Pacific Island Families Study: Parental perceptions of overweight obesity and future concern for child's weight status

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LIST OF PRESENTATIONS FROM THE THESIS

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Sorrento in the Park, Auckland. Pacific Island Food and Nutrition Action Group (PIFNAG).

ATTESTATION OF AUTHORSHIP

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signed…….

Date……..

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ABSTRACT

Across the life course, social and cultural determinants of overweight and obesity need better understanding. Two out of three New Zealand (NZ) born Pacific children are either overweight or obese but little is known about the perception of overweight, expressed as a level of concern, of Pacific parents. The aim of this study was to analyse data collected at birth, four and six years in the Pacific Island Families (PIF) study to provide longitudinal information about the relationship of parental perceptions of child weight status and actual weight status. The influence of the context of the socio economic and cultural environment at the birth of the child could also be explored.

A total of 569 parent child dyads (299 boys (52.5%), 270 girls (47.5%); 47.1% Samoan, 20.9% Tongan, 18.6 % Cook Island, 4.9% Niue, 8.4% other Pacific) were examined in this Parental Perception of Overweight Obesity Study (PPOS). At four and six years the question was asked of the parent "How concerned are you about your child becoming overweight?" Possible answers ranged from "unconcerned" through increasing levels of concern to "very concerned". At four and six years weight, height and percentage body fat were measured and body mass index (BMI) derived. Weight status and levels of adiposity were referenced to international standards. Mothers' BMI (n=140) was calculated using height and weight measured when their child was six years old.

The majority of parents were unconcerned at four and six years (62% and 69.1%) about the future overweight status of their child. Between four and six years 15.6% of parents maintained a level of concern and 47.1% remained unconcerned, 15.3% became more concerned and 22.0% went from any level of concern to unconcerned. Using the international Cole cut-offs, at four years 40.1 % of the children were classified as normal, 34.1%, as overweight and 25.8% obese. At six years the proportions were similar; normal 41.3%, overweight 31.1% and obese 27.6%. Compared with the Centre for Disease Control (CDC) children centiles 2000, at four years the mean BMI standard deviation score (SD) was 1.62 ±1.08 (±SD) and six years 1.38 ±0.88. At four and six years the proportion of parents who were concerned was related to the child weight status e.g. at 6 years 20% of parents of normal children, 28% percent of parents of overweight and 51% of parents of obese children were concerned (p trend <0.0001). The factors associated with parental perception were examined in a multivariate model using logistic regression. Factors examined included the sex of the child, acculturation, ethnicity, education, smoking, marital status, mothers age, household income, parity and

household size. Ethnicity and parity were found to have statistical significance ($p<0.0001$) in relation to parental perception. Identification with Tongan ethnicity was related to a higher proportion of concerned parents and an increased number of children in the family were related to a smaller proportion of concerned parents. Using an obesity cut-off of 30kg/m^2 for maternal BMI, 92.1% of mothers were obese. There was no association of maternal BMI with child body size.

This study is unique because it was able to examine, in a contemporary Pacific cohort, the association of actual child overweight and obesity with parental concern for future overweight status of their child. While the level of concern was low and the prevalence of overweight and obesity high, the context of the socio economic and demographic environment must be taken into account in the formulation of interventions. Overweight and obese Pacific children may benefit from interventions that target the awareness of parents, making them more conscious of the relationship of obesity with food and activity patterns and give practical support to change the environment.

Interventions firstly should address the socio economic demographic environment of a Pacific family. Then emphasis should be placed on the life course concept, highlighting firstly the socio cultural exposures from conception that are associated with childhood overweight and obesity and secondly the increasing inability/difficulty in reversing health projections established during childhood, which may motivate parents to provide and adapt the child's environment. Careful consideration should be made when disseminating information about perception to the parents of overweight and obese children, as not to unnecessarily raise concern if appropriate and timely interventions are not intended. Support (socio, economic and cultural) should be made available to parents in conjunction with information. Whole family focussed interventions may be effective, targeting aspects both in the child's immediate and intermediate environment.

This study adds much needed ethnic-specific information, offering Pacific cultural insight of parental perception of childhood weight status. The study can be used to identify the opportunities for intervention within both the micro and macro scale of the environment of Pacific families. There are a number of stressors identified in socio economic environment that these Pacific families exist in and take precedence over concern for child weight status. Pacific parents have more pressing matters to worry about. Policies need to address the issue of easing these identified environmental stressors. (i.e. GST on fruit and vegetables to increase the recommended intake).

Communal interventions with multi level benefits and socially culturally significance may also be warranted.

ABBREVIATIONS

AROW	At risk for Overweight
%BF	Percentage body fat
BIA	Bioelectrical impedance analysis
BMI	Body Mass Index
CDC	Centre for disease control
CFQ	Child feeding questionnaire
CI	Confidence Interval
CVD	Cardiovascular disease
FM	Fat mass
FFM	Fat free mass
IOTF	International Obesity Task Force
MOH	Ministry of Health
NCNS	National Children's Nutrition Survey (2002)
NZ	New Zealand
NZHS	New Zealand Health Survey (2006/2007)
NZDep2001	New Zealand deprivation index tool (2001)
NZEO	New Zealand European and Other ethnicities
PIF	Pacific Islands Families study
PPOS	Parental perception of Overweight/Obesity study
r	Pearson correlation coefficient
TBW	Total body water
SES	Socio economic status
SD	Standard deviation
WHO	World Health Organisation

GLOSSARY

Acculturation: The attitudes, behaviours, values and beliefs of an individual or group are modified through contact with another culture: "modification of the culture of a group or individual as a result of contact with a different culture" (Berry, 2003).

Assimilators: Members of a minor culture who have a tendency to be aligned to the dominant culture for example scoring high in measures of New Zealand culture whilst scoring low in Pacific measures (Berry, 2003).

Body mass index: Weight measured in kilograms (kg) divided by height measured in meters (m) squared or kg/m^2 (World Health Organization, 2003).

Epigenetic: The development of an individual which results from the bi-directional interaction and exchange of hereditary and all levels of the environment (Berk, 2008). Changes in phenotype caused by changes in the way deoxyribose nucleic acid is expressed. (Fowden, Giussani, & Forhead, 2006). Epigenetic changes link to genetic predisposition, the effects of the environment and subsequent risk for disease.

Integrators: Individuals or groups who align themselves to two cultures, for example scoring high in measures of New Zealand culture as well as the Pacific measures (Berry, 2003).

Leptogenic: An environment that promotes healthy food choice and encourages physical activity (Swinburn, Egger, & Raza, 1999).

Obesogenic: "the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations" (Swinburn et al., 1999)

Optimistic bias: The tendency for individuals to underestimate and minimise potential health consequences as a result of a particular behaviour or beliefs held (Weinstein, 1989).

Marginals: When the individual or group is neither aligned to their own culture or the dominant culture, scoring low in both the New Zealand and Pacific measures (Berry, 2003).

Parental perception: The level of concern that the parent holds regarding the child becoming overweight in future.

Postpartum: Period after birth

Segregationals: Aligned more so to the traditional culture, scoring low in the New Zealand cultural measures and high in the Pacific cultural involvement (Berry, 2003).

Socio economic demographic: Reference to the wider social cultural economic environment in which individuals exist in. Includes cultural participation, affiliation, socio economic status, social practices and demographic background.

Standard deviation z-score: Score of the individual minus the mean of the reference population divided by the reference population standard deviation (SD)

Transtheoretical model: Readiness to change, provision of an environment that is inductive to a healthy weight (Prochaska, 2008)

CHAPTER 1: INTRODUCTION

The problem - Pacific overweight obesity problem

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health (World Health Organisation, 2000). Overweight and or obesity are increasing in the general population of New Zealand and is reported to be of the highest prevalence within Pacific people (Ministry of Health, 2008). The most recent national surveys reporting the rates of overweight and obesity amongst New Zealand children is the National Children's Nutrition Survey (NCNS) in 2002 (Ministry of Health, 2003) and the 2006/2007 New Zealand Health Survey (NZHS) (Ministry of Health, 2008). These survey results found that Pacific children were almost twice as likely to be overweight or obese relative to Maori, New Zealand European and other ethnic groupings with no change between 2002 and 2006/2007 (Ministry of Health, 2003, 2008).

The incidence or the rate of extreme obesity within Pacific children was reported to be 11 times greater than European children (Ministry of Health, 2008) and more than half of Pacific children aged 5-14 years were either overweight or obese in both 2002 and 2006/2007 (Ministry of Health, 2008). This is concerning because being overweight and/or obese is a risk factor for many cardiovascular diseases (CVD), cancers and diabetes (Burke, 2006; Raman, 2002). Pacific people have a higher prevalence and a younger age of onset for CVD, stroke, cancers and diabetes compared to other ethnic groupings within the New Zealand population (Ministry of Health, 2003). Furthermore, being overweight and/or obese in childhood increases the likelihood of being overweight or obese in adulthood (Burke, 2006; Hubert, Feinleib, McNamara, & Castelli, 1983; Raman, 2002).

Rationale

While there is much international literature on parental perceptions of child weight, knowledge on Pacific parental perception of child weight status is scarce. There is a need to explore the parental perceptions of different ethnic groups, and more so if particular ethnic groups exhibit unequally high numbers of overweight and obese children (Doolen, Alpert, & Miller, 2009; Metcalf, Scragg, Willoughby, Finau, & Tipene-Leach, 2000; O'Dea, 2008). There has been much research reported and reviewed concerning the genetic, physiological and environmental (physical) causes of

obesity in child populations, however further exploration in to the social and cultural causes of childhood obesity is required (Ebbeling, Pawlak, & Ludwig, 2002; Lobstein, Baur, & Uauy, 2004; Ward, 2008).

Parents have great influence on their child's immediate environment, influencing the nutritional, physical, social and cultural interactions that the child is subjected to daily (Hodges, 2003). The child's health including weight status and wellbeing can be linked to the influences the parents have on them, including for instance, the influence of the food environment (Campbell, Crawford, & Ball, 2006). Parents' ability to provide for the child is determined by the parents' own set of environmental and cultural factors, such as level of employment, education, wealth and health and together these factors may play a pivotal role in determining the attitudes and behaviours parents hold with regards to children's physical development (Huang et al., 2007).

An area which has increasingly become of importance is the contributions parents' perception has on influencing child weight status (Akerman, Williams, & Meunier, 2007). Parental perception for the purpose of this thesis is defined as the level of concern that parents hold regarding their child becoming overweight in future (Towns & D'Auria, 2009). The association between parental perception and child weight status can be assessed through the use of the Child Feeding Questionnaire (CFQ), a series of questions measuring the association between parental beliefs, values, behaviour and child obesity (Birch et al., 2001).

Parents may unknowingly reinforce an obesogenic environment for their child if they fail to perceive that their child is overweight and or obese. However parents' ability to reinforce a leptogenic environment is heavily dependent on the environment in which they exist and respond to (Jansen & Brug, 2006).

Using longitudinal data from the Pacific Island Families (PIF) study, this research sought to determine whether Pacific parental perception was accurately associated with the child's measured weight. By examining both parental concern and child weight status, the context of the socio-cultural environment was explored to discover whether any patterns of association were present. The findings will unpack associations of overweight, obese and perceptions with behaviours and the environment which will inform the understanding and design of specific Pacific obesity prevention efforts.

Context: Pacific population within New Zealand

A brief historical overview of the Pacific population in New Zealand is needed to provide a context for understanding the course of Pacific health and the state of where it is at today. The 2006 census information regarding Pacific peoples is described below, which is both the period from which the six year PIF information was drawn and the population from which the sample was taken.

Migration

Pacific Peoples make up 6.9% of the New Zealand population (Statistics, 2007). The growth of the Pacific population post war New Zealand was due to the surplus demands of the New Zealand labour market, allowing for Pacific peoples to readily migrate during the 1950s–1970s to fill the labour shortages (Wright & Hornblow, 2008). The majority of jobs that were on offer and which Pacific peoples were employed in were relatively low-paying unskilled occupations including labouring, factory work, and production lines of manufacturing companies, the freezing works and cleaning.

Following the economic down turn of the 1980s, immigration policies became more stringent with the introduction of the 'points based system' to deter the number of unskilled migrants entering the country and the subsequent economic burden they could potentially cause the already struggling economy (Krishnan, Schoeffel, & Warren, 1994). The requirements of the Immigration Amendment Act (1991) aimed to attract skilled immigrants, awarding points to those who could potentially add value to the New Zealand economy. The political move meant that Pacific peoples were less likely to fit the criteria. The immigration policies of New Zealand both immediately post war and during the early 90's are linked to the relative low socio economic status of Pacific peoples today and inadvertently their (poor) health status including overweight obesity.

Ethnic mix

The term 'Pacific' is a collective label which encompasses over 20 separate Polynesian ethnicities, each having a distinct history, language and culture (Statistics, 2006). Although it is common practice for government agencies to assess Pacific peoples as one homogenous group, the importance of addressing Pacific groups separately is highlighted in the health sector, which acknowledges the need to generate specific tailored programmes to suit the health experiences of each group to ensure positive outcomes (Schaaf, Scragg, & Metcalf, 2000).

In the 2006 census, Pacific peoples numbered approximately 270,000 which was an increase of 59% since 1991. The largest groups in 2006 were Samoan (49%), Cook Island (22%), Tongan (19%) and Niuean (8.5%). The four largest groups accounted for the majority of the Pacific population (Statistics, 2006). Of the minor Pacific ethnicities Fijian, Tokelauan and Tuvaluan made up 7% of the Pacific population. The ethnicity which had the largest increase since the 2001 census was the Tongan ethnicity with an increase of 24% (Statistics, 2007).

In many instances, Pacific people feature negatively among socioeconomic measures. Relative to the general population, Pacific peoples hold fewer qualifications, tend to be employed in unskilled occupations and receive lower incomes. In 2006 the Pacific median income was six percent lower than the national median (Statistics, 2006). The number of Pacific peoples with no school qualification since the 2001 census remained static at 35%. Of Pacific peoples aged between 15 and 64 years, 89% were employed. Pacific men were more likely to be employed than Pacific women and were also more likely to be employed as labourers, machine operators and drivers, technicians and trades workers whilst women were employed in clerical and administration, labourers, professionals, community or personal service workers (Statistics, 2007).

Pacific population age distribution

The growth of the Pacific population in recent times is primarily spurred on by high fertility rates rather than migration as in the 1950s. Pacific peoples on average are having more children, leading to a more youthful population relative to the rest of New Zealand (Ministry of Health, 2004). In 2006 the median age for Pacific peoples was 21 years, 14 years less than the national median age (Statistics, 2007).

The higher fertility rates of Pacific peoples means that their family sizes tend to be larger. Implications of a higher fertility means that the dependency ratio (the number of dependant individuals to the number of working individuals) will be higher, placing more pressure on household income gained by those members who are eligible to work or are of working age (15–65 years). In 2006, approximately 38% of the Pacific population was under the age of 15 years, with those over the age of 65 accounting for 4% of the population. The sum of these two age brackets indicates a high number of dependencies within the Pacific age cohort (Statistics, 2006).

Geography

The majority of Pacific peoples live in urban cities with the majority (67%) residing within the Auckland region. The district health board with the highest density of Pacific peoples is the Counties Manukau board where one in every three people is of Pacific heritage (Ministry of Health, 2004).

Over 80% of Pacific peoples were affiliated to a religion with Catholic being the major Christian denomination. Culturally it has been noted that Pacific peoples are heavily involved in traditional practices such as gift giving, and fulfilling obligations to church or extended families. These practices add pressure and further places economic and financial stress on Pacific households. It has been reported that three in every five Pacific families take part in traditional gift giving (Cowley, Paterson, & Williams, 2004).

At the time of the census, over half of Pacific peoples or three out of every five were New Zealand born. Moreover, the majority of overseas-born Pacific peoples had resided in New Zealand for less than 24 years, and of the major ethnic groups, 75% of Tongans born overseas had arrived after 1986 (Statistics, 2006). Of the seven major Pacific ethnic groups (Samoan, Cook Island, Tongan, Niuean, Fiji, Tokelau, Tuvalu), over half had the ability to speak in more than one language, with the ability to speak in their native tongue being dependant on whether the individual was born overseas. For instance, 90% of Samoans born overseas can speak the Samoan language compared to only 40% of New Zealand born Samoans (Statistics, 2007).

Income

The Pacific median annual income for the year 2006 for Pacific peoples of working age (15 years and over) was $20,500 which was 16% lower than the New Zealand median income of $24,000. Income levels are associated with age and sex. Pacific peoples aged between 15-19 years were more likely to earn less than $5,000 annually whilst peoples aged between 35-39 years were most likely to earn an income of $50,000. The age structure of Pacific peoples may be related to the median annual income being 16% lower than the national annual income. Pacific men were also more likely to earn more than Pacific women, with $24,500 compared to $17,400 respectively (Statistics, 2007).

Background of the Pacific Island Families study

As summarised above, Pacific peoples within New Zealand make up 6.9% of the population, have a high fertility rate and consequently a youthful population relative to other ethnic groupings (Statistics, 2007). Pacific peoples are over represented in negative health outcomes including overweight and obesity. Two out of three Pacific people live in the greater Auckland area and more than one in three Pacific people live in the Counties Manukau District Health Board area. Each year, Middlemore Hospital has the highest number of Pacific births of any hospital (Paterson, Cowley, Percival, & Williams, 2004). Prior to the PIF study there was little information to guide public health professionals in implementing effective ethnic appropriate programmes and strategies to curb the adverse health outcomes experienced by Pacific peoples (Paterson et al., 2008). Given the scarcity of this information, the PIF study was designed with the overall objective of informing policy, and programme implementation to increase the potential to create healthy Pacific families and communities within New Zealand (Paterson et al., 2006).

The PIF study is an epidemiological longitudinal prospective study, following a select birth cohort of children and their families (a more in depth description of design is provided within the Methods section of this thesis). Information covering a broad range of health aspects is collected of the children and their families. The PIF study's main objectives are:

> to provide information on Pacific peoples' health including cultural, economic, environmental and psychosocial factors associated with child health, developmental outcomes and family functioning.
>
> to determine how such factors individually and interactively influence both positively and negatively child, parent and family outcomes over time.
>
> to provide information that will help set quantifiable targets for Pacific peoples' health.

Selected information from the PIF database has been extracted for analysis in this sub study known as the Parental Perception of Overweight Obesity Study (PPOS). The PPOS is a snapshot of changes between four and six years in body size, perception of parents and of the economic and socio cultural environment the child has developed in, measured at baseline (six weeks postpartum). Through coupling of the children's environment at birth and their growth trajectories at four and six years, together with

parental concern at four and six years, the relationship between the environment, children's weight status change, and parental concern will be investigated.

The PPOS aims to address the study objectives of the PIF study through the provision of information describing the interaction of socio demographic cultural environment measures and the positive and negative associations with Pacific child weight status health from birth to six years. It is envisioned that the information will aid the health sector in the design of specific interventions that will achieve positive child health development (Paterson et al., 2006).

