventions indicate that attendance was not a source of intervention bias. However, the exposure in both interventions was less than anticipated and raises the possibility that the intervention effect was diluted. While not supported by the 'per protocol' analysis as it did not differ to the intention to treat results, the secondary analysis only included 37 families who attended >75% of intervention sessions. In future studies it would be useful to measure actual adherence rather than using attendance as a proxy. In built adherence assessment such as monitoring goal setting/achievement would also provide additional information on intervention use. While these monitoring measures could potentially improve parental accountability and adherence, they may also be considered a type of intervention (Table 1.4).

### 6.3.2.2 *Study power*

Despite achieving the calculated sample size and being one of the largest RCTs to date in the child weight management literature, insufficient study power is likely. A sample size of 126 (42 per group) was estimated to have 80% power to detect a conservative but clinically relevant 12 month reduction in BMI z score of 0.26 in the intervention groups, assuming 30% drop out (see section 2.5.1). Based on previous waitlisted control groups (149, 186, 187) it was anticipated that there would be no change or an increase in adiposity in the control group. This assumption is supported by Australian trends for low spontaneous remission of child overweight (34). So while recruitment was slow and was limited by 1) the need to balance recruitment against the prompt delivery of group intervention and 2) the timeline for completion of doctoral studies, the final number needed at 12 months was 88, with 91 subjects attending 12 month follow up.

However the reductions in adiposity in the wait listed control group were not anticipated and are likely to have affected study power. The concurrent control group was a volunteer sample, aware of the study purpose and 12 month follow up. They needed to have identified their child as overweight and be motivated to address child overweight to enquire about the study. The changes in adiposity and health behaviours observed in the waitlisted study group were not anticipated and are a study limitation. The results raise the following possibilities, 1) that enrolment in the study may have been a sufficient intervention to achieve necessary lifestyle change for child weight management in families ready to change, 2) these results increase risk of a type II error as sample size calculations were based on the assumption of no change in the control group, and 3) that the waitlisted control were not a true 'no control' group as they undertook lifestyle changes during waitlisting.



The results have implications for the design of child weight management studies and health service delivery. In the current climate of significant coverage of the issue of childhood overweight, it may not be possible to conduct child weight management studies that include a 'no intervention' control using volunteer recruitment. Another interpretation is that there may be simple strategies that can facilitate child weight management in motivated families. An example of this would be routine monitoring of growth of children through schools or medical practitioners with provision of simple 'healthy family living' messages. However while some trends for improvement were observed in the waitlisted group, the extent of change and limited improvements in broader health outcomes, particularly improved indicators of psychosocial health, still favour intervention.

Additionally, while stratified for gender at randomisation, differences in treatment responses by gender were not anticipated. Therefore the study was not powered to undertake formal gender sub-analysis, limiting interpretation of study findings. While there were no differences in results when only those families that attended >75% of study sessions compared to the intention to treat analysis, the small sample size also prevents any firm conclusions being drawn from this secondary analysis.

#### *6.3.2.3 Outcome assessment tools*

Despite a number of strengths associated with the study outcome assessment tools (see section 3.3.1.1), there were also limitations. Tool repeatability and sensitivity to detect change has not been validated for dietary and activity patterns assessment and body dissatisfaction tools. While the questions in the activity behaviour inventory were based on validated tools, validation in its present form was not conducted.

Energy and nutrient intake were not assessed given the flaws discussed in section 5.4.2. Instead food intake was assessed against the nutrition education tool used in the interventions (refer to section 5.4.2). The tool, developed for the purposes of the study, was validated against a 4 day food record (appendix 4). Validation results indicated parents overestimated child intake according to serves per day of each food group. Therefore this needs to be considered when interpreting eating behaviour results. Additionally, validation of parents' ability to estimate intake of 'extras foods' was not performed and there was no assessment of beverage intake.

In future studies, it would be worth utilising tools which have been validated and measure eating behaviours rather than/or in addition to actual intake (256, 257). These tools may also be useful in assessing relevant aspects of parenting in relation to child feeding practices. In the present study, parenting competency was assessed which was in line with standard evaluation of Triple P (207). At baseline overall parenting competency was high and there were not intervention-specific changes over time observed. Given the theory base available in terms of parenting techniques and styles associated with child feeding and development of healthy eating practices/overweight, evaluation of actual parenting style, child feeding behaviour and family eating behaviour may be more relevant than perceived parenting competency (see section 1.5.3) (258).

#### **6.4 Potential bias and study generalisability**

The study recruitment strategies resulted in two thirds of subjects being girls. While potential sampling bias was minimised by gender stratified randomisation, the imbalance in subject gender recruitment does have implications for study generalisability. Additionally, 18% of families did not attend 12 months follow up. While drop out was not different between study groups, children who did not attend follow up tended to be older and heavier children. So while there did not appear to be any systematic selection or follow up bias influencing study outcomes, the follow up patterns and intervention response by gender have implications for study generalisability.

The study sample was relatively homogeneous being female, obese, middle class and from overweight families and having overweight parents. This is similar to samples recruited in other studies which have also relied on volunteer recruitment (140). Study generalisability should be considered with the following in mind, 1) recruitment relied on volunteers who had to be aware of their child's weight status and motivated or ready to change, 2) younger and less obese children were more likely to attend 12 month follow up, and 3) while the majority of children recruited were girls, the interventions appeared to favour treatment effectiveness in boys. However this study is the first intervention in overweight Australian children reported since the mid-1980s and is directly generalisable to the Australian health care setting. This study also responds to the call for replication of studies outside of the US-based Epstein group (128, 140). It is also only the second study to have assessed the effectiveness of parent-led, family focused child weight management (161).

Future studies need to address the bias introduced by volunteer recruitment favouring studies of homogeneous, middle class, English-speaking samples. Given the likely social gradient of obesity (130), and possible variations in the aetiological mechanisms functioning in different populations (259), trialling of interventions with a range of populations is crucial. Results from this study and a previous report (241) also highlight the need to be able to analyse any differences in intervention response between boys and girls. This may have implications on intervention effectiveness and the needs of service delivery.

## **6.5 Implications for practice and future directions**

### **6.3.3 Implications for practice**

As highlighted in Table 1.6, while there is evidence from well designed RCTs to support family involvement in child weight management, recommendations around dietary management and age-appropriate behaviour modification for child weight management are level D, based on expert opinion (199).

This study strengthens the evidence base for practice recommendations by 1) supporting promotion of children's eating in line with the Australian dietary guidelines using the AGHE as modelling performed during intervention development show that the AGHE can theoretically reduce energy in Australian children's diets (249, appendix 6), 2) supporting a previous study (161) indicating that parents rather than children as the 'agent of change' may be the most appropriate form of family support for weight management in young children, and 3) indicate that use of general parenting skills training may be an age-appropriate behaviour modification strategy in young (6-9 year old) children. The moderate intervention effect observed in this study highlights the need for treatment beyond 6 months. This supports the view that treatment of overweight in childhood requires a sustained effort over a long period of time, likely 2+ years (260). This is explored further in section 6.5.2.1 below.

Metabolic consequences were commonly identified in this young, overweight community-based sample. However, while the changes in adiposity approximated clinically relevant weight outcomes, this did not translate to improved metabolic profile. While it is possible that this was secondary to insufficient power to detect changes in metabolic profile, it also highlights the need to ensure that the clinical expectations for weight change in children are appropriate. We need to ensure that treatment has the ability to improve health outcomes, not just reduce adiposity. Impaired psychosocial health indicators were also common in this young sample of overweight children. This highlights the need to assess psychosocial health as part of managing childhood overweight and ensure that treatment approaches do not have any negative impact on psychosocial health. There is also the need to design treatment strategies that may in fact improve psychosocial wellbeing with or independent of weight change. The intervention approach in this study did 'no harm', with positive benefits to self-esteem identified.

Finally the study results, in particular the process evaluation relating to session attendance has implications for intervention design and service delivery. While parents in this study were satisfied with the intervention approach, factors such as work, family commitments and time were reported as barriers to parent attendance at intervention sessions and intervention implementation. Given that it is crucial to have positive family and child outcomes and the need to manage limited health resources, ways to deliver flexible and realistic interventions and facilitate commitment to engagement in the interventions is needed. As discussed in section 6.4.2.2 below, research into ways to screen predictors for intervention failure or success and flexible program delivery may be useful to address these issues.

### **6.3.4 Future directions**

#### *6.3.4.1 Raising awareness of child overweight as a public health issue*

At the time this study was conducted, there was a lack of services for child weight management in Adelaide, and over 1 in 5 Australian children were overweight. Despite this, study recruitment proved difficult taking 12 months to recruit 111 families of 6-9 year olds. Children in this age group are not covered by routine monitoring of growth through either schools or health care settings. There are also low levels of awareness or concern amongst parents and health professionals about child overweight and its health consequences (38, 39). These factors are likely to impact on families' identification of child overweight and readiness for action or change. Therefore, raising awareness of the issue of child overweight is likely to still be an important strategy in both conducting obesity-related research and addressing the obesity epidemic. It may be necessary to look at screening of child growth as a study recruitment strategy, which would also address sampling bias introduced by relying on community volunteers.

#### 6.3.4.2 *Areas for further research into effective parent-led, family focused weight management for young children*

Following on from this study and the literature review in chapter 1, examples of areas for future research into child weight management include, 1) assessment of the long term effectiveness of parent-led, family focused child weight management, 2) managing maintenance or changing developmental needs using 'booster' intervention sessions, 3) comparison of dietary approaches in child weight management and 4) improving intervention adherence by looking to match interventions to the needs of families (eg flexible intervention delivery models, engaging low SES families) or children (eg for boys versus girls).

Given that 1) treatment of childhood overweight via growth with a slowed weight trajectory is likely to require long term treatment (>2 years) to normalise weight status (260) and 2) previous family-focused treatment in 6-11 year olds observed reductions in percent overweight through to 8 years follow up (162), it is important to assess the short, medium and long term effectiveness of interventions. However, given that long term follow up of child weight management studies will span a range of child development phases with changing needs, it may be useful to link follow up to 'booster' intervention sessions. These sessions could be tailored to be developmentally appropriate for the age of child at follow up. For example in older children intervention could start to involve the child in education. This would assist with subject retention in follow up studies, but more importantly acknowledge the chronic nature of childhood overweight. Booster sessions would allow treatment to be tailored to the needs of children as they change with growth and development, address issues of adherence and limited resources and explore the area of maintenance in addition to treatment.

Attendance at intervention sessions was a limitation in this study. Parent satisfaction suggested that missing intervention sessions was not secondary to the program not meeting their needs. Rather it reportedly related to factors such as time, family and work commitments. This may be reflective of societal changes, with parents having to manage multiple family priorities with family lifestyle receiving limited attention. In future studies, flexible intervention delivery options could be incorporated to address this. It would be possible to deliver the same intervention messages, but having families choose a delivery mode suitable to their needs (eg group-based interventions in a range of locations, self-study programs, use of e-mail and phone contact etc...). Use of adherence measures and stratification for choice of intervention could allow choice of education model to accommodate intervention flexibility, within the restraints of a RCT design.

In addition to characteristics of interventions that may predict or assist with success, research also needs to investigate the characteristics of children and families which may predict success. This would allow the development of screening tools to match treatment approaches to family needs. Many methods could be utilised to explore family and program characteristics that predict outcome. These include regression or factor analysis to look at what factors predict outcome, gender sub analysis, intervention adherence information and qualitative information. Some work in the area of qualitative research has provided useful information by exploring parents perception of their children diet (100, 261, 262). However this information or research methodology has not yet been applied to families during treatment for child overweight.

Finally, diet manipulation is a key strategy for promoting weight change. However, the focus in the child weight management literature has centred on the role of behavioural strategies and physical/sedentary activity in management. No randomised controlled trial longer than 6 months duration (intervention or follow up) has assessed the relative effectiveness of different dietary approaches for management childhood overweight (140).

There are no reviews in this area which consider the question of 'what is the best dietary approach for child weight management'. The literature is dominated by one approach from a single research group, the traffic light diet, which has only been evaluated within a behaviour therapy framework and has not been compared against any other dietary approach. There is an urgent need to conduct trials in child populations in which the primary research objective centres around direct comparison of dietary approaches. In particular different macronutrient profiles, healthy eating (unstructured) versus dietary prescription (structured), and the role of low fat products that are high in sugar (eg low fat plus/minus low fat products) need to be explored. These studies need to be carefully planned considering dietary composition, mode of nutrition education, target of education and assessment of dietary compliance.

#### *6.3.4.3 Beyond individual behaviour change*

Child weight management studies conducted in the last few decades have been implemented within an obesogenic environment. Given that current behaviour modification theories (Table 1.4) only predict around 30% of the variation in eating behaviours, behaviour modification strategies commonly used may be inadequate to facilitate long term change in eating and activity behaviours (130, 135). The influence of non-(child) individual factors that influence children's lifestyle (eg external factors such as family and child's environment) and attention to issues relating to the barriers in initiating and maintaining lifestyle changes and addressing relapse are two areas not adequately researched. There is evidence from the theoretical and aetiological literature supporting the role of a number of environmental influences in the development of childhood overweight factors (eg child feeding practices and parental modelling) which are yet to be evaluated in terms of environmental interventions in the prevention and management of overweight in childhood (101).



## **6.4 Conclusion**

In conclusion, a parent-led family-focused intervention utilising parenting skills training and promoting a healthy family lifestyle is a promising weight management approach for young children. Results from this study suggest that a 10% reduction in adiposity may be expected and that both parenting skills training and lifestyle education are important components. The main strengths of this intervention approach include 1) that it is age-appropriate, 2) potentially sustainable long term, 3) provides a means of addressing the family and parental factors influencing children's eating and activity behaviours and 4) achieves moderate changes in adiposity levels, together with reversal of obesity-related health consequences such as impaired self esteem and health-related quality of life.

Research is required with a larger sample size to further evaluate parent-led, family-focused child weight management. Potential gender differences in treatment response also need to be examined and the relative role of treatment components explored. Ways to increase treatment effect and adherence, for example through 1) the use of treatment booster sessions adapted for changing child development phase, 2) examining factors that predict positive child weight management outcomes and 3) intervention delivery using flexible education models are possibilities that may greatly extend research and practice in the area of child weight management.



**FAMILY-FOCUSED MANAGEMENT  
OF OVERWEIGHT IN  
PRE-PUBERTAL CHILDREN –  
A RANDOMISED CONTROLLED TRIAL**

The Healthy Eating and Lifestyle  
through Positive Parenting (HELPP)  
study

Volume Two

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Submitted in fulfilment of the requirements  
for the degree of Doctor of Philosophy

December 2005

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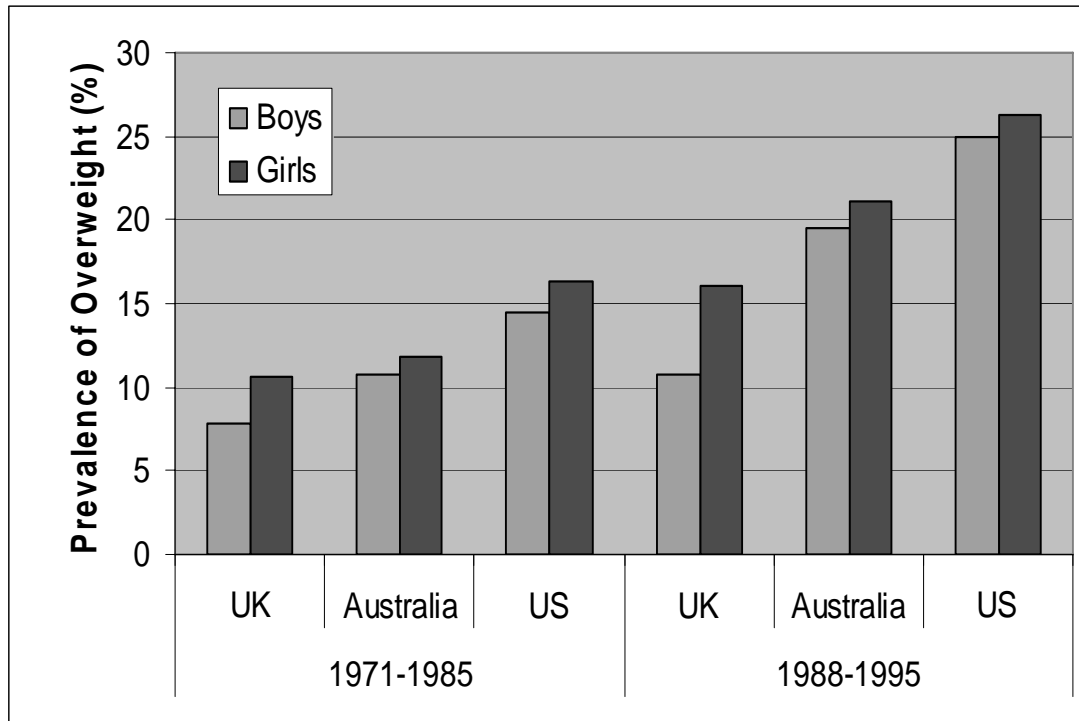
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## Tables and Figures Chapter 1



**Figure 1.1 The World Health Organisation multi-level public health approach to address the obesity epidemic utilising both prevention and management strategies. The size of each element represents its relative contribution (Reproduced from (1))**





<sup>1</sup> International standard definition proposed by the International Obesity Taskforce, includes overweight and obesity (20)

<sup>2</sup> UK 4-11 year olds 1974 data n=8010, 1994 data n=5874; Australia 7-15 year olds 1985 data n=8492, 2-18 year olds 1995 data n=2962; US 9-19 year olds 1971-1974 NHANES I data n=4472, 1988-1994 NHANES II data n=6108 (6, 35, 36)

**Figure 1.2 Prevalence of overweight<sup>1</sup> in children from the United Kingdom (UK), Australia and the United States (US) between 1971-1985<sup>2</sup> and 1988-1995<sup>2</sup>**

**Table 1.1 The health consequences associated with childhood overweight by relative prevalence (adapted from (1, 77))**

High Prevalence <sup>1</sup>	Intermediate Prevalence <sup>2</sup>	Low Prevalence <sup>2</sup>
<ul style="list-style-type: none"> <li>▪ Accelerated growth</li> <li>▪ Early sexual maturation</li> <li>▪ Poor psychosocial well being (eg low self esteem, body dissatisfaction, impaired family functioning)</li> <li>▪ Persistence of overweight into adulthood (late onset and severe obesity)</li> <li>▪ Dyslipidaemia</li> <li>▪ Elevated blood pressure</li> </ul>	<ul style="list-style-type: none"> <li>▪ Hepatic steatosis</li> <li>▪ Raised liver enzymes (~10% obese children)</li> <li>▪ Abnormal glucose metabolism (eg 25% of children with <i>Acanthosis nigricans</i> are obese, Type 2 diabetes incidence in US adolescents increased 10-fold 1982 to present)</li> <li>▪ Persistence into adulthood (varies by age of onset and severity)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Orthopaedic conditions (eg 30-50% of children with slipped capital femoral epiphysis are overweight)</li> <li>▪ Sleep apnoea (eg 7% of obese children, with &gt;30% obese children have breathing difficulty)</li> <li>▪ Polycystic ovary syndrome (in adolescence)</li> <li>▪ Pseudotumour cerebri (rare but 50% of cases are obese children)</li> <li>▪ Cholelithiasis (50% of adolescent cases are obese)</li> <li>▪ Hypertension (1% of 5-18 year olds, 60% are overweight)</li> </ul>

<sup>1</sup> Details of actual prevalence rates discussed in text (see section 1.4) <sup>2</sup> Details of prevalence rates given were possible

**Table 1.2 Prevalence rates of the Metabolic Syndrome (MS) in adults and children**

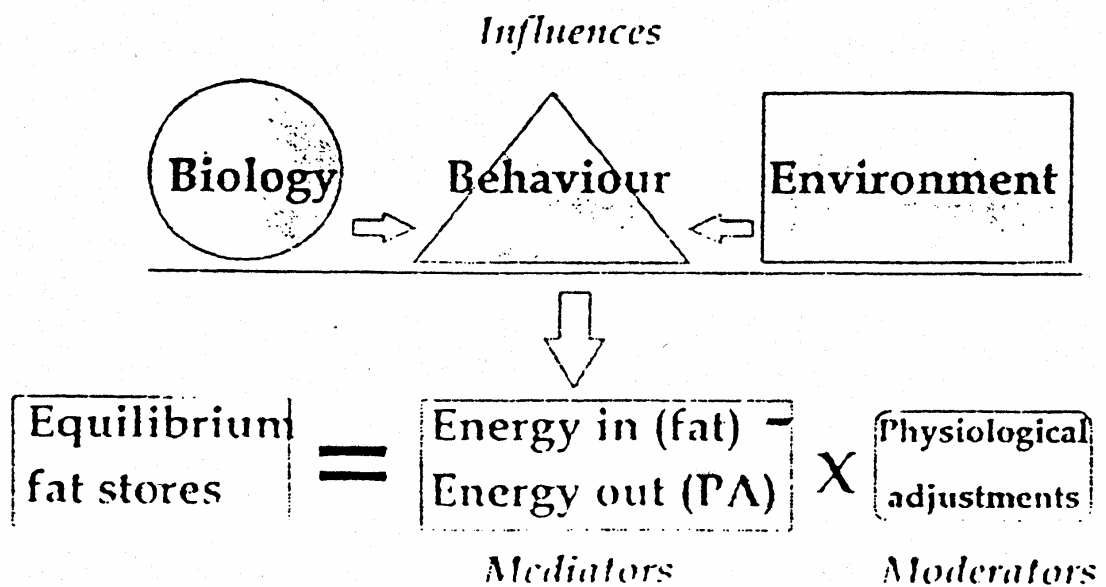
Author & setting	Population	MS definition and risk factor cut points	Prevalence
<b>Adults</b>			
Ford 2004 (53)	Male and female $\geq 20$ years. N=6436	NCEP <sup>1</sup>	NHANES III 24%
US nationally representative	NHANES (1988-1994) 38% truncal obesity and N=1677 NHANES 1999-2000 44% truncal obesity	Waist >102cm men/>88cm women, TG $\geq 1.7$ mmol/L, HDL-C < 1.0mmol/L men/ <1.2mmol/L women, BP $\geq 130/85$ , Glucose $\geq 6.1$ mmol/L	NHANES 1999-2000 27% (p=0.09)
<b>Adolescents</b>			
Goodman 2004 (56) US Schools	N=1513, 12-19 years, 2% pre pubertal, majority white/black, 60% female	WHO <sup>2</sup> and NCEP. BP $\geq 85/130$ mmHg, waist >102cm men/>88cm women (BMI >95 <sup>th</sup> WHO), HDL-C <40mmol/L, glucose > 110 mg/dL, high insulin (WHO only, no cut point given)	4% NCEP 8% WHO (20-39% in obese)
Cook 2003 (54) US Community	NHANES III, 12-19 years, N=2316 tri racial	Presence of 3 risk factors (no insulin) Waist $\geq 90^{\text{th}}$ centile age/gender, Glucose $\geq 110$ mg/dL, BP $\geq 90^{\text{th}}$ centile for ht/age/ gender, TG >110 mg/dL, HDL-C <40mg/dL	4% 29% in overweight
Chen 1999 (218) US Community	Bogalusa, 5-17 years, n=5758, biracial	Presence of 4 risk factors; BMI, HT, TG/HDL-C ratio, insulin >75 <sup>th</sup> centile for age and gender (internal cut points)	4%
Rodriguez 2004 (57) Mexico Community	N=965 (13 $\pm$ 3years), 52% female, 29% overweight	NCEP, WHO AAC <sup>3</sup> , EGIR <sup>4</sup> , REGODCI5. SBP/DBP, BMI, TG $\geq 80^{\text{th}}$ centile for age and sex. Glucose $\geq 6.1$ mmol/L	4-8% 26% in obese.