CHAPTER 2: LITERATURE REVIEW

Introduction

This chapter sets the context of the life course model of health and disease. Review of relevant literature to the prevalence of obesity among adult populations with a focus on children is presented. Measurements of obesity and its associations with future health outcomes, the cost to the health system, exploration of the environment (ANGELO) in which obesity develops and parents' understanding, perception, involvement and influence on the development of obesity in (growth trajectory) their children over time.

Conceptual Underpinnings

The life course model of health and disease

The life course model is defined as the study of:

"long term effects on chronic disease risk of physical and social exposures during gestation, childhood, adolescence, young adulthood and later adult life. It includes biological, behavioural and psychosocial pathways that operate across an individual's life course, as well as across generations, to influence the development of chronic disease" (Ben-Shlomo & Kuh, 2002).

The life course perspective is a framework which contextualises the aetiology of disease throughout the development of individuals or groups. Epidemiological principles of linking disease outcomes experienced in later life are traced retrospectively to conception and the risk factors individuals experience throughout development (Ben-Shlomo & Kuh, 2002). The model not only accounts for the association between the magnitude of exposure to physical and social risk factors and disease development but goes further to identify the importance of the timing of exposures which occur throughout the life cycle (Ben-Shlomo & Kuh, 2002).

At the biological level it has been shown that exposures that occur during critical or sensitive stages of development have adverse effects in the functioning of physiological systems in later adult life. An example of this is the link between poor growth *in utero* and the development of cardio vascular disease (Fowden et al, 2006). Disruptions during the foetal stages of development are argued to have life lasting permanent alterations to the functioning of the cardio vascular system, and exposure to risk factors during adulthood only compound and speed up the development of chronic disease.

Furthermore, building on the concept of temporal significance is the notion that the greatest potential to alter the development of adult disease is earlier in the life course of an individual. For example, the window of opportunity to alter the weight status of an adult and decrease the risks for chronic diseases such as type 2 diabetes would be during childhood, if not earlier. Altering the weight status of an adult may also be responsive to the implementation of strategies during adolescence, which is another critical period of rapid cell division. Modifications to alter disease onset are therefore most effective and sustainable if exposure is earlier rather than later in life (Ben-Shlomo & Kuh, 2002).

Similarly, the life course perspective can be utilised to explain and understand the exposure to social and cultural influences over the life course (Ben-Shlomo & Kuh, 2002). A social example is the exposure of children to cigarette smoke prenatally which predisposes them to obesity (Oken, Levitan & Gillman, 2008) and a cultural influence would be the overfeeding of children (Kumanyika, 2008).

The perspective is utilised to also understand the development of disease through biopsychosocial pathways. Children who exist in socially deprived environments are likely to develop a range of diseases linked to cognitive and behavioural dysfunction and impairments. Identification and understanding of these social cultural environmental mechanisms and their interactions with genotype can be viewed under the life course perspective (Ben-Shlomo & Kuh, 2002). An example of the application of the life course mode is the development of antisocial behaviour in children (refer to Appendix A).

It is important to note that environment is an "umbrella term" that is used to describe the surroundings at the level of the molecule and metabolic pathways, the *in utero* environment of the foetus, the ecological interactions of a community and the interactions within the world; globalisation. One recent environmental construct is the use of the term "obesogenic environment" (Kirk, Penney & McHugh, 2010) and over the last ten years this understanding of this aspect of the environment has been developed.

Analysis Grid for Environments (ANGELO) framework

The most used tool to dissect the obesogenic environment is the Analysis Grid for Environments Linked to Obesity (ANGELO) framework, first proposed by Boyd Swinburn in 1999 (Swinburn et al, 1999). The ANGELO framework was developed to analyse and understand the mechanisms of the environment that encourage obesity. The

framework allows a community or group to identify and compartmentalise the different aspects that influence obesity within the environment, by size (macro and micro), and by type (physical, economic, political and socio cultural). The elements within the environment that encourage obesogenity or leptogeneity are identified, the ones that are possible to change at the community level are prioritised and a pragmatic action plan for interventions and programmes to target the specific pathways that lead to obesity or enable leptogeneity is developed with input and participation from the community. The framework also allows for action in the form of advocacy and political engagement to be taken by the community to change the macro environment. At an individual level, the policies that influence the population prevalence of obesity can be reduced simply to the increased consumption of energy dense foods, high in saturated fats, low in unrefined carbohydrates and reduced energy expenditure (Kumanyika, Jeffery, Morabia, Ritenbaugh & Antipatis, 2002).

Social Determinants

Similarly, the determinants of the health model adapted for childhood obesity offers a framework to identify potential opportunities (ranging from proximal to distal environments) to act on decreasing the influence of the environment in enabling obesogenic practices. This would allow better identification and understanding of contextual opportunities to act on enabling factors or barriers to achieving a healthy weight, to conceptualise obesogenic environments and identify potential interventions (Bambra et al, 2009).

Therefore the conceptual framework that underpins this thesis is a combination of the life course model of health and disease, interpreted using the ANGELO framework and including both biological and behavioural influences. This interpretation acknowledges the need to create supportive environments, which is one of the key tenets indentified in the Ottawa Charter (World Health Organisation, 1986), to unravel the complex interactions of environmental aspects such as eating habits, activity levels, and known indicators of being obese and to better understand how interventions may be applied that enable the Pacific community to achieve equity in health.

The next section will discuss from a global, Pacific and national perspective evidence on how the prevalence of obesity is increasing and why it is a particular concern for Pacific people in New Zealand.

Overweight and Obesity

To be able to identify the proportion of the population that is obese, there needs to be both a definition of obesity and criteria to measure relative body size.

Methods of measurement of obesity

The most universal means for measuring relative body size is the BMI. BMI is the standard for measuring and comparing relative body size amongst populations in epidemiological studies, due to its cost effectiveness, practicality and a strong association with body fatness. The calculation for BMI is the weight measured in kilograms (kg) divided by height measured in meters (m) squared, or $(kg)/(m)^2$ (World Health Organisation, 2006). The relationship between BMI and body fat is limited by the capability to distinguish between fat free mass (FFM) and fat mass (FM), which may lead to individuals being misclassified. An example of this is the variability of body fat (BF) composition or adiposity which can be seen between males and females during development (McCarthy, Cole, Fry, Jebb & Prentice, 2006) and different ethnic groups (Rush et al, 2003). However, BMI still provides a very useful measure for the weight status of a population because an increase in BMI is accurately associated with increased risk of CVD, cancer and other illness especially for populations.

It is of great importance that methods of measurement are accurate in order to correctly identify and compare at risks groups within populations and develop appropriate preventative programmes. Failure to do so may result in further exacerbating the already rising rates of obesity (Cole, Bellizzi, Flegal & Dietz, 2000).

The World Health Organisation (WHO) recommends the use of the BMI standards to determine overweight and obesity amongst adults (BMI = 25kg/m² overweight and 30kg/m² obese) (World Health Organisation, 2003, 2006). In children, separate age and sex specific BMI charts are used because children are growing and increase in weight and height at different rates during development. Furthermore children of different ages have different relative truncate lengths and reduced muscularity compared to adults. In general, BMI increases with age until linear bone growth stops, which is usually around the age of 18 years. The International Obesity Task Force (IOTF) commissioned by the WHO has provided cut-offs for children aged under 18 years by summating the BMI age curves of six populations (Cole et al, 2000). The Cole cut off criteria are based on six large cross-sectional growth studies (95,000 boys and girls) gathered from Brazil, Great Britain, Hong Kong, Netherlands, Singapore and the United States (Cole et al,

2000). At any given age, a child's BMI score can be measured against the chart to predict whether the score will pass through 25kg/m² and 30kg/m² at the projected age of 18 years and determine if the child is likely to have a healthy or unhealthy weight status in adulthood (Cole et al, 2000). This growth chart was updated in 2006 to include criteria to define thinness in children (Cole, Flegal, Nicholls & Jackson, 2007).

Although the BMI holds many merits as a surrogate measure of body composition, in children, who are growing, much scrutiny has been raised of recent due to its ambiguity. It has been noted that BMI only provides a crude measure for diagnosing excessive body fat (BF) in children; as it may not give appropriate readings in different ethnicities, sexes and in physically active children (McCarthy et al., 2006; Taylor, 2007). This may be of relevance to Pacific and other ethnic populations as evidence has been produced suggesting that different populations hold differences in the proportion of fat-free mass (FFM) to fat mass (FM) body composition (Rush et al., 2004; Rush, Plank, Laulu, & Robinson, 1997). The issue raised poses a risk for misrepresenting the proportion of populations being obese or overweight or thin (Rush, Plank, Davies, Watson, & Wall, 2003; Rush, Puniani, Valencia, Davies, & Plank, 2003; Rush, Scragg, Schaaf, Juranovich, & Plank, 2009). It is acknowledged however that the IOTF data set used to calculate these curves may not be representative of some specific ethnic populations including the Pacific (Cole et al., 2000). Furthermore the specific site of the body which fat accumulates is known to be a predictor of CVD. Accumulation of fat in the truncal and intra abdominal area is known to increase risk of CVD far more than accumulation of fat around the hips and thighs, an occurrence which the BMI measure is not sensitive to.

Bioimpedance Analysis

The limitations of the BMI in differentiating between fat free mass (FFM) and fat mass (FM) among different ethnicities, sexes and individuals at different developmental stages (i.e., children) points to the requirement for the use of a more sensitive method. The use of the bioelectrical impedance analysis (BIA) is one such method which provides a better estimate of body composition relative to the BMI, and can similarly be employed to measure populations due to its cost effectiveness, ease of application and non-invasiveness. BIA in principal is based on the volume of a conductor and the resistance it poses to a high frequency alternating current (Kyle et al., 2004).Simply, the body can be divided into two compartments, fat free mass (FFM) and fat mass (FM) .

Together they sum to body mass, or more commonly termed body weight. Fat mass is all the molecules of the body that will dissolve in ether, where FFM is the remainder. A major component of FFM is water – in children, water mass is about 76% of the total FFM. Therefore FFM which contains electrolytes dissolved in the water offers less resistance to current than fat mass (FM). The resistance that the body offers to an electrical current is related to the amount of water in the body, the distance between the entry and exit point of the current through the body and also the diameter of the body. Long and slender bodies then have more resistance than short and wide body types.

The measurement of bioimpedance involves applying a small, single frequency, alternating current (50 μA, 50 kHz) between two electrodes; one placed on the hand and one on the foot. Four mathematically related measurements between two or more electrodes on the hand and foot (phase, resistance, reactance and impedance) are made using the bioimpedance meter diameter, length and water between foot and hand. Impedance measures in conjunction with anthropometric measures (height and weight) are inserted into population specific prediction equations (Kyle et al., 2004). A prediction equation for use in Māori, Pacific and European children aged 5-14 years was validated using deuterium dilution, a gold standard for measurement of body water (Rush et al., 2003). This equation which predicts FFM requires measurement of height, weight and resistance. The equation had an R^2 value of 0.96 and a standard error estimate of 2.44 kg.

Measured %BF of a child can be compared to sex and age specific body fat (BF) percentile charts derived from a contemporary British paediatric population (McCarthy et al., 2006). The measurements for these British charts also used BIA measures which used an equation that was validated against whole body dual x-ray absorptiometry (DXA) measures, an accurate method of body fat measurement. The 85^{th} and 95^{th} centiles which equate to z-scores of 1.04 and 1.65 were selected as being over fat and obese respectively.

BIA measurements of %BF of different individuals or populations can be compared to the chart through the use of standard z scores (McCarthy et al., 2006). Z score calculations for %BF can be calculated for individual populations through the equation of the individual %BF score minus the mean %BF score of that population divided by the standard (SD) or variance of all %BF scores in that population.

$$Z = \frac{(\%BF \text{ score of the individual} - \text{mean } \%BF \text{ of population})}{\text{population standard deviation (SD)}}$$

Similarly, child growth charts have been produced for BMI scores for age. The Centre for Disease Control (CDC) United States, using anthropometric measures (height, weight, truncate measures, waist and head measurements) taken as part of comprehensive nationally representative health surveys, provided information to calculate age-specific growth charts for children (2-20 years) of which definitions of overweight and obesity corresponded to the 85^{th}-95^{th} percentile for overweight, and the $>95^{th}$ percentile for obese (Kuczmarski et al., 2000). Like the British growth chart for body fat, comparison of BMI (kg/m^2) of individuals or populations from other nations can be referenced to the CDC (2000) BMI growth charts through the use of Z-scores. Unlike the IOTF Cole cut off points, the CDC (2000) BMI growth chart centiles have the added advantage of being able to account for continuous measures rather than crude categorical variables (Kuczmarski et al., 2000).

Global prevalence of obesity

Adult population

In 1995 the WHO estimated that globally, approximately 200 million adults were obese. This figure increased to 400 million in 2005, whilst a further 1.6 billion adults were estimated to be overweight. Current projections estimate that by the year 2015, 700 million adults will be obese (World Health Organisation, 2003, 2006). The global prevalence of obesity amongst adult populations varies across nations. A tool for estimating country specific obesity prevalence rates for adults aged between 15 and 100 years has been developed by WHO (World Health Organisation, n.d.). In 2006/2007, the prevalence of obesity in New Zealand (defined as having a BMI of ≥30 kg/m2) was 25% for men and 26% for women, standardised for age (Ministry of Health, 2008). In 2005, New Zealand had comparable rates of obesity to Australia, Canada, and the United Kingdom; however unlike the other countries, females in New Zealand, had higher prevalence rates of obesity than males. The Pacific nations of Samoa, Tonga, the Cook Islands and Niue had noticeably higher prevalence of obesity than New Zealand, but a similar gender difference was apparent (Figure 2)

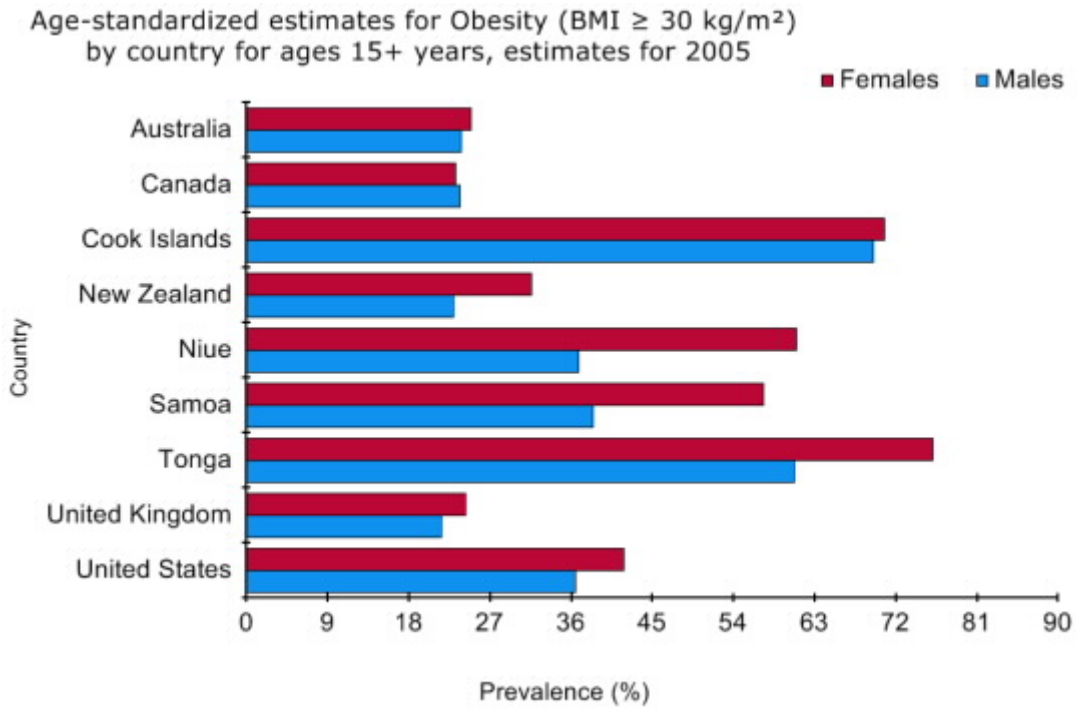


Figure 2.0: Obesity prevalence (%) by country for the year 2005 (World Health Organisation, n.d.)

Child population

Estimates for the prevalence rates of overweight and obesity among child populations worldwide are not as comprehensive as adult population estimates; however there is a link between child and adolescent populations, in that incidence of adult overweight and obesity may be accelerated when high rates of child overweight and obesity populations age and shift in to adulthood.

The prevalence of overweight and obesity among children is rising globally and has reached epidemic proportions (Jackson-Leach & Lobstein, 2006; James, 2006). In 2010, the WHO reported that an estimated 42 million children under the age of 5 are overweight, of which it is estimated that 35 million are from developing countries (World Health Organisation, 2000). The international obesity task force estimate that 10% of the world's school aged children carry excess fat (Lobstein et al., 2004). In the United States according to the CDC (2000) percentile growth charts, an estimated 12.4% of children aged between two and five, and 17% for ages six to 11 are overweight (95th percentile standardised for age and sex) (Weight-control Information Network, 2010).

Obesity in New Zealand

Adult population

The 2006/07 New Zealand Health Survey reported that one in four New Zealand adults were obese (26.5%) (Ministry of Health, 2008). Not surprisingly, there were significant differences in obesity prevalence by ethnicity. Compared to New Zealand European/Other (NZEO) ethnicities, Pacific adults were two and a half times more likely to be obese and Maori were one and a half times more likely to be obese. Other than ethnicity, there was a significant association of increased risk of obesity with neighbourhood deprivation as measured by the NZDep2001 tool (Ministry of Health, 2008). When looking at differences in levels of obesity in the Pacific ethnic groups, Tongan and Samoan men had the highest and similar levels of obesity (~60%) whilst 49% of Niuean men and 23% of Cook Island men were obese. For Pacific women, results were more similar with each ethnic group's obesity prevalence ranging from 70-78% (Sundborn et al., 2010).

From 1997 to 2007, there has been a steady increase in the prevalence of obesity from 18% to 25% for the whole of New Zealand. Furthermore, the average BMI has gone from 24.5 kg/m^2 to 26.8 kg/m^2 in women, and from 25.5 kg/m^2 to 27.2 kg/m^2 in men for the years 1982 to 2002 (Metcalf.et.al, 2000), meaning that the average New Zealander is now overweight according to WHO standards for overweight and obese.

Child population

In the 2006/07 New Zealand Health Survey, most (~68%) New Zealand children aged between 2-14 years were within an acceptable body weight. Twenty one percent were overweight and a further 8% were obese (Ministry of Health, 2008). However, there were significant differences by ethnicity. Similar to Pacific adults, Pacific children are more likely to be overweight or obese compared to New Zealand European/Other (NZEO) ethnicities. In the NCNS 2002 which measured the prevalence of obesity and overweight in children aged 11 to 14 years, Pacific children were found to be five times more likely to be obese than other ethnicities (Ministry of Health, 2003). More recently, 23.3% of Pacific children aged 2-14 years were found to be obese compared to 5.5% of New Zealand European/Other children, meaning that Pacific children were two and a half times more likely to be obese than the total New Zealand child population (New Zealand Health Survey, 2006/07). A study that looked at levels of extreme obesity in

children aged 3-7 years old, found that Pacific children were 10-11 times more likely to be extremely obese than their New Zealand European/Other (NZEO) counterparts (Gordon, 2003). For the total sample (New Zealand), 2.7% of children were extremely obese compared to 4% in the United States. Of Pacific children, 10.8% were found to be extremely obese compared to 0.8% for New Zealand European/Other (Gordon, 2003).