<sup>1</sup> National Cholesterol Education Program – Presence of 3 or more (of 5) risk factors (8) <sup>2</sup> World Health Organisation - Presence of insulin plus 2 (of 3) other RF (9) <sup>3</sup> American Association of Clinical Endocrinologists (10) <sup>4</sup> European Group for the study of Insulin Resistance (11), <sup>5</sup> Research Group on Diabetes and Chronic Illness (NCEP modified for children using US cut points for lipids and blood pressure) (10)

**Table 1.2 cont. Prevalence rates of the Metabolic Syndrome (MS) in adults and children**

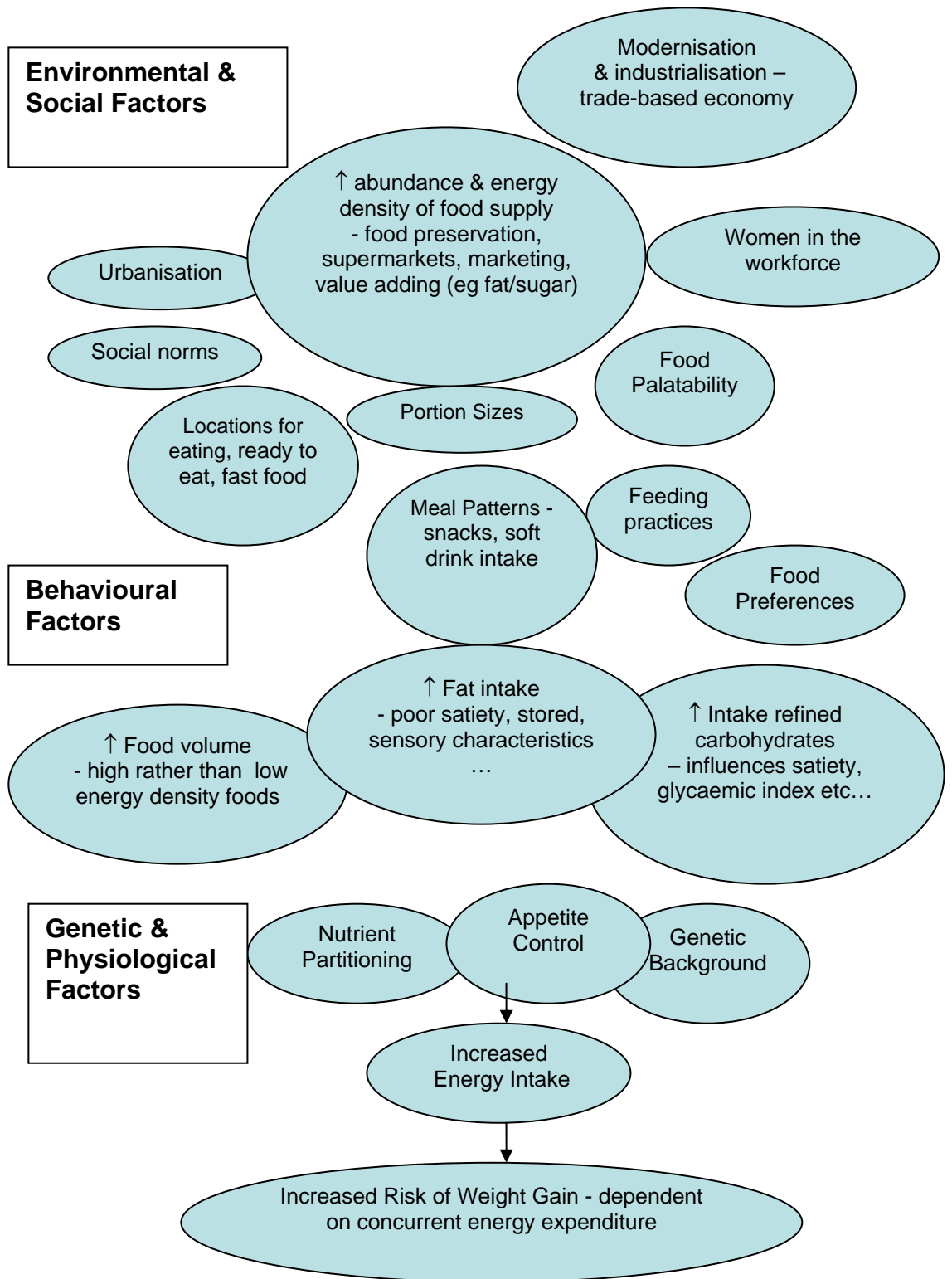
Author & setting	Population	MS Definition and risk factor cut points	Prevalence
<b>Children</b>			
Viner 2003 (58)	N=103, undergoing assessment of obesity	WHO modified for children.	33%
UK Obesity clinic, data retrospective & prospective	(BMI $\geq$ 95 <sup>th</sup> UK centile, no genetic/medical cause), 2-18 year, 35% male, 72% z score >3.0, 38% pre-pubertal	BMI $\geq$ 95 <sup>th</sup> UK centile for age and sex, Impaired glucose homeostasis (insulin $\geq$ 15/30/20 mU/L re Tanner <2/2-3/post) or glucose $\geq$ 6.1mM/L or glucose at 120min $\geq$ 7.8mM/l, SBP $\geq$ 95 <sup>th</sup> centile (US), Any of TG $\geq$ 1.75mm/L, HDL-C<0.9mm/L, TC $\geq$ 95 <sup>th</sup> centile, normative US data	35 versus 28% BMI z score < versus >3.0 NS
Weiss 2004 US obese sample Clinical setting	439 4-20 <u>obese</u> children BMI>97 <sup>th</sup> centile (US)	NCEP and WHO modified BMI z score $\geq$ 2 (severe >2.5), BP >95 <sup>th</sup> centile (US), TG >95 <sup>th</sup> centile (US), HDL<5 <sup>th</sup> centile (US), Glucose >7.8mM/l at 2 hours, Insulin >15 HOMA score (ref)	39% BMI z score $\geq$ 2, 50% BMI z score >2.5, 0% in normal-over-weight
Lambert 2004 Canada Community (school)	9, 13, 16 n=2244	Definition 1 Any 3 variables listed, Definition 2 hyperinsulinaemia + any 2 of the variables listed BMI $\geq$ 85 <sup>th</sup> P, Insulin $\geq$ 75 <sup>th</sup> P, HDL-C $\leq$ 25 <sup>th</sup> P, TG $\geq$ 75 <sup>th</sup> P, SBP $\geq$ 75 <sup>th</sup> P Ht-specific, Glucose $\geq$ 6.1 $\leq$ 7.0mmol/l	Definition 1 14% Definition 2 12%

<sup>1</sup> National Cholesterol Education Program – Presence of 3 or more (of 5) risk factors (8) <sup>2</sup> World Health Organisation - Presence of insulin plus 2 (of 3) other RF (9) <sup>3</sup> American Association of Clinical Endocrinologists (10) <sup>4</sup> European Group for the study of Insulin Resistance (11), <sup>5</sup> Research Group on Diabetes and Chronic Illness (NCEP modified for children using US cut points for lipids and blood pressure) (10)

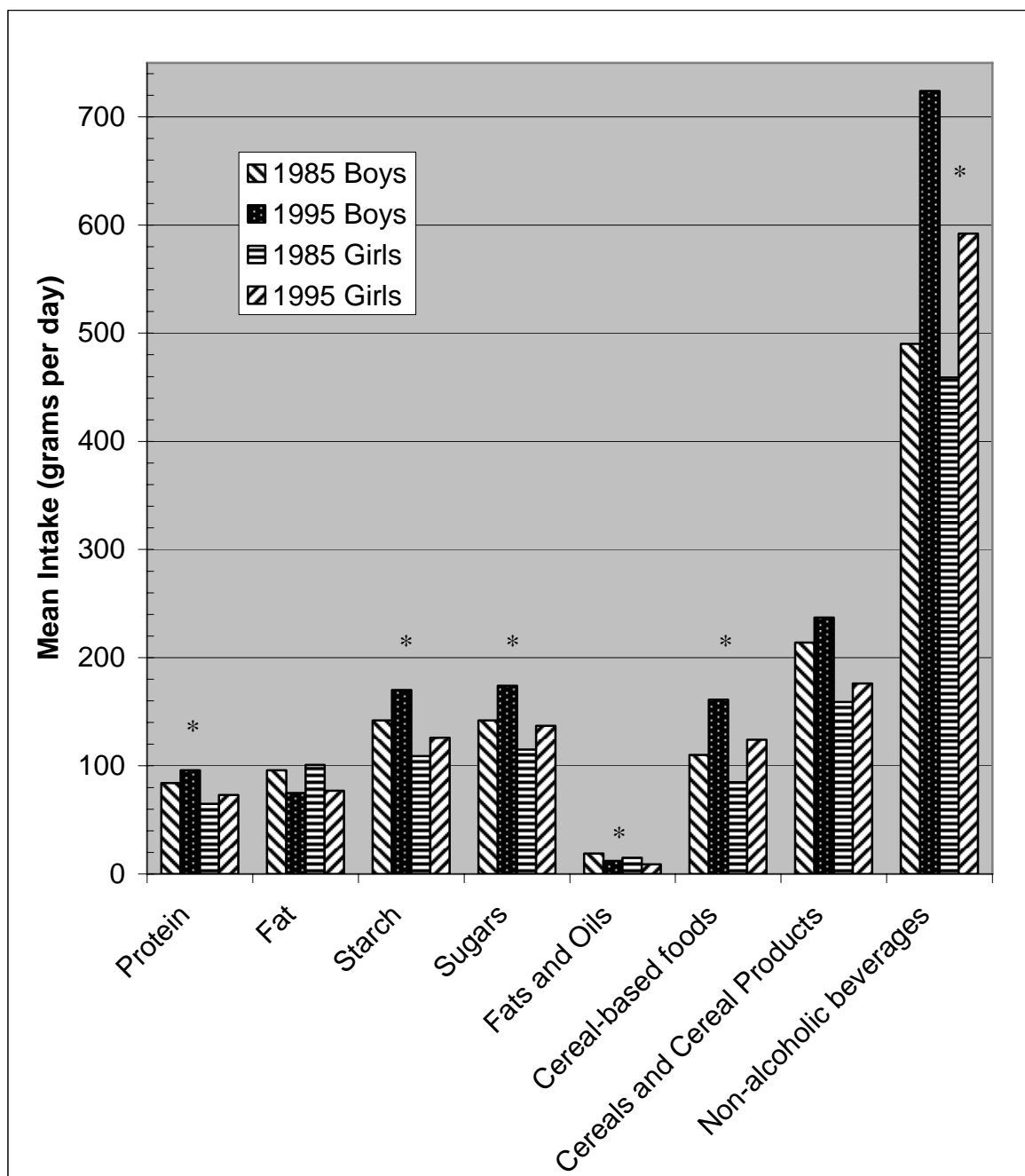


**FIG. 1.** An ecological model for understanding obesity (PA, physical activity).

Figure 1.3 Aetiological model of overweight as the interaction between genetic, physiological, behavioural and environmental factors (reproduced from (79))

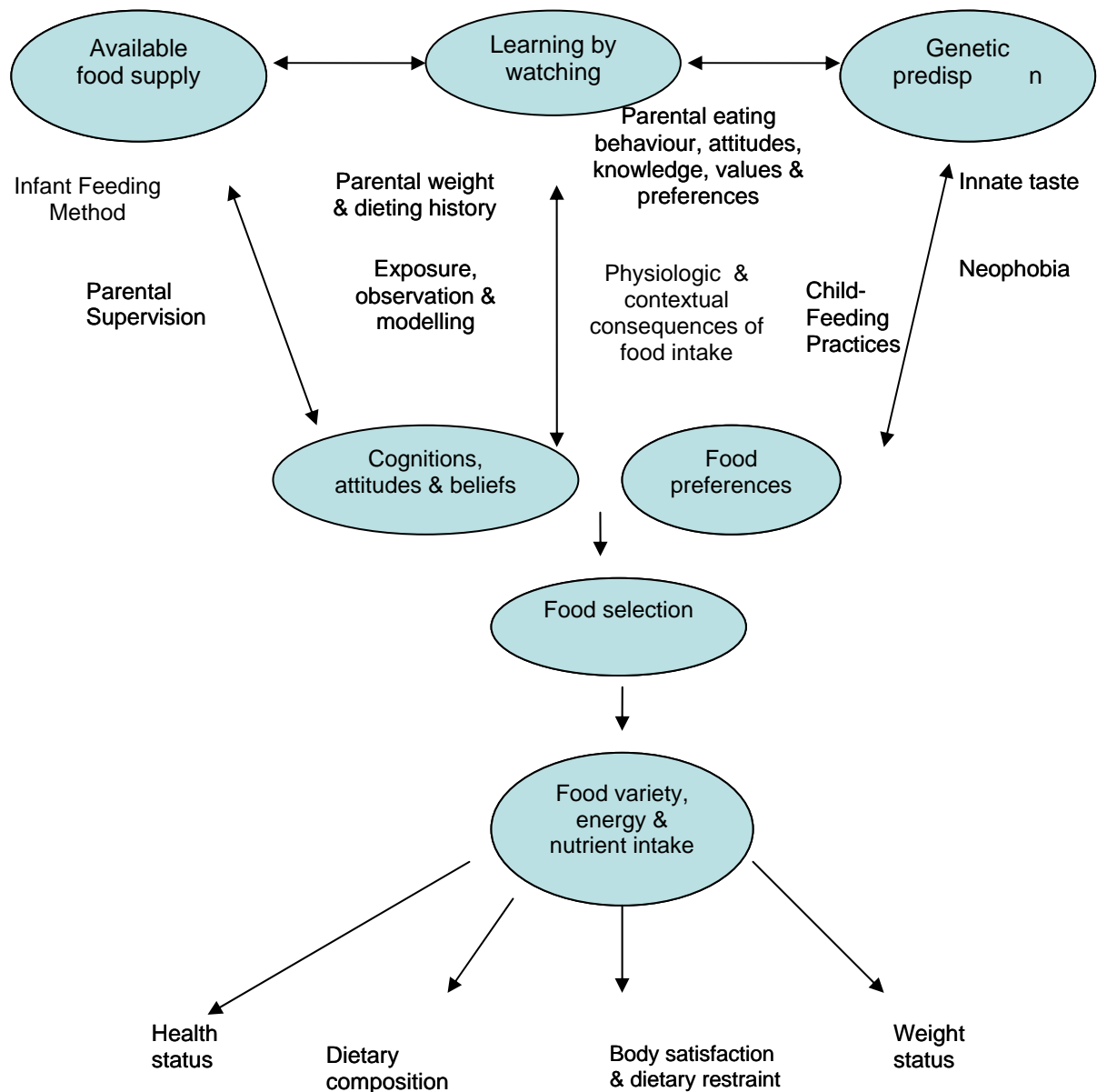


**Figure 1.4 Dietary factors involved in the aetiology overweight**



\*  $p < 0.05$  comparing intake 1985 and 1995 for boys and girls

**Figure 1.5 Changes in selected nutrient and food intake of Australian boys and girls aged 10-15 years between 1985 and 1995 (85)**



**Figure 1.6 Parental and family factors influencing children's food preferences, eating beliefs and habits (adapted from (102, 103, 106)**



**Table 1.3 Summary of systematic reviews of the effectiveness of dietary approaches for adult weight management versus no treatment (124) or each other (125, 126)**

	Number of studies	Mean (CI) weight change (kg) (p<0.05 unless indicated, not significant NS)	
		12 months	>12 months
<b>Avenell 2004 (124)</b>			
<u>Low fat diet (LFD)</u> reduced fat (not specified) & energy (>6.7MJ/d)	13 (n=2081)	-5.31 (-5.86;-4.77)	60 months follow up (3 studies) -0.20 (-2.03;1.63, NS)
<u>Low calorie diet (LCD)</u> 4.2-6.7 MJ/d	1 (n=58, an adjunct therapy for post menopausal breast cancer)	-6.25 (-9.05; -3.45)	36 months follow up -6.1 (-10.7;-1.49, NS)
<u>Very low calorie diet (VLCD)</u> , <4.2 MJ/d	1 (n=38, looking at asthma)	-13.4 (-18.4;-8.4)	Nil follow up >12 months
	1 (versus LFD, n =16)	nil	24months -4.7 (-11.8;2.39, NS)
	2 (versus LCD, n=133)	-0.2 (-2.7;2.4, NS)	NS18mth -1.1 (-5.3;3.1, NS)
<u>Protein Sparing Modified Fast</u> Carbohydrates <40g/d	6 (versus LCDs, n=391 )	-3.6 (-7.4;2.2)	60 months follow up 0.2 (-5.7;6.1, NS)
<b>Pirozzo 2003 (125)</b>			
<u>Low Fat Diet</u> (3 20% fat, 3 unknown)	6 (n=594, 92% female)	1.1 (-1.6;3.8, NS)	18 months follow up 3.7 (-1.8;9.2, NS)
<b>Raben 2002 (126)</b>			
<u>Low glycaemic index (GI)</u>	20 (13 isoenergetic, 5 energy- restricted, 2 ad libitum energy)	-1.5±0.7kg low GI versus -1.6±0.5 low GI/control (NS)	nil

**Table 1.4 Overview of behaviour modification strategies used in weight management programs (adapted from (134, 179, 180))**

<b>Behaviour modification approaches</b>	<b>Theory base</b>	<b>Examples of strategies</b>
<b>Stimulus control</b>	<ul style="list-style-type: none"> <li>▪ Social learning principles - behaviour is acquired and maintained according to the antecedents, actual and consequences of behaviour</li> </ul>	<ul style="list-style-type: none"> <li>▪ Avoid shopping when hungry, shop from a list, eat at scheduled times, store food out of sight, practice declining food at parties, prepare one portion at a time, get support from friends and family</li> </ul>
<b>Positive reinforcement</b>		
<b>Management of eating behaviours</b>	<ul style="list-style-type: none"> <li>▪ Developed as therapist evaluation tool but found in itself to be effective strategy</li> </ul>	<ul style="list-style-type: none"> <li>▪ Keep a food and activity diary including time/place eating/type amount food/who present/feelings</li> </ul>
<b>Self-monitoring</b>		
<b>Nutrition and activity education</b>	<ul style="list-style-type: none"> <li>▪ Knowledge (declarative and procedural) changes behaviour</li> </ul>	<ul style="list-style-type: none"> <li>▪ Learn risks and benefits of overweight, make small sustained changes, learn how to label read</li> </ul>
<b>Cognitive restructuring</b>	<ul style="list-style-type: none"> <li>▪ Cognitive behaviour therapy – that behaviour is influenced by thoughts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Avoid unreasonable goals, focus on progress rather than failures or shortcomings</li> </ul>
<b>Parenting skills in child behaviour modification</b>	<ul style="list-style-type: none"> <li>▪ Social learning principles and child development theory – that children learn from observing those around them</li> </ul>	<ul style="list-style-type: none"> <li>▪ Being contingent and consistent, observant, able to reward, praise, modelling, limit setting. Managing resistance. Focus on support not policing failures</li> </ul>
<b>Goal setting and problem solving</b>	<ul style="list-style-type: none"> <li>▪ Maintenance and relapse prevention</li> </ul>	<ul style="list-style-type: none"> <li>▪ Contracting (behaviour and outcome), planning and preparation to overcome high risk situations</li> </ul>

**Table 1.5 Features of the Family Behavioural Weight Management Program which has been published extensively by Epstein and colleagues (summarised from (15, 138, 139))**

<b>Features</b>	<b>Description</b>
<b>Study Design</b>	<ul style="list-style-type: none"> <li>▪ Series of controlled outcome trials, unclear randomisation</li> <li>▪ Wait listed control or parallel treatment arm (~10 subjects/arm)</li> </ul>
<b>Setting</b>	<ul style="list-style-type: none"> <li>▪ Child Weight Control Clinic, University of Pittsburgh, United States</li> <li>▪ Sessions conducted by psychologists with a range of experience &amp; training (including students)</li> </ul>
<b>Population</b>	<ul style="list-style-type: none"> <li>▪ Families recruited via physicians &amp; newspaper adverts</li> <li>▪ Children; 8-12 years, 120-180% ideal weight for height, no behavioural, psychological, medical or physical conditions contraindicating weight (diet or activity) management</li> <li>▪ Parents; overweight, motivated, willing to attend all sessions &amp; able to complete homework, 'middle class'</li> </ul>
<b>Program</b>	<ul style="list-style-type: none"> <li>▪ Relative weight &lt;120% ideal weight for height</li> </ul>
<b>Aim</b>	<ul style="list-style-type: none"> <li>▪ Appropriate growth &amp; development</li> <li>▪ Nutrition education to support maintenance</li> <li>▪ Age-appropriate including addressing parental influences</li> </ul>
<b>Intervention</b>	<ul style="list-style-type: none"> <li>▪ Dietary - ~1200kcal/day Traffic Light Diet (see Table 1.9)</li> </ul>
<b>Components</b>	<ul style="list-style-type: none"> <li>▪ Activity - aerobics or lifestyle program (300-2800kcal/week)</li> <li>▪ Behavioural – comprehensive &amp; standardised (contingency management, self-monitoring weight &amp; behaviours, social learning principles, contracting, limited parenting skills)</li> <li>▪ Family support – child or shared responsibility</li> <li>▪ Group &amp; individual therapy (parent &amp; child separately)</li> <li>▪ 2-6 months treatment, 4-6 months maintenance, decreasing frequency of sessions (weekly to monthly)</li> </ul>
<b>Follow up</b>	<ul style="list-style-type: none"> <li>▪ Drop out 10 to 25%</li> <li>▪ Program &amp; follow up attendance facilitated by monetary incentive (deposit system)</li> </ul>

**Table 1.6 Summary of the National Health and Medical Research Council recommendations for conventional treatment in the Clinical Practice Guidelines for Management of Overweight and Obesity in Children and Adolescents (15)**

<b>Treatment component</b>	<b>Recommendation for practice</b>	<b>Evidence level<sup>1</sup></b>
<b>Overall approach</b>	<ul style="list-style-type: none"> <li>▪ Start management of overweight in childhood.</li> <li>▪ For young children weight maintenance rather than weight loss is appropriate</li> <li>▪ Make use of all conventional cornerstones or components of weight management – dietary, increased physical activity, decreased sedentary activity, family involvement and behaviour modification as the relative importance of each is unknown</li> </ul>	C
<b>Dietary</b>	<ul style="list-style-type: none"> <li>▪ Children and adolescents should be encouraged to follow the Australian dietary guidelines for children using the Australian Guide to Healthy Eating.</li> <li>▪ Studies are needed to determine the optimal dietary prescription for child weight management</li> </ul>	D
<b>Activity</b>		
<b>Physical activity</b>	<ul style="list-style-type: none"> <li>▪ Increase activity compared to current activity levels using age-appropriate activity.</li> <li>▪ The amount, type and intensity of physical activity required for child weight management is unclear</li> </ul>	B
<b>Sedentary activity</b>	<ul style="list-style-type: none"> <li>▪ Reduce the time children spend in sedentary activities each day (no specific time limit given)</li> </ul>	C
<b>Behaviour modification</b>	<ul style="list-style-type: none"> <li>▪ Simple age-appropriate behaviour modification strategies should be incorporated in any weight-management program (no details given)</li> </ul>	D
<b>Family support</b>	<ul style="list-style-type: none"> <li>▪ Involve parents in management of childhood overweight.</li> <li>▪ Parents can alter environments substantially, especially for primary school aged children</li> </ul>	B

<sup>1</sup> A – Rich body of high-quality RCT data; B – Limited body of RCT data or high-quality non-RCT data; C – limited evidence; D – No evidence, panel consensus (199)

**Table 1.7 Dietary strategies used to moderate energy intake for weight management in children**

<b>Mode of energy moderation<sup>1</sup></b>	<b>Practical strategies utilised</b>
<b>Specified energy intake</b>	
<p><b>Quantitative</b> (see table 1.8a &amp; section 1.6.4.1)</p>	<ul style="list-style-type: none"> <li>▪ Counting calories, prescribed meal plans, food provision (inpatient or camp programs), protein-sparing modified fasts</li> </ul>
<p><b>Semi-quantitative</b> (see Table 1.8b &amp; section 1.6.4.2)</p>	<ul style="list-style-type: none"> <li>▪ Point systems equivalent to set energy levels</li> </ul>
<b>Lower energy density</b>	
<p><b>Macronutrient manipulation</b> (see section 1.6.4.3)</p>	<ul style="list-style-type: none"> <li>▪ No set energy intake</li> <li>▪ Reduce fat intake, use low glycaemic index foods</li> </ul>
<p><b>Promoting ‘Healthy eating’ – macro &amp; micro-nutrient intake</b> (see Table 1.8c &amp; section 1.6.4.4)</p>	<ul style="list-style-type: none"> <li>▪ Improve food quality. Increase low energy density foods (eg fruit and vegetables) or follow food-based recommendations such as dietary guidelines (eg increasing fruit and vegetable intake, lowering fat and sugar intake)</li> </ul>
<b>Other dietary strategies</b>	
(see section 1.6.4.5)	
<p><b>Reduce food volume</b></p>	<ul style="list-style-type: none"> <li>▪ No set energy intake</li> <li>▪ Reduce portion sizes within and between food groups</li> <li>▪ Often linked to ‘healthy eating approaches’, usually a by-product of set energy level approaches. Not trialled as focused approach alone</li> </ul>
<p><b>Change food behaviours</b></p>	<ul style="list-style-type: none"> <li>▪ Serving style, child-feeding practices, cues to food intake, managing appetite. Often linked to behaviour modification strategies such as self-monitoring and stimulus control</li> </ul>
<p><b>Improve nutrition skills</b></p>	<ul style="list-style-type: none"> <li>▪ Label reading, recipe modification, cooking skills, menu planning</li> </ul>

<sup>1</sup> Cross-reference is made to relevant tables and text

**Table 1.8a Summary of studies using a specified energy intake and quantitative dietary approach for child weight management**

Author Year (ref) Country Setting	Subjects Study criteria Randomisation method Drop out (DO)	Study groups Intervention	Outcome measures	Baseline	Short term follow up – 3-6mths	Medium term follow up – 12mths	Evidence Level <sup>1</sup>  Comments
<b>Amador</b> 1990 (142) Cuba Outpatients	<ul style="list-style-type: none"> <li>▪ N=94 (49B) 11-13 yo</li> <li>▪ Tanner 2, BF &gt;25/30 &amp; ≤40/45% B/G. Nil disease/ medication last 6/12 related to o'wt or treatment</li> <li>▪ 'Randomly classified'</li> <li>▪ DO 57%</li> </ul>	1 D 250kJ/kg  2 D 170kJ/kg  Multi-D gp+I 6mth	wt	Group & pubertal status NS at baseline	6mth Δ wt B -4.5±2.7kg G -4.3±1.8kg B -7.6±2.8kg G -9.7±2.0kg B&G p<0.05 time Sig gp (p=na)	12mth Δ wt B -2.2±3.1kg G -2.2±3.8kg B-5.5±2.5kg G -8.1±2.2kg B&G p<0.05 time Sig gp (p=na)	II  Both groups D of 250kJ/kg between 6 and 12 months
<b>Reybroeck</b> 1990 (143) Belgium Outpatients	<ul style="list-style-type: none"> <li>▪ N=25 (10B) 4-16yo</li> <li>▪ No selection criteria</li> <li>▪ No randomisation method</li> <li>▪ DO 14% 4mth, 60% 12mth</li> </ul>	1 D  2 D + PA 8 mthly I	% o'wt (wt for ht)	50±25% 57±20%	4mths ↓ 16 ±10 %points ↓ 25±13 % points p<0.05 gp	8mths (cf 4mths) ↓4±5 %points -	III-2
<b>Schwingshandl</b> 1999 (145) Austria, public gym	<ul style="list-style-type: none"> <li>▪ N=30 (13B) 6-15yo</li> <li>▪ Nil selection criteria</li> <li>▪ Assigned at random</li> <li>▪ DO 0%</li> </ul>	1 D+PA (24 gym session)  2 D alone 12 week tx I D sessions	BMI z FFM (BIA)	5.6±2.5 34±8 5.33±1.8 37±10 NS at baseline	5.0±2.3* 37±11* 4.8±1.3* 37.5±10 *Gp diff p<0.05		I Focus was wt training & FFM
<b>Sung</b> 2002 (144) Hong Kong 13 Schools	<ul style="list-style-type: none"> <li>▪ N=82 (54B) 8-11yo</li> <li>▪ &gt;120% o'wt, health, Tanner&gt;2</li> <li>▪ Limited places, 82/151 eligible randomly selected maintaining ratio B:G, 2:1</li> <li>▪ DO; 50%</li> </ul>	1 D+PA  2 D  6 wks, f'ntly	BMI FFM	25.5±3.1 34±5 24.6±2.9 32±5	6wks 25.3±3.1 35±5* 24.1± 2.7 32.6±5 ** * p<0.05 time		II  See text for Δ in dietary intake. Blinded Dietitian
<b>Nuutinen</b> 1991 (146) Finland Camp or outpatients	<ul style="list-style-type: none"> <li>▪ N=82 (74%B) 6-16yo</li> <li>▪ &gt;120%owt</li> <li>▪ 34 matched &lt;120%owt controls</li> <li>▪ 5x 30-60min I Dietitian, 7gpx60min. Mth20-40min</li> </ul>	1 I or Gp BT  2 I non-BT  3 Control	% wt for ht	160±20% 142±13 110±8		↓15.8%points  p<0.001	III-2 D - 1400-2200 cal/d, 20/35/45 p/f/c

<sup>1</sup> I – systematic review of randomised control trials (RCTs); II – properly designed RCT, III-1 – well-designed pseudo-RCT, III-2 – comparative, cohort or interrupted time series study with concurrent control, III-3 – comparative study with historical control, ≥2 single-arm studies, IV – case series, post-test/ pre&post-test. DO drop out; B boys/G girls; D diet; A activity; BT behaviour therapy; TLD traffic light diet; NE nutrition education; IBW ideal body weight; BF body fat; wt weight; ht %o'wt percent overweight; height; sig significance; NS not significant; gp group; I individual; p/f/c protein/fat/carbohydrate; min minutes; mth month; wkly weekly; fntly fortnightly; ↑ increase; ↓ decrease, Δ change, ψ psychological

**Table 1.8b Summary of studies using a specified energy intake and semi-quantitative dietary approach for child weight management**

Author Year (ref) Country Setting	Subjects Study criteria Randomisation method Drop out (DO)	Study groups Intervention	Outcome measures	Baseline	Short term follow up – 3-6mths	Medium term follow up – 12mths	Evidence Level <sup>1</sup>  Comments
<b>Epstein</b> 1985 (151) US Weight clinic	<ul style="list-style-type: none"> <li>▪ N=23 (0B) 8-12yo</li> <li>▪ &gt;20% o'wt, safe for wt loss/PA, parent attend</li> <li>▪ Randomised stratified for age, %o'wt, fitness</li> <li>▪ DO 13% 6, 17% 12mth</li> </ul>	1 TLD + family BT 2 TLD+family BT+6 2 wkly 3 mile walk 12 mth; 8 wkly tx, 10 mthly M	% o'wt (wt for ht)	48%	6mth 29±22% o'wt 6mth 20±23% o'wt  Time & gp p<.05	12mth 29±22% o'wt 12mth 23±29% o'wt  Time p<.05 Gp NS	II
<b>Epstein</b> 1984 & 1994, study 2 (141, 149) US Weight clinic	<ul style="list-style-type: none"> <li>▪ 53 (?B) 8-12yo</li> <li>▪ 20-80% o'wt, willing attend, healthy</li> <li>▪ Randomly assigned, stratified for child wt</li> <li>▪ DO 13% 6mth, 39% 12mth, 11% 5&amp;10 yr (?self report)</li> </ul>	1 6mth wait-list C 2 TLD + family BT 3 TLD + family BT +lifestyle Tx 6 mth 15 sessions. 8 wkly+ 7 in 20wk, gp+l	% o'wt (ideal wt adj)  (BMI also)	43%	6mth 47 23  27   Sig gps ½ v C	12mth NA 27%, ↓16 -6 5y -8 10y 28 ↓15 -8 5y, -10 10y   Sig tm, ns gp 5&10yr	II
<b>Johnson</b> 1997 (150) US, Uni ψ Community volunteers	<ul style="list-style-type: none"> <li>▪ N=32 (9 B) 8-17yo</li> <li>▪ 8-16yrs, &gt;20% IBW, P attend, motivated, healthy</li> <li>▪ Randomly allocated</li> <li>▪ DO13% 4mth, 44% 5yr</li> </ul>	1 NE:D→A+CBT 2 EN:A →D+CBT 3 DA info. n=28, 16wk 14 wkly session	%>IBW Self-report data	169% 153% 187%	Sig ↓ Sig ↓ NS ↓	5y 137% IBW no SD* 138% IBW 175%IBW  *p<0.01 v gp 3. NS 1v2.	III-3  D - TLD
<b>Levine</b> 2001 (152) US, Uni ψ community volunteers	<ul style="list-style-type: none"> <li>▪ N=24 (13 boys) 8-12yo</li> <li>▪ &gt;160% IBW, no ψ or other tx</li> <li>▪ DO 33%</li> </ul>	1 Epstein program 8-12 session, frequency na	Wt/BMI %IBW	80±20/35±5 192±21%		~12mth78±21/33±6 181±3, P<0.02	IV

<sup>1</sup> I – systematic review of randomised control trials (RCTs); II – properly designed RCT, III-1 – well-designed pseudo-RCT, III-2 – comparative, cohort or interrupted time series study with concurrent control, III-3 – comparative study with historical control, ≥2 single-arm studies, IV – case series, post-test/ pre&post-test. DO drop out; B boys/G girls; D diet; A activity; BT behaviour therapy; TLD traffic light diet; NE nutrition education; IBW ideal body weight; BF body fat; wt weight; ht %o'wt percent overweight; height; sig significance; NS not significant; gp group; I individual; p/f/c protein/fat/carbohydrate; min minutes; mth month; wkly weekly; fntly fortnightly; ↑ increase; ↓ decrease, Δ change, ψ psychological

**Table 1.8c Summary of studies using a child (155) or family (148, 162) healthy eating dietary approach for child weight management**

Author Year (ref) Country Setting	Subjects Study criteria Randomisation method Drop out (DO)	Study groups Intervention	Outcome measures	Baseline	Short term follow up – 3-6mths	Medium term follow up – 12mths	Evidence Level <sup>1</sup>  Comments
<b>Braet</b> 1997 (155) Belgium Outpatients or camp	<ul style="list-style-type: none"> <li>▪ N=141 7-14yo.</li> <li>▪ Normal IQ, <math>\geq 20 &lt; 55\%</math> o'wt, healthy</li> <li>▪ Assigned only to gp 1</li> <li>▪ Older child &gt; drop out</li> </ul>	1 98/148 Behavioural program (camp, gp or I)	%o'wt (wt for ht)	40 $\pm$ 10		30 $\pm$ 10	III-2
		2 57 advice only; subjects declining gp 1 camp		35 $\pm$ 10		30 $\pm$ 10	
		3 54 Parallel control group (nearby schools). 11mths; 7 fortnightly 'intensive' child only (Gp or I) or 10d camp + all 7mthly family f'up		36 $\pm$ 10 Gp 3 lower %o'wt		40 $\pm$ 10 P<0.001 time & tx	
<b>Epstein</b> 2001 (148) US Community volunteers	<ul style="list-style-type: none"> <li>▪ N=27/30 (17 girls) 6-11y BMI &lt;85P. Parents BMI &gt;85P</li> <li>▪ Willing attend obesity prevention program, no other program, no diet/psych issues</li> <li>▪ Random assignment</li> </ul>	1 Family reinforced for $\uparrow$ F+V (gradual to 5 per day) + parent TLD (1200-1500+100 kcal/d), healthy lifestyle environment, behaviour modification	%>50P BMI for sex/age	7 $\pm$ 6 3 $\pm$ 2 13 $\pm$ 8	na	%o'wt NS  $\uparrow$ 1 $\pm$ 1 $\downarrow$ 5 $\pm$ 8	II
		2 Family reinforced $\downarrow$ high fat/sugar (gradual to 10wk) + parent TLD (1200-1500 +100kcal/d), healthy lifestyle environment, behaviour modification 6mth; 8xwkly, 4xf'nightly, 2xmthly. Gp + I	F+V serves Red foods	7 $\pm$ 8 3 $\pm$ 2 14 $\pm$ 8		%o'wt NS $\uparrow$ 0.5 $\pm$ 1 $\downarrow$ 9 $\pm$ 8  Red food time <0.05. NS gp	Prevention study, parents attend
<b>Golan</b> 1998&2004 Israel (161, 162) Uni $\psi$ dept	<ul style="list-style-type: none"> <li>▪ N=60 6-11yo.</li> <li>▪ Wt&gt;20%o'wt. No <math>\psi</math>, dual parents families, agree attend,</li> <li>▪ Randomly assigned matched for age/sex</li> </ul>	1 Parent sole agent of change Nutrition education, limits of responsibility, BT, parenting 12mth. 14x1h gp (15 parent couples/gp), 4wkly, 4 1/14ly, 6 6/52ly + 5x15 all family I	% o'wt (50P)	40 $\pm$ 3 (20-95)%	3mth 38 $\pm$ 5% 8mth 31 $\pm$ 5%	12/18mth 25 $\pm$ 5/26 8yr (n=50) $\downarrow$ 29% points	II
		2 Child sole agent of change Prescribed diet 1500kcal/d 12mth 30 1hr gp sessions (15 children/gp)	% o'wt (50P)	39 $\pm$ 4 (20-102)% 36 $\pm$ 5%		31 $\pm$ 5 ( $\downarrow$ 8% points)/37 8 yr $\downarrow$ 20 % points	

<sup>1</sup> I – systematic review of randomised control trials (RCTs); II – properly designed RCT, III-1 – well-designed pseudo-RCT, III-2 – comparative, cohort or interrupted 200 time series study with concurrent control, III-3 – comparative study with historical control,  $\geq 2$  single-arm studies, IV – case series, post-test/ pre&post-test. DO drop out; B boys/G girls; D diet; A activity; BT behaviour therapy; TLD traffic light diet; NE nutrition education; IBW ideal body weight; BF body fat; wt weight; ht %o'wt percent overweight; height; sig significance; NS not significant; gp group; I individual; p/f/c protein/fat/carbohydrate; min minutes; mth month; wkly weekly; fntly fortnightly;  $\uparrow$  increase;  $\downarrow$  decrease,  $\Delta$  change,  $\psi$  psychological



**Table 1.9 The traffic light diet (TLD), a set energy, semi-quantitative approach to energy moderation and the most commonly used dietary strategy in child weight management studies (adapted from (138, 139))**

	<b>Description</b>
<b>Nutritional goals</b>	<ul style="list-style-type: none"> <li>▪ restrict calories (900-1300 kcal/d based on child's age)</li> <li>▪ achieve US RDA guidelines</li> <li>▪ reduce sugar and saturated fat intake</li> <li>▪ improve nutrient density per calorie</li> <li>▪ easy to implement and adhere</li> <li>▪ promote change in food preference and eating patterns</li> </ul> <p>(limited data regarding education, implementation and achievements of these goals other than calorie restriction)</p>
<b>Process</b>	<ul style="list-style-type: none"> <li>▪ Foods into colour-coded categories based on energy content; <ul style="list-style-type: none"> <li>red 'stop' &gt;20kcal more than the average serving for that group (limit of 4-15/week)</li> <li>yellow 'approach caution' within 20kcal of the average foods within that food group (fruit=40kcal, so fruit up to 60kcal)</li> <li>green 'go' &lt;20kcal/ave serving provision of food.</li> </ul> </li> <li>▪ Combined dishes are coded red if they contain any red single foods</li> <li>▪ Within the colours, foods are placed into 11 groups with children encouraged to eat from a range of groups</li> </ul>
<b>Prescription</b>	Individualised child prescribed number of food serves to achieve set level of energy restriction using food exchange lists
<b>Maintenance</b>	After treatment, intake increased gradually (100kcal/week) until energy balance (weight stability) achieved

**Table 1.10 Summary of studies using family support (parent attendance and/or supporting parents) in child weight management**

Author Year (ref) Country Setting	Subjects Study criteria Randomisation method Drop out (DO)	Study groups Intervention	Outcome measures	Baseline	Short term follow up – 3-6mths	Medium term follow up – 12mths	Evidence Level <sup>1</sup>  Comments
<b>Epstein</b> 1994 (263) US Weight clinic	<ul style="list-style-type: none"> <li>158 (42 B) 6-12yo</li> <li>20-100% o'wt, intact families, parent o'wt, willing to participate, no <math>\Psi</math>, learning</li> <li>Randomised, no details</li> </ul>	1 Non-specific target 2 P+C targeted 3 C targeted  wkly 8-12 + mthly 6-12mth	$\Delta\%$ points o' wt ht, age ( $<19$ yrs)	44 $\pm$ 16%		+8 (5y)/ +8 (10y) % points -15 (5y)/ -15 (10y) % points +2 (5y)/ -2 (10y) % points P $<0.05$ ; 5yrs, gp 2v3& 1;10y gp 2v1	II
<b>Kirchenbaum</b> 1984 (193) US Uni $\Psi$ dept	<ul style="list-style-type: none"> <li>N=40 (23 B)9-13 yo</li> <li>Literate, <math>\geq 20\%</math> o'wt P+C, motivated, nil wt prog</li> <li>Random assignment (matched for P/C sex, child age, P/C %o'wt)</li> <li>40 follow up</li> </ul>	1 P+C attended, shared responsibility 2 C only attended, child expert 3 WLC 9 weekly sessions	%o'wt	58 $\pm$ 26%  39 $\pm$ 18%  42 $\pm$ 20% NS	3 mth 53 $\pm$ 26%  31 $\pm$ 18%  46 $\pm$ 21% Gp 1 v 3, p $<0.01$ . Gp 3 p $<0.05$ time	51 $\pm$ 28%  33 $\pm$ 18%  - 12mth $\downarrow$ 6% p=0.04 time	II
<b>Golan</b> 1998&2004 Israel (161, 162) Uni $\Psi$ dept	<ul style="list-style-type: none"> <li>N=60 6-11 yo</li> <li>Wt<math>&gt;20\%</math> o; 'wt. No psych, both parents at home, agree attend, do Q'aires, have reg check ups.</li> <li>DO 17% 8 yrs</li> </ul>	1 P sole agent $\Delta$  2 C sole agent $\Delta$	% o'wt (50P)	40 $\pm$ 3% (20-95)  39 $\pm$ 4% (20-102)	8mth 31 $\pm$ 5%  36 $\pm$ 5%  Sig gp	12mth 25 $\pm$ 5% $\downarrow$ 15% points 8yr $\downarrow$ 29% points 31 $\pm$ 5% $\downarrow$ 8% points 8yr $\downarrow$ 20 % points P $<.05$ time & gp 12 mth 8 yr	II  See table 1.8c for intervention details
<b>Israel</b> 1994 (194) US Uni $\Psi$ dept	<ul style="list-style-type: none"> <li>N=30 8-13yo</li> <li><math>&gt;20\%</math> o'wt</li> </ul>	1 BT+parenting 2 BT+parenting+child self mx  6 mth, 8 x wkly, 9 x fntly	%o'wt	46 $\pm$ 17%  48 $\pm$ 18%	6mth 33% $\downarrow$ 13%  33% $\downarrow$ 16% points P $<.001$ time ns gp	12mth 45% $\downarrow$ 1; 3yr 52 $\uparrow$ 6 42% $\downarrow$ 6% points 3yr 43% $\downarrow$ 5% points NS gp or time	III-1

<sup>1</sup> I – systematic review of randomised control trials (RCTs); II – properly designed RCT, III-1 – well-designed pseudo-RCT, III-2 – comparative, cohort or interrupted time series study with concurrent control, III-3 – comparative study with historical control,  $\geq 2$  single-arm studies, IV – case series, post-test/ pre&post-test. DO drop out; B boys/G girls; D diet; A activity; BT; behaviour therapy; BF body fat; wt weight; ht height; sig significance; NS not significant; gp group; I individual; %o'wt percent overweight; p/f/c protein/fat/carbohydrate; min minutes; mth month; wkly weekly; fntly fortnightly;  $\uparrow$  increase;  $\downarrow$  decrease,  $\Delta$  change,  $\Psi$  psychological, TLD traffic light diet; IBW ideal body weight; NE nutrition education;

Author Year (ref) Country Setting	Subjects, Study criteria Randomisation method Drop out (DO)	Study groups Intervention	Outcome measures	Baseline	Short term follow up – 3-6mths	Medium term follow up – 12mths	Evidence Level <sup>1</sup>  Comments
<b>Israel</b> 1985 (187) US Uni ψ dept	<ul style="list-style-type: none"> <li>N=33 (10B) 8-12 yo</li> <li>&gt;20% o'wt, healthy</li> <li>Randomly assigned stratified for age &amp; %o'wt</li> </ul>	1 BT P+C separate 2 BT + Parenting P+C separate 3 WLC 9wkly 90min.gp3 2x1hr P L	%o'wt	53±20 46±20 56±16	9wk 41±22 39±22 55±16 p<0.01 1&2 v 3	12mth 45±21 40±33 - gp1p<.001, gp2 ns v wk9	II
<b>Graves</b> 1988 (181) US Uni ψ dept	<ul style="list-style-type: none"> <li>N=40 (?B?G) 6-12yo</li> <li>20% o'wt, parent attend, healthy, no wt meds/prog</li> <li>Randomised (strat o'wt)</li> <li>DO 20%</li> </ul>	1 BT+parental PS P+C attend 2 BT P+C attend 3 D+A P+C attend 8wks wkly 60min	%o'wt	53±21 56±36 52±22	6mth 28±18% ↓25% points 46±39 ↓10 42±18 ↓10 Timexgp p<0.01	na	II
<b>Epstein</b> 2000 (185) US Weight clinic	<ul style="list-style-type: none"> <li>N=62 (25 B) mean10±1yo</li> <li>&gt;20%o'wt, neither par o'wt, willing attend, 3rd grade literacy, no wt program, ψ or activity restriction</li> <li>randomised gender, C +P%o'wt stratified</li> </ul>	1 Epstein + PS P+C 2 Epstein + PS C 3 Epstein (BT, TLD, A) P+C 6mth, 16wkly + 2mthly	z score (not UK)	2.8±0.9 2.6±.9 2.7±.9 NS	6mth 1.5±0.9 ↓ 1.3 1.2±.8 ↓1.4 1.2±.8 ↓1.5	12mth 1.7±1 ↓1.1 24mth 2.3±0.9 ↓0.5 1.3±.9 ↓1.3 24mth 1.7±.9 ↓0.9 1.4±.9 ↓1.3 24mth 1.6±1↓1.1 P<0.02 gp by time (gp 3)	II
<b>Eliakim</b> 2002 (195) Israel Outpatients	<ul style="list-style-type: none"> <li>N=177+ 5 C (100B), 10yo, 40% pubertal.</li> <li>Nil organic obesity/meds</li> <li>Not randomised, 65% DO</li> </ul>	1 3mth tx,mthly Dietitian, 2/wk PA, 3wkly lecture 2 D+A "usual care" advice, 1 visit Dietitian	BMI %>95th BMI %ile	26.1±.3 81% 25.2±1.4 80%	6mth ↓1.1±0.2 ↑0.7±.2 both p<.05 time		III-2 P agent of Δ children 6-8yo 69% ↓BMI
<b>Kingsley</b> 1977 (186)	<ul style="list-style-type: none"> <li>N=40 (16B), 10-11yo</li> <li>&gt;90<sup>th</sup> %ile for weight, family support, healthy</li> <li>random allocation, DO 70%</li> </ul>	1 P+C attend 2 C attend (P written) 3 P attend 4 WLC (8 weeks)	Δ% o'wt baseline 7 mthf'up	Not given	-4% -2% -5% 0% at 8wks	NS between gps at 28 weeks	II Stratified for gender, age, weight

<sup>1</sup> I – systematic review of randomised control trials (RCTs); II – properly designed RCT, III-1 – well-designed pseudo-RCT, III-2 – comparative, cohort or interrupted time series study with concurrent control, III-3 – comparative study with historical control, ≥2 single-arm studies, IV – case series, post-test/ pre&post-test. DO drop out; B boys/G girls; D diet; A activity; BT; behaviour therapy; BF body fat; wt weight; ht height; sig significance; NS not significant; gp group; I individual; %o'wt percent overweight; p/f/c protein/fat/carbohydrate; min minutes; mth month; wkly weekly; fntly fortnightly; ↑ increase; ↓ decrease, Δ change, ψ psychological, TLD traffic light diet; IBW ideal body weight; NE nutrition education;

**Table 1.11 Summary of secondary outcomes examined as part of weight management programs conducted with children**

Reference	Health Outcome	Study characteristics	Key findings
NHMRC 2003 (15) Epstein 1998 (139)	<b>Growth</b>	4 studies, 7-12 yo, tx 3-mths, f'up 14 mths, weight reduction ~25% points	2 normal growth, 2 slowed but normalised once treatment ceased. Slowed growth associated with greater restriction (eg <0.17MJ/kg but not >0.25MJ/kg).
NHMRC 2003 Epstein 1998	<b>Lipid profile</b>	4 studies (n=41-50), 8-12 yo, tx 6-12 mth, f'up 2-5 yrs, weight reduction 20-50% points, 5 years 55% DO	↓TC (-.3), TG (-.6), ↑HDL-C (+.2) ΔHDL-C change associated with Δwt & fitness not diet
NHMRC 2003 Epstein 1998	<b>Blood pressure</b>	No studies in children	-
NHMRC 2003 Epstein 1998	<b>Insulin</b>	4 studies, no ages given, tx 4-12 mths, f'up 4 -60 mths, weight reduction ~15% points	10-20% ↓4-12 mths - rises over time with stable weight status. Obese girls, no Δ insulin with weight Δ
French (66) Epstein 1998	<b>Self esteem</b>	3 studies (N=n=26-89), 7-12 yo tx unknown, f'up 18mth (1), weight change unknown	↑ self esteem all 3 studies, only 1 study Δself esteem was associated with ↓ decreased adiposity
Epstein 1998	<b>Body esteem &amp; Disordered eating</b>	1 study (n=47), children 8-12 yo. tx 12 mths, f'up 24 mths. Weight ↓13±13% points	No Δ in prevalence of eating disorders, wt dissatisfaction, disturbed eating
Ravens (200) Epstein 1998	<b>HR-QOL</b>	1 study (n=584), 12 yo. Inpatient tx and f'up 12 mths, Adiposity change na	↑ German KINDL scores (physical/psychosocial functioning, SE)
Epstein 1998	<b>Child/family behaviour/capacity</b>	1 study see under body esteem above	↓internalising & behaviour problems, ↑child behavioural competence. Parent ↓ distress.
Epstein 1998	<b>Process evaluation</b>	1 study (n=60), 6-11 yo Tx & f'up 12 months, weight reduction 8-15%	Variation in adiposity ↓ explained by intervention type (7%), attendance (5%), eating/activity change (27%)

yo years old; tx treatment; f'up follow up; Δ change; DO drop out; mth months; HR-QOL health-related quality of life; KINDL measures HR-QOL; SE self esteem

## Tables and Figures Chapter 2

**Table 2.1 Goals of two parent-led, family focused weight management programs for 6 to 9 year olds utilising parenting skills training plus intensive lifestyle education (P+DA) or parenting skills training alone (P)**

<b>Program Goals</b> <sup>1</sup>	<b>Objectives &amp; Strategies - P+DA</b>	<b>Objectives &amp; Strategies - P</b>
<p><b>Parent-led family focused approach</b></p> <ul style="list-style-type: none"> <li>▪ Support parental ability to initiate &amp; maintain child behaviour modification</li> </ul>	<ul style="list-style-type: none"> <li>▪ Parenting skills training using principles - Ensure a safe, interesting environment; Create a positive learning environment; Use assertive discipline; Have realistic expectations; Take care of oneself as a parent (207)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Parenting skills training using principles as for P+DA group</li> </ul>
<p><b>Promote sustained energy intake moderation &amp; 'healthy eating'</b></p> <ul style="list-style-type: none"> <li>▪ Food quantity (overall food volume, within and between food groups)</li> <li>▪ Food quality (nutrient &amp; energy density, intake saturated fat)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Use the Australian Guide to Healthy Eating to buy, prepare and serve family meals and snacks (205)</li> <li>▪ AGHE serve sizes &amp; daily food group serves for family members provided</li> <li>▪ Parent monitoring of child and family intake using AGHE</li> <li>▪ AHGE linked to food-based recommendations to lower energy intake eg lunch box &amp; snack choices from cereals, vegetable, fruit &amp; dairy food groups, use cereal-based 'extras' sparingly. Encourage water, limit juice to 150ml/day. 2-3 serves 1-2% fat (ice-cream/cheese 1-2/week) (249)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Use the Australian Guide to Healthy Eating to buy, prepare and serve family meals and snacks (205)</li> <li>▪ No specific information. Figure 1.1 provided and families encouraged to 'eat most, eat moderately, eat occasionally/ in small amounts' for various food groups</li> <li>▪ Families <u>not</u> asked to monitor food intake.</li> <li>▪ No specific food recommendations.</li> <li>▪ Nil</li> </ul>
<p><b>Promote increase in activity</b></p> <ul style="list-style-type: none"> <li>▪ Create active opportunities</li> <li>▪ Limit inactive opportunities</li> </ul>	<ul style="list-style-type: none"> <li>▪ label reading, recipe modification, child feeding practices, managing appetite</li> <li>▪ Be active often in a variety of ways aiming for 30 min/day physical activity and be active in play, transport, chores, family activities etc...</li> <li>▪ Limit total 'screen time' to 7 to 10 hours per week</li> <li>▪ Education around importance of physical activity, potential barriers and how to overcome these</li> </ul>	<ul style="list-style-type: none"> <li>▪ Be active often in a variety of ways aiming for 30 min/day physical activity and be active in</li> <li>▪ play, transport, chores, family activities etc...</li> <li>▪ Limit total 'screen time' to 7 to 10 hours/ week</li> <li>▪ No specific education how to achieve this</li> <li>▪ Nil</li> </ul>
<ul style="list-style-type: none"> <li>▪ Increase child motor skills</li> </ul>	<ul style="list-style-type: none"> <li>▪ Fortnightly (4) &amp; monthly (3) structured, fun, skills-based games sessions for children, aerobic fitness &amp; movement skills. Families asked to use at home</li> </ul>	

<sup>1</sup> Derived from literature, refer to Chapter 1 section 1.7

**Table 2.2 Structure and content of two child weight management programs for 6 to 9 year olds which involved parenting skills training plus intensive lifestyle education (P+DA) or parenting skills training alone (P)**

Week	P+DA	P
1	A family approach to child weight management Parenting principles; Influences on children's behaviour; goal setting & monitoring <sup>1</sup>	<ul style="list-style-type: none"> <li>▪ Week 1-4 same as P+DA</li> <li>▪ <b>Week 4 Lifestyle pamphlet provided</b></li> </ul>
2	Encouraging desirable behaviour <sup>1</sup>	
3	Managing behaviour change <sup>1</sup>	
4	Planning Ahead - Family survival tips, high risk situations, planned activities routines <sup>1</sup>	
5	Individual telephone session - Parent driven agenda, content dependent on family goals & challenges <sup>1</sup> & Factors influencing weight gain; pros & cons of being a healthy weight <sup>2</sup>	Individual telephone session <sup>1</sup>
6	Individual telephone session <sup>1</sup>	Individual telephone session <sup>1</sup>
7	Individual telephone session <sup>1</sup> & The Australian guide to healthy eating & label reading <sup>2</sup>	Individual telephone session <sup>1</sup>
8	Individual telephone session <sup>1</sup>	Individual telephone session <sup>1</sup>
9	Physical activity & family food battles <sup>2</sup>	
10		
11	Recipe modification & takeaway <sup>2</sup>	
12		Individual telephone session
13	Individual telephone session	
14		
15	Managing appetite <sup>2</sup>	
16		Individual telephone session
17	Individual telephone session	
18		
19	Self esteem & teasing <sup>2</sup>	
20		Individual telephone session
21	Individual telephone session	
22		
23	Progress review & planning ahead <sup>2</sup>	
<b>Total</b>	4 wkly 2hr Triple P group sessions, 4 wkly 15 min Triple P phone calls 4 fortnightly and 3 mthly 1hr DA <sup>2</sup> group sessions, 3 mthly 15min phone calls	4wkly 2hr Triple P <sup>1</sup> group sessions, 4wkly 15 min Triple P phone calls, 3 mthly 15 min support calls

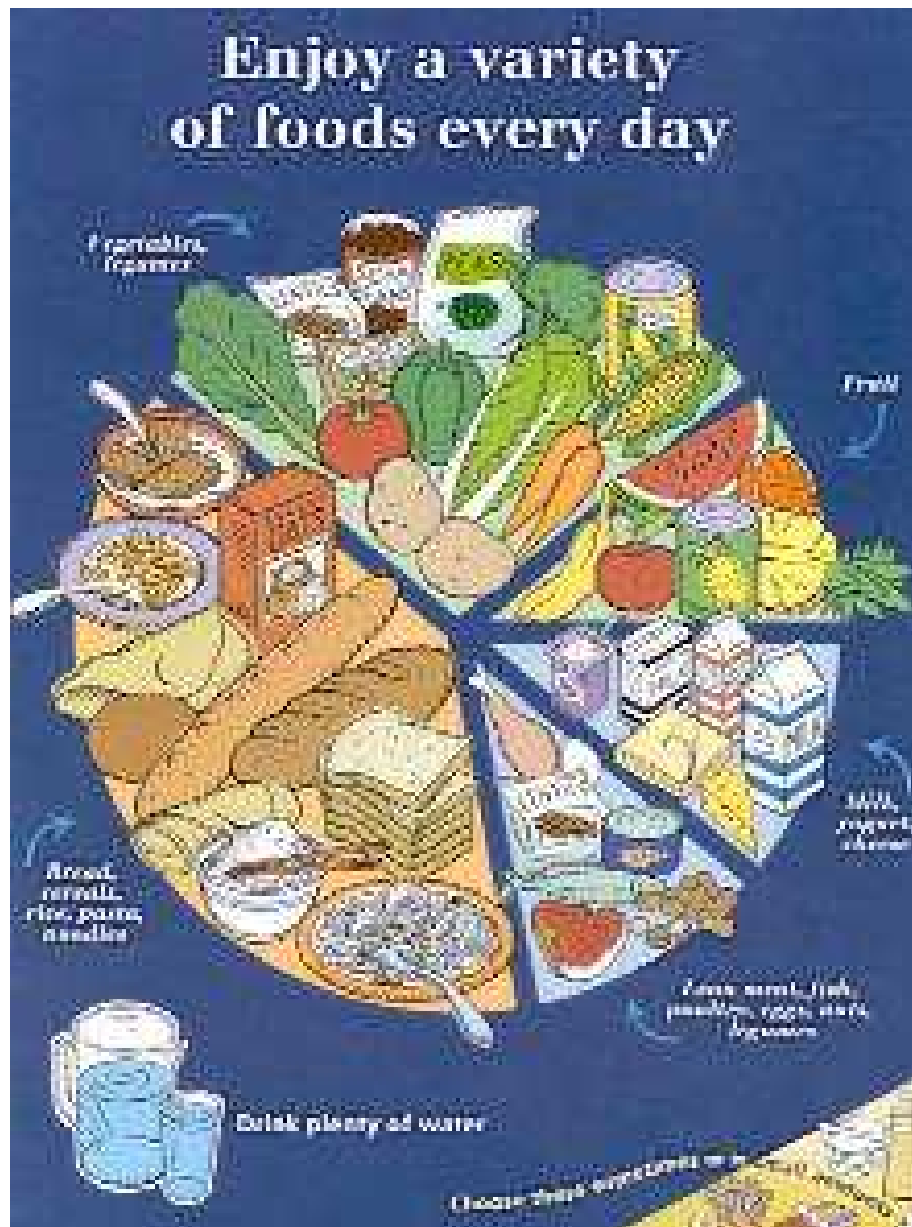
<sup>1</sup> Triple P – Positive Parenting Program, parents attend alone (46) <sup>2</sup> DA – Intensive lifestyle education group sessions focusing on diet and activity, parent attend while children in group activity sessions (refer to appendix 2 for details of sessions)