Overweight obesity health implications and cost

Overweight and obesity is defined as the accumulation of excessive fat that is detrimental to health (Ministry of Health, 2008). Excess weight is a major contributor to the global burden of chronic disease and disability (World Health Organisation, 2006). The increase in the prevalence of obesity has been perpetuated by the creation of obesogenic environments. The increase in access to foods that are energy rich but nutritionally poor, with high sugar content and saturated fat coupled with a lack of exercise has compounded the rising rates (World Health Organisation, 2003).

Obesity or being overweight in adulthood increases the risk for diet related diseases, including type 2 diabetes, cardiovascular disease, hypertension, stroke and certain cancers, leading to an early death or a reduced quality of life (Duncan, Schofield, Duncan, Kolt, & Rush, 2004; Ministry of Health, 2003; World Health Organisation, 2003). Children who are overweight or obese are more likely to be overweight or obese in adulthood. Therefore, understanding the predisposing factors that facilitate obesity in childhood is needed in order to mitigate the prevalence of excessive fat accumulation in childhood and the increased risk of developing various chronic conditions later in life including atheroma, high blood pressure, type 2 diabetes mellitus and cardiovascular disease (Duncan et al., 2004; Raman, 2002).

The health consequences of childhood obesity are both immediate and long term (Burke, 2006). Short-term health consequences include hip and knee joint dysfunction, impairment to liver function, obstruction of the airway leading to sleep apnea, and early sexual maturation in girls. Immediate consequences include psychological stigmatization, poor self-esteem, and depression. Adult morbidities include type 2 diabetes mellitus, which has been noted to be diagnosed earlier for obese people. The temporal categories of disease are arbitrary, and diseases that develop in childhood may develop later in adolescence or in adulthood (Burke, 2006).

Cost to the health system

According to the WHO, the burden posed by obesity on the health budgets of individual nations account for between two to six percent of a nation's total health care cost (World Health Organisation, 2003). Within the New Zealand health system, the district health boards (DHB) projected the cost of obesity operations to cost in excess of $47 million over a three year period (Ministry of Health, 2008). In 1997, as part of a risk assessment of the burden of disease attributable to nutrition related risk factors, high BMI, in part, contributed to 11% of deaths (Stefanogiannis, 2005). The financial cost, loss of potential healthy life years, and mortality burden caused by obesity support the advocacy for public health preventative measures to relieve the financial pressure already placed on the health system through secondary and tertiary treatments for obesity sufferers (Duncan et al., 2004; Ministry of Health, 2008).

The complexity of the obesity crisis validates the exploration in to the socio economic cultural environment. There have been numerous studies that have investigated and validated associations of childhood obesity and the socio economic cultural environment. Some known associations include the influence of socioeconomic position, gender, age and ethnicity in the development of obesity within childhood populations (O'Dea, 2008). One area which warrants further exploration is the association of parental perception and childhood obesity.

Parental perception and child weight status

Assessment of parental perception

The association between parental perception and child weight status can be assessed through the use of the Child Feeding Questionnaire (CFQ). The CFQ is a self report survey, containing questions which explore the underlying attitudes, beliefs and behaviours of parents and the level of influence this may have on feeding practices leading to childhood obesity. One component of the CFQ measures perceived weight of the child, against which parental concern for the child weight status in future is assessed. The CFQ has been validated for use on parents of school aged children and has been tested cross culturally for validation (Birch, et al., 2001).

Literature on parental perception of child's weight can be loosely divided in two categories, firstly literature that concentrates on recognition of child's actual weight status and secondly concern for child's weight status. Recognition studies explicitly

measure the ability of parents to discriminate current weight status of children. An exemplar would be "is your child overweight", with possible answers ranging from "not true", "somewhat true" to "very true" (Jansen & Brug, 2006). Other forms of recognition may refer directly to the child's current weight status with possible responses indicating the actual weight status i.e. "extremely underweight" to "extremely overweight" (Etelson, Brand, Patrick, & Shirali, 2003).

Studies which measured parental perception as a level of concern for child's future weight status require parents to assess the current weight status of the child and the potential for that child to be overweight in adolescence or adulthood. An example, "how concerned would you be if your child was overweight as an adult?" with answers ranging from "not at all concerned" to "very concerned" (Crawford, Timperio, Telford, & Salmon, 2006). A component of the parental concern type question is that it offers an insight into not only the parents understanding of weight recognition but also their understanding of the associated health risks with larger weight.

Studies which have used parental recognition as the measure for parental perception have been referred to; however, the PIF study did not capture the measure of parental recognition of child's current weight. Definitions of overweight or obesity according to BMI vary across countries posing difficulty in comparing the levels of parental perception of weight status. When prevalence of overweight or obesity is stated, the reference charts or population will be accompanied. The most widely used BMI for age reference charts or population references include the UK reference (1990), the CDC (2000) and the IOTF.

The working definition that was employed for this thesis was that parental perception is; *"The level of concern the parent holds with regards to the child becoming overweight in future"* (Towns, 2009)

Perception of childhood overweight and obesity

International literature has shown that parents of overweight children tend to underestimate the weight of their children (Carnell, Edwards, Croker, Boniface, & Wardle, 2005; De La, et al., 2009; He & Evans, 2007; Scholtens et al., 2007). The trend of parents being more likely to misperceive their child's weight status when their child is overweight or obese occurs consistently across many countries, irrespective of the socio-demographic background including ethnicity, culture and parents level of educational attainment (Carnell, et al., 2005; Jansen & Brug, 2006).

Consistent with previous weight recognition studies few parents of young overweight children recognized or were concerned over their child's weight. A point of difference is however, as the overweight child aged, the level of concern of parents regarding the child's weight increased. The parents of older overweight children were more likely to recognize that their child as overweight compared than parents of younger overweight children (Carnell, et al., 2005; Eckstein, et al., 2006). Concern also increased if the parents were themselves overweight and or obese. The findings indicate concern for children's weight status may be a function of age and that the attitudes of the parents shift as the children age (Carnell, et al., 2005).

Parents who themselves are overweight are more likely to have children who are overweight or at risk of overweight (AROW). Overweight or obese parents are also less likely to recognise obesity or overweight in themselves, furthermore they are even less likely to accurately identify overweight and obesity in their child (Jansen & Brug, 2006) It has been shown that obese and overweight adult populations - the self reporting of own bodyweight tends to be systematically underestimated relative to actual measured weight (Metcalf, Scragg, Willoughby, Finau, & Tipene-Leach, 2000; Scholtens, et al., 2007). Similarly the parents of children with a high BMI tended to underestimate weight of their own children suggesting that prevalence's based on reported weights of children may be underestimated (Etelson, et al., 2003; Scholtens, et al., 2007). Furthermore it is evident that inaccurate parental perceptions are likely to contribute to increases in childhood overweight obesity though inaction (Krebs & Jacobson, 2003).

Several studies (De La, 2007) have found a gender bias affecting parental perception, where by daughters weight is overestimated in comparison to sons. The bias may be explained by a societal disposition to the acceptance of having larger sons, but trimmer daughters.

Comparative Study

Parental perceptions of their child's weight status was assessed in a study that looked at three to five year old children of predominantly European ethnicity in an outer London suburb (Carnell, et al., 2005) In this study the majority – approximately three quarters (74%) of children were of normal weight status, whilst 18% were overweight and a further 8% were obese (referenced to the IOTF). Although only 26% of children were overweight and or obese, 46% of parents reported concern for their child's weight. Within each weight status 40% of normal weight children's parents were unnecessarily

concerned for their child's weight, whilst 63% of overweight children's parents were concerned and over three quarters (76%) of obese children's parents were concerned for their child's weight.

These findings showed that the odds of parental concern progressively increased for overweight and obese children. The odds that a parent was concerned for their child's weight was two and a half times for overweight children's parents and four and a half times for obese children's parents when compared to levels of concern in parents of normal weight children. Concern was also higher for those parents who themselves overweight (1.9 times) and obese (2.5 times). Generally parents of three to five year olds in this study showed poor awareness of their child's current weight status. Carnell et al. (2005) suggests that reframing the discussions with parents and emphasising prevention of future overweight may be an effective way to engage with parents (Carnell, et al., 2005).

There is a growing need to address parents' awareness and understanding so that they may be able to correctly identify overweight and obesity in their children and make the necessary behavioural changes to mitigate the occurrence of excessive weight (fat accumulation) in their children and the consequential negative health outcomes. Furthermore, behaviour of children is influenced significantly by the decisions and actions of their parents. The underestimation of weight may be in part due to the parents limited level of understanding of excessive weight and the associated health risks in children.

Parents of overweight children underestimate the weight of their children and fail to recognize that their child has a weight problem or misconceive the child's weight (Etelson, et al., 2003). The universal occurrence of this bias may suggest that similar beliefs and attitudes in relation to child's weight status span across various cultures. However, the majority of the studies have only been conducted in western countries (United States, Netherlands and Britain) and little has been published on the perceptions of various ethnicities.

It has been noted that overweight parents often fail to recognise that they themselves are obese. The failure of parents to recognise overweight in their children offers insight into their readiness for action, in that they may not be ready to provide the necessary environment conducive for weight loss (Jansen & Brug, 2006). The difference in understanding may explain the lack of motivation and concern of parents to make

alterations to the lifestyle and behaviour of their overweight and or obese children (Eckstein, et al., 2006; Jeffery, Voss, Metcalf, Alba, & Wilkin, 2005).

The underestimation of weight may be due to the lack of congruence between parents' understanding of overweight and obesity and clinical understandings of the health issue. Not only do parents of overweight or obese children underestimate the overweight status of their child but the health risk associated with obesity.

Explanations for misperception and underestimation

Some of the proposed explanations for parents not being able to identify overweight or obese weight status of their children include; not being familiar with definitions of overweight and obesity or that the excess fat that the child carries is attributed to baby fat and that the child will grow out of the condition. Other reasons that have been suggested as factors for misperception is that failure for parents to admit to their child being overweight, as it might reflect negatively on their parenting (Myers & Vargas, 2000) This occurrence can be explained by a notion proposed by Weinstein (1989) termed "optimistic bias". The phenomenon optimistic bias is a maladaptive mechanism in relation to parental perception that occurs when parents fail to see or minimize the true potential consequences of their child being overweight as they would in other children. In line with the phenomenon is that parents who acquire higher levels of education, or are more informed tend to accurately perceive the weight status of their children (Carnell, et al., 2005; Eckstein, et al., 2006).

The increased prevalence in the global rates of overweight and obese populations has changed the perceptions of society as to what body size constitutes normal. This general shift in what society constitutes as being fat, the shifting of norms is also a possible contributing factor for the misperception of parents (Young-Hyman, Herman, Scott & Schlundt, 2000)

Pacific Cultural attitudes and socioeconomic environment

Historically Polynesian cultures have viewed larger body sizes to be more desirable as it was associated with wealth and health status (Craig, Swinburn, Matenga-Smith, Matangi, & Vaughn, 1996; Metcalf, et al., 2000). Contemporary perceptions show that this view is at least not held amongst some Pacific groups (Brewis, McGarvey, Jones, & Swinburn, 1998). A New Zealand study which sampled an ethnically diverse group of adolescents found that Pacific adolescents were concerned if they had a weight issue,

suggesting an attitude change towards preferring smaller body size (Utter, Scragg, Denny, & Schaaf, 2009).

There is a wealth of information on the causes of obesity and the associated morbidities. However, an area that is less understood is the influence of Pacific parents' attitudes (parental perception) and behaviours on their children and the role that ethnicity may have. Parents' behaviour and attitude towards obesity and overweight play a significant role in developing their children's perception of the health issue (Raman, 2002).

A study that compared perceptions of body size in middle aged European, Maori and Pacific adults in New Zealand found that those Pacific adults were eight times more likely to perceive themselves as being smaller than their European counter parts. Individuals with no post school qualification, and belong to a lower socio economic grouping were also shown to misperceive their body size (Metcalf, et al., 2000).

Social and cultural aspects of childhood obesity have not been explored or exhausted in comparison to other areas of underlying factors of obesity such as genetic investigation, physical activity and nutritional and dietary aspects (Lobstein, Baur, & Uauy, 2004). Explorations in to cultural and social aspects of obesity within pacific populations have revealed complex perceptual relationships. An example of this is the common cultural, social beliefs about body image such as the preference for young pacific boys to pursue larger body sizes, muscular (Ricciardelli, et al., 2007).

In a comparative study involving adults from Samoa and Auckland, New Zealand the assessment of perception on body size was tested. The results of the study suggested that the Pacific participants were aware of their overweight status and desired a smaller body type, however they remained positive about their current weight status, even if they were of a higher BMI (Brewis et al 1998).

The socio economic demographic environment, in which Pacific peoples exist in, plays a crucial role in determining their perceptions. Within New Zealand the environment in which Pacific families exist in has been well documented and describes the following aspects; pacific socioeconomic status, education levels of attainment, retention of mother tongue (language), employment type, gambling practices, and participation , alcohol consumption, maternal smoking during pregnancy (Butler, Williams, Paterson, & Tukuitonga, 2004) housing tenure (rental) and overcrowding (Butler, Williams, Tukuitonga, & Paterson, 2003) and access to food (Rush, Puniani, Snowling, & Paterson, 2007). Low socio economic status of families is associated with the

purchasing of density calorie rich foods (Drewnowski, 2004). The physical environment also has an association with childhood obesity, in that if parents perceive the environmental hazard, parents are less likely to encourage or allow the physical activity of their children (Timperio, Salmon, Telford, & Crawford, 2005). It is well documented that deprivation increases the risk of being overweight or obese. (Ministry of Health, 2008).

Parental knowledge and awareness

Ensuring that parents are fully aware of the associated health risks that overweight obese children face is essential to motivating parents to create a more supportive environment to attain and maintain a healthy weight. The general understanding of the populace of what constitutes as being overweight or obese differs from the clinical definitions (Eckstein, et al., 2006). If parental assessment of their overweight and obese children is incorrect; that is their overweight child is perceived to have no weight issue, then they as parents will fail to act accordingly and will not provide the necessary means to change (Jansen & Brug, 2006).

In contemporary society the obesity epidemic has increasingly become a health issue for all. Studies have shown that an inverse socio demographic pattern of obesity is no longer prominent and that obesity is affecting individuals at all levels throughout society (Jeffery, et al., 2005). The significant increase in childhood obesity and its associated co-morbidities warrants strong and comprehensive efforts by all nations to prevent its occurrence. The most effective means by which this can be accomplished is through the early detection of individuals who are at risk. Relevant and specific implementation of programmes may be needed to curb the rising prevalence rates through changing the attitudes of individuals regarding obesity (Krebs & Jacobson, 2003). Of concern are children who are overweight as they are likely to become obese in future if suitable and timely interventions are not put in place (Taylor, 2007). Perceptions of people regarding weight status differ from clinical definitions which may explain the lack of motivation of people to make lifestyle behavioural changes (Jeffery et al., 2005). Parents may need to be educated in the specified health risks that children are placed when they are in different weight statuses.

The success of programmes may be reflective on the ability of parents to change their perceptions on obesity, or more accurately recognise that their child is overweight and or obese in the first instance. Furthermore, parents need the capacity to make changes to

the child's environment. Knowledge, awareness coupled with support to provide the necessary resources to make long lasting changes to the child's environment.

The most influential people in a child's immediate environment are the parents. However, much of the literature cited in review, systematically shows that a significant number of parents do not realize the true weight status of their children (Doolen, et al., 2009) Parents play an important role in moulding behaviours and attitudes of children. The involvement of parents in the prevention and treatment of childhood obesity is paramount.

In a longitudinal study which followed the weight loss of children over a period of 10 years, the intervention group of which consisted of parent child dyad lost the most weight (Epstein, Wing, Koeske, Andrasik & Ossip, 1981). No more recent publications were found that support the conclusion that interventions that involve both the parents and the child are more effective than interventions that target the child or the parent in isolation.

Policy linkage

Interventions for the prevention and treatment of child obesity are most effective when they involve the family of the child (Epstein, Myers, Raynor & Saelens, 1998). Parents have the potential to influence the child's nutritional and physical activity patterns positively to encourage weight loss (Rhee, De Lago, Arscott-Mills, Mehta, & Davis, 2005). An understanding of the link between parent's perceptions and concerns and actual body size is essential in the development of interventions for Pacific communities. This is significantly important for Pacific communities in New Zealand as our Pacific community has an unequal burden of overweight and obesity and its related illness.

This information should contribute to the design of specific Pacific prevention efforts that are focused on the unpacking of overweight and obese attitudes and behaviours. One area that the findings may assist is the understanding of the inability of parents to recognize their children's weight problems (Eckstein, et al., 2006).

The literature review has assessed the complex relationship that parental perceptions of child's weight status can have on the child's weight status. It is apparent that this relationship is unclear especially for Pacific people in New Zealand. There is a need for this relationship to be further investigated.

Aims

This research aims to examine whether Pacific parental (majority are mothers) perception (concern) of their child's weight status (normal/overweight/obese) is accurately associated with their actual weight.

Key objectives of the Pacific Perception of Overweight and Obesity Study (PPOS):

To investigate the perceptions of Pacific parents of their child's weight on the basis of the relationship between parental perception of child's weight and actual weight standardized for age and sex *.

To investigate the change in parental perception and child's weight at 4 and 6 years postpartum.

To investigate socio-economic and demographic factors that may influence the perception of parents by exploring patterns of association between socio-demographic and environmental variables (ethnicity of the parents and children, marital status of parents, age of parents, income levels of the households, acculturation levels of parent, highest education attainment, smoking status) and parental perception with child weight status (unconcerned, concerned, fairly concerned and very concerned) at baseline.

Hypotheses

Parental perception offers a level of insight into the understanding/awareness of the parents with regards to the weight of [their] children. If parental perception is indicated by a low level of concern and their child is overweight or obese, then perhaps there is an inability on the parent's behalf to recognize correctly what body size constitutes a healthy weight.

Parents of obese and or overweight children will underestimate the (body size) weight of their children, this will be reflected through:

a) More parents of overweight and obese children will not be concerned than be concerned about their child becoming overweight in future [at both time points].

b) Parents level of concern regarding their child becoming overweight in future will change, increases at six years postpartum in comparison to four years postpartum.

c) Parents level of concern regarding their child's weight status will remain the same over the two time periods.

Chapter 3: Methods

Introduction

This chapter describes relevant methods employed in both the Pacific Islands Families Study (PIFS) and the Parental Perceptions of Obesity Study (PPOS). Initially background information on the sample and study design for each will be reported. Following this an account of procedural and administrative practices is given. A broad description is provided of clusters of variables around key themes such as the demographic and social context, parental perceptions of overweight and obesity, and the measurement of overweight and obesity in both mother and child. Ethical approval and considerations will then be described prior to outlining statistical methods that were used for data analysis

Background of the PIF study

The PIF study is a longitudinal birth cohort that recruited 1398 Pacific children born in Middlemore Hospital (South Auckland, New Zealand) from 15th March to 17th December 2000. All children that had either a Pacific parent (mother or father) were eligible to be part of this study. To date the PIF study has gathered data from mothers, children, fathers, and teachers at 6 weeks, 2, 4, 6 and 9 year phases (postpartum). The purpose for this study is to inform strategic and tactical recommendations to improve the health and well-being of Pacific children and families. Information on many different areas of health and the development of Pacific children and families gathered using multidisciplinary instruments forms a robust base for this study to explore a vast array of subject matter (Paterson et al., 2006; Paterson et al., 2008).