**Table 2.3 Application of the general child behaviour ‘Positive Parenting Program’ Planned Activities Routine<sup>®</sup> to weight-related behaviours (207)**

<b>Context</b>	<ul style="list-style-type: none"> <li>▪ Snacking after school on high fat, high sugar foods through to dinner</li> </ul>
<b>Rules or Goals</b>	<ul style="list-style-type: none"> <li>▪ Afternoon snack chosen from the AGHE ‘plate’ (205)</li> <li>▪ We have breaks between meals and snacks</li> <li>▪ Come to mum or dad when hungry</li> </ul>
<b>Planning and Preparation</b>	<ul style="list-style-type: none"> <li>▪ Monitor intake and identify reasons for snacking (eg boredom, emotional eating)</li> <li>▪ Family discussion of rules; why, what etc...</li> <li>▪ Ensure home food supply fits family rules</li> <li>▪ Have AGHE snack available when arrive home from school</li> </ul>
<b>Engaging Activities</b>	<ul style="list-style-type: none"> <li>▪ AGHE snacks list including some snacks that child can prepare themselves or explores a new food from AGHE</li> <li>▪ After-school activities list (indoor, outdoor, sitting, active. Have play equipment visible)</li> <li>▪ After-school routine (links to ↓screen time); develop hobby, motor skills, homework, help prepare dinner</li> </ul>
<b>Rewards for new behaviour</b>	<ul style="list-style-type: none"> <li>▪ Descriptive praise when healthy snack choice made or child observed to break between snack and next meal</li> <li>▪ Choice (within limits) of snacks (new ideas)</li> <li>▪ Behaviour chart rewarding appropriate choices</li> <li>▪ Quality time; talking about day with parents</li> </ul>
<b>Management of old behaviour</b>	<ul style="list-style-type: none"> <li>▪ Have rules for transparent expectations for child and parent</li> <li>▪ Remind child of the rules (eg when accesses cupboard without asking)</li> <li>▪ Use immediate and logical consequences (eg take snack away if asking for high fat/sugar snacks or does not appear hungry)</li> <li>▪ Use the Triple P ‘compliance routine’ to be consistent and encourage obeying rules</li> </ul>
<b>Follow up discussion and set new goals</b>	<ul style="list-style-type: none"> <li>▪ Were goals achieved?</li> <li>▪ Identify any barriers to achieving goals and adjust plan</li> <li>▪ Encourage appropriate snack choices when visiting friends or out and about</li> </ul>



Figure 2.1 The Australian Guide to Healthy Eating (AGHE); the national food selection guide recommending volume and quality of foods within and between the five food groups, water and 'extras' (high energy/fat/sugar/salt) foods (205)



**Figure 2.2 An activity pyramid appropriate to guide recommendations for physical and sedentary activity levels in 6-9 year old children (taken from (209))**



**Table 2.4 Child-specific cut points used to define presence of cardiovascular risk factors in 6-9 year old pre pubertal children**

<b>Cardiovascular risk factor</b>	<b>Cut point</b>	<b>Source</b>
Fasting total cholesterol	$\geq 4.40\text{mmol/L}$	<ul style="list-style-type: none"> <li>75<sup>th</sup> percentile from the US Lipid Research Prevalence Study using a lipid conversion factor of mg/dL x 0.0259 (225)</li> </ul>
Fasting low density lipoprotein	$\geq 2.85\text{mmol/L}$	
Fasting triglycerides	$>1.81\text{mmol/L}$	
Fasting high density lipoprotein	$<0.82\text{mmol/L}$	<ul style="list-style-type: none"> <li>recommendations from the American Academy of Paediatrics using a lipid conversion factor of mg/dL x 0.0259 (225)</li> </ul>
Systolic blood pressure	Age, height & gender specific	<ul style="list-style-type: none"> <li>95<sup>th</sup> percentile for age (to the nearest year), gender and height using US reference population (245)</li> </ul>
Diastolic blood pressure	Age, height & gender specific	<ul style="list-style-type: none"> <li>95<sup>th</sup> percentile for age (to the nearest year), gender and height using US reference population (245)</li> </ul>
Fasting glucose	$>7.9\text{mmol/L}$	<ul style="list-style-type: none"> <li>as defined in the 3<sup>rd</sup> National Health and Nutrition Examination survey (55)</li> </ul>
Fasting insulin	$>35\text{ pmol/L}$ boys $>41\text{pmol/L}$ girls	<ul style="list-style-type: none"> <li>75<sup>th</sup> percentiles of a Canadian community based sample of 783 subjects aged nine years (55)</li> </ul>

**Table 2.5 The 13 domains of health-related quality of life (HR-QOL) assessed in the 50-item Parent Report Child Health Questionnaire (CHQ PF50) grouped according to physical, psychosocial or family functioning (adapted from (222))**

	HR-QOL domain	CHQ PF 50 items	Interpretation of low scores (on a scale of 0-100)	Interpretation of high scores (on a scale of 0-100)
<b>Physical functioning</b>	Physical activities limited by physical health	6	Child limited in performing all physical activities, including self care due to health	Child performs all types of physical activities, including vigorous without health limitation
	Role/social activities limited by physical health	2	Child limited in school work or activities with friends due to physical health	Child had no limitations in school work or activities with friends due to physical health
	Bodily pain/discomfort	2	Child has severe, frequent, limiting bodily pain	Child has no pain or limitations due to pain
	General health perceptions	6	Parent believes child's health is poor and likely to worsen	Parent believes child's health is excellent
<b>Psychosocial functioning</b>	Role/social activities limited by emotional/social problems	3	Child limited in school work or activities with friends due to emotional or behaviour problems	Child has no limitations in school work or activities with friends due to emotional or behaviour problems
	Behavioural problems	6	Child often exhibits aggressive, immature, delinquent behaviour	Child never exhibits aggressive, immature, delinquent behaviour
	Emotional problems	5	Child has feelings of anxiety and depressions all the time	Child feels peaceful, happy and calm all of the time
	Self-esteem	6	Child is very dissatisfied with abilities, looks, relationships and life overall	Child is very satisfied with abilities, looks, relationships and life overall
<b>Family functioning</b>	Emotional impact on parents	3	Parent experiences worry/concern resulting from child's physical/psychosocial health	Parent experiences no worry/concern from child's physical or psychosocial health
	Time impact on parents	3	Parent experiences limitations in personal time due to child's physical or psychosocial health	Parent experiences no limitations in personal time due to child's physical/ psychosocial health
	Impact on family activities	6	Child's health often limits and interrupts family activities and is a source of family tension	Child's health never limits or interrupts family activities and is not a source of family tension
	Family cohesion	1	Family's ability to get along is rated poor	Family's ability to get along is rated excellent
<b>Overall</b>	Change in health	1	Child's health worse than 1 year ago	Child's health better than 1 year ago

**Table 2.6 Comparison of traditional and linear mixed model (mixed-effects) approaches for the analysis of repeated measure data (reproduced from (237))**

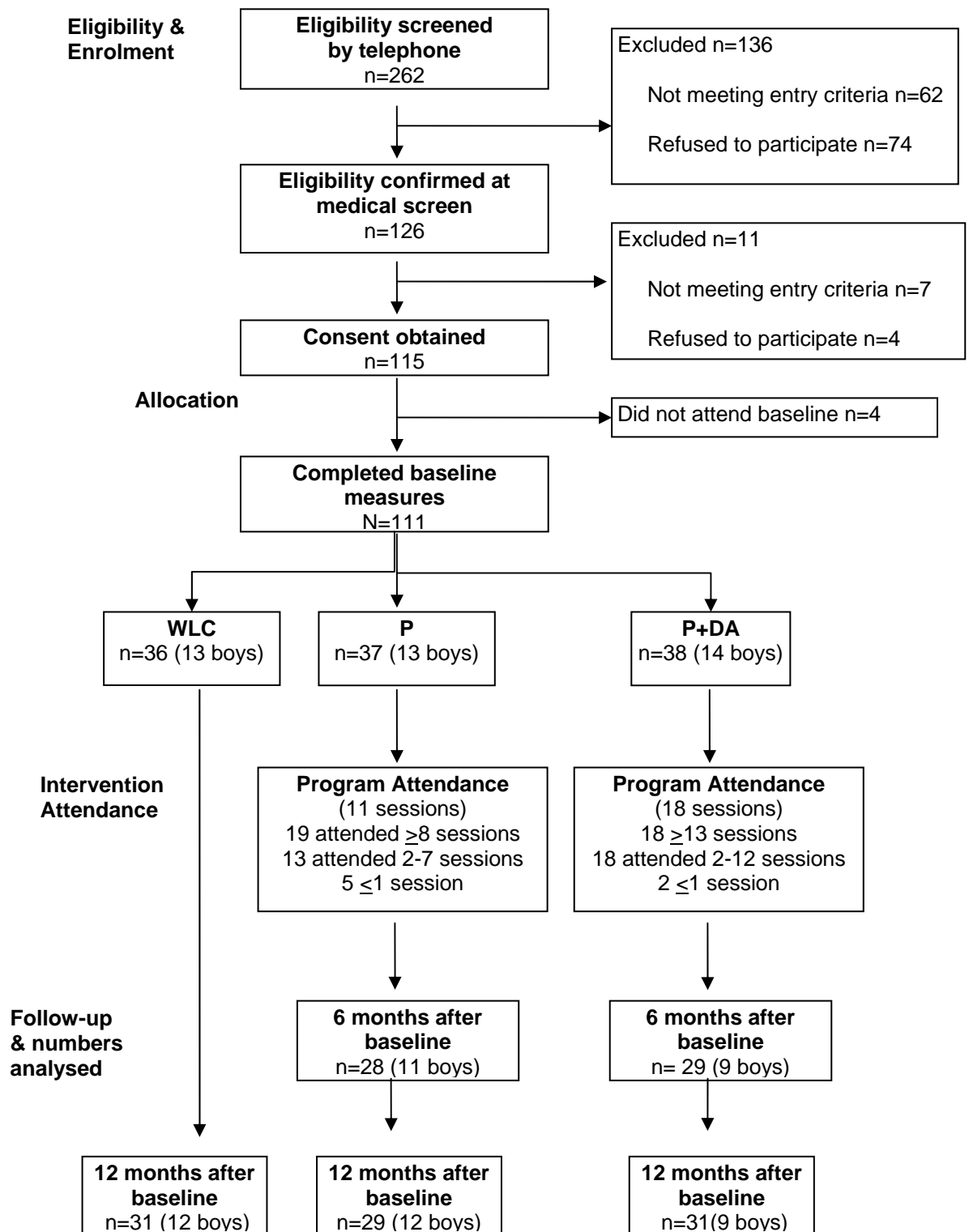
	<b>End-Point Analysis</b>	<b>rANOVA</b>	<b>rMANOVA</b>	<b>Mixed-Effects Analysis</b>
Complete data required on every subject	Yes	No*	Yes	No
Possible effect of omitting subjects with missing values	Sample bias	Sample bias	Sample bias	Not applicable†
Possible effects of imputation of missing data	Estimation bias	Estimation bias	Estimation bias	Not applicable†
Subjects measured at different time points	Yes	No	No	Yes
Description of time effect	Simple	Flexible	Flexible	Flexible
Estimation of individual trends	No	No	No	Yes
Restrictive assumptions about correlation pattern	Not applicable	Yes	No	No
Time-dependent covariates	No	Yes	No	Yes
Ease of implementation	Very easy	Easy	Easy	Hard
Computational complexity	Low	Low	Medium	High

Abbreviations: rANOVA, univariate repeated-measures analysis of variance; rMANOVA, multivariate repeated-measures analysis of variance.

\*Subjects with missing data are often omitted from the analysis.

†It is not necessary to omit subjects with missing values from the analysis or to impute missing values.

## Tables and Figures Chapter 3



**Figure 3.1 Progress of subjects through the phases of the randomised controlled trial from recruitment to analysis by group allocation to either parenting alone (P), parenting plus intensive lifestyle education (P+DA) or waitlisting for intervention for 12 months (WLC)**

**Table 3.1 The number of enquires received from families interested in participating in the study and the number (percent) of families enrolling in the study by recruitment strategy**

<b>Recruitment strategy</b>	<b>Enquires</b>	<b>Enrolled in study (%)</b>
Local newspapers	72	41 (57)
Unknown	53	12 (23)
School newsletters	45	23 (51)
Television coverage	29	12 (41)
Statewide newspapers	18	8 (44)
Other health avenues	14	6 (43)
Paediatricians	13	4 (31)
General practitioners	8	1 (13)
Other print media	7	2 (29)
Word of Mouth	3	2 (67)
<b>Total</b>	<b>262</b>	<b>111 (42)</b>



**Table 3.2 Mean±SD or percent for indicators of socioeconomic status and family structure of 111 families at baseline of the study compared with the mean values of the South Australian (SA) population**

	Study families	SA population <sup>1</sup>
SEIFA index <sup>2</sup> -		
Disadvantage	1014±78	1002
Advantage	997±73	960
Resources	983±58	963
Education	1001±57	964
Parents married/defacto	73%	74%
Parents separated/divorced	27%	26%
Family size (number of children)		
One	16%	na
Two	51%	
Three	23%	
Four or more	10%	
Family position of		
child enrolled in study	53%	
First	32%	na
Second	10%	
Third	5%	
Fourth or later		

<sup>1</sup> Data from the 2001 Australian Census (264)

<sup>2</sup> Socio-Economic Index for Areas, higher values indicate higher socioeconomic status (for details refer to section 2.4.6.1 (223))

**Table 3.3 Mean±SD anthropometric measurements and weight status of 6-9 year old pre-pubertal children at baseline of the study**

	All	Boys	Girls	p value <sup>1</sup>
n	111	41	70	
Age (years)	8.2±1.1	8.6±1.0	7.9±1.2	<0.01
Height (cm)	136.3±8.3	140.2±7.9	134.2±7.8	<0.01
Height z score <sup>2</sup>	1.25±0.91	1.37±1.03	1.17±0.81	0.01
Weight (kg)	45.6±9.0	48.7±10.1	43.8±7.8	0.01
BMI (kg/m <sup>2</sup> )	24.3±2.6	24.5±2.8	24.1±2.5	0.41
BMI z score <sup>3</sup>	2.75±0.52	2.84±0.43	2.70±0.56	0.19
Waist Circumference (cm)	77.3±7.3	80.0±7.5	75.8±6.8	<0.01
Waist Circumference z score <sup>3</sup>	3.20±0.65	3.53±0.67	3.02±0.57	<0.01
Weight Status (frequency, n) <sup>4</sup>				na
Non-overweight	1	0	1	
Overweight	22	6	16	
Obese	82	31	51	
Severely Obese	6	3	3	

<sup>1</sup> Independent t test by gender

<sup>2</sup> Calculated by comparing subject heights against US CDC 2000 reference population (214)

<sup>3</sup> Calculated by comparing subject values against UK reference population (215)

<sup>4</sup> Gender and age-specific BMI z score equating to BMI <25, ≥25, ≥30 or ≥40kg/m<sup>2</sup> at age 18 (15, 20).

**Table 3.4 Mean±SD age, anthropometry, parent characteristics and indicators of socioeconomic status for 6-9 year old pre-pubertal children at baseline of the study by site of intervention delivery<sup>1</sup>**

	<b>FMC</b>	<b>WCH</b>	<b>p value<sup>2</sup></b>
n	65	46	
Decimal age (years)	8.4±1.0	8.1±1.2	0.24
Height z score <sup>3</sup>	1.24±0.92	1.24±0.98	0.96
BMI z score <sup>3</sup>	2.65±0.48	2.88±0.55	0.03
Waist z score <sup>3</sup>	3.14±0.63	3.28±0.69	0.29
Mothers BMI (kg/m <sup>2</sup> )	28.9±7.0	30.6±7.4	0.24
Fathers BMI (kg/m <sup>2</sup> )	29.0±4.0	30.3±4.4	0.21
Parents age (years)	40.0±5.7	36.4±6.8	<0.01
SIEFA Indices <sup>4</sup>			
Advantage	1009±73	981±71	0.05
Disadvantage	1027±75	995±79	0.04
Resources	993±56	969±57	0.04
Education	1012±76	987±75	0.08

<sup>1</sup> Study sites were two tertiary teaching hospitals in metropolitan Adelaide, Flinders Medical Centre (FMC) and Women’s and Children’s Hospital (WCH)

<sup>2</sup> Independent t test by study site

<sup>3</sup> Height z score calculated using US CDC 2000 reference population, BMI and waist z scores calculated using UK reference population data (27, 214, 215)

<sup>4</sup> Socio-Economic Index for Areas, higher values indicate higher socioeconomic status (details in section 2.4.6.1) (223)

**Table 3.5 Mean±SD weight, body mass index (BMI) and BMI z score for 6-9 year old pre-pubertal children at baseline, and 6<sup>1</sup> and 12 months after parents commenced the parenting plus intensive lifestyle education (P+DA), parenting alone (P) interventions or were waitlisted for intervention for 12 months (WLC)**

	Weight (kg)			BMI (kg/m <sup>2</sup> )			BMI z score <sup>2</sup>				Change in BMI z score <sup>3</sup> (frequency)	
	Baseline	6 months	12 months	Baseline	6 months	12 months	Baseline	6 months	12 months	Difference (baseline-12 months)	↓	↑
n <sup>4</sup>	111	57	91	111	57	91	111	57	91	91	↓	↑
P+DA	45.3±10.6	45.3±8.1	47.7±8.7	24.1±3.0	23.6±2.4	23.9±2.8	2.74±0.58	2.52±0.53	2.43±0.68	-0.24±0.43	25	6
P	45.8±8.6	48.1±8.6	49.7±10.3	24.3±2.8	24.1±2.8	24.3±3.4	2.76±0.58	2.63±0.53	2.56±0.79	-0.15±0.47	22	7
WLC	45.6±7.6	-	51.2±9.5	24.4±2.0	-	25.0±2.6	2.75±0.39	-	2.60±0.57	-0.13±0.40	16	15

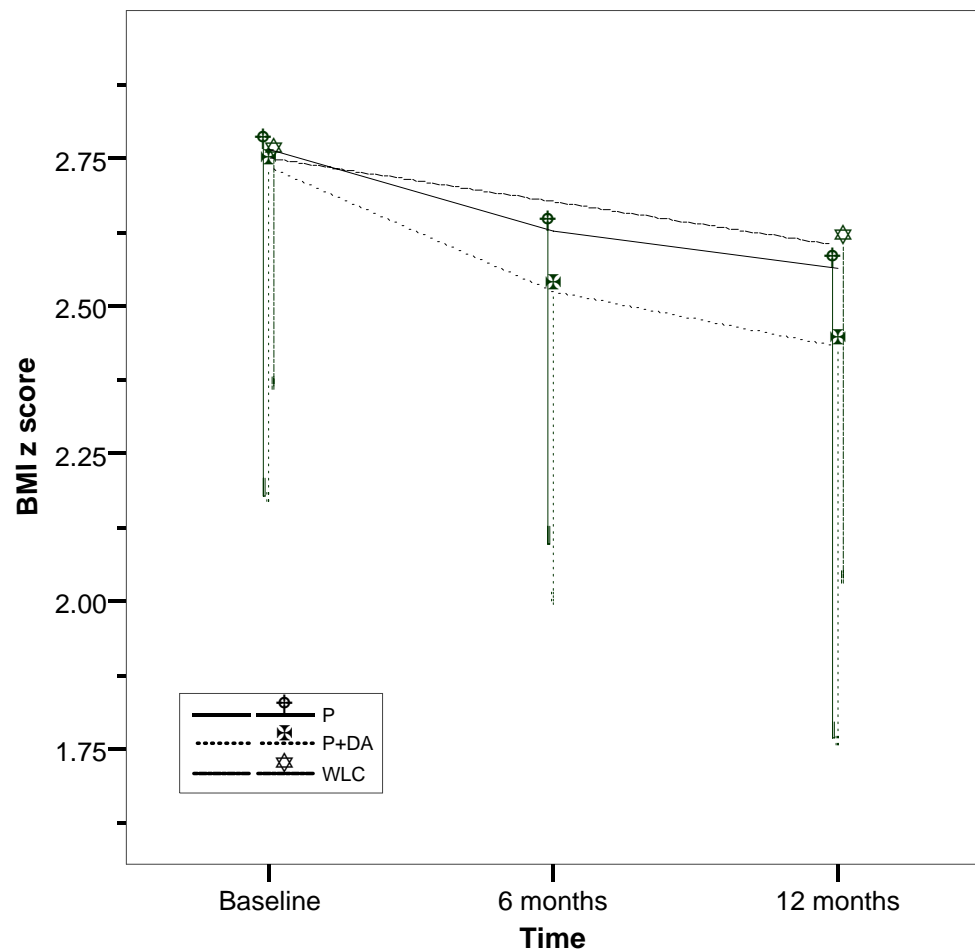
<sup>1</sup> no data collected for WLC at 6 months

<sup>2</sup> Intention to treat analysis, linear mixed model, group by time (p=0.76), group (p=0.89), time (p<0.001). Post hoc analysis (Bonferroni method) for time; baseline versus 12 months p=0.001; baseline versus 6 months p<0.01 and 6 versus 12 months p=1.00

<sup>3</sup> Chi square, p=0.03 direction of the change in BMI z score for individuals subjects at 12 months compared to baseline by study group. ↓ also includes no change in BMI z score. As both baseline and 12 month data required, n=91

<sup>4</sup> Number of children in each study arm at, **baseline** P+DA=38, P=37, WLC=36; **6 months** P+DA=29, P=28, WLC na; **12 months** P+DA=31, P=29, WLC=31

**Figure 3.2 Mean±SD body mass index (BMI) z score<sup>1</sup> for 6-9 year old pre-pubertal children at baseline (n=111), 6 (n=57) and 12 months (n=91) after parents commenced the six month parenting plus intensive lifestyle education (P+DA) or parenting alone (P) intervention or were waitlisted for intervention for 12 months (WLC)<sup>2</sup>**



<sup>1</sup> Intention to treat analysis, linear mixed model, group by time (p=0.76). Main effect for time p<0.01, post hoc analysis (Bonferroni method), baseline versus 12 months p=0.001; baseline versus 6 months p<0.01 and 6 versus 12 months p=1.00. No data collected for WLC at 6 months.

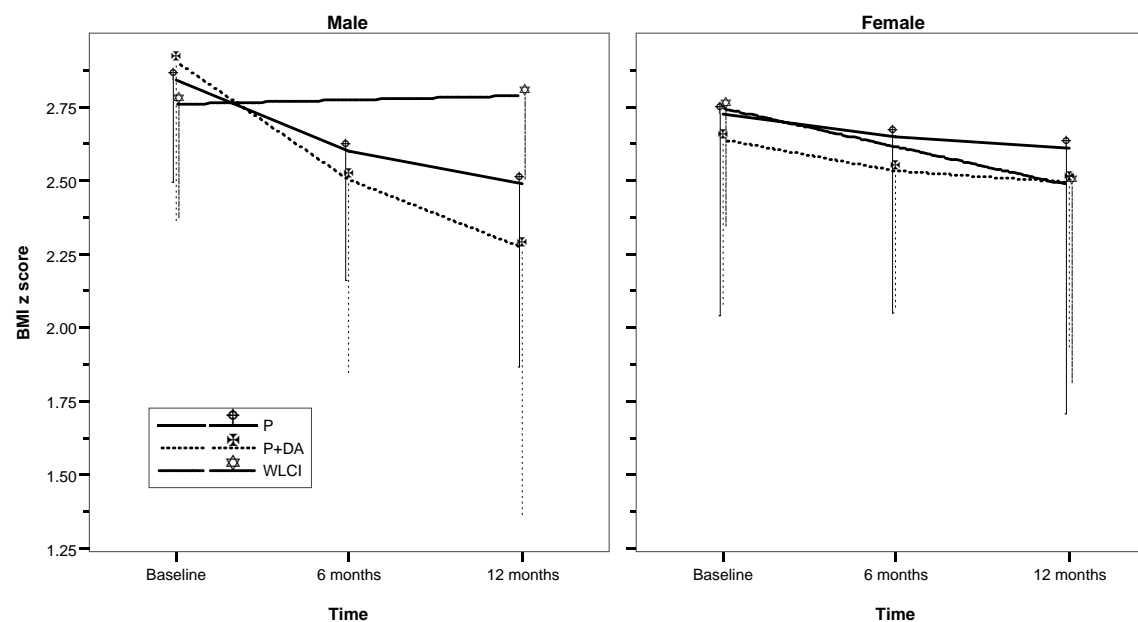
<sup>2</sup> Number of children in each study arm at, **baseline** P+DA=38, P=37, WLC=36; **6 months** P+DA=29, P=28, WLC na; **12 months** P+DA=31, P=29, WLC=31

**Table 3.6 Weight status<sup>1</sup> of 6-9 year old pre-pubertal children at baseline, and 6 and 12 months after parents commenced a 6 month parenting plus intensive lifestyle education (P+DA), parenting alone (P) intervention or were waitlisted for intervention for 12 months (WLC)**

	Baseline		6 months		12 months	
	n	Frequency (%)	n	Frequency (%)	n	Frequency (%)
<b>P+DA</b>	38		29		31	
Non overweight		0		0		1 (3)
Overweight		10 (26)		7 (24)		9 (29)
Obese		28 (74)		22 (76)		21 (68)
<b>P</b>	37		28		29	
Non overweight		1 (3)		0		1 (3)
Overweight		8 (22)		9 (32)		10 (35)
Obese		28 (75)		19 (68)		18 (62)
<b>WLC</b>	36		-		31	
Non overweight		0				1 (3)
Overweight		4 (11)				5 (16)
Obese		32 (89)				25 (81)

<sup>1</sup> Gender and age-specific BMI z score equating to BMI <25, ≥25, ≥30kg/m<sup>2</sup> at age 18 (20)

**Figure 3.3 Mean(SD) body mass index (BMI) z score<sup>1</sup> for 6-9 year old pre-pubertal children at baseline (40 boys, 71 girls), 6 (20 boys, 37 girls) and 12 months (33 boys, 59 girls) after parents commenced a 6 month parenting plus intensive lifestyle education (P+DA) or parenting alone (P) intervention or were waitlisted for intervention for 12 months (WLC)<sup>2</sup>**



<sup>1</sup> linear mixed model, group by time with gender ( $p=0.04$ ). Post hoc analysis not performed, given at 12 months  $n=12$ , 9, 12 boys for P, P+DA and WLC groups respectively

<sup>2</sup> Number of children in each study arm at, **baseline** P+DA=38, P=37, WLC=36; **6 months** P+DA=29, P=28, WLC na; **12 months** P+DA=31, P=29, WLC=31

**Table 3.7 Mean±SD weight (kg), body mass index (BMI), and BMI z score at baseline<sup>1</sup>, 6 and 12 months for 6-9 year old pre-pubertal children whose parents attended ≥75% of the parenting plus intensive lifestyle education (P+DA) or parenting alone (P) intervention or were waitlisted for intervention for 12 months (WLC)**

	Weight (kg)			BMI (kg/m <sup>2</sup> )			BMI z score <sup>2</sup>		
	Baseline	6 months	12 months	Baseline	6 months	12 months	Baseline	6 months	12 months
n <sup>3</sup>	73	35	65	73	35	65	73	35	65
P+DA	42.8±5.0	45.1±5.9	47.7±7.0	23.7±1.7	23.8±2.1	24.0±2.7	2.82±0.46	2.63±0.53	2.51±0.73
P	46.9±9.4	47.6±9.9	49.9±10.9	24.8±2.8	24.2±3.2	24.4±3.6	2.95±0.56	2.70±0.57	2.65±0.91
WLC	45.6±7.6	-	51.2±9.5	24.5±2.0	-	25.0±2.6	2.75±0.39	-	2.60±0.57

<sup>1</sup> Two-way ANOVA (group by gender) for age, height z score, weight, BMI and BMI z score, all p>0.05

<sup>2</sup> Per Protocol analysis, linear mixed model, group by time (p=0.71), time (p<0.01), post hoc analysis for time (Bonferroni method), baseline versus 12 months p<0.01; baseline versus 6 months p=0.02 and 6 versus 12 months p=0.66

<sup>3</sup> **Baseline** P+DA=18, P=19, WLC=36; **6 months** P+DA=18, P=17, WLC na; **12 months** P+DA=17, P=17, WLC=31



**Table 3.8 Mean±SD waist circumference and waist circumference z score<sup>1</sup> for 6-9 year old pre-pubertal children at baseline, 6 and 12 months after parents commenced a 6 month parenting plus intensive lifestyle education (P+DA) or parenting alone (P) child weight management program or were waitlisted for a program for 12 months (WLC)**

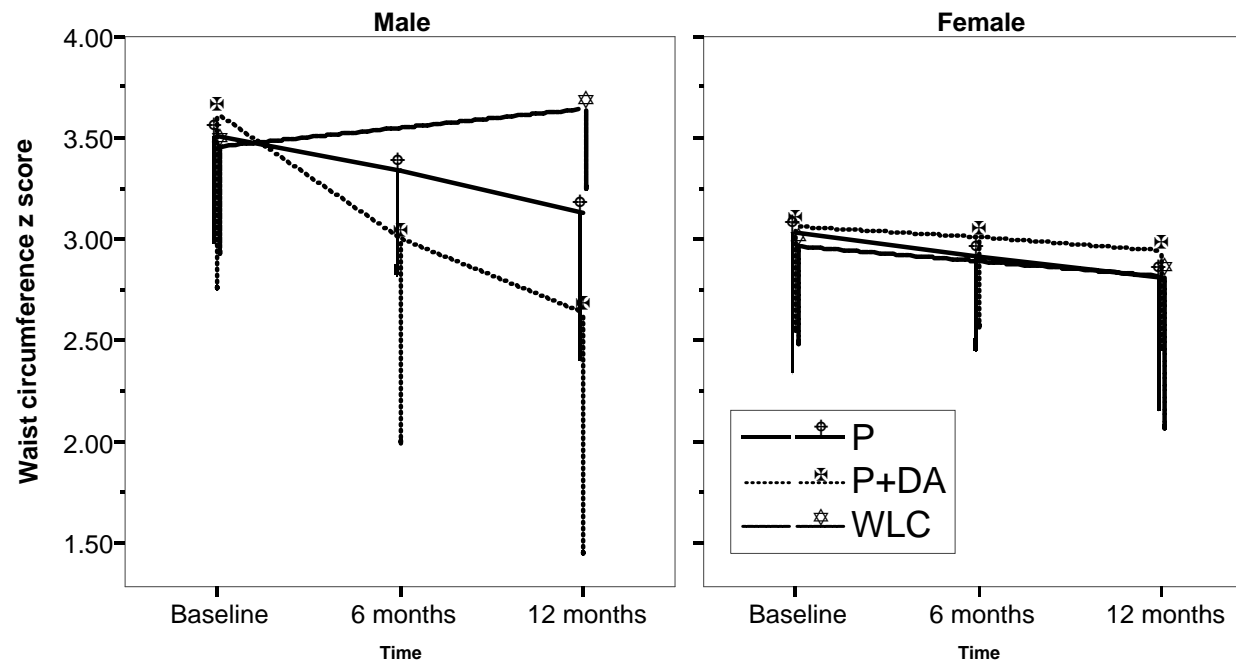
	Waist circumference (cm)			Waist circumference z score <sup>2</sup>		
	Baseline	6months	12months	Baseline	6months	12months
<b>n<sup>3</sup></b>	111	57	91	111	57	91
<b>P+DA</b>	77.8±8.0	76.4±6.9	76.5±7.3	3.27±0.73	3.00±0.67	2.85±0.78
<b>P</b>	77.1±7.4	76.8±6.7	76.8±8.1	3.20±0.67	3.08±0.52	2.93±0.69
<b>WLC</b>	77.0±6.7	-	79.7±8.0	3.14±0.56	-	3.14±0.75

<sup>1</sup> Calculated using UK reference population data (27)

<sup>2</sup> Intention to treat analysis, Linear mixed model, group by time with gender (p=0.03), group by time (p=0.02). Post hoc analysis of group by time interaction (Bonferroni method), **P+DA** 12 months versus baseline (p<0.01), 12 versus 6 months (p<0.01); **P** 12 months versus baseline (p=0.05); **WLC** (all p>0.05)

<sup>3</sup> Number of children in each study arm at, **baseline** P+DA=38, P=37, WLC=36; **6 months** P+DA=29, P=28, WLC na; **12 months** P+DA=31, P=29, WLC=31

**Figure 3.4 Mean±SD waist circumference z score<sup>1</sup> for 6-9 year old pre-pubertal children at baseline (40 boys, 71 girls), 6 (20 boys, 37 girls) and 12 months (33 boys, 59 girls) after parents commenced a 6 month parenting plus intensive lifestyle education (P+DA) or parenting alone (P) intervention or were waitlisted for intervention for 12 months (WLC)<sup>2</sup>**



<sup>1</sup> Linear mixed model group by time with gender (p=0.03). Post hoc analysis with gender not performed, given at 12 months n=12, 9, 12 boys for P, P+DA and WLC groups respectively

<sup>2</sup> Number of children in each study arm at, **baseline** P+DA=38, P=37, WLC=36; **6 months** P+DA=29, P=28, WLC na; **12 months** P+DA=31, P=29, WLC=31

**Table 3.9 Mean±SD waist circumference and waist circumference z score<sup>1</sup> at baseline<sup>2</sup>, 6 and 12 months for 6-9 year old pre-pubertal children whose parents attended ≥75% of the parenting plus intensive lifestyle education (P+DA) or parenting alone (P) intervention sessions or were waitlisted for intervention for 12 months (WLC)**

	Waist circumference (cm)			Waist circumference z score <sup>3</sup>		
	Baseline	6months	12months	Baseline	6months	12months
n <sup>4</sup>	73	35	65	73	35	65
P+DA	76.6±5.3	77.1±6.8	77.0±6.8	3.27±0.56	3.10±0.72	2.93±0.86
P	77.0±6.3	76.0±6.8	77.1±7.8	3.38±0.48	3.06±0.50	2.99±0.58
WLC	77.0±6.7	-	79.7±8.0	3.14±0.56	-	3.14±0.75

<sup>1</sup> calculated using UK reference population data (27)

<sup>2</sup> two-way ANOVA (group and gender), waist circumference (p=0.11) and waist z score (3.46±0.58 boys, 3.1±0.48 girls, p=0.01) at baseline, all p>0.05 by study group

<sup>3</sup> Per protocol analysis, linear mixed model, group by time with sex (p=0.03)

<sup>4</sup> **Baseline** P+DA=18, P=19, WLC=36; **6 months** P+DA=18, P=17, WLC na; **12 months** P+DA=17, P=17, WLC=31

## Tables and Figures Chapter 4

**Table 4.1 Mean±SD height and height z score<sup>1</sup> for 6-9 year old pre-pubertal children at baseline, 6 and 12 months after parents commenced the parenting plus lifestyle education (P+DA) or parenting alone (P) intervention or were waitlisted for intervention for 12 months (WLC)**

	Height (cm)			Height z score <sup>2</sup>		
	Baseline	6 months	12 months	Baseline <sup>3</sup>	6 months	12 months
n	111	57	91	111	57	91
All	136.3±8.3	139.3±8.3	142.0±8.1	1.2±0.9	1.4±0.9	1.3±0.9
P+DA	135.9±8.6	137.7±7.3	141.0±7.3	1.2±0.9	1.2±0.8	1.3±0.8
P	137.9±8.8	140.9±9.1	142.5±9.1	1.5±1.0	1.6±0.9	1.5±1.0
WLC	136.2±7.7	-	142.5±8.2	1.0±0.8	-	1.1±0.9

<sup>1</sup> calculated from CDC 2000 US reference population (214)

<sup>2</sup> linear mixed model, group by time (p=0.39), group (p=0.10), time (p<0.01)

<sup>3</sup> Two-way ANOVA with group and gender (p= 0.08)

**Table 4.2 Metabolic variables obtained from 6-9 year old pre-pubertal children at baseline, 6 and 12 months measurement sessions with percent of those enrolled at baseline**

	<b>Baseline</b>	<b>6 months</b>	<b>12 months</b>
Blood collected <sup>1,2</sup>	104 (94)	52 (69)	71 (64)
P+DA	38 (100)	28 (74)	25 (66)
P	33 (89)	24 (65)	21 (57)
WLC	33 (92)	-	25 (69)
Insulin <sup>3</sup>	101 (91)	50 (67)	71 (64)
Blood pressure <sup>4</sup>	110 (99)	56 (75)	87 (78)

<sup>1</sup> child anthropometric measurement obtained from 57/75 at 6 months, 91/111 at 12 months

<sup>2</sup> analysed for fasting total cholesterol and fractions, triglycerides and glucose

<sup>3</sup> insufficient volume of blood collected to perform insulin analysis, baseline n=2 P group, 2 P+DA group, 1 WLC extra; 6 months n=2 P group; 12 months nil missing

<sup>4</sup> data missing at baseline n=1 WLC group; 6 months n=1 P+DA group; 12 months n=2 P group, 1 P+DA group and 1 WLC group

**Table 4.3 Metabolic variables for 6-9 year old pre-pubertal children at baseline of the study, and prevalence of elevated metabolic risk factors at baseline and 12 months follow up**

	categorical cut point <sup>1</sup>	Baseline Mean±SD	Prevalence of metabolic risk factors			
			Baseline		12 months	
			frequency	percent	frequency	percent
<b>n</b>		104 <sup>2</sup>	101 <sup>3</sup>		71 <sup>3</sup>	
<b>TC (mmol/L)</b>	≥ 4.40	4.48±0.89	48	46	39	55
<b>LDL-C (mmol/L)</b>	≥2.85	2.83±0.82	45	43	40	56
<b>HDL-C (mmol/L)</b>	<0.82	1.31±0.24	4	4	7	10
<b>TG (mmol/L)</b>	>1.81	0.74±0.58	3	3	2	3
<b>SBP (mmHg)</b>	Age and gender specific	116±11	46	42	33	38
<b>DBP (mmHg)</b>	Age and gender specific	58±7	1	1	1	1
<b>Glucose (mmol/L)</b>	>7.9	4.44±0.78	0	0	0	0
<b>Insulin (pmol/L)</b>	>35 boys, >41 girls	79±37	86	85	66	93

<sup>1</sup> cut point indicating elevated cardiovascular risk, refer to section 2.4.6.6 for details and table 2.4 for cut point justification

<sup>2</sup> n=110 for blood pressure, n=101 for insulin, refer to table 4.2 for details

<sup>3</sup> analysis using subjects with complete metabolic data only

**Table 4.4 Mean±SD for metabolic variables for 6-9 year old pre-pubertal children at baseline, 6 and 12 months by study group (parenting plus intensive lifestyle education, P+DA; parenting alone, P; waitlisted for intervention for 12 months, WLC)**

	Time point	Study group			p value <sup>1</sup>
		P+DA	P	WLC	
<b>TC<sup>2</sup></b>	Baseline	4.41±0.87	4.59±1.09	4.43±0.65	0.47
<b>(mmol/L)</b>	6 months	4.66±0.77	4.62±0.70	-	
	12 months	4.57±0.88	4.59±0.76	4.43±0.59	
<b>LDL-C<sup>3</sup></b>	Baseline	2.76±0.81	2.93±1.03	2.82±0.57	0.42
<b>(mmol/L)</b>	6 months	3.01±0.67	2.89±0.59	-	
	12 months	2.99±0.70	3.00±0.70	2.89±0.59	
<b>HDL-C<sup>4</sup></b>	Baseline	1.31±0.23	1.28±0.25	1.32±0.25	0.96
<b>(mmol/L)</b>	6 months	1.29±0.25	1.35±0.27	-	
	12 months	1.26±0.26	1.27±0.25	1.20±0.25	
<b>TG<sup>5</sup></b>	Baseline	0.75±0.49	0.84±0.80	0.63±0.39	0.98
<b>(mmol/L)</b>	6 months	0.79±0.51	0.83±0.64	-	
	12 months	0.71±0.47	0.72±0.48	0.75±0.45	

<sup>1</sup> linear mixed model, group by time interaction (with gender for HDL-C analysis). All main effects of group were p>0.05

<sup>2</sup> main effect of time p<0.01, 6 months versus baseline (p=0.25), 12 months versus baseline (p<0.01), 12 months versus 6 months (p=1.00), refer to table 4.2 for details for n values

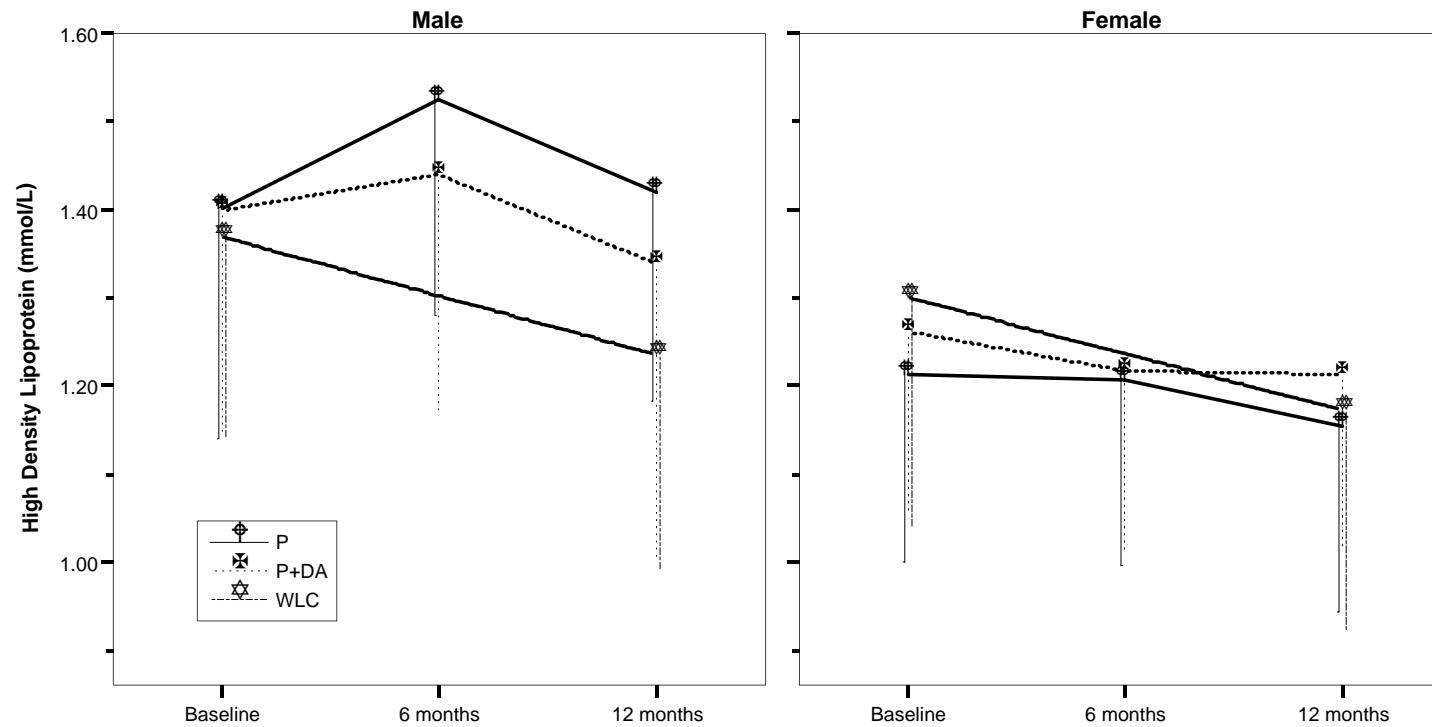
<sup>3</sup> main effect of time p<0.01, 6 months versus baseline (p=0.32), 12 months versus baseline (p<0.01), 12 months versus 6 months (p=1.00), refer to table 4.2 for details for n values

<sup>4</sup> main effect of time p<0.01, 6 months versus baseline (p=1.00), 12 months versus baseline (p=0.03), 12 months versus 6 months (p=0.06), refer to table 4.2 for details for n values

<sup>5</sup> main effect of time p=0.98, refer to table 4.2 for details for n values



**Figure 4.1 Mean±SD HDL-C for 6-9 year old pre-pubertal children at baseline and 6 and 12 months after parents participated in the parenting plus intensive lifestyle education (P+DA) or parenting alone (P) intervention or were wait listed for intervention for 12 months (WLC)<sup>1</sup>**



<sup>1</sup> linear mixed model, group by time by gender ( $p=0.96$ ), main effect for group ( $p=0.86$ ), gender ( $p<0.01$ ) and time ( $p=0.01$ ). Refer to table 4.2 for n values

**Table 4.5 Mean±SD systolic (SBP) and diastolic (DBP) blood pressure for 6-9 year old pre-pubertal children at baseline, 6 and 12 months by study group (parenting plus intensive lifestyle education, P+DA; parenting alone, P; waitlisted for intervention for 12 months, WLC)**

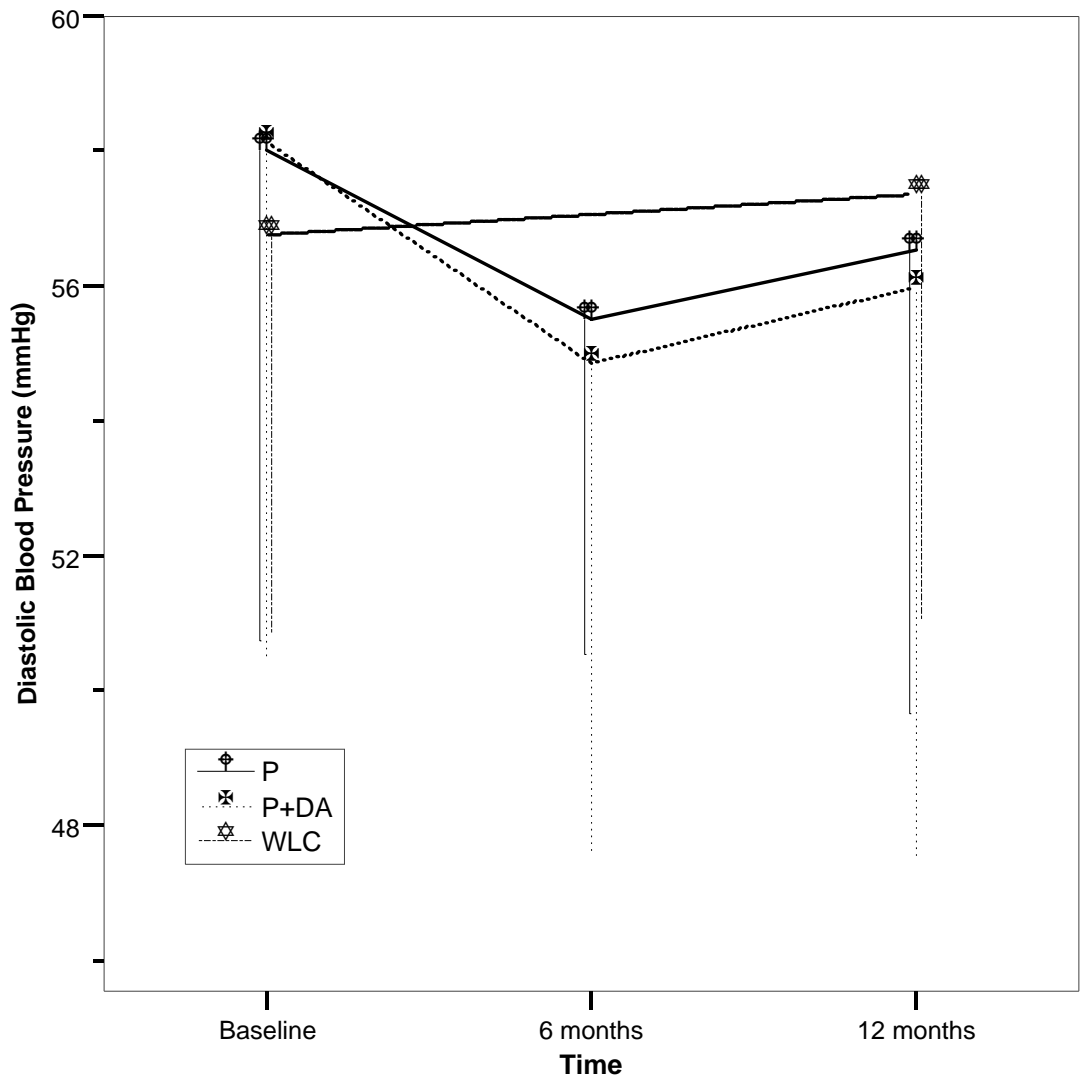
		Study group			P value <sup>1</sup>
		P+DA	P	WLC	
<b>SBP<sup>2</sup></b> <b>(mmHg)</b>	Baseline	113±9	117±12	117±11	0.49
	6 months	115±10	118±6	-	
	12 months	116±10	117±6	117±8	
<b>DBP<sup>3</sup></b> <b>(mmHg)</b>	Baseline	58±8	58±7	57±6	0.82
	6 months	55±7	56±5	-	
	12 months	56±8	57±7	57±6	

<sup>1</sup> linear mixed model, group by time interaction

<sup>2</sup> Main effect of group (p=0.14) and time (p=0.42), refer to table 4.2 for details for n values

<sup>3</sup> Main effect of group (p=0.93) and time (p=0.03). Post hoc analysis of time (Bonferroni method), 6 months versus baseline (p=0.04), 12 months versus baseline (p=1.0), 12 months versus 6 months (p=0.20), refer to table 4.2 for details for n values

**Figure 4.2 Mean±SD diastolic blood pressure for 6-9 year old pre-pubertal children at baseline, 6 and 12 months after parents participated in a parenting plus intensive lifestyle education (P+DA) or parenting alone (P) intervention or were wait listed for intervention for 12 months (WLC)<sup>1</sup>**



<sup>1</sup> linear mixed model, group by time ( $p=0.82$ ), group ( $p=0.93$ ), time ( $p=0.03$ ). Post hoc analysis of time (Bonferroni method), baseline versus 6 months ( $p=0.04$ ), baseline versus 12 months ( $p=1.00$ ), 12 months versus baseline ( $p=0.20$ ). Refer to table 4.2 for details for n values

**Table 4.6 Mean±SD glucose and insulin for 6-9 year old pre-pubertal children at baseline, 6 and 12 months by study group (parenting plus intensive lifestyle education, P+DA; parenting alone, P; waitlisted for intervention for 12 months, WLC)**

	time point	Study group			p value <sup>1</sup>
		P+DA	P	WLC	
<b>Glucose<sup>2</sup></b> <b>(mmol/L)</b>	Baseline	4.4±0.8	4.4±0.8	4.5±0.8	0.88
	6 months	4.6±0.5	4.5±0.4	-	
	12 months	4.6±0.4	4.5±0.5	4.5±0.4	
<b>Insulin<sup>3</sup></b> <b>(pmol/L)</b>	Baseline	78±45	80±33	80±33	0.84
	6 months	80±43	80±34	-	
	12 months	92±71	84±52	92±52	

<sup>1</sup> linear mixed model, group by time interaction

<sup>2</sup> Main effect of group (p=0.76) and time (p=0.33), refer to table 4.2 for details for n values

<sup>3</sup> Main effect of group (p=0.95) and time (p=0.10), refer to table 4.2 for details for n values

**Table 4.7 Construct validity<sup>1</sup> of the child body image size (CBIS) tool measuring body size dissatisfaction in 6-9 year old pre-pubertal children at baseline of the study**

	Age range (years)	n	Correlation CBIS versus perceived body image		Correlation CBIS versus desired body image	
			r	p value	r	p value
<b>All</b>		110 <sup>2</sup>	0.29	<0.01	-0.39	<0.01
<b>Boys</b>		40	0.41	0.01	-0.26	0.11
<b>Girls</b>		70	0.24	0.05	-0.45	<0.01
<b>Boys</b>	6-7.9	11	0.69	0.02	-0.63	0.04
	8-10	29	0.33	0.08	-0.03	0.64
<b>Girls</b>	6-7.9	32	0.23	0.21	-0.42	0.02
	8-10	38	0.25	0.13	-0.49	<0.01

<sup>1</sup> assessed as the correlation (Pearson) between the CBIS perceived-desired body figure discrepancy and 2 single body image items

<sup>2</sup> One child refused to complete the CBIS at baseline

**Table 4.8 Child reported body size dissatisfaction by gender in 6-9 year old pre-pubertal children at baseline of the study compared to a normative Australian community sample**

<b>Six to nine year old overweight children</b>					<b>Seven to twelve year old community children (227) (across the weight spectrum)</b>			
	<b>n</b>	<b>Perceived body figure</b>	<b>Desired body figure</b>	<b>Perceived-desired discrepancy</b>	<b>n</b>	<b>Perceived body figure</b>	<b>Desired body figure</b>	<b>Perceived-desired discrepancy</b>
Boys	40	4.7±1.0 <sup>1</sup>	2.3±1.0	2.5±1.2 <sup>1</sup>	148	2.9±1.3	2.7±1.1	0.3±1.5
Girls	70	5.0±1.1 <sup>1</sup>	2.5±1.1	2.5±1.4 <sup>1</sup>	162	3.1±1.3	2.7±1.3	0.5±1.4

<sup>1</sup>Independent t test, p<0.001 (study subjects versus community sample)

**Table 4.9 Child reported body size dissatisfaction at baseline<sup>1</sup>, 6 and 12 months following parent participation in the parenting plus intensive lifestyle education (P+DA) or parenting alone (P) intervention or waitlisting for intervention for 12 months (WLC)<sup>2</sup>**

	<b>Baseline</b>	<b>6 months</b>	<b>12 months</b>
<b>n<sup>3</sup></b>	110	57	87
<b>P+DA</b>	2.5±1.3	2.1±1.0	2.2±1.2
<b>P</b>	2.5±1.4	2.2±1.3	1.8±1.3
<b>WLC</b>	2.4±1.4	-	2.1±1.6

<sup>1</sup> one-way ANOVA, p=0.92 by group at baseline

<sup>2</sup> linear mixed model, time by group (p=0.45), group (p=0.80), time (p=0.01)

<sup>3</sup> Children refused to complete interview at baseline (n=1), interview not completed at 12 months (n=4)

**Table 4.10 Mean±SD scores for parent-reported domains of health-related quality of life for 6-9 year old pre-pubertal children at baseline of the study (HELPP) compared to 5-10 year old Victorian school children (222)**