Description of and selection of the PPOS study

The Parental Perceptions of Obesity Study (PPOS) is comprised of a sub-sample of the PIFS. As stated earlier the PPOS aims to assess parental perceptions of their child's weight status and identify factors that influence perception and weight status. As the central focus of this study was the relationships between body size and parental perception, data was included only for participants who had both body size (height and weight) and parental perception measurements in 2004 and 2006 following the process outlined in Figure 3.1. Briefly at 6 weeks postpartum, the information of 1376 mothers and 1398 children were eligible for analysis. The exclusion of children of multiple birth

status (23 pairs of twins), and/or of low birth weight (<2500 grams), pre-term (37 weeks), and with a mother having gestational diabetes (n=227) was applied and reduced the number of mothers and children (n=1171). In all, 569 children and mothers met the measurement criteria at both four and six years. Of these, variables extracted for the PPOS are listed in Table 3.1 and the process of establishing the final PPOS study sample is modelled in consort diagram Figure 3.2.

As part of the primary protocol, mothers were asked using a likert scale type question that assessed their perception with regards to their child's weight status. A total of 1066 parents at four years and 1019 at six years responded to the question (Figure 3.1). There were 914 parents who responded to the perception question at both the four and six year phase. At both four and six years, as part of the child protocol, the height and weight of children were measured from which their body mass index (BMI) was derived. Of those children whose parents answered the parental perception question at both the four and six year phase, and had their child's weight and height measured, 569 complete sets of data satisfied the inclusion criteria for the PPOS (Figure 3.2).

At six years, the %BF of 517 children was gathered, as well as the BMI of 140 mothers (BMI scores of greater than 60 units was excluded due to the improbability of these scores occurring) for further explorative analysis (Figure 3.2).

Table 3.1: List of variables used in the Parental Perceptions of Obesity Study

Phase	Protocol	
	Child	**Parent**
6 weeks	Sex	Acculturation
	Birth weight	Relationship to child
		Mother's age
		Ethnicity
		Education
		Household income
		Parity
		Usual number of people in the house
		Mothers smoking status during pregnancy
		Infant feeding practice
4 years	BMI	Concern
	Body fatness	
6 years	BMI	Concern
	Body fatness	BMI

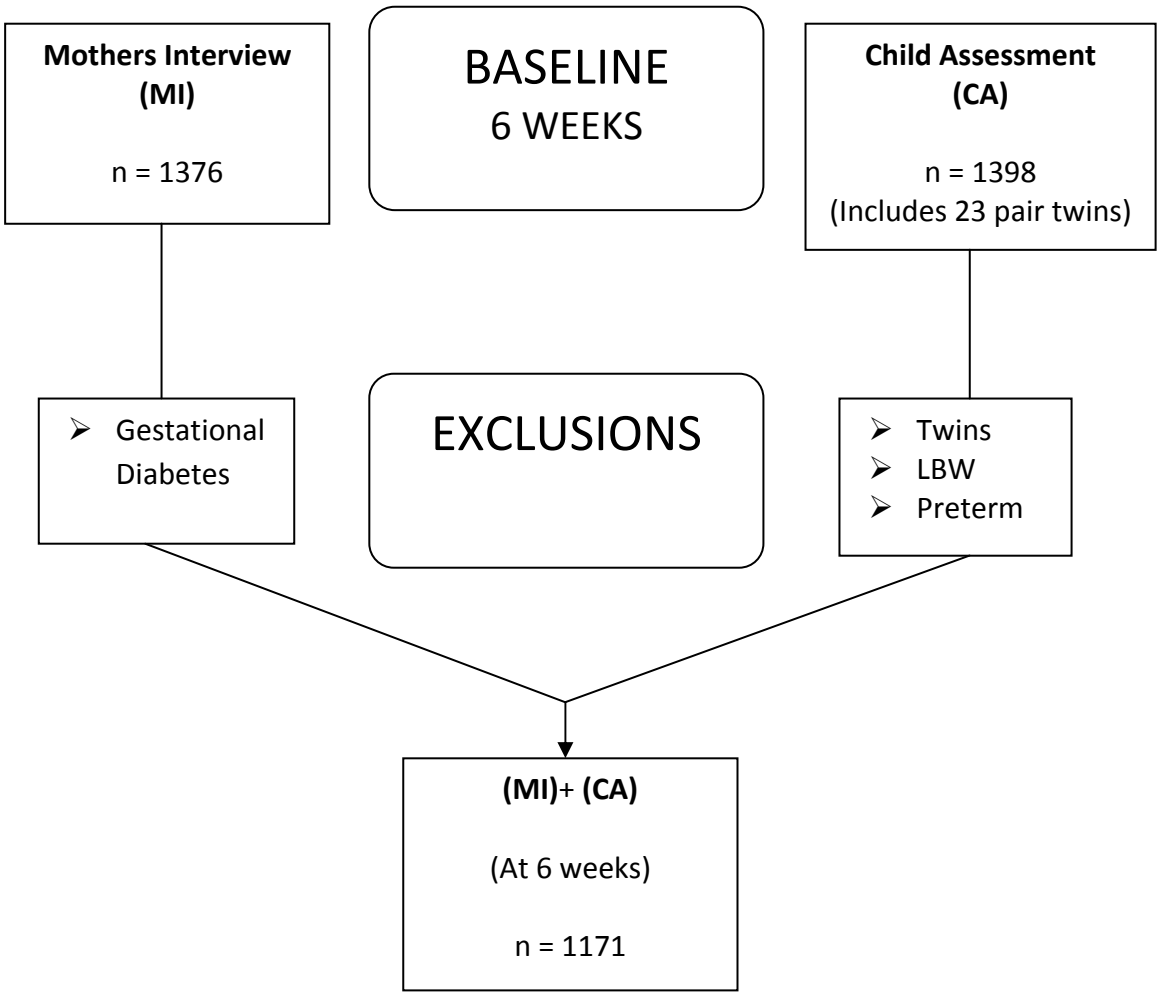
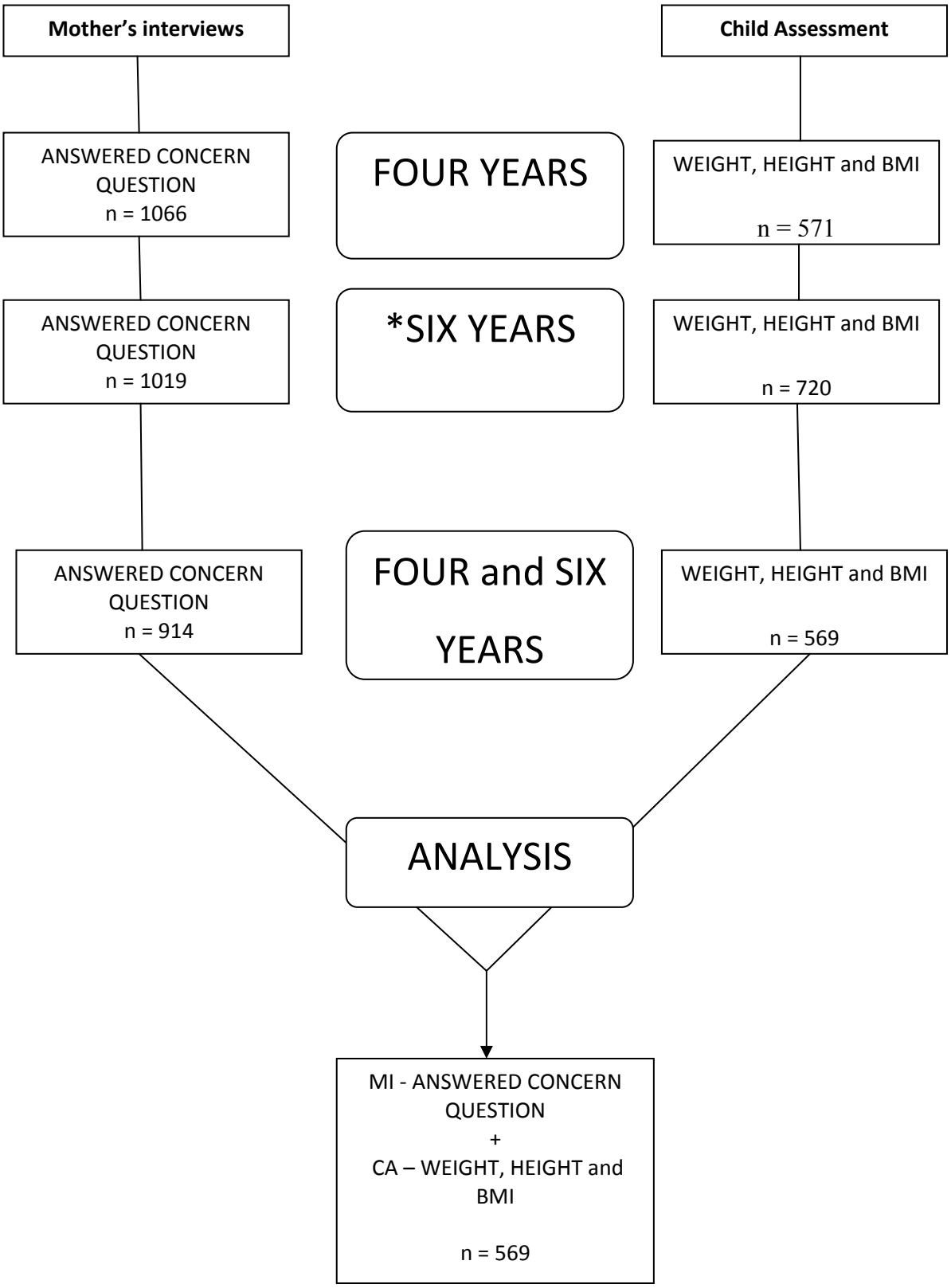


Figure 3.1: Inclusion criteria for Pacific Island Families Study (PIFS)



*Additional measurements such as Mothers BMI (n = 140) and children's anthropometry and percentage body fat (n = 517) were taken for further analysis.

Figure 3.2: Inclusion criteria for Parental Perception of Obesity Study (PPOS)

Procedures and practices to ensure data accuracy

Stringent procedures were used to ensure data gathered were both reliable and valid. This included training and monitoring of interviewers in both questionnaire and child anthropometry measures. All physical measurements were repeated and only accepted if within a specified tolerance. Data was then checked and coded by an independent person before it was entered into the PIFS database. All measuring equipment was checked on a regular basis and serviced when necessary. Data was cleaned following predetermined criteria of probable and impossible measures including realistic relationships such as height in relation to weight.

Questionnaire administration

The maternal interviews were administered by trained female interviewers, who, when possible, were ethnically matched to the mothers. Following consent, the interviews were conducted in the participant's home. The interviews took approximately one hour, and the responses of the mothers were recorded by the interviewer only. Initially (at the 6 week phase) translated questionnaires were made in Pacific languages (Samoan, Tongan, and Cook Island Maori) as well as English. However, only 14% of Pacific mothers chose to have the survey administered in one of the Pacific languages. Due to the low preference for translated questionnaires, subsequent surveys were made available only in English (Paterson et al., 2008) and verbally translated by the interviewer when needed.

Demographic and socio-cultural context

Demographic information including ethnicity of the parents and children, marital status of parents, age of parents, income levels of the parents, acculturation levels of parents (level of affiliation to culture), highest education attainment, and smoking practices of mother was also collected. Specific information is listed here, and detailed in Appendix K and L:

Socio-economic/environment and demographic factors at birth

Ethnicity of the parents and children

Marital status of parents at birth

Age of parents at birth

Income levels of the parents, households at birth

Acculturation levels of parents at birth

Highest education attainment at birth

Child's weight status at birth, four and six years

Environmental variables at birth

Smoking status of mother at birth

Child's feeding practices birth to six weeks.

To assess the socioeconomic environment of the child, information from the six week or baseline phase was extracted (acculturation, relationship to child, mother's age, ethnicity, education, household income, parity, usual number of people in the house, smoking status during pregnancy and infant feeding). Following the conceptual framework of the life course model of health and disease, the immediate environment that the child was subjected to postpartum was the focus of the PPOS and influence, if any, with parental perception and eventual weight status at four and six years was examined.

Parental perception of overweight and obesity

At four and six years of age, questions were also asked about parental perceptions of their child's weight, which indicated the level of concern parents had for the child becoming overweight in future (unconcerned, concerned, fairly concerned and very concerned). For a large part of the analyses, this variable was dichotomised in to concern (that combined all concerned variables) and unconcerned.

Derivation of parental perception question

The parental perception question was extracted from the Child Feeding Questionnaire (CFQ), "a self report measure to assess parental belief, attitudes and practices regarding child feeding, with a focus on obesity proneness in children" (Birch et al., 2001). This question was specifically designed to assess a parent's perceptions and concerns regarding childhood obesity. The questionnaire is considered appropriate for parents of normally developing school aged children (Refer to Appendix F and G for the questionnaire proper).

Maternal anthropometry

The height of the mothers was measured using a stadiometer, measured to the nearest 0.1 cm. Weight was measured using Seca scales, and measured to the nearest 0.1 kg, with mothers wearing light clothing. Two measurements, each of the height and weight were taken, with the average of the two readings being the final reading. If the two measurements differed by 0.5 cm for height or 0.5kg for weight, a third reading was taken and the closest two of the three measures would be used (Oliver, Schluter, Paterson, Kolt & Schofield, 2009). Body mass index was calculated as weight (in kilograms) divided by height squared (in meters): $(kg)/(m)^2$. Ethnic specific cut offs were applied to determine the weight status of the mothers, with overweight being $26kg/m^2$, and obese $32kg/m^2$ (World Health Organisation, 2006; World Health Organisation, n.d)

Child anthropometry

Birth weight was extracted from hospital discharge summaries. At four and six years of age, anthropometric measurements (height, weight) were made in duplicate and repeated a third time if not within 0.1 kg for weight and 0.5cm for height. Child weight was measured in light clothing to the nearest 0.1 kg. Children were asked to remove their shoes before their standing height was measured to the nearest 0.1 cm. Equipment was standardised, procedures documented in an operations manual and operators trained. As with maternal anthropometry, child BMI was calculated as $(kg)/(m)^2$. Child age was determined as the difference between the date of measurement and the date of birth.

At age four and six years, body fatness was estimated from hand-to-foot 50 kHz bioimpedance measurements (IMP5, Impedimed, Brisbane, Australia) using a prediction equation developed in a similar population. (Rush et al., 2003). Standard deviation (SD) scores for weight, height and BMI were calculated using CDC 2000 criteria (Kuczmarski et al., 2000) and SD scores for body fat percentage (%BF) at six years were derived from the formula developed by McCarthy et al. (2006) from British school children. Cole cut-offs were used for determining overweight and obesity in the child cohort (Cole et al., 2007) The above SD scores and categories were determined with an Excel™ add-in kindly supplied by Professor Tim Cole, University College, London.

Ethics

Ethical approval for each stage of the PIF study was obtained from the Auckland Branch of the National Ethics Committee (First Two Years of Life Phase at 6 weeks, 12 months, 24 months): AIT801, and the Transition to School Phase (4 years, 6 years): AITX0202. There was also support from the Royal New Zealand Plunket Society and the South Auckland Health Clinical Board (Paterson et al., 2006; Paterson et al., 2008).The PPOS did not require further ethics approval because it used existing data, and the author is part of the PIFS research team.

Careful ethical consideration was still made however to protect the anonymity of the participants and the security of their information. Extraction of selected pieces of information had to be justified and permission for extraction had to be sought from the Directors of the PIFS and was facilitated by the PIFS Data manager. Only information deemed relevant to the PPOS was accessible for analysis.

Statistics

Simple cross tabulation, descriptive statistics, frequencies and percentages of socio demographic variables were calculated for participants of the PPOS and compared to the PIF cohort measures at baseline (six weeks). Categorical variables were recoded as necessary to simplify analysis (See Appendix K and L).

Continuous statistics are presented as mean, standard deviation and minimum and maximum values. Descriptive categorical statistics are described as frequencies and percentages. Differences between frequencies were examined by use of 95% confidence intervals (95% CI) and determined as follows:

Standard Error (SE) of percentage response of interest (%response)

= √((%response * (100 - %response))/number of responses

Width of the 95%CI=1.96*SE

Lower 95%CI=%response –width of 95%CI

Upper 95%CI=%response + width of 95%CI

The chi-squared test was applied to determine linear associations with categorical scales ranks and differences in frequency of bivariate categorical variables. Initial analysis calculated the proportion of Pacific children in the PIF study at four and six years who were obese, overweight, within the normal range, underweight and very underweight

according to the International Obesity Task Force age and sex specific criteria (Cole et al., 2007). Sex and age specific BMI standard deviation scores were determined from the CDC growth centile charts (Kuczmarski et al., 2000). ANCOVA for change scores – Pearson's for associations of continuous variables and normal distribution check. Data were analysed using the Excel program™ and SPSS 15 provided by SPSS Chicago IL. The significance level was set at $p<0.05$.

Given the large number of socioeconomic and demographic predictors relative to the sample size and collinearity of the variables, principal components analysis (PCA) was used as a means to reduce the complexity of the variables. Principal component analysis extracts from the original variables a set of components (or factors) that account for most of the variance. An orthogonal varimax rotation was used, and factors with an eigenvalue >1 were retained. Individual variables with a factor load of >0.5 for a given PCA derived factor are reported as composing that factor. The variables identified in this analysis (e.g., household income, age, parity, marital status, how baby fed in first 6 weeks, smoking status during pregnancy, usual number of residents in household, acculturation, highest education qualification (see Appendix D and E) were then re-examined using logistic regression.

Socio cultural demographic variables and parental concern, child's weight status, overweight and/or obese status versus parental concern at six years were inserted in to a univariate odds ratio (95% CI) model to test for any significant associations. The same socio cultural demographic variables were entered into a multiple logistic regression model to control for potential confounding effects by means of adjustment.

Chapter 4: Results

Parental Perception of Overweight Obesity Study (PPOS)

Data was analysed in the 569 families who provided responses to the body size perception question at both the four and six year sampling phases, and socioeconomic demographic variables measured at baseline and is presented in this section. Although there was the ability to present exhaustive summaries of measurements from both the four and six year measurement sampling points, generally the emphasis was placed on the six year phase as the outcome criteria, however, when significant, analyses on the sample at four years have been included to show longitudinal significance.

At birth (six weeks postpartum), four years and six years 97% of the respondents were the birth mothers of the children in the parental perception of overweight/obesity study (PPOS) and due to the low numbers of thin children referenced to the IOTF weight status grades at age four (0.7%) and age six (0.2 %), the thin children were included in the normal for weight category (Cole et al., 2007).