Child Health Questionnaire Scale Item <sup>1</sup>		HELPP	Normal	p value <sup>2</sup>	HELPP	Normal	p value <sup>2</sup>
	Child age group (years)	6-7	5-7		8-9	8-10	
	n	43	1014		68	1392	
<b>Physical functioning</b>	Physical activities limited by physical health	92±12	96±14	0.05	90±15	95±15	0.001
	Role/social activities limited by physical health	91±17	96±14	0.07	92±21	95±17	0.25
	Bodily pain/discomfort	80±23	86±17	0.10	75±24	84±18	0.01
	General health perceptions	67±17	76±16	0.01	67±17	77±16	0.001
<b>Psychosocial functioning</b>	Role/social activities limited by emotional/social problems	91±18	95±16	0.20	87±24	94±17	0.05
	Behavioural problems	71±18	75±15	0.20	64±17	76±15	0.001
	Emotional problems	66±9	80±11	0.001	63±12	80±12	0.001
	Self-esteem	70±18	85±15	0.001	64±18	82±16	0.001
<b>Family functioning</b>	Emotional impact on parents	63±22	82±19	0.001	60±21	81±21	0.001
	Time impact on parents	87±20	91±17	0.20	84±21	90±18	0.05
	Impact on family activities	77±17	85±17	0.01	71±21	85±17	0.001
	Family cohesion	67±26	79±19	0.01	67±22	77±20	0.001

<sup>1</sup> HR-QOL assessed using the Child Health Questionnaire (CHQ PF50) with higher scores indicating better HR-QOL (refer to Table 2.5)

<sup>2</sup> t test study versus community sample, significant at p<0.002 (shaded)



**Table 4.11 Median and interquartile range for domains of health-related quality of life (HR-QOL)<sup>1</sup> in 6-9 year old pre-pubertal children reported by parents at baseline (n=111)<sup>2</sup>, 6 (n=57) and 12 (n=91) months of the study by intervention group<sup>3</sup>**

	Physical functioning			Psychosocial functioning			Family functioning		
	Baseline	6 months	12 months	Baseline	6 months	12 months	Baseline	6 months	12 months
	<b>Physical activities limited by physical health</b>			<b>Role/social activities limited by emotional health</b>			<b>Emotional impact on parents</b>		
P+DA	94 83;100	100 100;100	100 89;100	100 78;100	100 89; 100	100 100;100 <sup>6</sup>	63 50;75	83 67; 92 <sup>5</sup>	83 67;92 <sup>6</sup>
P	100 89;100	10 94;100	100 94;100	100 89;100	100 100; 100	100 94;100	58 50;75	75 58; 92	83 67;92 <sup>6</sup>
WLC	100 86;100	-	100 94;100	100 94;100	-	100 100;100	68 50;75	-	75 58;83
	<b>Role/social activities limited by physical health</b>			<b>Behaviour problems</b>			<b>Time impact on parents</b>		
P+DA	100 100;100	100 100;100	100 100;100 <sup>6</sup>	64 56;83	77 64;81	77 68;81 <sup>6</sup>	89 78;100	100 89; 100	89 78;100
P	100 100;100	100 100;100	100 100;100	64 48;75	68 60;82	75 64;82 <sup>7</sup>	89 78;100	89 72; 100	100 78;100
WLC	100 100;100	-	100 100;100	73 61;77	-	73 56;81	89 78;100	-	100 100;100
	<b>Bodily pain and discomfort</b>			<b>Emotional problems</b>			<b>Impact on family activities</b>		
P+DA	75 60;100	80 70; 100	80 70;100	70 60;75	80 70; 80 <sup>5</sup>	80 70;90 <sup>6</sup>	77 58;92	85 69; 92	92 75;96 <sup>6</sup>
P	80 60;100	90 80 100	100 75;100	60 55;65	80 73; 88 <sup>5</sup>	75 65;90 <sup>6</sup>	75 58;88	83 69; 92	92 71;96
WLC	80 50;100	-	80 70;100	65 55;70	-	75 65;85 <sup>6</sup>	75 63;88	-	83 63;88
	<b>Global health perception</b>			<b>Self esteem</b>			<b>Family cohesion</b>		
P+DA	68 56;77	77 64; 83 <sup>5</sup>	77 68;83 <sup>6</sup>	67 54;83	79 67;88	79 71;92 <sup>4,6</sup>	85 60;85	60 60; 85	85 60;100
P	71 60;85	74 60;81	77 60;89	71 54;79	81 63; 94 <sup>5</sup>	83 67;92 <sup>4,6</sup>	60 30;85	85 60; 85	85 60;85 <sup>6</sup>
WLC	66 50;77	-	73 60;79	65 56;75	-	67 54;75	60 60;85	-	73 60;85

<sup>1</sup> Parental perceived child HR-QOL assessed using the Child Health Questionnaire (CHQ PF50). Higher scores indicate better HR-QOL (see section 2.4.6.9); <sup>2</sup> Kruskal-Wallis by group at baseline all items p>0.05 <sup>3</sup> P+DA Parenting plus lifestyle education, P parenting alone, WLC waitlisted for intervention for 12 months; <sup>4</sup> Kruskal-Wallis by group at 12 months. Post hoc analysis P+DA and P versus WLC p<0.05, P+DA versus P p>0.05 <sup>5</sup> Wilcoxon signed rank test (with Bonferroni corrections for multiple comparisons) 6 months versus baseline, p<0.02 <sup>6</sup> Wilcoxon signed rank test (with Bonferroni corrections for multiple comparisons) 12 months versus baseline, p<0.02 <sup>7</sup> Wilcoxon signed rank test (with Bonferroni corrections for multiple comparisons) 12 months versus 6 months, p<0.02

## Tables and Figures Chapter 5

**Table 5.1 Frequency of parent attendance<sup>1</sup> at the parenting alone (P n=37) and parenting plus intensive lifestyle education (P+DA n=38) intervention sessions**

	<b>All sessions<sup>2</sup></b> <b>(group and individual telephone calls)</b>		<b>Parenting skills training</b> <b>sessions</b>		<b>Lifestyle education</b> <b>sessions</b>
	<b>P</b>	<b>P+DA</b>	<b>P</b>	<b>P+DA</b>	<b>P+DA</b>
Number of sessions	11	18	8	8	7
Poor Attended <50%	13	10	10	10	10
Fair Attended 50-74%	5	10	6	4	10
Good Attended ≥75%	19	18	21	24	18

<sup>1</sup> categories were arbitrarily chosen based on attendance to more sessions equating to higher program exposure and maybe indicating greater parent engagement with the program. ≥75% attendance chosen to give some leeway for occasional or unexpected missed sessions (eg illness) over a 6 month time frame (see section 2.5.5)

<sup>2</sup> refer to Table 2.2 for details on the type, frequency and content of sessions

**Table 5.2 Number of parents completing evaluation measures at baseline, 6 and 12 months after participating in the 6 month parenting alone (P) or parenting plus intensive lifestyle education (P+DA) interventions or being wait listed for intervention for 12 months (WLC)**

	Baseline				6 months				12 months			
	P	P+DA	WLC	Total	P	P+DA	WLC	Total	P	P+DA	WLC	Total
Parents attending measurements	37	38	36	111	28	29		57	29	31	31	91
Program attendance			na		37	38		75			na	
Satisfaction questionnaire <sup>1</sup>			na		10	26	na	36 <sup>1</sup>	na	na	21	21
FFQ, activity inventory, PSOC <sup>2</sup>	37	38	36	111	27	29		56	29	30	30	89
Mothers weight status	37	38	36	111	27	28		55	28	27	26	81
Fathers weight status	27	26	23	76	17	15		32	17	15	14	46

<sup>1</sup> 53 parents completed the satisfaction questionnaire but 17 parents did not indicate which intervention program they participated in. This could not be determined later as questionnaires were anonymous; therefore data from these 17 parents were not included in the analysis

<sup>2</sup> Measures completed in the same booklet of questionnaires, FFQ=Food frequency questionnaire; PSOC=parent sense of competency scale (refer to sections 2.4.6.12 and 2.4.6.13 for details)

**Table 5.3 Parent responses when asked at the end of the intervention about their satisfaction with the 6 month child weight management programs, parenting alone (P) or parenting plus intensive lifestyle education (P+DA)**

Likert response range	All parents <sup>1</sup>			Parents in P group			Parents in P+DA group		
	n	5-7	3-4	1-2	5-7	3-4	1-2	5-7	3-4
How would you rate the quality of the service provided during the program?	53	0	0	10	0	0	26	0	0
To what extent did you receive the type of help wanted?	43	9	1	8	2	0	13	2	1
How satisfied are you with the amount of help received during the program?	46	5	2	10	0	0	22	2	2
To what extent has the program assisted you in making the required family lifestyle changes?	47	5	1	10	0	0	24	2	0

<sup>1</sup> 53 parents completed the satisfaction questionnaire with results presented under 'all parents'. However 17 parents did not indicate which intervention program they participated in. This could not be determined later as questionnaires were anonymous hence n=10 and n=26 only for analysis by specific intervention group

**Table 5.4 Responses circled<sup>1</sup> by study parents participating in the parenting alone (P) or the parenting plus intensive lifestyle education (P+DA) intervention programs when asked about factors they felt had impacted on their ability to attend intervention sessions and implement the program at home**

n <sup>2</sup>	P		P+DA	
	Attendance	Implementation	Attendance	Implementation
	Barriers	Barriers	Barriers	Barriers
Program <sup>3</sup>	1	4	10	6
Family <sup>4</sup>	12	5	24	29
Other	0	1	5	2

<sup>1</sup> parents could circle more than one barrier

<sup>2</sup> 53 parents completed the satisfaction questionnaire immediately upon completion of the intervention program (ie 6 months). However 17 parents did not indicate which intervention program they participated in. This could not be determined later as questionnaires were anonymous hence n=10 and n=26 only for analysis by specific intervention group

<sup>3</sup> responses relating to the timing or frequency of sessions, difficulties with transport to sessions or the program failed to meet parent's needs are grouped together

<sup>4</sup> responses relating to family or work commitments, family member illness or lack of time are grouped together

**Table 5.5 Summary of parent responses<sup>1</sup> to open-ended questions about what they most liked, what they least liked and what else should have been in the parenting alone (P) or parenting plus intensive lifestyle education (P+DA) intervention programs**

Quoted responses were coded under the following themes -	n	P	P+DA
<b>Liked Most</b>			
Structure of the Program		6	13
Lifestyle information/education		4	8
Parenting skills training		7	7
Facilitator-related		3	6
Taking a 'whole family' approach		1	3
<b>Liked Least</b>			
Program logistics		3	9
No suggestions provided		7	7
Making changes/being challenged		0	4
Lack of diet information		3	0
Parenting skills training		2	2
<b>Suggestions for program inclusions</b>			
Nothing		5	17
Diet-related information		8	1
Psychosocial-related information		0	2
Other (involve the child)		1	1
<b>Other comments</b>			
Nil		2	5
Positive		9	14
Negative		3	2

<sup>1</sup> parents were able to provide more than one response

**Table 5.6 Summary of parent responses<sup>1</sup> to open-ended questions asking about what they felt they had learnt and what changes they had made immediately following completion of the parenting alone (P) or parenting plus intensive lifestyle education (P+DA) intervention programs**

Quoted responses were coded under the themes –	<b>P</b>	<b>P+DA</b>
n	10	26
<b>List 3 things you have learnt to assist with managing child weight</b>		
AGHE <sup>2</sup> (quality or type of foods)	2	14
Extras (high energy/fat/sugar/salt) foods	4	6
Parenting or behaviour modification	13	12
Nutrition skills	1	5
Activity	7 (3 TV)	9 (2 TV)
Health	1	2
Family-focused child weight management	2	4
<b>List 3 eating and activity changes your family has made</b>		
Increased parent control/awareness	9	13
Decreased television viewing	3	7
Increased activity levels	9	10
Reduced intake of 'extras' foods	9	12
Increased the variety/quality/type of food	8	7
Changed beverage intake	0	4

<sup>1</sup> parents were able to provide more than one response

<sup>2</sup> The Australian Guide to Healthy Eating (205)



**Table 5.7 Median (IQR) daily food group serves for children at baseline<sup>1</sup> (n=106), 6<sup>1</sup> (n=54) and 12 (n=91) months following parent participation in the parenting plus lifestyle education (P+DA) or parenting alone (P) intervention or 12 month intervention waitlist (WLC)**

Recommended serves AGHE food groups <sup>2</sup>	Study group	Baseline <sup>3</sup>	6 Months	12 Months	p value <sup>4</sup>
<b>3 to 6 serves breads and cereals/day</b>	P+DA	3.0 (2.0:3.7)	3.0 (2.1:3.5)	3.0 (2.5:3.4)	0.92
	P	3.0 (2.4:4.0)	3.0 (2.0:4.2)	3.0 (2.1:4.0)	
	WLC	3.0 (2.0:3.9)	-	2.7 (2.0:3.3)	
<b>4 to 5 serves vegetables/day</b>	P+DA	2.0 (1.2:2.2)	2.1 (2.0:3.0)	2.3 (1.5:3.0)	0.23
	P	2.0 (1.4:3.0)	2.0 (1.8:3.0)	2.0 (1.0:3.0)	
	WLC	1.7 (1.0:2.7)	-	1.8 (1.0:2.6)	
<b>1 to 2 serves fruit/day</b>	P+DA	1.7 (1.0:2.5)	2.0 (1.6:2.6)	2.0 (1.4:2.7)	0.22
	P	2.0 (1.3:3.3)	2.0 (1.2:2.7)	2.1 (1.9:2.8)	
	WLC	2.0 (1.2:2.4)	-	1.7 (1.0:2.0)	
<b>3 serves of dairy/day</b>	P+DA	2.0 (1.0:3.0)	2.3 (1.5:3.0)	2.0 (1.3:3.0)	0.18
	P	2.5 (2.0:3.3)	2.0 (1.5:3.0)	2.4 (2.0:3.0)	
	WLC	2.0 (1.2:3.0)	-	2.0 (1.4:2.7)	
<b>0.5 to 1.5 serves of meat/day</b>	P+DA	1.7 (1.0:2.0)	1.5 (1.0:2.0)	1.7 (1.0:2.0)	0.90
	P	2.0 (1.0:2.7)	1.7 (1.0:2.0)	1.7 (1.1:2.2)	
	WLC	1.1 (1.0:1.9)	-	1.4 (1.0:1.9)	
<b>0 to 2 serves extras/day</b>	P+DA	3.5 (2.5:4.5)	2.0 (1.5:2.5)	2.0 (2.0:3.0)	0.02
	P	3.0 (2.4:3.4)	1.5 (1.5:2.0)	2.3 (1.5:3.0)	
	WLC	3.0 (2.0:3.5)	-	2.5 (1.9:4.0)	

<sup>1</sup> data collected insufficient for analysis at baseline (n=5) and 6 months (n=3), <sup>2</sup> food group serves recommended for 4-11 year olds using pattern where 100% nutrient and energy requirements are met using all the food groups (205), assessed using a food frequency questionnaire (see section 2.4.6.12 for details), <sup>3</sup> Mann Whitney U or Kruskal-Wallis at baseline by gender, group, weight status or program attendance, P>0.05, <sup>4</sup> linear mixed model for group by time interaction

**Table 5.8 Median (interquartile range) minutes per day engaged in small screen activities<sup>1</sup> and active play<sup>1</sup> for study children at baseline, 6 and 12 months following parent participation in the parenting plus intensive lifestyle education (P+DA) or parenting alone (P) intervention or wait listing for intervention for 12 months**

		Baseline <sup>2</sup>	6 Months	12 months
n <sup>3</sup>		89	54	90
Small screen use <sup>4</sup>	<b>P</b>	278 (169:360)	223 (109:315)	134 (110:216)
Active play <sup>4</sup>		215 (164:314)	341 (295:676)	340 (255:525)
Small screen use	<b>P+DA</b>	270 (210:320)	208 (148:307)	124 (69:183)
Active play		230 (145:367)	250 (160:414)	288 (166:423)
Small screen use	<b>WLC</b>	313 (203:386)	-	147 (91:207)
Active play		213 (131:329)	-	265 (142:405)

<sup>1</sup> assessed using non-validated, parent report inventory (see section 2.4.6.12)

<sup>2</sup> Kruskal-Wallis at baseline for group and gender, p>0.05 for both variables

<sup>3</sup> data collected insufficient for analysis at baseline (n=22), 6 months (n=3) and 12 months (n=1)

<sup>4</sup> linear mixed model for group by time interaction, small screen use p=0.76 and active play p=0.06

**Table 5.9 Baseline parents sense of competency (PSOC, (231)), satisfaction with parenting and perceived parenting efficacy for parents of study children at baseline by child gender**

	Child gender	n	Study sample at baseline <sup>1</sup>	Community sample <sup>2</sup>	p-value <sup>3</sup>
<b>PSOC<sup>4</sup></b>	Boys	40	65±10	63±10	0.20
	Girls	71	67±11	64±11	0.10
<b>PSOC - satisfaction</b>	Boys	40	38±7	38±6	0.20
	Girls	71	38±7	39±6	0.20
<b>PSOC - efficacy</b>	Boys	40	27±5	25±6	<0.05
	Girls	71	29±6	26±7	<0.01

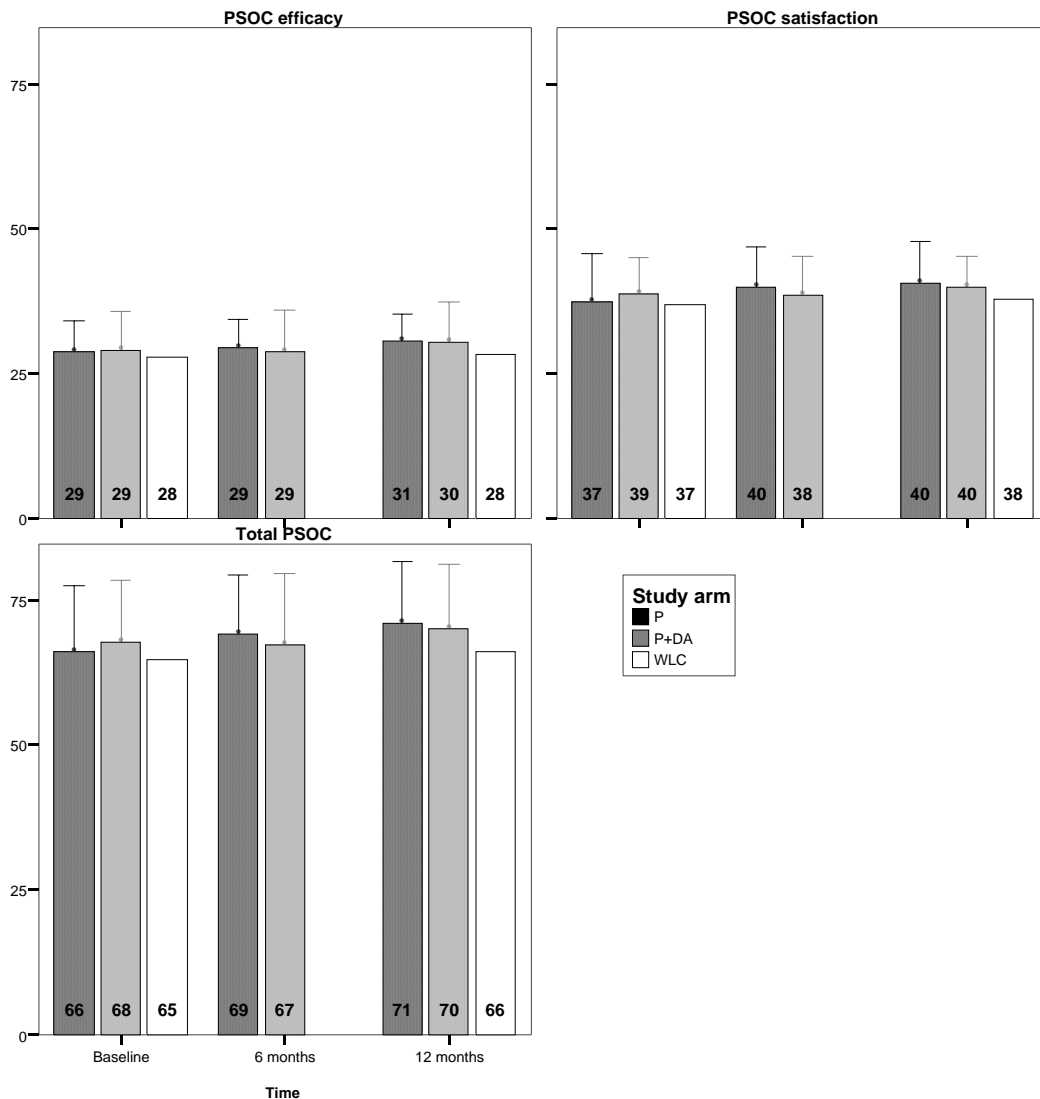
<sup>1</sup> Independent t test for baseline differences by gender; p=0.28, 0.98, 0.05 respectively for overall parent sense of competency and the satisfaction and efficacy sub scores

<sup>2</sup> Maternal perceived sense of competency, parenting satisfaction and efficacy for 75 boys and 54 girls aged 7 to 9 years from community sample in a large Canadian city (231)

<sup>3</sup> Independent t test by study versus community sample

<sup>4</sup> higher scores indicate higher parental competency, parenting satisfaction and perceived parenting efficacy

**Figure 5.1 Mean±SD parent self-reported parent sense of competency (PSOC), satisfaction with parenting (PSOC-satisfaction) and perceived parenting efficacy (PSOC-efficacy) at baseline<sup>1</sup> (n=111), 6 (n=56) and 12 months (n=89) after parent participation in the parenting plus lifestyle education (P+DA) or parenting alone (P) interventions or waitlisting for intervention for 12 months<sup>2</sup>**



<sup>1</sup> one-way ANOVA by group at baseline, overall PSOC (p=0.43), PSOC-satisfaction (p=0.48), PSOC-perceived efficacy (p=0.60)

<sup>2</sup> linear mixed model, group by time interaction (PSOC p=0.07; PSOC-satisfaction p=0.06; PSOC-perceived efficacy p=0.44), main effect of group (all p>0.05), main effect of time (all p<0.05). Post hoc analysis of time (Bonferroni method) PSOC, PSOC-satisfaction, PSOC-perceived efficacy 12 months versus baseline p<0.05. All other time comparisons p>0.05

**Table 5.10 Mean±SD body mass index (BMI) and waist circumference for parents of 6-9 year old pre-pubertal overweight children at baseline, and 6 and 12 months following parent participation in the parenting plus intensive lifestyle education (P+DA) or parenting alone (P) child weight management intervention or waitlisting for intervention for 12 months**

		Baseline <sup>1</sup>	6months	12 months	p value <sup>2</sup>
<b>Mothers BMI</b> (kg/m <sup>2</sup> )	n	111	55	55	0.20
	P	28.5±5.3	28.2±5.4	27.5±4.8	
	P+DA	30.6±7.9	30.6±8.2	29.8±8.5	
	WLC	29.8±8.0	-	29.2±5.5	
<b>Mothers waist circumference</b> (cm)	n	109	54	80	0.45
	P	87.8±12.0	86.5±11.8	85.1±9.1	
	P+DA	93.1±17.7	93.3±19.0	90.7±18.5	
	WLC	87.9±12.7	-	88.9±13.7	
<b>Fathers BMI</b> (kg/m <sup>2</sup> )	n	76	32	46	0.01
	P	29.7±4.6	29.2±5.1	29.2±3.8	
	P+DA	29.7±3.8	28.6±2.8	28.4±3.5	
	WLC	29.3±4.3	-	29.7±4.6	
<b>Fathers waist circumference</b> (cm)	n	67	29	53	0.74
	P	103.8±12.7	103.5±12.2	99.2±8.6	
	P+DA	102.7±10.4	96.6±6.4	95.3±8.2	
	WLC	99.6±12.7	-	103.8±17.4	

<sup>1</sup> one-way ANOVA at baseline by study group, BMI mother (p=0.10), father (p=0.82) and waist circumference mother (p=0.20), father (p=0.50)

<sup>2</sup> linear mixed model for group by time interaction. Where p for interaction was not significant analysis of main effects for group and time found all p>0.05. Refer to text for post hoc analysis of fathers BMI

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Appendix 1 Example of the written resources for the  
parenting plus intensive lifestyle education group

## Facilitators Checklist - HELPP Lifestyle Support Program

**Session 3** Cohort \_\_\_\_\_ Date \_\_\_\_\_ Location \_\_\_\_\_

### Materials and Equipment



- Attendance list
- Name tags
- Facilitator manual
- Session 3 PowerPoint slides\* + checklist
- Parent support written materials
  - Session handout (food + activity)
- Overhead projector
- Blank overhead transparencies & pens
- Be familiar with material, arrive early and greet parents as they arrive

### Session Activities

#### Introduction

15 minutes

- Welcome to session 3
- Agenda **Slide 1**
  - Review of session 2
  - Progress at home (homework review)
  - Content
    - Being active in a variety of ways
    - Avoiding family food battles (family food tasks & family eating habits)
  - Set homework
  - Session summary
- Review of session 2
  - Key points
    - Question - what main ideas did you take from S2 into your home?
    - **Slide 2** Cover - AGHE plate recommends what to eat and in what amount for different ages (wide variety within and between food groups, water, **extras** sometimes or in small amounts). Good v better options within food groups. How to develop/monitor patterns.
    - What was suggested as best places start? - **Slide 3**. Water, extras (to B+C, F+V), dairy 2-3/d, fat meat + veg.
    - Any Qs? Enjoyment of extras may need change parent/child mindset.
  - Homework activities **slide 4 & 5**
    - progress (changes made, sharing experiences + ideas, 1 min each)
    - Highlight problems and barriers (blank OH). Gp brainstorm solutions.

## Content

### Being active in a variety of ways

10 minutes

- 10 000 steps a day (in adults) recommended for good health. In children - children who are active in play burn up many calories over a long period of time. Being active, a way of life.
- Motivation to move
  - Weight management, cardiovascular fitness, motor skills & co-ordination, bone health, self-esteem.
- **Slide 6 PA pyramid**
  - limit tv and allow choice for alternatives will overall increase activity levels
  - other sitting (move every 30min)
  - Be active - everyday (transport, play, chores), 3-5/wk aerobic & recreation, 2-3/wk leisure & strength
  - **slide 7** ask for suggestions and consider type of activity as is best intervention but has most barriers.
    - Ideas and how to overcome barriers.

### Avoiding family food battles

15 minutes

- Making change easy and sustainable
  - As well as considering what foods to choose, need to look at ways to promote healthy eating in children and consider family habits or behaviours that may promote unhealthy eating patterns
- Family food tasks (material from 'The Family Weight Management Program' CHW, Sydney)
  - Role play **A slide 8** (problems & possible differences/similar situations eg promoting veg intake)
  - Quiz **slides 9 and 10**

#### Who decides

How much a child should eat Par/Child

What food is served to kids Par/Child

When food is served to kids Par/Child

Whether or not the child should eat Par/Child

#### True or false

Kids should not have snacks in between meals

Parents can help children try new foods by setting a good example and eating a variety of foods

Parents should tell their kids they have to eat everything on their plates

Most kids like to eat new foods

Water is good to give kids between meals if they are thirsty

- Role play **B slide 11 parent** (scheduled meals & snacks, limited choice (healthy), food supply, 1 new 1 familiar (highlight and no demanding to eat), clear, calm, logical consequences, engaging distraction), consistent). **Child** (yes I'm hungry, choice, how much). Could add eaten at table, if not resolved miss meal.
- Parent's role (**slide 12, 13**)
  - What food is offered (canteen, café - limited choice, share with sibling).
  - When food is offered

- Consider eating habits/patterns
  - Certain habits commonly associated or promote intake excess, inappropriate types of food
  - Where, when (meals and snacks), serving strategies (plate, portioned), environment (seated, no tv), non-hungry eating
  - At table, while seated, from place, only eating, only hungry
  
- Child's role (slide 14,15)
  - How much to eat of what is served
  - Whether to eat at all
- **Slide 16** How can sharing family food tasks help avoid family food battles & promote healthy choices being the easy choices? Write on handout

### Set homework

3 minutes

1. Each week identify 1-2 changes to work on as a family around foods eaten or provided
  - using monitoring tools from session 1 can help identify goals
  - consider rules of sharing family food tasks and healthy eating patterns
  - PPP planned activities routines can help you plan and easily implement goals
  
2. Continue to work towards goal of 7-10 hours TV etc... per week using planned activities routine
  
3. Complete activity session handout and monitor/encourage activity aim (30 min each day)

### Session Close

2 minutes

- Different types of activity - focus on tv and play, best intervention, address barriers
- Recall AGHE to highlight what to eat and in what amounts
- AGHE the what, started looking at the how, sharing family food tasks + rules around eating patterns using the PPP PAR can assist this, this is the behaviour change
- Started working on already, hopefully some useful info
- S4 Appetite + ?Ask for ideas
- All the best for the hard work at home next 2 weeks, keep it up!!