This chapter is divided into the following sections:

1. Comparison of demographic and lifestyle characteristics of Parental Perception of Overweight/Obesity (PPOS) sub-study (n=569) with the whole PIF cohort (n=1398).
2. Descriptive statistics of parental perceptions (concern versus unconcerned) of their child's body size at four and six years old.
3. Descriptive statistics of prevalence of normal, overweight, and obesity of PPOS at four and six years old.
4. Associations of accurate/inaccurate parental perception (concern) of child's body size with explanatory variables including body composition measures and parental changes in perceptions compared with changes in child's actual body size and
5. in the 140 mothers who had their BMI measured at six years, comparison with perceptions and child body size and growth.

Section One: Comparison of Pacific Island Families Study (PIF) and Parental Perception of Overweight Obesity Study (PPOS)

Comparison of demographic and socioeconomic factors between the Parental Perception of Overweight Obesity (PPOS) to the Pacific Islands Families study (PIF)

At six weeks postpartum there were no differences in age, ethnicity and cultural alignment of the mother between the PPOS (n=569) subsample and the PIF cohort (n=1398, Table 4.1) Maternal socioeconomic demographic characteristics; social marital status, education, household income, household size and smoking during pregnancy frequencies also were not different between studies (Table 4.2). The profile of the PIF cohort does however show that a high proportion of the cohort have demographic and social factors that are evidence of low socio economic status (Table 3). For instance, the mothers' median age was less than 30 years, slightly more than half of them were legally partnered, and only one out of four had post school qualifications. Furthermore, their median household income was around $30,000 per annum, four out of five households had at least five occupants, almost one third of them had at least eight children, and one in five mothers smoked during pregnancy.

Table 4.1: Comparison of the selected maternal demographic characteristics

Comparison of the selected maternal demographic characteristics of the Parental Perception of Overweight/obesity Study (PPOS) study subsample with Pacific Island Families study (PIF) cohort.

Demographic Characteristic	**PIF cohort N =1398 n (%)**	**Selected sample n=569 n (%)**
Age		
< 20 years	111 (7.9)	38 (6.7)
20 - 29 years	732 (52.4)	276 (48.5)
30 – 39 years	508 (36.3)	229 (40.2)
40 + years	46 (3.3)	25 (4.4)
Missing	1 (0.1)	1 (0.2)
Mother's ethnicity		
Samoan	659 (47.1)	268 (47.1)
Cook Island	233 (16.7)	106 (18.6)
Niuean	61 (4.4)	28 (4.9)
Tongan	296 (21.2)	119 (20.9)
Other Pacific	47 (3.4)	10 (1.8)
Non-Pacific	102 (7.3)	38 (6.7)
Cultural alignment		
Assimilator	444 (31.8)	185 (32.5)
Separator	452 (32.3)	187 (32.9)
Integrator	236 (16.9)	98 (17.2)
Marginal	255 (18.2)	93 (16.3)
Missing	11 (0.8)	6 (1.1)

Table 4.2: Comparison of selected maternal socioeconomic characteristics

Comparison of selected maternal socioeconomic characteristics of the Parental Perception of Overweight/obesity Study (PPOS) subsample with the Pacific Island Families study (PIF) cohort.

Demographic Characteristic	PIF cohort n=1398 n (%)	Selected sample n=569 n (%)
Social marital status		
Partnered legally married	791 (56.6)	345 (60.6)
Partnered defacto	332 (23.7)	125 (22.0)
Non-partnered	275 (19.7)	99 (17.4)
Education		
No formal qualifications	541 (38.7)	200 (35.1)
Secondary school qualifications	471 (33.7)	211 (37.1)
Post-school qualifications	386 (27.6)	158 (27.8)
Household income (annual)		
$0-$20 000	466 (33.3)	181 (31.8)
$20 001-$40 000	717 (51.3)	297 (52.2)
$> 40 000	165 (11.8)	74 (13.0)
Unknown	50 (3.6)	17 (3.0)
Household size (persons)		
2 – 4	287 (20.5)	124 (21.8)
5 – 7	706 (50.5)	275 (48.3)
8 or more	404 (28.9)	170 (29.9)
Missing	1 (0.1)	0
Smoked during pregnancy		
Yes	345 (24.7)	127 (22.3)
No	1047 (74.9)	437 (76.8)
Missing	6 (0.4)	5 (.9)

Demographic characteristics and selected aspects of infant feeding practices are presented in Table 4.3. Child profiles of the PIF cohort and the PPOS were similar in both studies. There were slightly more boys than girls, three out of four children were born into families with more than one child and half of the children were exclusively breast fed in their first six weeks of life.

Table 4.3 Comparison of child demographic characteristics and infant feeding practice

Comparison of child demographic characteristics and infant feeding practice of the Parental Perception of Overweight/obesity Study (PPOS) subsample with the Pacific Island Families study (PIF) cohort at birth and six weeks.

Demographic Characteristic	PIF cohort n=1398 n (%)	Selected sample n=569 n (%)
Sex		
Male	718 (51.4)	299 (52.5)
Female	680 (48.6)	270 (47.5)
Birth weight		
Low <2500g	72 (5.2)	2 (0.4)
2500g and more	1307 (93.5)	567 (99.6)
Missing	19 (1.4)	0
Birth parity		
1	374 (26.8)	135 (23.7)
2-4	782 (55.9)	328 (57.6)
5	223 (16.0)	106 (18.6)
Unknown	19 (1.4)	0
Infant feeding (at 6 weeks)		
Breastfeed only	686 (49.1)	309 (54.3)
Bottle fed	180 (12.9)	60 (10.5)
Combination	531 (38.0)	200 (35.1)
Missing	1 (0.0)	0

Section Two: Parental perceptions and perception change expressed as a level of concern for child becoming overweight of the Parental Perception of Overweight obesity study (PPOS) at age four and six years

The original question "How concerned are you about your child becoming overweight?" had five levels of responses (Table 4.4). The majority (more than 60%) of parents/caregivers in both 2004 and 2006 responded that they were not concerned. In 2004 when children were four years old 62.4% (95% CI, 58.4 to 66.4) of parents reported being "unconcerned" with their child becoming overweight. This proportion of "unconcerned" parents increased to 69.1% (95% CI, 65.3 to 72.9) two years later, when the children were six years old. This increase was marginally significant. Meanwhile, only eight percent of parents in 2004 and five percent in 2006 indicated that they were either "fairly concerned" or "very concerned".

Table 4.4: Parental perception expressed as a level of concern (five categories)

Parental perception expressed as a level of concern (five categories) of the Parental Perception of Overweight/obesity study (PPOS) (n=569) regarding their child becoming overweight in future at years 2004 and 2006.

Parental Perception	2004 n (%)	2006 n (%)
Unconcerned	355 (62.4)	393 (69.1)
A little concerned	114 (20.0)	61 (10.7)
Concerned	52 (9.1)	86 (15.1)
Fairly concerned	19 (3.3)	10 (1.8)
Very concerned	29 (5.1)	19 (3.3)

The majority of parents/caregivers responded that they were "unconcerned" or not concerned. The responses in each of the remaining levels of "concerned" ("A little concerned," "Concerned," "fairly concerned" and "very concerned") were small (Table 4.4), and therefore collapsed in to one level of "concern," resulting in two levels: "unconcerned" and "concerned" (Table 4.5). There was a marginal decrease (6.7%) in the number of parents concerned between 2004 and 2006.

Table 4.5: Parental perception expressed as a level of concern (two categories)

Parental perception expressed as a level of concern (two categories) of the Parental Perception of Overweight/obesity study (PPOS) (n=569) regarding their child becoming overweight in future from age four to age six years.

Parental Perception	2004 n (%)	2006 n (%)
Unconcerned	355 (62.4)	393 (69.1)
Concerned	214 (37.6)	176 (30.9)

The majority (62.7%) of the parents/caregivers did not change their perceptions between the time period 2004 to 2006, when the child was aged four and six years. Of those parents/caregivers who did change their perception from four to six years, more changed from concerned to unconcerned (22%) than from unconcerned to concerned (15.3%) (Table 4.6).

Table 4.6: Change in parental perception expressed as a level of concern

Change in parental perception expressed as a level of concern of the Parental Perception of Overweight/obesity Study (PPOS) (n=569) regarding their child becoming overweight in future, from age four to age six years.

Parental Perception	2004 to 2006 n (%)
Stayed not concerned	268 (47.1)
Concerned to unconcerned	125 (22.0)
Unconcerned to concerned	87 (15.3)
Stayed concerned	89 (15.6)

Parental perceptions expressed as a level of concern by ethnicity at age four and six years (Table 4.7) and parental perceptions as a level of concern by sex (Table 4.8) are described here. Tongan mothers did not follow the same pattern of concern as the other major ethnic groups. For instance, Tongan parents showed the highest levels of concern at both time points and were the only group that reported an increase in concern from four to six years (Table 4.7). From four to six years, their level of parental concern almost doubled (47.1% to 79.8%, Table 4.7) however for all other ethnic groups, parental levels of concern decreased on average by 46%. There were no differences in the pattern of concern between parents of boys or girls (Table 4.8).

Table 4.7: Parental perception as a level of concern regarding child becoming overweight in future by child ethnicity

Parental perception as a level of concern regarding child becoming overweight in future of the Parental Perception of Overweight/obesity Study (PPOS)(n = 569) at four and six years by child ethnicity.

Child Ethnicity	2004		2006	
	Concerned	Unconcerned	Concerned	Unconcerned
	n (%)	n (%)	n (%)	n (%)
Samoan	89 (33.2)	179 (66.8)	46 (17.2)	222 (82.8)
Cook Island	41 (38.7)	65 (61.3)	19 (17.9)	87 (82.1)
Tongan	56 (47.1)	63 (52.9)	95 (79.8)	24 (20.2)
Other Pacific	17 (44.7)	21 (55.3)	9 (23.7)	29 (76.3)
Non Pacific	11 (28.9)	27 (71.1)	7 (18.4)	31 (81.6)
Total	214	355	176	393
	p=0.066		p=.0.000	

Note. p value derived from chi square test.

Table 4.8: Parental perception as a level of concern regarding child becoming overweight in future by sex

Parental perception as a level of concern regarding child becoming overweight in future of the Parental Perception of Overweight/obesity Study (PPOS)(n = 569) at four and six years by sex

Sex	2004		2006	
	Concerned	Unconcerned	Concerned	Unconcerned
	n (%)	n (%)	n (%)	n (%)
Male	117 (39.1)	182 (60.9)	92 (30.8)	207 (69.8)
Female	97 (35.9)	173 (64.1)	84 (31.1)	186 (68.9)
Total	214	355	176	393
	p = 0.431		p = 0.930	

Note. p value derived from chi square test.

Socioeconomic and demographic predictors were analysed using the principal components analysis (PCA) to reduce the complexity of the variables. A set of components or factors were identified The variables identified in this analysis (e.g., household income, age, parity, marital status, how baby fed in first 6 weeks, smoking status during pregnancy, usual number of residents in household, acculturation, highest education qualification, (see Appendix D and E) were then re-examined using logistic regression.

Table 4.9: Univariate logistic regression of parental perception expressed as a level of concern

Univariate logistic regression of parental perception expressed as a level of concern at six years of the Parental Perception of Overweight/obesity Study (PPOS) (n=569) on selected socioeconomic demographic characteristics of mother and child from birth (6 weeks postpartum).

		Univariate odds ratio	
Variable	**Category**	**OR**	**(95% CI)**
Sex of child	Male	1.0	-
	Female	1.02	(0.71, 1.45)
Acculturation	Assimilator	1.0	
	Separator	1.47	(0.95, 2.29)
	Integrator	1.14	(0.66, 1.95)
	Marginalist	1.29	(0.75, 2.21)
Mother's ethnicity	Samoan	1.0	-
	Cook Island	0.91	(0.45, 1.86)
	Tongan	22.93	(12.38, 42.49)***
	Other Pacific	1.60	(0.64, 3.99)
	Non Pacific	0.99	(0.37, 2.68)
Education	No Formal Education	1.0	-
	Secondary School	1.18	(0.78, 1.79)
	Post school	0.93	(0.59, 1.47)
Smoking in pregnancy	No	1.0	-
	Yes	0.51	(0.32, 0.82)**
Marital status	Married	1.00	-
	De-facto	0.49	(0.31, 0.79)**
	Single	0.43	(0.25, 0.73)**
Mother's age	<20 years	1.0	-
	20 – 29 years	1.34	(0.61, 2.95)
	30 – 39 years	1.76	(0.80, 3.91)
	40 years +	0.81	(0.24, 2.76)
Household income	$0 - $20,000	1.00	-
	$20,001 - $40,000	1.07	(0.72, 1.60)
	$40,000 +	1.13	(0.63, 2.02)
	Unknown	0.98	(0.33, 2.92)
Parity	1	1.00	-
	2-4	0.75	(0.49, 1.15)
	5+	0.92	(0.54, 1.58)
Household size	2-4	1.00	-
	5-7	1.16	(0.73, 1.85)
	8+	1.22	(0.73, 2.02)

The reference category for the univariate logistic regression was "Unconcerned."
Levels of significance, *p<0.05, **p<0.01, ***p<0.0001

Selected socioeconomic demographic characteristics of both mother and child taken at baseline (six weeks postpartum) were analysed against parental perception of parents expressed as level of concern (concerned, unconcerned) at six years, using univariate logistic regression modelling. From these analyses the mother being of Tongan descent significantly increased the odds of being concerned for the future weight status of the child. Mothers were less concerned about the child's future overweight status if they had smoked during pregnancy, or were in single or de-facto relationships (Table 4.9).

Table 4.10: Multiple logistic regression of parental perception expressed as a level of concern

Multiple logistic regression of parental perception expressed as a level of concern at six years of the Parental Perception of Overweight/obesity Study (PPOS) (n=569) on selected socio economic demographic characteristics of mother and child from birth (6 weeks postpartum).

		Multivariate odds ratio	
***Variable**	**Category**	**OR**	**(95% CI)**
Sex of child	Male	1.00	-
	Female	0.83	(0.53, 1.31)
Acculturation	Assimilator	1.00	-
	Separator	0.75	(0.39, 1.48)
	Integrator	0.95	(0.47, 1.90)
	Marginalist	0.72	(0.35, 1.47)
Mother's ethnicity	Samoan	1.00	
	Cook Island	0.91	(0.45, 1.86)
	Tongan	22.93	(12.38, 42.49)***
	Other Pacific	1.60	(0.64, 3.99)
	Non-Pacific	0.99	(0.37, 2.68)
Education	No Formal Education	1.00	-
	Secondary School	1.13	(0.65, 1.97)
	Post school	0.88	(0.48, 1.63)
Smoking during pregnancy	No	1.00	-
	Yes	0.91	(0.51, 1.63)
Marital status	Married	1.00	
	De-facto	1.08	(0.58, 2.00)
	Single	0.63	(0.29, 1.37)
Mother's age	<20 years	1.00	-
	20 – 29 years	1.42	(0.54, 3.73)
	30 – 39 years	2.42	(0.86, 6.85)
	40 years +	0.77	(0.16, 3.65)
Household income	$0 - $20,000	1.00	-
	$20,001 - $40,000	0.76	(0.42, 1.38)
	$40,000 +	0.65	(0.29, 1.44)
	Unknown	0.63	(0.15, 2.59)
Parity	1	1.00	-
	2-4	0.52	(0.30, 0.92)*
	5+	0.32	(0.14, 0.77)*
Household size	2-4	1.00	-
	5-7	1.25	(0.69, 2.26)
	8+	1.68	(0.86, 3.27)

The reference category for the multiple logistic regression was "Unconcerned."
Levels of significance, *p<0.05, **p<0.01, ***p<0.0001

To adjust for potential confounding effects, all variables in Table 4.9 were simultaneously entered into a multiple logistic regression model (Table 4.10). When controlling for the effects of all other variables, the effect of non-smoking and married status of mothers failed to remain significant. Tongan ethnicity of mothers however

remained significant and a higher level of parity attained significance. The odds of mothers being concerned for the future overweight status of their children increased if the mothers were of Tongan ethnicity but decreased if the child had siblings (Table 4.10).

Summary of Parental perception

More than six out of ten parents remained unconcerned about their child's weight status at both four and six years. The majority of parents held the same perception (six out of ten) between four and six years.

For ethnicity only, Tongan mothers' level of concern increased between four and six years. The odds of the parents being concerned about the child's weight status increased if the mother was Tongan, whilst the odds of the parent being unconcerned strengthened if the mother had more than one child.

Section Three: Weight Status – Body mass index (BMI) z-score and IOTF grade

In both 2004 and 2006 the BMI z-score of the children was on average more than 1 z-score larger than the CDC 2000 child (Table 4.11). However, by this same standard, on average, these Pacific children were comparatively smaller in 2006 ($p<0.0001$) than in 2004 (Kuczmarski et al., 2000). Similarly, by the IOTF standard, 59.9% were overweight or obese in 2004 and 58.7% in 2006 (Cole et al., 2000).

Table 4.11: Body mass index (BMI) referenced to Centre for disease control (CDC 2000) growth chart

Body mass index (BMI) referenced to Centre for disease control (CDC 2000) growth chart (Kuczmarski et al., 2000) and International obesity Task force grade (Cole et al., 2007) for children of the parental perception of childhood overweight/obese study (PPOS) (n=569) at four and six years.

	2004 Mean ± SD (range)	**2006** Mean ± SD (range)
CDC 2000 BMI z-score (Kuczmarski et al., 2000)	1.62 ± 1.08 (-1.38, 5.62)	1.38 ± 0.88* (-1.25, 3.36)
IOTF Grade (Cole et al., 2007)	n (%)	n (%)
Normal	228 (40.1)	235 (41.3)
Overweight	194 (34.1)	177 (31.1)
Obese	147 (25.8)	157 (27.6)

$p<0.0001$ between four and six years, paired t test.

From four to six years the distribution amongst weight categories generally remained constant within ethnicity, with the exception of the Cook Island ethnic group. The Cook Island ethnic group showed a shift of approximately 10% moving from the overweight category to the obese category; however the shift was not statistically significant. This shift means that the Cook Island group became more similar to the other groups rather than having fewer obese children as was observed at four years (Table 4.12).

Table 4.12: Child weight status IOTF categories by ethnicity and sex

Child weight status IOTF categories (Cole et al., 2000) of the Parental Perception of Overweight/obesity Study (PPOS) (n=569) at four and six years by ethnicity and sex.

	2004			2006		
Ethnicity	Normal	Overweight	Obese	Normal	Overweight	Obese
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Samoan	101 (37.7)	93(34.7)	74 (27.6)	104 (38.8)	91 (34.0)	73 (27.2)
Cook Island	42 (39.6)	42(39.6)	22(20.8)	44 (41.5)	30 (28.3)	32 (30.2)
Tongan	44 (37.0)	37 (31.1)	38 (31.9)	48 (40.3)	35 (29.4)	36 (30.3)
Other Pacific	41 (53.9)	22 (28.9)	13 (17.2)	49 (57.0)	21 (24.4)	16 (18.6)
Total	228 (40.1)	194 (34.1) p=0.074	147 (25.8)	235(41.3)	177(31.1) p = 0.416	157(27.6)
Sex	Normal	Overweight	Obese	Normal	Overweight	Obese
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Male	118 (39.5)	96 (32.1)	85 (28.4)	118 (39.5)	90 (30.1)	91 (30.4)
Female	110 (40.7)	98 (36.3)	62 (23.0)	117 (43.3)	87 (32.2)	66 (24.4)
Total	228 (40.1)	194 (34.1) p=0.297	147 (25.8)	235 (41.3)	177 (31.1) p=0.277	157 (27.6)

Note. p value derived from chi square test.