### Session notes

\* PowerPoint slides available on request

## **Parent handout – parenting plus intensive lifestyle education group**



# A HEALTHY LIFESTYLE FOR A HEALTHY WEIGHT - SESSION 3

H ealthy  
E ating and  
L ifestyle through  
P ositive  
P arenting

## Agenda

- Review of Session 2 and 'homework'
- Physical activity pyramid and active play ideas brainstorm
- Avoiding family food battles
- Homework preparation
- Watch children's activity session

## Changes Achieved

- 
- 
- 

## Keeping on Getting Active

- 
- 

## Still to Go (any barriers?)

- 
- 
- 
- 
- 

## Sharing family food tasks - "The parent provides, the child decides"

### The Parent

You decide what food to serve

Serve a variety of foods from within the AGHE 'plate'

Include something your child likes at each meal

Give 2-3 choices within (your healthy) boundaries

Remember that you are responsible for their access to food. If you don't want them to eat a certain food - don't buy it!

This will help you avoid saying 'no' all the time.

You offer food and drinks at regular times

Have a schedule for meals and snacks & stick to it. Don't give access to the fridge or cupboards in between.

These strategies help you teach children to learn about healthy food as an 'everyday', enjoyable occurrence and manage their appetite. It also avoids nagging.

Other rules you might have at home about eating habits are -

Only at the table

Only while seated

Only from a plate

Only when hungry (need to ask "Are you hungry?")

## Sharing family food tasks - "The parent provides, the child decides"

### The Child

Kids decide whether to eat the food you have served

Don't worry if they choose to miss a snack or meal. If they know the schedule they know when they next can eat.

Even if a child chooses not to eat, have them come to the table so they know meal times are family times.

Children choose whether to eat new foods, if they choose not to don't prepare something else or give in, continue to offer small amounts and role model enjoyment

**Kids decide how much to eat of what you have served**

Serve small portions (they are not adults) and let child ask for more if they are still hungry. You might delay this by 15-30 minutes or only offer low calorie foods (eg vegetables) as seconds.

Don't tell the child they have eaten enough or too much.

Again, these strategies encourage children to listen to their bodies and appetites while avoiding argument

How can sharing family food tasks help avoid family food battles & promote healthy choices being the easy choices?

- 
- 
- 
- 

**Homework Activities**

1. Each week identify 1-2 changes to work on as a family around foods eaten or provided

using monitoring tools from session 1 can help identify goals

consider rules of sharing family food tasks and healthy eating patterns

PPP planned activities routines can help you plan and easily implement goals

2. Continue to work towards goal of 7-10 hours TV etc... per week using planned activities routine

3. Complete activity session handout and monitor/encourage activity aim (30 min each day)

Appendix 2 Pamphlet provided to the parenting alone  
and waitlisted control study groups

Children need food for growth, development and daily activity. The choice of food is important to ensure energy and nutrient needs are met.

Eating even slightly more than needed or not being active, leads gradually to overweight. Lifestyles that promote this make overweight one of the most common problems in children.

It is important that a healthy weight is achieved through a nutritionally balanced diet and adequate physical activity.

Children still have a lot of growing to do so the aim is to *keep a child's weight the same, allowing them to 'grow' into their weight.*

This may take a long time so it is important to be patient and remain committed to gradual long-term change.

Attention needs to be given to the amount and type of food your child eats and also how active they are. Food habits such as eating in front of the tv or eating when bored, are also important to address.

You as a parent (and food provider) play an important role in planning and watching this balance and persisting with the changes you want to make.

## EATING A HEALTHY VARIED DIET

The AUSTRALIAN GUIDE TO HEALTHY EATING (see pamphlet) can help you choose meals and snacks for your child that won't promote weight gain.

Eat Most - Plan meals and snacks from foods in the bread & cereals, vegetables (including legumes) and fruits sections, prepared mainly without added fat.

Eat Moderately - Dairy products (milk, yoghurt or cheese) are needed 2-3 times each day. Lean meat, poultry, fish, eggs or nuts are only needed once each day. Remove all visible fat and use fat reduced options (Eg Skimmer, Tone, Light cheese).

Use in Small Amounts - Small amounts of fat are needed each day from oil in cooking or margarine on bread. Avoid butter and cream.

Eat Occasionally - Cakes, biscuits, chocolate, lollies, muesli bars, Roll-ups®, chips, ice cream, soft drinks, pies/pasties and takeaway foods. These types of foods are not needed everyday. Choose from this section only a couple of times each week.

In children, **snacks** are important in ensuring adequate nutrient intake. However, too often they are chosen from 'eat occasionally' foods.

Provide children with 2-3 snacks each day from within the circle of the Australian Guide to Healthy Eating.

### SNACK IDEAS

- Fruit loaf + glass of skimmer milk
- Fruit smoothies
- 2 pikelets topped with banana
- Flat bread + grated salad rolled up
- Fresh fruit cut up as fruit salad
- Salad sticks (carrot, celery, cucumber) served with low fat dip (tzatziki or humus)
- Freeze yoghurt, milk, diet cordial or fruit for ice-blocks
- Breakfast cereal + skimmer milk
- A small handful of rice crackers, pretzels or Mini Weets®
- Fruit/date or pumpkin scones
- Popcorn (airpopped) with dried fruit
- Bowl vegetable soup
- English muffin 'pizza' toppers

Water should be the drink offered to quench thirst. Soft drinks<sup>284</sup> and juice should only be offered occasionally.

## BEING ACTIVE IN A VARIETY OF WAYS

Physical activity is important not only for weight management but for overall health, especially healthy hearts and bones. Being active also promotes good self-esteem.

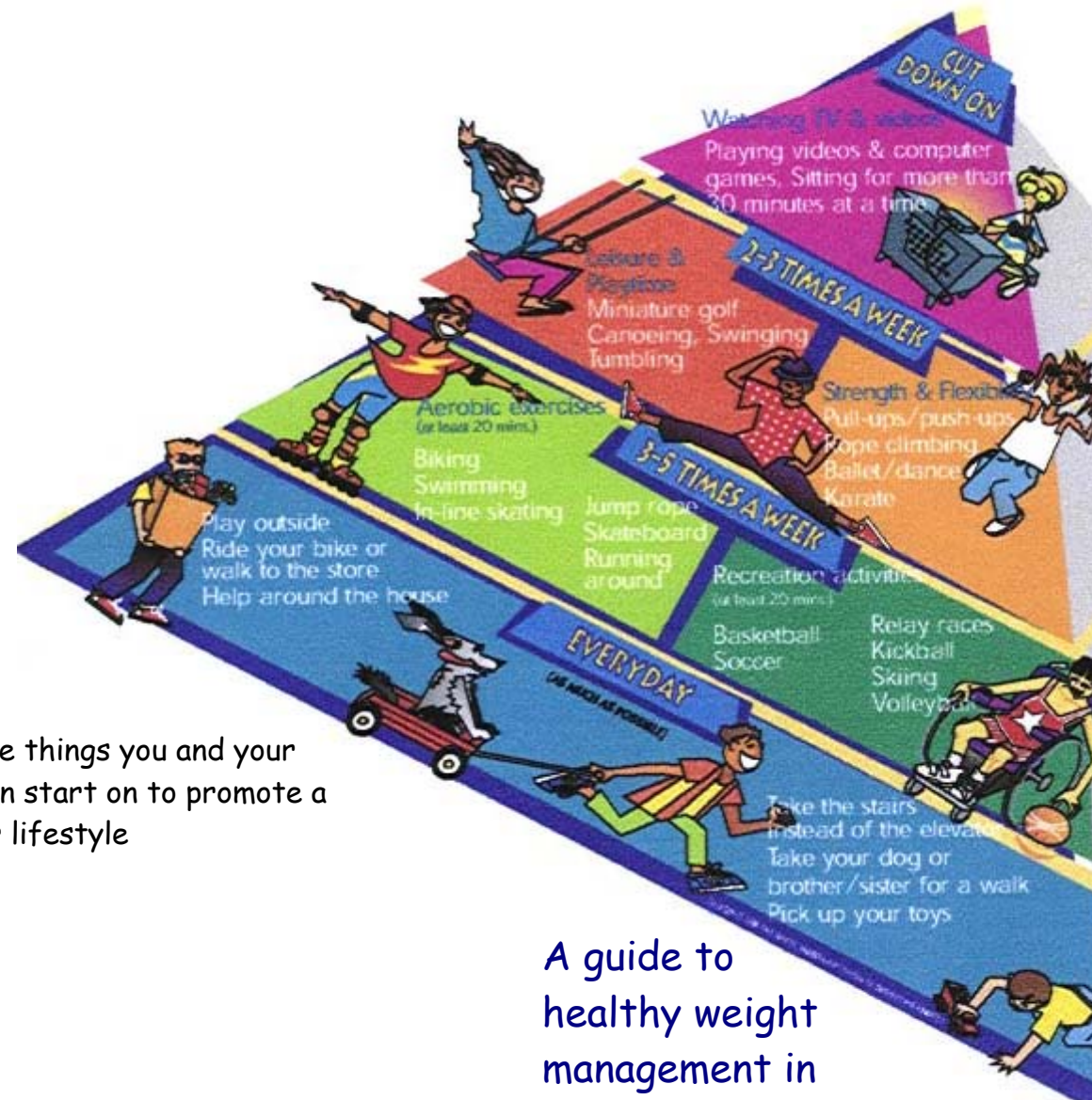
The pyramid in this pamphlet is a guide for encouraging children to be active.

Be active in daily life - Encourage active options for play, getting places and family activities. Walk or cycle your child to school or to the shops. Plan active family outings like bike riding or visits to the park or beach.

Monitor periods of non-activity or sitting - try keeping time spent watching tv or videos, on the computer or playing video games in balance with other activities.

It is suggested that children spend no more than 7 to 10 hours on these activities each week. Avoid these being the first suggestion for entertainment. Set up rules about use of these types of activities and provide alternative suggestions.

Physical activity - encourage your child to participate in physical activities such as games, sport, dance and physical play for at least 30 minutes on a daily basis.



List three things you and your family can start on to promote a healthier lifestyle

- 1)
- 2)
- 3)

A guide to healthy weight management in

Appendix 3 Example of the activity sessions children in  
the parenting plus intensive lifestyle education study  
group

**Note – The development of the activity sessions was contracted out to physical activity experts. The authors of the activity sessions are Mr Max Martin and Professor Kevin Norton, Professor of Exercise Science, School of Health, University of Adelaide.**

# HELPP Child Activity Session 3

In this session we played

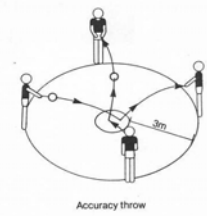
Activity 1 - **Accuracy throw** (ball handling skills)

Equipment - 1 hoop, masking tape (or beanbags) and 1 ball

Instructions - Mark standing positions 3 m out from a hoop.

Children underarm (or chest pass, or one handed shoulder pass) the ball to bounce in the hoop for their partner to catch. Can they do it 5 times?

Healthy  
Eating and  
Lifestyle through  
Positive  
Partnerships



Activity 2 - **Throwing stations** (over-arm throw)

Equipment - markers, 2 plastic bottles, 2 hoops, marking tape, 2 tennis balls

Instructions - Station 1 - distance throw, throw the beanbag as far as possible

Station 2 - hit the skittle (place the skittle 10 m from starting line)

Station 3 - Hoop throw (place hoop 10 m from starting line)

Station 4 - rebound throw (place starting line 10 m from wall. Mark a target - such as a hoop taped to the wall. Throw a beanbag/ball at the target on the wall).



Activity 3 - **Throw-run-throw** (throwing, aerobic fitness)

The game I liked the best was \_\_\_\_\_

Suggested Home - **Activity 2 above - Throwing Stations.** Mark positions using buckets Activity or pots (plant). Use balls or bean bag. Fill bottles with dirt to make 'skittle'. Rope can be used in place of hoops. Get children involved in designing the throwing stations and vary the task (type of station, distance they need to throw etc...) over the fortnight.

During the next two weeks I would like to do - (tick at least two from each column)

**Playtime Suggestions \***

**Family Activities \***

Throwing Stations	☐	Trip to beach or pool	☐
Dribbling obstacle course	☐	Family bike ride	☐
Dancing to music	☐	Soccer, cricket or tennis	☐
Paper plane racing	☐	Take the dog for a walk	☐
Other _____	☐	Other _____	☐
Other _____	☐	Other _____	☐

## Appendix 4 Validation of a tool to assess food group intake in 5-10 year old children

This study was implemented by Ms Kate Wood and Ms Jane Bowen during a Summer Scholarship project under the supervision of Dr Anthea Magarey and Rebecca Golley and who were responsible for the study design, tool development, and validation protocol and undertook the data analysis.

### **Objective**

To determine parents' ability to assess their 5-10 year old child's dietary intake using the food groups as defined by The Australian Guide to Healthy Eating (AGHE, Figure 2.1) (1).

### **Study design**

Cross-sectional. Comparison of parent estimates of child food group intake against estimates from 4, 24 hour food records.

### **Subjects**

Between January and March 2003, 45 5-10 year olds and their parents were recruited via staff email lists at Flinders Medical Centre, notice board advertisements at shopping and swimming centres and ineligible families for a child weight management study.

### **Data Collection**

Parents and their children were asked to attend a single appointment at the Department of Nutrition and Dietetics, Flinders University. Parents were provided with the study information sheet, and informed consent (parental and third party for child) and home contact details were obtained. Children's gender and age were recorded. Height and weight were obtained with children in light clothing, without shoes using calibrated portable scales and a portable height measure. Parent's then completed the HELPP child food intake questionnaire (appendix 5) which asked them to estimate their child's intake of serves of the five food groups according to the AGHE on an average weekday and an average weekend day. Finally, parents were provided instruction on how to keep a diet record using household measures and were provided with record forms and reply paid envelopes.

Over the following 4-6 weeks parents completed four 24-hour food records. Record days were selected at random by study staff, but included 3 weekdays and one weekend day. Parents were notified by telephone the day before the record was to be kept. Following completion of the food record, parents returned the records by mail. Records were checked for completion upon receipt, with any discrepancies checked with parents to ensure complete, accurate, usable data.



## Analysis

A sample size of 60 was estimated to provide a sensitivity of 90±7.5% with 95% confidence. Daily mean intake as number of five food groups serves per day were estimated from the HELPP child food intake questionnaire and the food records.

For the HELPP child food intake questionnaire, average daily intake was weighted for weekday and weekend patterns (eg [parents estimate of weekday x 5 + parents estimate of weekend day x 2]/7). For the food records, serves of each of the five food groups were categorised by a Dietitian into one of the AGHE food groups. Recorded grams were then converted into AGHE serving sizes and averaged over the 4 days. Analysis was performed in SPSS for Windows version 11.5 (SPSS Inc, Chicago). Food group serves assessed by the two methods were compared by Spearman correlation. Significant associations were investigated further using the Bland-Altman method for comparison of two methods was used to assess the agreement between the mean of the four food records for serves of each core food group (2).

## Results

Table 2. Median (IQ range), Spearman correlation coefficient (p) and limits of agreement for the two estimates of serves of each food group

	<b>Breads &amp; Cereals</b>	<b>Vegetables</b>	<b>Fruit</b>	<b>Dairy foods</b>	<b>Meat &amp; alternatives</b>
4 x 24 h records	2.0 (1.5:3.0)	1.5 (0.7:2.0)	1.5 (1.0:2.3)	1.5 (1.0:2.0)	1.0 (0.5:1.4)
HELPP questionnaire	2.8 (2.0:3.0)	1.9 (1.0:2.3)	2.1 (1.3:3.0)	2.0 (1.9:3.0)	1.4 (1.0:2.0)
r (p)	0.34 (0.02)	0.25 (0.10)	0.54 (<0.01)	0.59 (<0.01)	0.42 (<0.01)
Limits agreement	-2.5 – 1.4	-2.4 – 1.4	-2.4 – 1.4	-2.3 – 0.7	-1.9 – 0.8

## Conclusion

There were weak to moderate correlations between the 2 assessment methods for 4 of 5 AGHE food groups. However, there was a consistent bias to overestimate intake of AGHE food groups using the HELPP by the child food intake questionnaire and the limits of agreement were wide.

## References

1. Smith A, Kellett E, Schmerlaib Y. The Australian Guide to Healthy Eating. Canberra: Commonwealth Department of Health and Family Services; 1998.
2. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet 1986;i:307-10.

## Appendix 5 Data collection sheets

### Study eligibility screening form

#### HELPP Eligibility Screen

To be completed for all potential participants to assess eligibility for entry into HELPP study.

After screen, please direct families to HELPP dietitian or contact 8204 5186.

**H** ealthy  
**E** ating and  
**L** ifestyle through  
**P** ositive  
**P** arenting

**Answer of NO to questions 1 – 4 excludes entry into HELPP.**

1) Parent (and child) able to answer questions and participate in medical screen to determine if child can enter into HELPP? Yes   
No

if no, reason and action taken? \_\_\_\_\_

2) Child's full name \_\_\_\_\_ Male   
Female

3) Child's date of birth \_\_\_/\_\_\_/\_\_\_ (aged 6 and 9– up to 10<sup>th</sup> birthday?) Yes   
No

#### Anthropometrics

Height (cm) .

Weight (kg) .

Body Mass Index (kg/m<sup>2</sup>) .

4) BMI within HELPP range? (refer to table) Yes   
No

If no, action taken? \_\_\_\_\_

Appropriate BMI ranges for inclusion into HELPP study (age, gender specific)

#### Boys

#### Girls

Age	BMI above	BMI below (3.5BMI SD)	Age	BMI above	BMI below (3.5BMI SD)
5.5	17.45	22.49	5.5	17.20	24.02
6	17.55	23.03	6	17.34	24.73
6.5	17.71	23.74	6.5	17.53	25.5
7	17.92	24.63	7	17.75	26.56
7.5	18.16	25.67	7.5	18.03	27.62
8	18.44	26.83	8	18.35	28.7
8.5	18.76	28.07	8.5	18.69	29.78
9	19.10	29.36	9	19.07	30.83
9.5	19.46	30.63	9.5	19.45	31.83

\* BMI greater than 3.5 BMI SD is beyond the scope of the HELPP study which is primarily aiming to address the management of overweight and prevention of obesity

If the answer to any of questions 5 - 7 is YES, the child is not eligible for HELPP

5) Pubertal development: Pubic hair present (Tanner stage 2 or greater) Yes   
 No

6) Does the child take any of the following medications? Yes   
**if yes, please circle relevant medication(s)** No

- Ritalin or other therapy for attention deficit hyper-activity disorder
- long-term steroids (short-term for acute asthma & inhaled steroids acceptable)
- anti-psychotic medications
- other medications that may influence weight gain \_\_\_\_\_

7) Does the child have any of the following conditions or disabilities? Yes   
**if yes, please circle relevant condition or disability** No

- Prader-Willi syndrome
- diabetes
- cystic fibrosis
- PKU or other metabolic disorder
- significant physical disability or developmental disability (eg. restricts age-appropriate play)
- Other (primary conditions or syndromes associated with obesity)
- Bardet-Biedl syndrome
- Coeliac disease
- Multiple food allergies

**If the child is eligible for inclusion in HELPP, refer child and parent to the study dietitian Rebecca Gehling for study information and consent or contact 8204 5186.**

**Study Personnel – answers of YES indicate eligibility for HELPP**

One caregiver able to attend all group sessions? Yes / No

Parent comfortable with completing multiple questionnaires and reading written information? Yes / No

**Child meets HELPP criteria?** YES   
 If no, reason and action taken? \_\_\_\_\_ NO

Care-givers Name (surname) \_\_\_\_\_ (given) \_\_\_\_\_

Address \_\_\_\_\_ Suburb \_\_\_\_\_ Postcode \_\_\_\_\_

Phone Contact \_\_\_\_\_ other/e-mail \_\_\_\_\_

▪ **Appointment for medical screen given** Yes   
 Date \_\_/\_\_/\_\_\_\_ Time \_\_:\_\_\_ Doctor – No

If no, action taken \_\_\_\_\_

▪ **Consented to participation in HELPP** Yes   
 If no, action taken \_\_\_\_\_ No

▪ **Appointment for baseline measurement given** Yes   
 Date \_\_/\_\_/\_\_\_\_ Time \_\_:\_\_\_ if no, action taken \_\_\_\_\_ No

# Anthropometric data collection sheet

## Baseline Measurement Form

**H**ealthy  
**E**ating and  
**L**ifestyle through  
**P**ositive  
**P**arenting

1. HELPP ID number

2. HELPP site FMC  1  
 WCH  2

*All non-shaded sections for completion by blinded HELPP assessor and/or paediatric nurse at baseline of HELPP study.*

Age (to nearest half year)

Gender

Female  2

Child's baseline height

Child's baseline weight

Child's baseline Body mass index (BMI)

Child's baseline BMI standard deviation (for age and gender)

### Truncal Adiposity

Child's baseline waist circumference

### Metabolic Profile

Blood taken (pathology reports to be attached)

Total cholesterol

HDL cholesterol

LDL cholesterol (calculated)

Triglyceride

Serum glucose

Serum insulin

Calculated glucose:insulin ratio (calculate in SPSS)

.

Male  1

cm    .

weight (kg)   .

kg/m<sup>2</sup>   .

.

cm    .

Yes / No

mmol/L  .

mmol/L  .

mmol/L  .

mmol/L  .

mmol/L  .

mmol/L

.

### Blood Pressure

Systolic blood pressure

Diastolic blood pressure

### Psychosocial Variables

Body Image interview completed

Yes / No

Body Image Score

20-24. Parent questionnaire pack completed and checked?

Yes / No

Caregiver Anthropometrics - Caregiver measured

Mother

Father

Other

Mother's height (reported )

Mother's baseline weight (reported )

Mother's baseline body mass index (BMI)

Mother's baseline waist circumference (reported )

Father's height (reported )

mmHg

mmHg

cm    .

Weight (kg)   .

kg/m<sup>2</sup>   .

cm    .

cm    .

Father's baseline weight (reported )

Weight (kg)  .

Father's baseline body mass index (BMI)

kg/m<sup>2</sup>  .

Father's baseline waist circumference (reported )

cm  .

All unshaded baseline measures complete

Yes / No

If no, which and follow up action planned

Assessor Initial \_\_\_\_\_ Date \_\_\_\_\_

Group allocated and study program schedule provided and discussed Yes / No

If no, why and follow up action planned \_\_\_\_\_

Comments \_\_\_\_\_

**Parent completed demographic, psychosocial and health behaviour questionnaire**

**H** ealthy  
**E** ating and  
**L** ifestyle through  
**P** ositive  
Parenting

Study ID

1. This booklet contains a series of questionnaires looking at children's health, behaviour and their family. You will find enclosed a -
  - Child Health Questionnaire
  - Eyberg Child Behaviour Inventory (not used in this thesis)
  - Being a Parent Questionnaire
  - HELPP Child Food Intake Questionnaire
  - HELPP Child Activity InventoryThe booklet will take around 45 to 60 minutes to complete.
2. Between questionnaires there is some repetition of questions. However, each questionnaire is individual, so please complete every section, even if some questions look alike.
3. All answers are private and your individual answers will not be shared with anyone. Your answers will remain confidential.
4. There are no right or wrong answers. If you have any queries about how to answer a questions, please ask HELPP staff
5. Your child will also complete one questionnaire with HELPP staff. It is a 10 min interview looking at how children feel about their body and appearance

Thank you for your participation in the HELPP study. Please feel free to ask for a tea or coffee while filling out this booklet!

# Aust CHQ PF50

## Authorised Australian Adaptation

### Instructions

- This booklet asks about your child's health and well-being. It is private and your individual answers will not be shared with anyone. Your answers will remain confidential.
- Answer by marking the appropriate box for each question.
- Some questions may look alike but each one is different. Some questions ask about problems your child may not have. That's great, but it's important for us to know. Please answer each question.
- There are no right or wrong answers. If you are unsure how to answer a question, please give the best answer you can and make a comment in the margin.



## Your child's global health

---

1.1. In general, would you say **your child's health** is:

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Excellent	Very good	Good	Fair	Poor

## Your child's physical activities

---

*The following questions ask about physical activities your child might do during the day.*

2.1. During the **past 4 weeks**, has your child been limited in any of the following activities due to **health problems**?

	Yes, limited a lot	Yes, somewh t limited	Yes, limited a little	No, not limite d
a. Doing things that take <b>a lot</b> of energy, such as playing soccer,	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Doing things that take <b>some</b> energy such as riding a bike or	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Ability (physically) to get around the neighbourhood playground or school areas?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Walking one block (100 metres) or climbing one flight of stairs?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Bending, lifting, or stooping?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Taking care of her/himself, that is, eating, dressing, bathing, or going to the toilet?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Your child's everyday activities

---

3.1. During the **past 4 weeks**, has your child's school work or activities with friends been limited in any of the following ways due to **EMOTIONAL** difficulties or problems with his/her **BEHAVIOUR**?

Yes, limited a lot	Yes, somewh at limited	Yes, limited a little	No, not limite d
--------------------------	---------------------------------	-----------------------------	---------------------------

- a. limited in the KIND of schoolwork or activities with friends he/she could
- b. limited in the AMOUNT of time he/she could spend on schoolwork or activities with friends?
- c. limited in PERFORMING schoolwork or activities with friends (it took extra

3.2. During the **past 4 weeks**, has your child's school work or activities with friends been limited in any of the following ways due to problems with his/her **PHYSICAL** health?

- |   | Yes,<br>limited<br>a lot | Yes,<br>somewh<br>at<br>limited | Yes,<br>limite<br>d<br>a<br>little | No,<br>not<br>limited    |
|---|--------------------------|---------------------------------|------------------------------------|--------------------------|
| a. limited in the KIND of schoolwork or activities with friends he/she could                  | <input type="checkbox"/> | <input type="checkbox"/>        | <input type="checkbox"/>           | <input type="checkbox"/> |
| b. Limited by the AMOUNT of time he/she could spend on schoolwork or activities with friends? | <input type="checkbox"/> | <input type="checkbox"/>        | <input type="checkbox"/>           | <input type="checkbox"/> |

### Pain

---

4.1. During the **past 4 weeks**, how **much** bodily pain or discomfort has your child had?

- |                          |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| None                     | Very mild                | Mild                     | Moderate                 | Severe                   | Very severe              |

4.2. During the **past 4 weeks**, how **often** has your child had bodily pain or discomfort?

- |                          |                          |                          |                          |                          |                               |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>      |
| None of the time         | Once or twice            | A few times              | Fairly often             | Very often               | Every day or almost every day |

### Behaviour

---

*Below is a list of items that describe children's behaviour or problems they sometimes have.*

**5.1.** How often during the **past 4 weeks** did each of the following statements describe your child?

		Very often	Fairly often	Sometime s	Almos t never	Neve r
a.	argued a lot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b.	had difficulty concentrating or paying	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c.	lied or cheated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d.	stole inside or outside the home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e.	had tantrums or a hot temper	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**5.2.** Compared to other children your child's age, in general would you say his/her behaviour is:

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Excellent	Very good	Good	Fair	Poor

## Well being

---

*The following phrases are about children's moods.*

**6.1.** During the past 4 weeks, **how much of the time** do you think your child:

		All of the	Most of the	Some of the time	A little of the	None of the time
a.	felt like crying?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b.	felt lonely?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c.	acted nervous?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d.	acted bothered or upset?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- e. acted cheerful?