Body weights of the child at birth, four and six years were all positively correlated (Table 4.13). The association of birth weight with measures of body size BMI and BMI z-score (CDC 2000) at ages four and six years are weak but all statistically significant ranging from r=0.157 to r=0.208. This means that between 2 and 4% of the body size at four and six years is explained. However the association between body size BMI and BMI z-score (CDC 2000) at ages four and six years are moderately to highly correlated with a Pearson correlation coefficient for BMI of = 0.794 and for BMI z-score of 0.764 meaning 63% and 58% of the variation are accounted for by the weight status of two years previous. The patterns of association in Table 4.13 show the body weight from birth through age four years to age six.

The pattern of association between child weight and BMI status and mother's body size measured when the child was 6 years was explored in the 140 dyads measured. Positive and significant associations were found between mother's weight at 6 years and child weight at birth, four and six years (r=0.182, 0.173 and 0.168 respectively, all $p<0.05$). Parent weight or BMI was not related to the BMI z-scores of the child at four and six years. Therefore about 3% of the child's weight may be explained by the weight of the mother.

Table 4.13: Correlation coefficient matrix of body size measures

Correlation coefficient matrix of body size measures child birth weight, body mass index (BMI) (Cole et al., 2000) and BMI z-score s (Kuczmarski et al., 2000) at four and six years

		Childs Birth weight	Childs Weight 4 years	Childs Weight 6 years	Childs BMI CDC (2000) 4 years	Childs BMI CDC (2000) 6 years
Childs Birth weight	Pearson Correlation	1.000	0.255**	0.202**	0.208**	0.182**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000
	N	569	569	569	569	569
Childs Weight 4 years	Pearson Correlation	0.255**	1.000	0.835**	0.834**	0.699**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000
	N	569	569	569	569	569
Childs Weight 6 years	Pearson Correlation	0.202**	0.835**	1.000	0.724**	0.847**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000
	N	569	569	569	569	569
Childs BMI CDC (2000) 4 years	Pearson Correlation	0.208**	0.834**	0.724**	1.000	0.764**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000
	N	569	569	569	569	569
Childs BMI CDC (2000) 6 years	Pearson Correlation	0.182**	0.699**	0.847**	0.764**	1.000
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	
	N	569	569	569	569	569

Levels of significance, *p<0.05, **p<0.01

Univariate logistic regression was used to analyse socioeconomic demographic characteristics of both mother and child at birth and the weight status of the child at the six year phase (Table 4.14). Children who were overweight or obese were combined in to one category and referenced against normal for weight children according to the IOTF cut off grades (Cole et al., 2000) at 6 years. From these analyses the odds of children to be overweight or obese decreased if their mothers were non-Pacific or if the child themselves was of a Pacific ethnicity other than Samoan, Cook Island, Tongan or Niuean, or if the household income was of a certain level ($20,001-$40,000, unknown) or had many siblings (2-4 children). Caution should be taken in the interpretation of the significance of the odds for non-Pacific mothers, other-Pacific children and unknown household income results as the small sample sizes for each of the categories was small.

Table 4.14: Univariate logistic regression of child being overweight or obese at six years

Univariate logistic regression of child being overweight or obese at six years of the Parental Perception of Overweight/obesity Study (PPOS) (n=569) analysed against selected socio-economic demographic characteristics of mother and child from birth (6 weeks postpartum).

		Univariate odds ratio	
Variable	**Category**	**OR**	**(95%, CI)**
Sex of child	Male	1.00	-
	Female	0.85	(0.61,1.19)
Acculturation	Assimilator	1.00	-
	Separator	1.39	(0.92, 2.1)
	Integrator	1.43	(0.87, 2.36)
	Marginalist	1.38	(0.83, 2.29)
Mother's ethnicity	Samoan	1.00	-
	Cook Island	0.89	(0.57, 1.41)
	Tongan	0.94	(0.60, 1.46)
	Other Pacific	0.78	(0.40, 1.55)
	Non Pacific	0.46	(0.23, 0.92)**
Child's ethnicity	Samoan	1.00	-
	Cook Island	0.89	(0.57, 1.41)
	Niuean	0.73	(0.34, 1.60)
	Tongan	0.94	(0.60, 1.46)
	Other Pacific	0.54	(0.29, 0.99)**
Education	No Formal Education	1.00	-
	Secondary School	0.88	(0.59, 1.30)
	Post school	0.85	(0.55, 1.29)
Smoking during pregnancy	No	1.00	-
	Yes	1.31	(0.87, 1.96)
Marital status	Married	1.00	-
	De-facto	0.86	(0.57, 1.30)
	Single	1.17	(0.74, 1.86)
Mother's age	<20 years	1.00	-
	20 – 29 years	0.61	(0.29, 1.26)
	30 – 39 years	0.71	(0.34, 1.49)
	40 years +	0.43	(0.16, 1.21)
Household income	$0 - $20,000	1.00	-
	$20,001 - $40,000	0.63	(0.43, 0.92)**
	$40,000 +	0.71	(0.41, 1.23)
	Unknown	0.36	(0.13, 0.98)**
Parity of mother	1	1.00	-
	2-4	0.62	(0.41, 0.94)**
	5+	0.73	(0.43, 1.24)
Usual number in the House	2-4	1.00	-
	5-7	1.30	(0.85, 1.99)
	8+	1.54	(0.96, 2.47)

The reference category for the univariate logistic regression was "normal."
Levels of significance, *p<0.05, **p<0.01, ***p<0.0001

Table 4.15: Multiple logistic regression of child being overweight or obese

Multiple logistic regression of child being overweight or obese at six years of the Parental Perception of Overweight/obesity Study (PPOS) (n = 569) analysed against selected socio- economic demographic characteristics of mother and child from birth (6 weeks postpartum).

		(Multivariate) Odds Ratio	
Variable	**Category**	**OR**	**(95% CI)**
Sex of child	Male	1.00	-
	Female	0.77	(0.51,1.16)
Acculturation	Assimilator	1.00	-
	Separator	0.91	(0.49,1.67
	Integrator	1.15	(0.61,2.16
	Marginalist	1.57	(0.85,2.92
Mother's ethnicity	Samoan	1.00	-
	Cook Island	0.76	(0.44, 1.33)
	Tongan	0.99	(0.61, 1.59)
	Other Pacific	0.68	(0.31, 1.47)
	Non Pacific	0.49	(0.22, 1.08)
Child's ethnicity	Samoan	1.00	-
	Cook Island	0.95	(0.51, 1.78)
	Niuean	0.74	(0.81, 6.67)
	Tongan	0.39	(0.21, 0.75)***
	Other Pacific	0.37	(0.12, 1.12)
Education (highest attainment)	No Formal Education	1.00	-
	Secondary School	1.30	(0.79, 2.15)
	Post school	1.18	(0.67, 2.06)
Smoking during pregnancy	No	1.00	-
	Yes	1.56	(0.98, 2.50)
Marital status	Married	1.00	-
	De-facto	0.88	(0.54, 1.45)
	Single	0.79	(0.43, 1.46)
Mothers age	<20 years	1.00	-
	20 – 29 years	0.94	(0.39, 2.25)
	30 – 39 years	0.83	(0.32, 2.15)
	40 years +	1.69	(0.47, 6.03)
Household income	$0 - $20,000	1.00	-
	$20,001 - $40,000	0.61	(0.38, 0.99)*
	$40,000 +	0.72	(0.38, 1.39)
	Unknown	0.39	(0.13, 1.18)
Parity	1	1.00	-
	2-4	0.54	(0.34, 0.87)*
	5+	0.57	(0.29, 1.14)
Household size	2-4	1.00	-
	5-7	1.38	(0.79, 2.39)
	8+	1.25	(0.68, 2.32)

The reference category for the multiple logistic regression was "normal."
Levels of significance, *p<0.05, **p<0.01, ***p<0.0001

To adjust for potential confounding effects, all variables in Table 4.14 were simultaneously entered into a multiple logistic regression model (Table 4.15). When controlling for the effects of all other variables, the effect of mother's ethnicity (non-Pacific), child's ethnicity (other Pacific), and unknown level of household income failed to remain significant (Table 4.14). However ethnicity of the child became significant if the child was Tongan, decreasing the odds of being overweight or obese at six years. Although parity and household income still decreased the odds of the child being overweight or obese at six years, the level of significance decreased to ($p<0.05$) (Table 14.5).

Summary of Weight Status

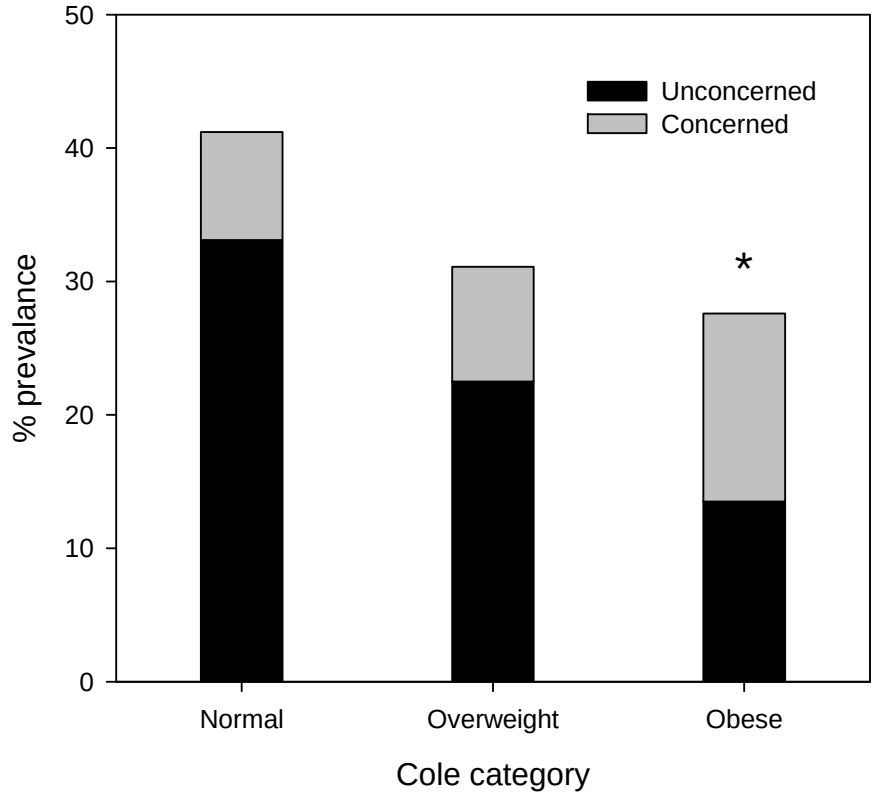
On average, Pacific children are larger than the CDC child 2000. The majority of the children remained overweight and/or obese between age four and age six (marginally smaller).

Child's weight status tracks from four to six years.

The odds of the child being overweight or obese at six years decreased if the child was of Tongan descent, belonged to a household with a low to intermediate income, or if the child had siblings.

Section Four: Associations between parental perception expressed as a level of concern and international standards of body size for children at six years

Figure 4.1 presents the weight status distribution of the children at age six years according to the IOTF grade (Cole et al., 2000) and the level of parental concern (unconcerned, concerned) shown by parents at six years. The proportion of concerned parents increased as the weight status category increased and was significant for trend ($p<0.0001$). For normal weight children, 1 in 5 (21%) parents were concerned for their child's overweight status; for overweight children approximately 1 in 4 (28%) parents have concern whilst for obese children, 1 in 2 (51%) parents are concerned (Figure 3). This trend was similar at four years.

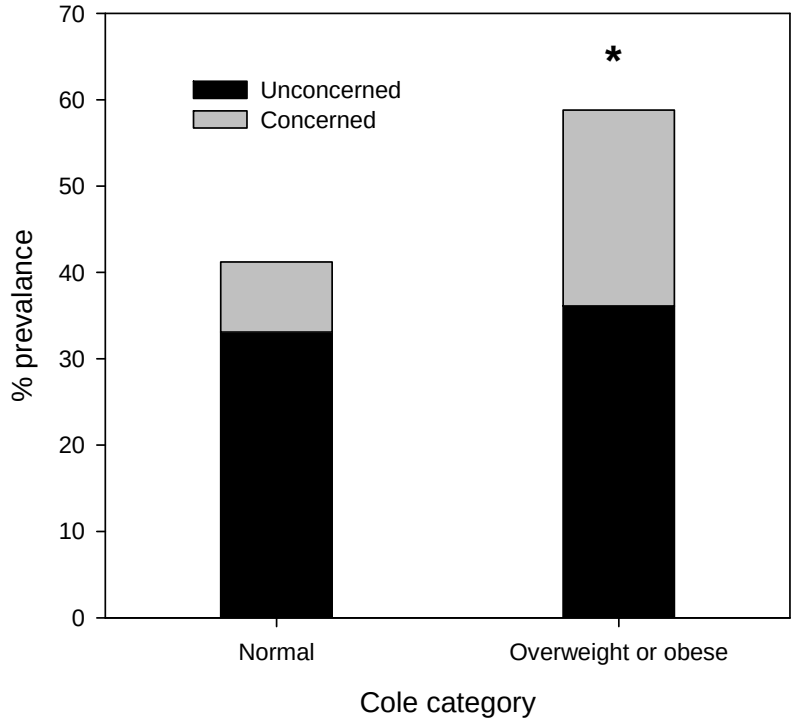


*p<0.0001 Chi squared test compared with normal.
p trend <0.0001

Figure 4.1: Prevalence of parental perception (concern, unconcerned) at six years of normal, overweight and obese.

Prevalence of parental perception (concern, unconcerned) at six years of the Parental Perceptions of Overweight obesity Study (PPOS) (n=569) and child's weight status at age 6 years, classified by IOTF (Cole et al., 2000) categories of normal, overweight and obese.

Figure 4.2 combines the overweight and obese children at age six according to the IOTF grade into one category (overweight and obese) (Cole et al., 2000). The proportion of concerned parents of children normal for weight status is at 20% (meaning on average, 1 in 5 parents of normal children are concerned for their child's overweight status) while the proportion of parents concerned for the overweight status of their overweight/obese child is almost double at 39% (2 in every 5).



*p<0.0001 Chi squared test compared with normal.

Figure 4.2: Prevalence of parental perception (concern, unconcerned) at six years normal and overweight and or obese.

Prevalence of parental perception (concern, unconcerned) at six years of the Parental Perceptions of Overweight obesity Study (PPOS) (n=569) and child's weight status at age six years, classified by IOTF (Cole et al., 2000) categories of normal and overweight or obese.

Section Five: Socio economic and demographic moderators of parental perceptions and body size (%BF and BMI z-score).

Children normal for weight according to the IOTF grades (Cole et al., 2000) at age six years were removed from the following univariate and multiple logistic regression analysis (Tables 4.16 and 4.17) to explore the relationship between parental perception expressed as a level of concern (unconcerned, concerned) at six years and overweight and obese weight status at age six.

Socioeconomic demographic characteristics of both mother and child at baseline (six weeks postpartum) and parental perception (concern, unconcerned) at six years were included in the univariate logistic regression analysis. The odds of parents of overweight and obese children being concerned for child's future overweight status increased if the mother or the child was Tongan. The odds of mothers being unconcerned for their child's future overweight status was strengthened if the mother had smoked during pregnancy or if the mothers were in an unstable relationship with their spouse at birth (six weeks postpartum) (Table 4.16).

Table 4.16: Univariate logistic regression of parental perception expressed as a level of concern at six years

Univariate logistic regression of parental perception expressed as a level of concern at six years of the Parental Perception of Overweight/obesity Study (PPOS) (n=569) on selected socioeconomic demographic characteristics of mother and child from birth (6 weeks postpartum) for overweight and obese (Cole et al., 2000) children only.

		Univariate Odds Ratio	
Variable	**Category**	**OR**	**(95% CI)**
Sex of child	Male	1.0	-
	Female	0.90	(0.58 1.40)
Acculturation	Assimilator	1.0	
	Separator	1.26	(0.73, 2.20)
	Integrator	1.19	(0.61, 2.29)
	Marginalist	1.24	(0.63, 2.42)
Mother's ethnicity	Samoan	1.0	-
	Cook Island	0.98	(0.50, 1.91)
	Tongan	11.46	(5.80, 22.62)***
	Other Pacific	1.41	(0.53, 3.72)
	Non Pacific	1.69	(0.58, 4.92)
Child's ethnicity	Samoan	1.0	-
	Cook Island	0.98	(0.50, 1.91)
	Niuean	1.02	(0.31, 3.38)
	Tongan	11.46	(5.80, 22.62)***
	Other Pacific	1.95	(0.78, 4.88)
Education	No Formal Education	1.0	-
	Secondary School	1.15	(0.69, 1.92)
	Post school	0.96	(0.54, 1.68)
Smoking in pregnancy	No	1.0	-
	Yes	0.52	(0.30, 0.90)*
Marital status	Married	1.00	-
	De-facto	0.53	(0.30, 0.95)*
	Single	0.42	(0.22, 0.79)**
Mothers age	<20 years	1.0	-
	20 – 29 years	1.28	(0.53, 3.14)
	30 – 39 years	1.71	(0.70, 4.20)
	40 years +	1.13	(0.26, 4.85)
Household income	$0 - $20,000	1.00	-
	$20,001 - $40,000	1.30	(0.80, 2.12)
	$40,000 +	1.39	(0.68, 2.83)
	Unknown	2.57	(0.55, 12.03)
Parity	1	1.00	-
	2-4	0.80	(0.48, 1.35)
	5+	0.84	(0.44, 1.63)
Household size	2-4	1.00	-
	5-7	1.22	(0.67, 2.22)
	8+	1.13	(0.60, 2.15)

The reference category for the univariate logistic regression was "Unconcerned."
Levels of significance * p <0.05, **p<0.01, ***p<0.0001

To adjust for potential confounding effects, all variables in Table 4.16 were simultaneously entered into a multiple logistic regression model (Table 4.17). When controlling for the effects of all other variables, the effect of smoking during pregnancy and marital status failed to remain significant. Ethnicity for both mother and child remained significant, whilst the parity of the mother became significant. The odds of mothers being concerned for the future over the status of their overweight and/or obese child at 6 years increased if the mother and/or the child were of Tongan descent. The odds of mothers being unconcerned strengthened if they had five or more children (at baseline) (Table 4.17).

Table 4.17: Multiple logistic regression of parental perception expressed as a level of concern at six years

Multiple logistic regression of parental perception expressed as a level of concern at six years of the Parental Perception of Overweight/obesity Study (PPOS) (n=569) on selected socioeconomic demographic characteristics of mother and child from birth (6 weeks postpartum) for overweight and obese (Cole et al., 2000) children only.

		Multiple Odds Ratio	
Variable	**Category**	**OR**	**(95% CI)**
Sex of child	Male	1.00	-
	Female	0.64	(0.37, 1.10)
Acculturation	Assimilator	1.00	-
	Separator	0.91	(0.41, 2.0)
	Integrator	1.29	(0.57, 2.94)
	Marginalist	0.88	(0.38, 2.08)
Mother's ethnicity	Samoan	1.00	-
	Cook Island	0.88	(0.38, 2.04)
	Tongan	14.00	(6.48, 30.22)***
	Other Pacific	1.71	(0.56, 5.21)
	Non Pacific	2.11	(0.61, 7.30)
Child's ethnicity	Samoan	1.00	-
	Cook Island	0.88	(0.38, 2.03)
	Niuean	1.13	(0.29, 4.33)
	Tongan	13.74	(6.37, 29.63)***
	Other Pacific	2.10	(0.61, 7.28)
Education	No Formal Education	1.00	-
	Secondary School	1.07	(0.56, 2.05)
	Post school	0.97	(0.47, 1.99)
Smoking in pregnancy	No	1.00	-
	Yes	0.80	(0.42, 1.60)
Marital status	Married	1.00	-
	De-facto	1.06	(0.50, 2.23)
	Single	0.67	(0.28, 1.65)
Mothers age	<20 years	1.00	-
	20 – 29 years	1.50	(0.49, 4.53)
	30 – 39 years	2.74	(0.82, 9.19)
	40 years +	1.07	(0.17, 6.74)
Household income	$0 - $20,000	1.00	-
	$20,001 - $40,000	0.85	(0.43, 1.71)
	$40,000 +	0.75	(0.29, 1.92)
	Unknown	1.45	(0.23, 9.26)
Parity	1	1.00	-
	2-4	0.60	(0.31, 1.16)
	5+	0.30	(0.11, 0.82)*
Household size	2-4	1.00	-
	5-7	1.50	(0.73, 3.11)
	8+	1.89	(0.84, 4.26)

The reference category for the multiple logistic regression was "Unconcerned."
Levels of significance, *p<0.05, **p<0.01, ***p<0.0001

At four and six years by categories of change in parental perception, the mean BMI z-scores of the children of the parental perception of overweight study (PPOS) were positive and significantly greater than zero. Figure 4.3 shows the change, if any, of parental concern over a two year period and the mean BMI z-score of their children at four and six years. The mean BMI z-score of children who had parents that were concerned or changed their level of concern (increased, decreased, no change), was significantly greater than the BMI z-score of children whose parents stayed unconcerned at both four and six year phases. The BMI z-score of children whose parents' concern increased or decreased between the two phases was not significantly different from each other. Between the two time periods, the overall difference in mean BMI z-score of PPOS children compared to the reference population (CDC 2000, American children) decreased. The average of the BMI z-scores of children whose parents stayed unconcerned was the smallest (+1.2 z-score at age four years and +1.1 z-score at age six years). The mean BMI z-score of children whose parents stayed concerned was the highest (+2.3 z-score at age four years and 1.9 z-score at age six years) (Figure 4.3).

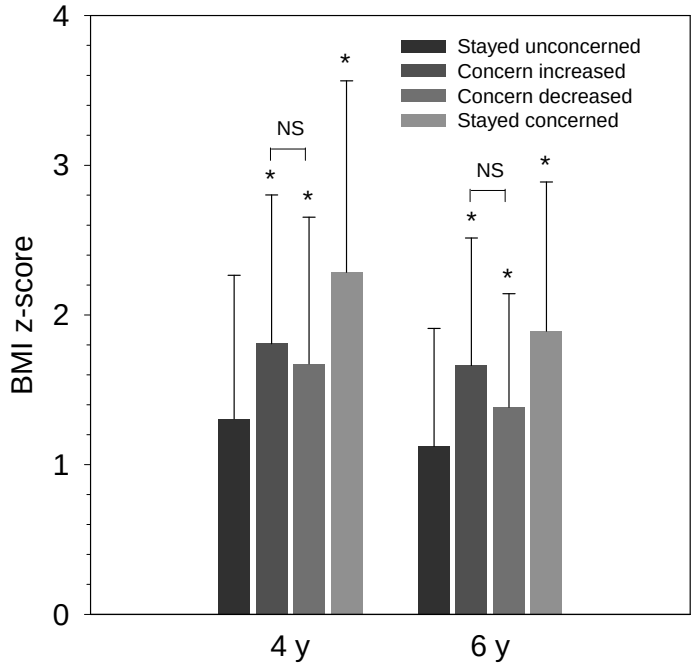


Figure 4.3: Mean Body mass index (BMI) z-score (Kuczmarski et al., 2000) standardised for age and sex of children at age four and six years

Mean Body mass index (BMI) z-score (Kuczmarski et al., 2000) standardised for age and sex of children at age four and six years (CDC 2000) categorised by the perception change (change in concern) of their parents over four and six years.

Note. *Significantly different to the "stayed unconcerned" group.

Error bars are standard deviation (SD).

NS: No significant difference between the BMI z-score of children whose parents concern increased and concern decreased over four and six years.

At four and six years by categories of change in parental perception, the percentage (%) body fat z-scores of the children of the parental perception of overweight study (PPOS) determined against the British child population (McCarthy et al., 2006) were significantly greater than zero (Figure 4.4). Figure 4.4 shows parental concern change (increased, decreased, no change) over a two year period, and the mean % body fat z-score of their children at age six. The mean % body fat z-score of children whose parents' concern decreased and stayed concerned between the two time periods was statistically greater from the mean % body fat z-score of children whose parents stayed unconcerned. The mean % fat z-score of children whose parents' concern increased between the two periods was not statistically different from the mean % fat z-score of children whose parents stayed unconcerned. The mean % body fat z-scores of children whose parents stayed unconcerned was the smallest (+1.7 z-score) followed by the mean % body fat z-scores of children whose parents' concern decreased (+2 z-score) and the highest mean fat percentage z-score was of children whose parents stayed concerned (+2.3 z-score).

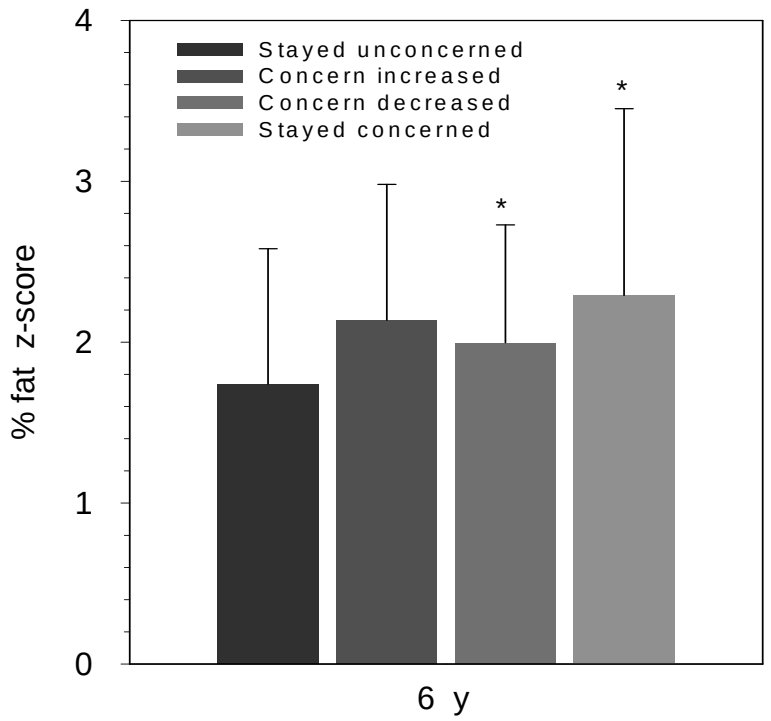


Figure 4.4: Mean percentage (%) body fat z-score, standardised for age and sex

Mean percentage (%) body fat z-score, standardised for age and sex (McCarthy et al., 2006) of six year old children categorised by the perception change (change in concern) of their parents over four and six years.

Note. *Significantly different to the "stayed unconcerned" group.
Error bars are standard deviation (SD).

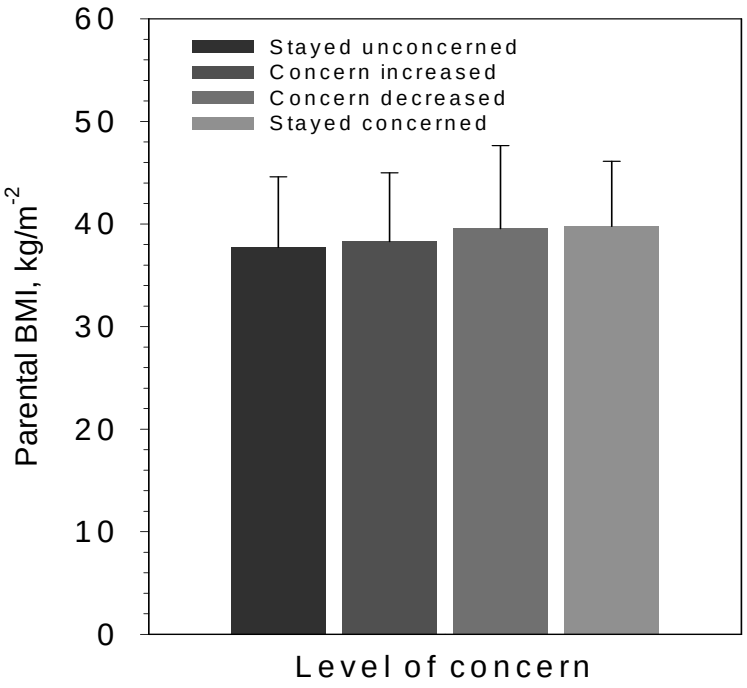


Figure 4.5: Mean parental body mass index (BMI)

Mean parental body mass index (BMI) determined by the World Health Organisation (2006) measured at six years categorised by perception change (change in concern) over four and six years.

Note. Number of parents measured (n) by category = 140 (58, 25, 33, 24).
No significant differences in mean parental BMI (kg/m^2) was observed between categories of parental perception change (change in concern) over four and six years.

The pattern of association between child weight and BMI status and mother's body size measured when the child was 6 years was explored in the 140 dyads measured. Positive and significant associations were found between mother's weight at 6 years and child weight at birth, four and six years ($r=0.182$, 0.173 and 0.168 respectively, all $p<0.05$). Parent weight or BMI was not related to the BMI z-scores of the child at four and six years. Therefore about 3% of the child's weight may be explained by the weight of the mother.

The mean parental BMI was 38.6 ± 7.1 kg/m^2 and ranged between 19.9 kg/m^2 and 60.1 kg/m^2. Mothers' perception (concern) change between four and six years was not related to their BMI (kg/m^2) (Figure 4.5).

Summary of Moderators of Parental Perception

For overweight and obese children at six years the odds of the parents being concerned about weight status increased if the mother and the child were Tongan. The odds of being concerned decreased if the mother had more than five children.

Pacific children on average at four and six years are larger (higher BMI z-score) than the reference population (CDC 2000). For both BMI z-score parents who were unconcerned at both four and six years had significantly smaller children than parents who were concerned. Parents who were concerned at both time points had the largest children.

For mean %BF, unconcerned parents at four and six years had the smallest children.

Chapter 5: Discussion

Summary of main findings

This thesis has shown in a representative sample (n=569) of children from the Pacific Island Families study at age four and six years, that:

- Six out of ten Pacific parents were unconcerned about their child becoming overweight.
- Mothers' weight was associated with the weight of the child at birth, four and six years.
- Measured against international standards, six out of ten Pacific children were overweight or obese at both four and six years.
- For the Pacific children classified as overweight or obese, three out of five of their parents were not concerned about their child becoming overweight
- For the Pacific children classified as normal, one out of five Pacific parents were concerned about their child becoming overweight.
- As BMI score and classification of weight status of Pacific children increased, the proportion of Pacific parents concerned at both four and six years increased.
- Socioeconomic and demographic lifestyle factors were found to significantly influence the perception Pacific parents had of their child's weight.
- Tongan parents were more likely to be concerned about their child becoming overweight. Tongan children were also less likely to be overweight or obese at six years postpartum
- Greater parity decreased the level of concern Parents had about the child becoming overweight.
- Children who had 2-4 siblings were less likely to be overweight or obese than children with no siblings.
- Pacific Children were less likely to be overweight and/or obese in households with a combined total income of between $20,000-$40,000 compared to the lower household income bracket of 0-$20,000.

Each of the above findings are highlighted when related to the context of the life course model (Ben-Shlomo, 2002,) and the obesogenic environment (Kumanyika, 2008).

A feature of the life course model is its recognition of the multiple pathways and ability to describe the complex interactions between psychosocial and biological mechanisms that lead to adulthood disease. The nature of the current study has the ability to describe the interactions between the children, their environment at birth, their development through the tracking of growth trajectories, and the perception of their mothers. The outcome measure of whether the child became overweight and or obese at six years can retrospectively be traced to the socioeconomic, demographic and environmental exposures the child was subjected to at birth, as well as to the perception of their mothers to assess whether any associations are present. The comprehensive collection of socioeconomic and demographic information also allows for the assessment of the magnitude of exposure to known obesogenic risk factors, such as the exposure of children to varying levels of household income and its associations with obesity. Information at birth (6 weeks postpartum) was selected and analysed based on the tenet that the exposures to risk factors during early stages or sensitive periods of development may present the greatest opportunity to alter the growth trajectory of children. Moreover, the biological information of only 569 healthy children (that were full term, not born to mothers who had gestational diabetes and not of multiple birth status) was used to limit potential confounding variables associated with weight status. The socio demographic economic environment of the children of the PPOS at birth (baseline measure six weeks postpartum) was observed, and the overall patterns which emerged showed a number of interesting features. In terms of families, these children were born into families who already had children, and to parents who tended to be in legitimate relationships. Furthermore, for the majority of the Pacific households these children were born into, their total income was less than $40,000 annually. With respect to mothers, over half of the children in the cohort were born to mothers under the age of 30 years, with the majority of the mothers being of Samoan, Tongan or Cook Island descent. Furthermore, the majority of these children's mothers were non-smokers during their pregnancy, despite having limited academic qualifications (i.e., they had either secondary school qualifications or none).Taken together, the demographic findings of the PPOS confirm some of the trends already established in both the New Zealand census (Statistics, 2006; 2007) and the greater PIF study (Paterson et al., 2006; Paterson et al., 2002), in that this cohort's families indeed had a high fertility rate, limited qualifications and a potentially high dependency ratio, highlighting the low socioeconomic status of these families. Moreover, within the PIF study, the low socioeconomic status of Pacific families had been observed further through measures

including overcrowding (Butler et al., 2003), housing issues (Butler et al., 2003) and food insecurity (Rush et al., 2007).

Parental perceptions – Four to six years

Consistent with international findings, there was an apparent lack of concern shown by mothers of the PPOS with regards to the future overweight status of their child. At six years, the majority of parents (69.1%) were unconcerned about their child becoming overweight. The lack of concern appeared to track across time with a similar pattern observed at four years, where 62.4% of parents were unconcerned. Contrary to findings in literature, where the concern of parents increased as their child aged, concern levels of the parents of the PPOS decreased at six years by 6.7%. Further inspection into the changes in parental concern over the two year period revealed a similar pattern. The majority of parents (47.1%) remained unconcerned, 37.3% of parents registered a change in attitude, becoming more or less concerned, and 15.6 % remained concerned.

Socioeconomic and demographic lifestyle factors found to be significant in influencing the perception of parents included ethnicity and parity. Previous works on Pacific populations have revealed that Tongans, relative to the other Pacific groupings tend to feature within the upper limits of negative health measures. For instance, a study conducted by Sundborn et al. (2010), revealed that Tongan males and females had the highest rates of adult obesity amongst Pacific people (60% and 78% respectively). However, this study found that Tongan mothers were more likely to be concerned at both four and six years of their child's life about their child's future weight status, this level of concern being statistically significant.

As children aged, fewer parents showed concern, contrary to the expectation that generally, as children age, levels of concern regarding children's weight increase (Carnell et al., 2005, Eckstein et al., 2006). The Tongan ethnic group however does follow this pattern as they showed increased levels (almost twice) of concern as their children aged. Although Tongan mothers' levels of concern were higher than other Pacific groups at age four years, no statistical difference was reached. However at age six, Tongan levels of parental concern increased markedly from 47% to 80% whilst levels of concern of other Pacific groups decreased from between 33-39% at age four years, to between 17-21% at age six years.

The increased level of concern Tongan parents showed may be due to the poorer health status of the adult Tongan population as discussed earlier. Poorer health status of adults may make them as a population more health conscious – especially when it comes to their children. Furthermore the high number of Tongans belonging to churches provides opportunities for health information to be shared amongst the congregation community aiding to and potentially raising the awareness of health issues amongst this ethnic population.

The sex of the child has been known to play a role in determining the perception of the parents (e.g., De La et al, 2009). In this study however, the sex of the child was not associated with any differences in levels of concern parents had for their child's weight.

Body Weight status – Four to six years old

The weight status of the children in the PPOS showed similar patterns observed in National Childs Nutrition Survey: (2002), the New Zealand Health Survey (2006/2007) and the PIF study and although the prevalence of overweight and obese children remains high, it has at least appeared to have stabilised between the two time points (Ministry of Health, 2003a, 2008). Measured against international standards (Cole et al., 2000), six out of ten children were found to be overweight or obese at both four and six years.

Pacific people for the same BMI score as other ethnic groupings within New Zealand have a higher fat free mass (FFM) to fat mass (FM) ratio. Although this physiological difference may appear to overestimate the relative rate of overweight and obesity of Pacific peoples, it is counteracted by the higher normal distribution of Pacific BMI means relative to other ethnic groups (Rush et al., 2004). Assessment of BMI z scores of the children at both time points when measured against international standards (Kuczmarski, 2000) found that the children of the PPOS were 1.5 SD z –score larger, and further assessment of the %BF of the children referenced against British children, found that the Pacific children was significantly higher in mean %BF, ranging from +1.7 to +2.3 z-score.

A recent study conducted within the Pacific Island Families Studies (PIF: PAC) also reported the high level of overweight and obesity in both the adult and child population (Oliver et al., 2009). In this study parental physical activity (PA), body size and the health of children were assessed. These findings reported that the rate of overweight and/or obesity for mothers and their children were 97%, and 60% respectively (Oliver et

al 2009). The PPOS study found similar overweight and obesity weight status proportions amongst parents and children. Unexpectedly, this study found that PA did not show any association with children's BMI.