## Self esteem

---

The following asks about your child's satisfaction with self, school, and others. It may be helpful if you keep in mind how other children your child's age might feel about these areas.

7.1. During the **past 4 weeks**, how satisfied do you think your child has felt about:

		Very satisfie d	Somewh at satisfie d	Neither satisfied nor dissatisfi ed	Somewha t dissatisfi ed	Very dissatisfi ed
a.	his/her school ability?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b.	his/her athletic ability?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c.	his/her friendships?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d.	his/her looks/appearance?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e.	his/her family relationships?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f.	his/her life overall?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Your child's health

---

*The following statements are about health in general.*

8.1. How true or false is each statement for your child?

		Definitel y true	Mostl y true	Don't know	Mostl y false	Definitel y false
a.	my child seems to be less healthy than other children I know	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b.	my child has never been seriously ill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c.	when there is something going around my child usually catches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- d. I expect my child will have a very healthy life
- e. I worry about my child's health more than other people worry about their children's health

**8.2. Compared to one year ago, how would you rate your child's health now:**

Much better now  Somewhat better  About the same  Somewhat worse   
 Much worse now  now than 1 year ago  now as 1 year ago  now than 1 year ago  than 1  
 ago

**You and your family**

---

**9.1. During the past 4 weeks, how MUCH emotional worry or concern did each of the following cause YOU?**

- |   | None at all              | A little bit             | Some                     | Quite a bit              | A lot                    |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| a. your child's physical health                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b. your child's emotional well-being or behaviour | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c. your child's attention or learning abilities   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

9.2. During the **past 4 weeks**, were YOU LIMITED in the amount of time YOU had for your own personal needs because of:

	Yes, limited me a lot	Yes, limited me some	Yes, limited me a little	No, did not limit me
a. your child's physical health	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. your child's emotional well-being	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. your child's attention or learning <i>or behaviour</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9.3. During the past 4 weeks, **how often** has your child's health or behaviour:

	Very often	Fairl y often	Sometim es	Almos t never	Never
a. limited the types of activities you could do as a family?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. interrupted various everyday family activities (eating meals.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. limited your ability as a family to "pick up and go" on a moment's	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. caused tension or conflict in your home?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. been a source of disagreement or arguments in your family?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. caused you to cancel or change plans (personal or work) at the	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9.4. Sometimes families may have difficulty getting along with one another. They do not always agree and they may get angry. In general, how would you rate your family's ability to get along with one another?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Excellent	Very good	Good	Fair	Poor

## Facts about your child

---

10.1. Is your child:

Male

Female

10.2. This child is my: (mark **one** box)

1st

2nd

3rd

4th

5th or more

10.3. How many children do you have altogether? (mark **one** box)

1

2

3

4

5 or more

10.4. What is your child's date of birth?

\_\_\_/\_\_\_/\_\_\_

Date

Month

Year

10.5. Was your child born at term?

Yes

No

Don't know

If no, at how many weeks were they born? \_\_\_\_\_ weeks

10.6. What was your child's weight at birth? \_\_\_\_\_

10.7. Have you ever breastfed your child?

Yes

No

If no, please go to question 10.11.

10.8 What was the total time your child was breastfed only?

\_\_\_\_\_ or \_\_\_\_\_ or \_\_\_\_\_  
Days Weeks Months

10.9. At what age was your child given formula regularly (ie: at least once per day)?

\_\_\_\_\_ or \_\_\_\_\_ or \_\_\_\_\_ or \_\_\_\_\_  
Days Weeks Months Never

10.10. Including times of weaning (moving on to solid foods), what was the total time your child was breastfed for?

\_\_\_\_\_ or \_\_\_\_\_ or \_\_\_\_\_  
Days Weeks Months

10.11. To the best of your knowledge is your child up to date with immunisations for his/her age?

Yes No Don't know

10.12. What grade is your child in this year? (mark **one** box)

Preparatory  Year 4  Year 8   
Year 1  Year 5  Year 9   
Year 2  Year 6  Year 10   
Year 3  Year 7  Year 11   
Year 12

10.13. Has your child ever repeated a grade?

Yes No

If **YES**, which grade/s?

Preparatory  Year 4  Year 8   
Year 1  Year 5  Year 9



Year 2  Year 6  Year 10   
 Year 3  Year 7  Year 11   
 Year 12

**10.14.** Does your child have any of the following conditions? (answer **every** question)

	No	Yes, but does not see a health professional regularly	Yes, and sees a health professiona I regularly
a. anxiety problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. attention problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. behaviour problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. asthma	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. chronic respiratory, lung or breathing trouble (not asthma)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. chronic allergies or sinus trouble	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. chronic orthopaedic, bone or joint problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. chronic rheumatic disease	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. dental problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. depression	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. developmental delay or intellectual disability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l. diabetes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m. epilepsy (seizure disorder)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n. hearing impairment or deafness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
o. learning problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
p. sleep disturbance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
q. speech problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
r. vision problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
s. does your child have any other chronic medical condition that is affecting what they do or how they feel? (Please describe below)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Your own health and well being

11.1. In general, would you say **your own** health is:

Excellent    Very good    Good    Fair    Poor

11.2. Do YOU have an illness or health concern that requires you to see a health care professional frequently?

No

Yes (please

describe)\_\_\_\_\_

**Facts about you**

12.1. What is the date today?

\_\_\_/\_\_\_/\_\_\_  
Day    Month    Year

12.2. Are you:

Male

Female

12.3. What is your date of birth?

\_\_\_/\_\_\_/\_\_\_  
Day    Month    Year

12.4. Which of the following best describes your relationship to this child?

Biological  
parent

Step parent  
Foster parent

Guardian/

Adoptive parent  
explain below)

Other (please

12.5. Which of the following best describes your current marital status?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Single/Never Widowed Married	Married	Defacto	Separated/ Divorced	

12.6. Are you Aboriginal/Torres Strait Islander?

<input type="checkbox"/>	<input type="checkbox"/>
Yes	No

12.7. Were you born in Australia?

<input type="checkbox"/>	<input type="checkbox"/>
Yes	No

a) If NO, where were you born?

United Kingdom or Ireland	<input type="checkbox"/>	Italy	<input type="checkbox"/>
New Zealand	<input type="checkbox"/>	Greece	<input type="checkbox"/>
Vietnam	<input type="checkbox"/>	Spain	<input type="checkbox"/>
China	<input type="checkbox"/>	Turkey	<input type="checkbox"/>
Former Yugoslav Republics	<input type="checkbox"/>	Malaysia	<input type="checkbox"/>
Macedonia	<input type="checkbox"/>	Russia	<input type="checkbox"/>
Hong Kong & Macau	<input type="checkbox"/>	Other (please _____ _____)	
		specify)	

b) If NO, how long have you lived in Australia?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
less than 1 year	1-5 years	6-10 years or more	11-20 years	20 years

12.8. What is your post code?

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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**BEING A PARENT SCALE (Parent Sense of Competency)**

Johnston C, Mash EJ. A measure of parenting satisfaction and efficacy. *Journal of Clinical Child Psychology* 1989;18:167-175.

**Directions:** On this questionnaire are 16 items relating to your feelings about being a parent. Please read each item carefully and rate whether you feel it applies to you, by circling a number from 1 (strongly agree) to 6 (strongly disagree) on the scale.

The rating scale is as follows:

1. Strongly agree
2. Agree
3. Mildly agree
4. Mildly disagree
5. Disagree
6. Strongly disagree

- |     |  |   |   |   |   |   |   |
|-----|--|---|---|---|---|---|---|
| 1.  | The problems of taking care of a child are easy to solve once you know how your actions affect your child, an understanding I have acquired. | 1 | 2 | 3 | 4 | 5 | 6 |
| 1.  | Even though being a parent could be rewarding, I am frustrated now while my child is at his/her present age.                                 | 1 | 2 | 3 | 4 | 5 | 6 |
| 3.  | I go to bed the same way I wake up in the morning, feeling I have not accomplished a whole lot.  | 1 | 2 | 3 | 4 | 5 | 6 |
| 4.  | I do not know why it is, but sometimes when I'm supposed to be in control, I feel more like the one being manipulated.                       | 1 | 2 | 3 | 4 | 5 | 6 |
| 5.  | My mother/father was better prepared to be a good mother/father than I am.   | 1 | 2 | 3 | 4 | 5 | 6 |
| 6.  | I would make a fine model for a new mother/father to follow in order to learn what she would need to know in order to be a good parent.      | 1 | 2 | 3 | 4 | 5 | 6 |
| 7.  | Being a parent is manageable and any problems are easily solved.   | 1 | 2 | 3 | 4 | 5 | 6 |
| 8.  | A difficult problem in being a parent is not knowing whether you're doing a good job or a bad one.   | 1 | 2 | 3 | 4 | 5 | 6 |
| 9.  | Sometimes I feel like I'm not getting anything done.   | 1 | 2 | 3 | 4 | 5 | 6 |
| 10. | I meet my own personal expectations for expertise in caring for my child.  | 1 | 2 | 3 | 4 | 5 | 6 |
| 11. | If anyone can find the answer to what is troubling my child, I am the one.   | 1 | 2 | 3 | 4 | 5 | 6 |
| 12. | My talents and interests are in other areas, not in being a parent.  | 1 | 2 | 3 | 4 | 5 | 6 |
| 13. | Considering how long I've been a mother/father, I feel thoroughly familiar with this role.   | 1 | 2 | 3 | 4 | 5 | 6 |
| 14. | If being a mother/father were only more interesting, I would be motivated to do a better job as a parent.                                    | 1 | 2 | 3 | 4 | 5 | 6 |
| 15. | I honestly believe that I have all the skills necessary to be a good mother/father to my child.  | 1 | 2 | 3 | 4 | 5 | 6 |
| 16. | Being a parent makes me tense and anxious.   | 1 | 2 | 3 | 4 | 5 | 6 |

**HELPP CHILD FOOD INTAKE QUESTIONNAIRE**

The questionnaire you are about to complete asks questions relating to what your child eats. Sections 1 asks questions about how frequently certain foods are eaten and section 2 looks broadly at your child's food pattern. Please read the instructions carefully and approach HELPP staff with any queries before commencing the questionnaire.

### THIS IS HOW TO ANSWER SECTION 1

If your child NEVER has a food .....write N

If they RARELY have a food (less than once a month).....write R

If your child usually eats a food

About once a MONTH write 1M

About twice a MONTH write 2M

About three times a MONTH write 3M

About once a WEEK write 1W

About twice a WEEK write 2W

About three times a WEEK write 3W

And so on (4W, 5W, 6W, etc)

About once a DAY write 1D

About twice a DAY write 2D

And so on 3D, 4D, 5D, etc)

#### STANDARD SERVES

Alongside each food there is a "standard serve" size. The "standard" serve is not necessarily your child's "normal" serve, it is simply there to help us measure food intake. If your child usually eats **more** or **less** than the standard serve size for a particular food, please indicate on the **COMMENTS** line **how much** more, or less, is eaten at a time. For example, if when your child eats ice cream they have **one** "scoop" instead of our "standard" serve of **two** "scoops", indicate how often ice cream is eaten, and then write "one scoop only" on the comments line.

Here Are Some Examples

#### HOW TO ANSWER

NEVER	RARELY	Times a MONTH	Times a WEEK	Times a DAY
N	R	1 M	1 W	1 D
		2	2	2 D
		3	3	3
			and so on	and so on

How Often		Comments	
Savoury biscuits (eg Jatz) 2 biscuits		<u>1 D</u>	<u>4 biscuits</u>
Milk 1 cup	<u>4D</u>		
Ice cream 1 scoop		<u>3W</u>	<u>two scoops</u>

The person above has, on average: **Two serves** of Jatz biscuits **once a day**, **four cups** of milk **every day** and **two scoops** of ice cream **three times a week**.

Section 1

HELPP Child Food Intake Questionnaire

HOW OFTEN DOES YOUR CHILD HAVE THESE FOODS?

NEVER	RARELY	Times a MONTH	Times a WEEK	Times a DAY
	R	1 M	1 W	1
N		2	2	2 D
		3	3	3
			and so on	and so on

How often does your child have milk

	Serve size	How often	Comments
On cereal	half cup	_____	_____
To drink	1 cup (250ml)	_____	_____
As flavoured milk	1 small carton ( 300 ml)	_____	_____

What type of milk does your child usually drink eg whole, skimmer, tone, shape, So Good

HOW OFTEN DOES YOUR CHILD HAVE

	Serve size	How often	Comments
Spread on toast, bread, biscuits, bun etc (butter, dairy soft, flora, canola, Meadowlea)	2 teaspoons	_____	_____

What type of spread does he/she usually have \_\_\_\_\_

HOW OFTEN DOES YOUR CHILD HAVE

	Serve size	How often	Comments
Cheese	1 Pre-packaged slice	_____	_____
	$\frac{1}{2}$ Cube 2.5cm x 2.5cm x 2.5 cm	_____	_____
Yoghurt	1 x 200ml carton	_____	_____
Cream	1 tablespoon (20ml)	_____	_____
Icecream	From a tub - 1 scoop	_____	_____
	individual (drumstick, magnum, twin-choc)	_____	_____

HELPP Child Food Intake Questionnaire

HOW OFTEN DOES YOUR CHILD HAVE THESE FOODS?

NEVER	RARELY	Times a MONTH	Times a WEEK	Times a DAY
	R	1 M	1 W	1
N		2	2	2 D
		3	3	3
			and so on	and so on

HOW OFTEN DOES YOUR CHILD HAVE

	Serve size	How often	Comments
Plain sweet biscuits (nice, family assorted)	2 biscuits	_____	_____
Cream biscuits (monte carlo, delta cream)	1	_____	_____
Chocolate coated (tim-tam, mint slice)	1	_____	_____

Home made slice	1 piece	_____	_____
A donut (Balfour's chocolate, sprinkles)	1	_____	_____
Savoury biscuits (Jatz)	2 biscuits	_____	_____
Instant noodles (maggi noodles)	1 packet	_____	_____
Potato crisps	Sml pkt, 1 of 12	_____	_____
Corn chips, other snacks (twisties)	Sml pkt, 1 of 12	_____	_____
Potato chips hot (oven baked, McDonalds)	1 cup	_____	_____
Chocolate bar, Fun size bar (Mars)	1	_____	_____
Block chocolate	3 squares	_____	_____
Muesli bars	1	_____	_____
Peanut paste	2 level teaspns	_____	_____
Cake eg Swiss roll	1 slice	_____	_____
Bun (finger , fruit)	1	_____	_____
Muffins (homemade, plain, blueberry)	1	_____	_____
Fruit pies (family 18cm diameter)	one eighth	_____	_____

#### HELPP Child Food Intake Questionnaire

##### HOW OFTEN DOES YOUR CHILD HAVE THESE FOODS?

NEVER	RARELY	Times a MONTH	Times a WEEK	Times a DAY
N	R	1 M	1 W	1
		2	2	2 D
		3	3	3
			and so on	and so on

##### HOW OFTEN DOES YOUR CHILD HAVE

	Serve size	How often	Comments
Meat pie: individual (Vili's, balfour's)	1	_____	_____
Meat pie: family pie (18cm diameter)	one sixth	_____	_____
Sausage roll, individual	1 large	_____	_____
Pizza (Pizza Hut, frozen, homemade)	$\frac{1}{4}$ regular	_____	_____
Hamburgers (commercial)			
no cheese - small (Junior burger)	1	_____	_____
- large (double beef, whopper)	1	_____	_____
with cheese - small (Junior burger)	1	_____	_____
- large (double beef, whopper)	1	_____	_____
Chicken: roast, grilled, casseroled, NO skin	drumstick or $\frac{1}{2}$ leg or $\frac{1}{2}$ breast	_____	_____
Chicken: roast, grilled, casseroled, WITH skin	drumstick or $\frac{1}{2}$ leg or $\frac{1}{2}$ breast	_____	_____
Chicken commercial coating (eg KFC)	1 piece	_____	_____
Chicken nuggets	3 pieces	_____	_____

Sausages,			
Beef, pork, BBQ	2 thin or 1 thick	_____	_____
frankfurts Eg hot dog	1	_____	_____
Processed meats, Fritz, salami	2-3 slices	_____	_____
Beef patty, eg frozen hamburger patty	1	_____	_____

Section 2

This section asks you to consider your child's food pattern by different food groups. Please indicate how many sample serves (see below) of each of the following food groups your child has on an average school day and on an average weekend day?

Food group	Number of serves to nearest half serve	
	school day	weekend day
bread, cereals, rice, pasta, noodles		
vegetables		
fruit		
milk, cheese, yoghurt		
meat, poultry, fish, eggs, nuts		

Food group	Sample serve
<b>Bread, cereal, rice, pasta noodles etc</b>	2 slices of bread 1 medium bread roll 1 cup cooked rice, pasta, noodles 1 1/3 cup breakfast cereal flakes 1/2 cup muesli
<b>Vegetables</b>	75g or 1/2 cup cooked vegetables 1 cup salad vegetables 1 potato 5 cm diameter, 1/2 cup mashed potato (hot chips NOT included) 75g or 1/2 cup cooked dried beans, peas, lentils
<b>Fruit</b>	1 medium piece eg apple, banana, orange, pear 2 small pieces eg apricots, plums, kiwi fruit 1 cup diced pieces or canned fruit 1/2 cup fruit juice dried fruit - 4 apricot halves, 1 1/2 tablespoons sultanas
<b>Milk, yoghurt, cheese</b>	250ml (1 cup) fresh, long-life, liquid milk 40g (2 prepacked slices) cheese 200g (1 small carton) yoghurt 250ml (1 cup) custard (icecream NOT included) 1/2 cup evaporated milk
<b>Meat, fish, poultry, eggs, nuts,</b>	approx 100g meat eg 2 slices roast meat 0.5cm thick 2 small chops (sausage NOT included) 1/2 cup cooked mince 1/2 chicken breast, 2 chicken drumsticks, 6 crumbed nuggets approx 120 g fish eg 2 1/2 fish fingers 1 large fish fillet 1/2 cup tuna drained 2 small eggs, 1/3 cup peanuts, almonds, 2 tablespoons peanut butter



## HELPP 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.

**Does your child watch television or videos before school?** No  1  
Yes  2

If yes, on average for how long? ----- minutes

**Does your child watch TV or videos after school or in the evening of school days?** No  1  
Yes  2

If yes, on average for how long? ----- minutes

**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

**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

**How does your child get to school?** Walk  1  
Bus/train  2  
By car  3  
Bicycle  4

**How does your child get home from school?** Walk  1  
Bus/train  2  
By car  3  
Bicycle  4

**How much time (minutes) does your child engage in the following activities?**

	<b>On an average week day</b>	<b>On an average weekend day</b>
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) - - -		

**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 HELPP staff.**

## Child Body Image Scale

Truby H, Paxton SJ. Development of the Children's Body Image Scale. *Brit J Clin Psychol* 2002;41:185-203. (Body figures copyright H Truby 2002)

Study ID number:

### 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. I will write your answers down.*

**H** ealthy  
**E** ating and  
**L** ifestyle through  
**P** ositive  
**P** arenting

*These are some pictures of children about your age, can you pick the child that you think your body is most like?*

Code

BMI Chosen

*If you could choose a body, which of the pictures would you want your body to be like?*

Code

BMI Chosen

**Are you happy about the way your body looks?**

No

Yes

If yes go to question 6)

*What do you like about your body?*

*What don't you like about your body?*

*Are there any parts of your body you would like to change?*

No

Yes

If yes, what are they?

*Do you think your body is*

Too thin

A little too thin

Just right

A little too fat  
Too fat

*Would you like to be*

A little thinner  
Stay the same  
A little fatter  
Much fatter

*Have you ever tried to lose weight?*

No

Yes

If yes, how did you do this?

*Have you ever tried to put on weight?*

No

Yes

*If yes, how did you do this?*

*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

*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  → reconfirm responses

**A**



**B**



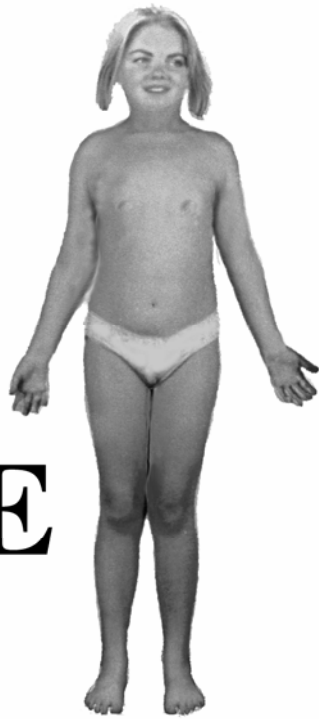
**C**



**D**



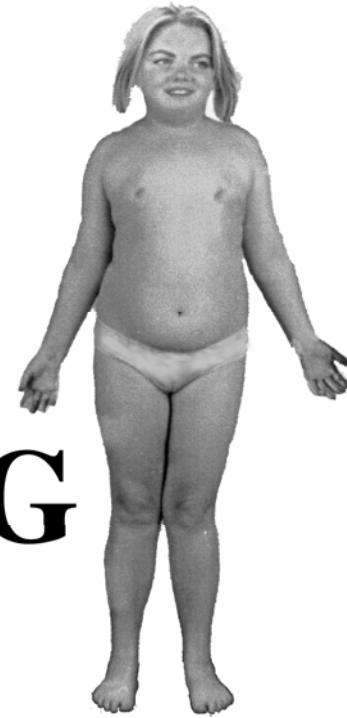
**E**



**F**



**G**



**A**



**B**



**C**



**D**



**E**



**F**



**G**



## Satisfaction questionnaire

### HELPP Program Satisfaction Questionnaire

This questionnaire will help us to evaluate and improve the HELPP 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.

I was in group A (PPP)  or  
I was in group B (PPP & lifestyle sessions)

**Circle the response that best describes how you honestly feel.**

1. How would you rate the quality of the service you and your child received during the program?

7                      6                      5                      4                      3                      2                      1  
Excellent                      Good                      Fair                      Poor

2. Did you receive the type of help you wanted from the program?

1                      2                      3                      4                      5                      6                      7  
No definitely not                      No not really                      Yes generally                      Yes definitely

3. How satisfied were you with the *amount of help* you and your child received during the program?

1                      2                      3                      4                      5                      6                      7  
Quite dissatisfied                      Dissatisfied                      Satisfied                      Very satisfied

4. What did you like most about the program?

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5. What did you like least about the program?

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6. Was there anything else that should have been included in the program?

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7. Has the program helped you make changes to your child's eating and activity patterns?

7                      6                      5                      4                      3                      2                      1  
Yes, it has helped a great deal                      Yes, it has helped somewhat                      No, it hasn't helped much                      No, it made things worse

**Please see over page**

8. What program resources assisted you with making changes to your child's eating and activity patterns (may circle more than one)?

PPP group sessions                      PPP manual                      Individual phone sessions  
Lifestyle sessions (if applicable)                      Lifestyle written information

9. List 3 things you have learnt from the program that has assisted you with managing weight issues in children?

a) \_\_\_\_\_

b) \_\_\_\_\_

c) \_\_\_\_\_

10. List 3 changes to your families eating and activity patterns your family has made as a result of the program?

a) \_\_\_\_\_

b) \_\_\_\_\_

c) \_\_\_\_\_

11. What will help your family maintain these changes over the next 6 to 12 months?

12. Circle factors that prevented your attendance to program sessions (may circle more than one).

Transport	Family commitments	Work commitments	Illness
Session times	Too many sessions	Sessions not meeting needs	
Other _____	Other _____		

13. Circle factors preventing use of program material between sessions (may circle more than one)

Lack of time	Family commitments	Work commitments	Illness
Program too demanding		Program not meeting needs	
Not enough time between sessions		Too many changes needed	
Didn't know what I was meant to do		Other _____	

14. If you were to seek help again for managing weight issues in children, would you repeat the HELPP program (circle)? Yes / No

15. Since beginning this program, have you sought further assistance for your child's weight from any other source? If so, please describe.

\_\_\_\_\_

16. Do you have any other comments about this program?

\_\_\_\_\_

\_\_\_\_\_

THANK YOU



## Appendix 6 Papers, abstracts and conference presentations arising from this thesis

### Papers

Golley RK, Magarey A, Steinbeck K, Baur L & Daniels LA. *'Comparison of metabolic syndrome prevalence using six different definitions in overweight pre-pubertal children enrolled in a weight management study'*. International Journal of Obesity. Accepted September 2005 (2005IJO00150RR) (attached below).

Gehling RK, Magarey A & Daniels L. *'Food-based recommendations to reduce fat intake: an evidence-based approach to the development of a family-focused child weight management programme'*. Journal of Paediatrics and Child Health, 41; 112-118, 2005 (attached below).

### Abstracts

Gehling R, Magarey A & Daniels L. *'Cross-sectional analysis of cardiovascular risk factor clustering in overweight children aged six to nine years prior to family-focused weight intervention'*. Proceedings from the "Childhood Obesity: From Basic Knowledge to Effective prevention" Zaragoza, Spain, IJO 28(S3);S109, 2004.

Gehling R, Magarey A & Daniels L. *'Theoretical model and preliminary evaluation of a family-focused child weight management program – The HELPP study'*. Proceedings from the "Childhood Obesity: From Basic Knowledge to Effective prevention" Zaragoza, Spain, IJO 28(S3);S124, 2004.

### Conference Presentations

Golley RK, Magarey AM, Baur LA, Steinbeck K, Daniels LA. Effectiveness of a family-focused weight management program in 6-9 year old pre-pubertal children – 12-month outcomes of the HELPP RCT. Oral 21, 14<sup>th</sup> Annual Scientific Meeting ASSO, Adelaide, SA 2005 (Best student oral presentation).

Gehling R, Magarey A & Daniels L. *'Theoretical model and preliminary evaluation of a family-focused child weight management program – The HELPP study'*. Poster 11, 13<sup>th</sup> Annual Scientific Meeting Australasian Society for the Study of Obesity, Brisbane Qld 2004.

Gehling R, Magarey A & Daniels A. *'Cardiovascular risk factor prevalence in pre-pubescent overweight children prior to family-focused weight intervention'*. Oral presentation 22<sup>nd</sup> National Conference DAA. Melbourne Vic 2004.

Magarey A, Gehling R & Wood K. *'Assessing fat and food group intake in 5-10 year old children'*. Poster 28 22<sup>nd</sup> National Conference DAA. Vic 2004.

Gehling R, Magarey AM & Daniels LA. *'Baseline description and cardiovascular risk factors in pre-pubescent overweight children before family-focused weight intervention'*. Oral 033 12<sup>th</sup> Annual Scientific Meeting Australasian Society for the Study of Obesity, Hunter Valley NSW 2003.

Gehling R. *'Challenges and lessons learned from intervention studies in child obesity – The HELPP study'*. Oral ACORN Symposium, 12<sup>th</sup> Annual Scientific Meeting Australasian Society for the Study of Obesity, Hunter Valley NSW 2003.

Gehling R, Magarey A, Daniels L. *'An evidence-based approach to modifying children's fat intake – what foods should we target?'* Poster 41 21<sup>st</sup> National Conference DAA. Cairns Qld 2003.

Gehling R, Magarey AM & Daniels LA. *'Fat intake recommendations for children: an evidence based approach'*. Oral 1136, Proceedings from the Australian Health & Medical Research Congress. Melbourne. 2002.