Parental perception and child weight status

Given that the prevalence of overweight and obesity is high amongst Pacific children at four and six years of age, and the parental concern of Pacific parents is low it is inevitable that a level of discordance between the perception and actual weight status would emerge. At six years, for children classified as overweight or obese, three out of five of their parents (or 40%) were not concerned about their child becoming overweight. For the children classified as normal, one out of five parents (or 20%) were concerned about their child becoming overweight. The pattern was present at the four year measures also. There have been a number of studies worldwide which have also looked at the level of parental concern, and have found that parents from different ethnicities show a lack of concern for their child becoming overweight in future. It seems that the lack of concern shown by the parents of the PPOS is not an isolated phenomenon (Crawford et al., 2006; Carnell et al., 2005). As stated, the concern of parents was reflective of the weight status of their child. As BMI SD z-scores and IOTF weight classification increased, the proportion of parents concerned at both four and six years increased, with the number of concerned parents of overweight and obese children being twice that of the number of concerned parents of normal children. This pattern seems to suggest that parental concern has a positive relationship with the weight category/status of the child, this relationship being significant with a trend p-value for trend $p<0.0001$.

A study conducted in Great Britain similarly assessed the parental concern of parents of their 3-5 year old children and showed that only 26% of these children were overweight or obese, (Carnell et al., 2005) compared to 59% in the PPOS. However, their parental level of concern was much higher. Of their obese children, 76% of parents were concerned compared to 50% of obese children in the PPOS study. The finding highlights differences in children's weight status between ethnicities but also the potential cultural differences that affect perceptions, where larger bodies may be more tolerated within Pacific communities. Historically, Pacific peoples have held positive values and beliefs regarding larger body size (Brewis et al., 1998). The prevalence of overweight and obese Pacific peoples suggests that these values have transcended

through the generations, and now affect the perceptions of Pacific parents in contemporary society. The higher level of concern shown by Tongan parents and significantly lower level of overweight and obesity as well as findings described above by Carnell point to the notion that unrealistic perceptions of the PIFS parents may contribute to the high level of overweight and obesity in their children.

The influence of socioeconomic and demographic lifestyle factors on both the weight status of children and parental perception was investigated. Multivariate analysis of the influence of socio demographic variables on the weight status of the children revealed that ethnicity of the child (Tongan), higher household income ($20,001-$40,000 compared to ≤$20,000) and higher parity (2 and 4 children compared to 1 child) were protective factors for children of the PPOS being obese and or overweight. A investigation that focussed on factor related to food security of the PIFS (Rush et al., 2007), found that an increased number of children (parity) was identified as an added environmental stressor among Pacific families and during times of financial constraint, However, in these times of greater financial constraint Pacific families would purchase more nutritious foods. This behaviour adheres to the Tongan concept of *faka-potopoto* or *fusi mo'omo*, whereby in times financial hardship, scarce resources, in this case, the purchasing of food is managed more wisely to fit the demands of the occupants of the household. This may explain why those children who are from families of higher parity were less likely to be overweight or obese.

Multivariate analysis was performed to assess the influence of socioeconomic demographic measures in moderating parental perception. Again a significant association was found with ethnicity. Tongan (mother and child) ethnicity increased the odds of parents being concerned for their child's future overweight status. Higher parity lowered the level of parental concern for their child's future weight status. The dependency ratio of larger families would suggest that parents may be under a number of socio environmental pressures and given that average household incomes of the Pacific families are relatively low, mothers with higher parity may be too stressed worrying about other things which may not allow them to pay sufficient attention with regard to their child's weight status. It is interesting to note that that higher parity lowers the likelihood of a child being overweight or obese, however, lowers the likelihood of the parent showing concern for their child's weight generally and when assessing overweight and obese children only.

Strengths

The comprehensive collection of information that has included socio-economic demographic information of children, their families and to an extent their environment as well as health has provided this opportunity to explore multiple associations of parental perception and child's weight in the Pacific families in New Zealand. The longitudinal aspect of the PIFS has allowed for the tracking of individuals' health and exposures to socioeconomic demographic variables. Information at two time points was available in the present research and was used to assess the same parent's perception. Previous literature has only assessed cross sectional information.

The PIF study being a birth cohort offers the perfect opportunity to test some of the key concepts of the life course model. The repeated measure of both psycho-social and biological exposures has and will continue to offer insight in to the occurrence of diseases or health outcomes for the children of the study and secondly the assurance of power and the repeated measure of the same population at different phases will provide invaluable information regarding exposure and health outcome relationships over time.

The representative sample (PPOS was similar to that of the PIF cohort at 6 weeks) and its findings may be generalised to the wider Pacific community as the largest Pacific groupings, namely Samoan, Cook Islands and Tongans are represented (acknowledged however is the low number of Niuean and other Pacific groupings but similar to the PIF study) (Paterson et al., 2002).

Limitations

The parental perception question may not have been appropriate for this population; however a confirmatory factor analysis study performed on Hispanic populations suggest that the measure of the question is valid across different ethnic populations (Birch et al., 2001).

The homogeneity of the cohort may have masked associations that otherwise might be present or significant if there was more variance amongst the sample. Many of the socioeconomic demographic characteristics are shared by a large portion the PPOS sample.

Interpretation of the ethnic information should be taken with caution as although the Samoan, Cook Island and the Tongan sub-sample may have sufficient numbers, or

power to make inferences to the greater Pacific populations, the relative low numbers of the Niuean and other Pacific groups make the findings less transferable.

As part of the PIF study, procedures and practices have been put in place to ensure data accuracy. It includes the monitoring and tracking of the interviewers. During the administration phase of the protocols, mothers where ethnically matched where possible to ensure cultural receptiveness, including the ability to translate the questionnaires. This may present the potential for bias as mothers may be more inclined to give socially/culturally acceptable responses to interviewers of the same ethnicity. Procedures however have been established within the PIF study to counteract such bias, such as the monitoring of information gathered and comparison of interviewer responses weekly.

Future action and Recommendations

Do perceptions need to be changed? What support is needed? Sustainability? Is it an ethnic difference? Is it acculturation? Do Pacific parents have the means to make changes to their overweight child's life? It has been suggested that more qualitative research is needed to explore why parents misperceive their child's weight, to identify what the underlying factors are.

It would be beneficial if future research within the PIFS could reinstate the parental concern measure at 11 years phase to test and trace the perception of parents, and complement this with a weight recognition item to explicitly measure the ability of Pacific parents to correctly identify the weight status of their children. Children at age 11 years, enter into a critical development period where puberty may be taking place. Body weight status may change which may be associated with the perception of the parents. Identified in the literature (e.g., Eckstein et al., 2006) is also the trend of parents to be more concerned as the child reaches maturity. The investigation of this pattern may provide invaluable information for paediatric health research.

The PPOS has only stated associations of parental perceptions and weight status. A qualitative study designed to investigate the underlying reasons for why (Pacific) parents harbour the level of concerns they hold and why Tongan parents differ to other Pacific groups is warranted. Again, the potential to gain information on this issue could provide information which may increase the efficacy of obesity preventative measures.

Implications

The findings of the present study pose many implications for policy, health professionals, communities and families. In the context of policy, the findings provide further support to address some of the environmental stressors which may be directly/indirectly influencing the prevalence of obesity. Identified socio-economic demographic variables which decrease the level of parental concern for future overweight status may be addressed through the ANGELO model, where small modifications to the obesogenic environment may translate into population wide benefits. An example would be to reduce the goods and services tax (GST) on fruit and vegetables to increase the recommended intake.

Implications for health workers and communities include the dissemination of the information provided by the study to Pacific families. Appropriate methods for the dissemination of the information may also be required to consider cultural appropriateness. The adoption of information may also prove useful for population wide social marketing campaigns to ensure dissemination to the wider community. Moreover, the information may prove useful to ethnicities other than Pacific.

Addressing the hypothesis

The aim of the PPOS was to examine whether Pacific parental perception of their child's weight status was accurately associated with the actual weight status of the child. The results of the PPOS suggest that the majority of Pacific parents do not recognise the weight status of their children. This is shown by the high proportion of parents of overweight and obese children who are not concerned for future overweight status.

Overall, parental perception has decreased for the 2 year period from age 4 and 6 years. However, Tongan parents' level of concern almost doubled. Weight status of the children remained stable with approximately 60% of children being overweight or obese at both 4 and 6 years of age.

These findings suggest that there has been a population shift in what is considered a normal weight status for both Pacific children and adults. This population shift has normalised higher weight status and impaired the ability of parents to correctly identify whether their child is overweight or obese. The implications of this are not conducive to providing the necessary environment for a healthy weight child to develop. It is

therefore suggested that in combination with interventions aimed to address built-, physical, and social-environmental factors that drive obesity the re-alignment of Pacific parental perceptions is needed to be part of this overall approach to help address and prevent future childhood and adult obesity in Pacific populations. Statistical analyses of the identified socio-economic and demographic factors which influence the perception of parents were analysed. The results of the analysis revealed patterns of association with the increase or decrease of parental concern. Identified socioeconomic and demographic variables that were significant in the prediction of parental concern include ethnicity and parity. When the analysis was repeated to find associations between parents of overweight and obese children only, ethnicity and parity remained significant.

The following hypotheses were addressed in this (PPOS) study.

a) More parents of overweight and obese children will not be concerned than be concerned about their child becoming overweight in future [at both time points].

   There were a larger proportion of parents of overweight and obese children who were unconcerned for the future weight status of their children (61%). This statement is true.

b) Parents' level of concern regarding their child becoming overweight in future will change, increase at six years postpartum in comparison to four years postpartum.

   The level of concern of the parents of the PPOS did increase between four and six years but only marginally (6.7%).

c) Parents' beliefs and attitudes regarding their child's weight status will remain the same over the two time periods.

   The level of concern shown by parents regarding their weight status remained stable over two years. The majority of parents held the same level of concern (62.7%), whilst a smaller proportion (30.9%) of parents' concern either increased or decreased.

Conclusions

Parental concern offers a level of insight into the level of understanding that the parents have with regards to the association between weight status and health. Parental concern observed in this study over a period of two years revealed that Pacific parents are less concerned for their child's future weight status. The majority of Pacific children and Pacific mothers in this study were either overweight or obese. The findings suggest that in line with international literature, Pacific parents may not be fully aware of the relationship between the development of adulthood co-morbidities and the child's overweight status. Other reasons may be that Pacific parents are unable to distinguish between the different categories of child weight status, due to the pressures of the socioeconomic environment, suggesting that weight status of the child may not be a relatively high priority. The prevalence of overweight and obesity amongst Pacific children, mothers and their families are high, which may be caused by a shift in population ideals of weight status, normalising higher body mass.

The findings of the PPOS show that the trajectory for obesity becomes more acute through the child's lifecycle so that obesity amongst Pacific populations becomes intergenerational and endemic. Measures to combat Pacific poor health must aim to break this cycle.

This study in the context of the life course model, ANGELO and social determinants model identifies many opportunities for intervention, to change the perception of Pacific parents form being unconcerned to being concerned for child weight status. The association between parental perception and socioeconomic demographic measures are an important starting point for the health sector to consider implementation to affect change to address and reduce the prevalence of overweight and obesity amongst Pacific children.

Personal insights based on the experience of the author

My personal experience within my own Pacific community has allowed me to witness firsthand the interaction between parental perception and its influence on children's weight status. The cultural practices and traditions that we hold as Pacific people play a major role in influencing the parental perception of child weight status. My observations suggest that being concerned for children's weight status is not a major priority for Pacific peoples, as there are more pressing demands to be concerned for, such as meeting payments of rent, mortgages, carrying out obligations to extended family and religious practices.

Numerous studies have consistently shown the high rates of Pacific obesity within both adult and child populations. The social ties between Pacific peoples and communities are ones that are strong, with the majority of Pacific peoples belonging to churches or equivalent communities. The social groupings to which we belong influence our judgements, beliefs and attitudes. Within Pacific communities, being overweight or obese is the norm, and parents' judgements of child weight status may be skewed because of this. The Framingham study shows that the likelihood of individuals becoming obese increases if the individuals share social ties with overweight or obese people (Christakis, 2007). This notion is applicable to Pacific communities, as the high number of overweight and obese Pacific people makes it inevitable that social ties between overweight and obese people will be shared. This highlights the danger of intergenerational obesity. However, the fact that some Pacific parents recognise that overweight and obesity is a problem offers hope to the possibility of breaking the cycle that leads to intergenerational obesity. Cultural and educational interventions can be devised to increase parental awareness and concern and ultimately changes in parental behaviour. That discussion however is beyond the scope of this study.

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APPENDICES

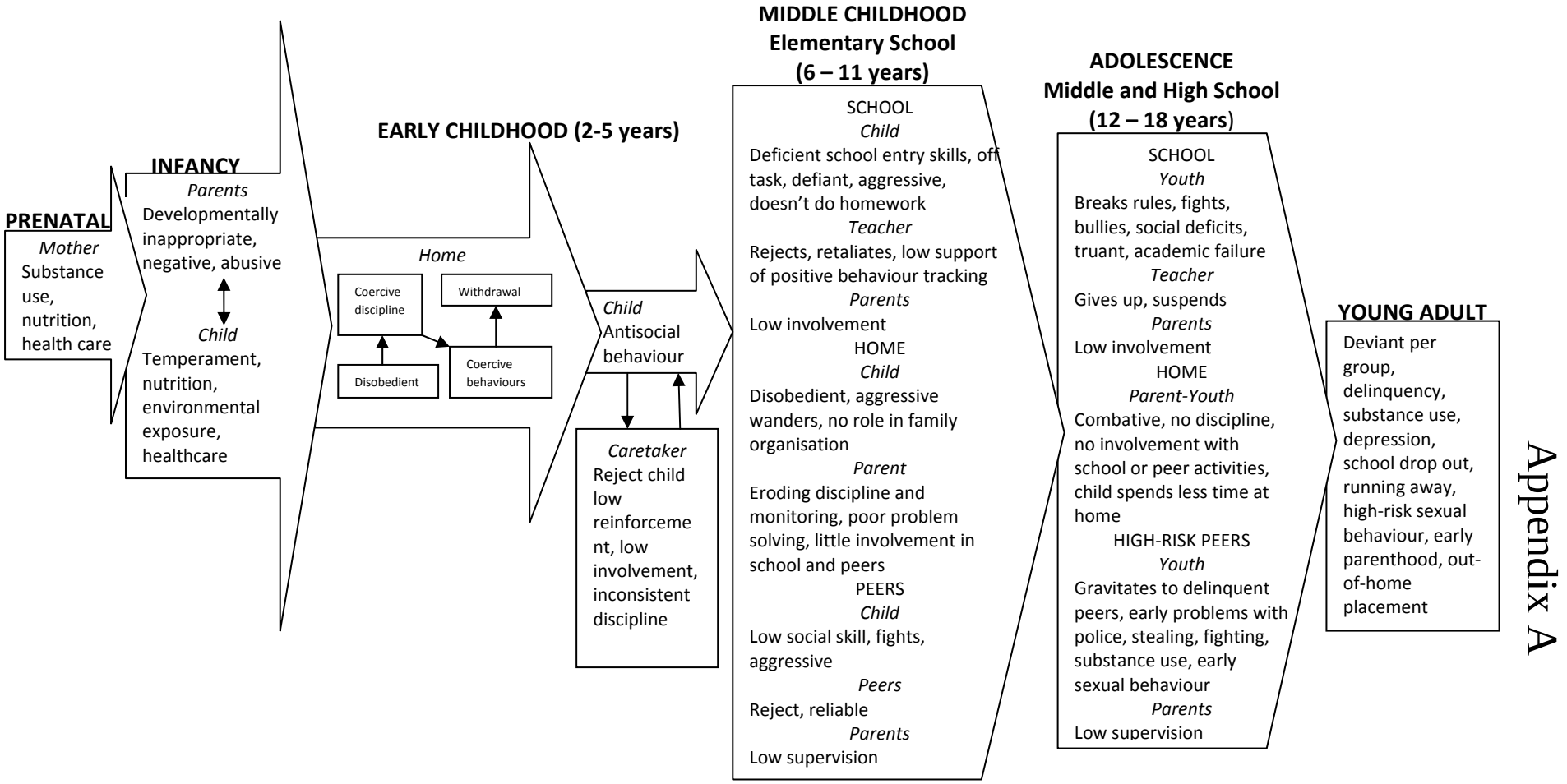


Figure 1. Life course model for the development of Antisocial Behaviour (adapted from Reid & Eddy, 1997) shows the prenatal environment as having an influence on antisocial behaviour. Similarly the prenatal environment has an influence on the development of overweight and obesity. Thus the model provides theoretical underpinning, design, analyses and interpretation of findings for this thesis.

Appendix A

Appendix B

Table B1. The ANGELO grid with the settings, sectors, and environmental elements discussed.

Environment size / Environment type	Micro environment (settings) Food Physical Activity	Macro environment (sectors) Food Physical Activity
Physical	What is available?	
Economic	What are the costs?	
Policy	What are the rules?	
Sociocultural	What are the attitudes, beliefs and perceptions	

Adapted from Swinburn et al. (1999).

Appendix C

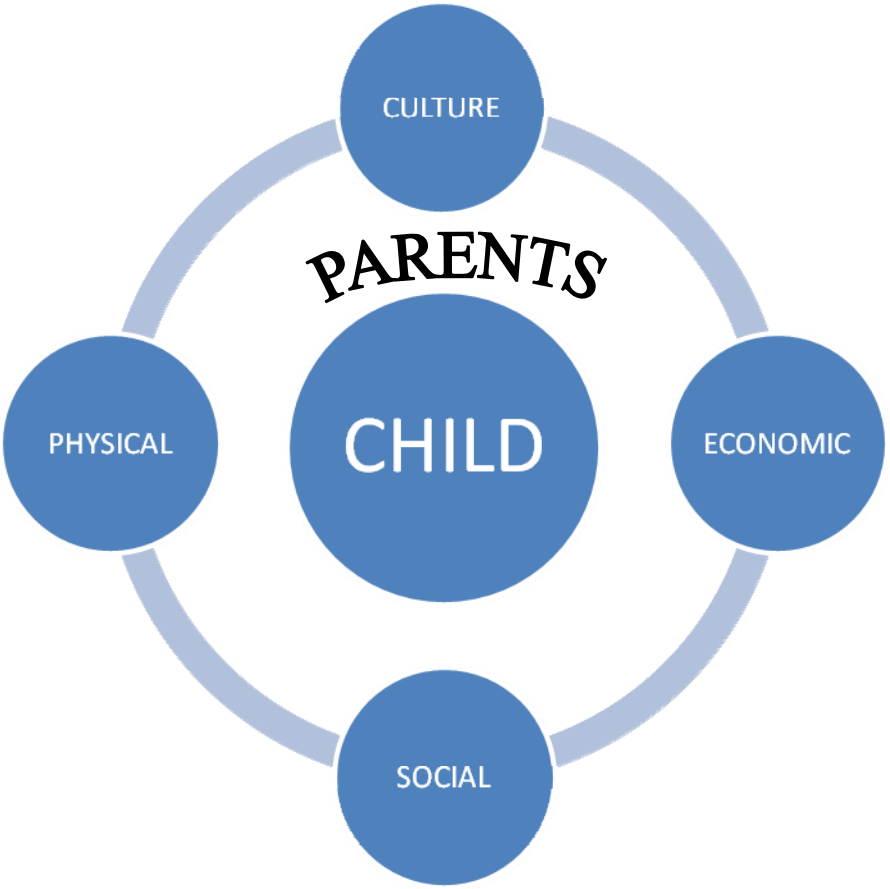


Figure 2. Determinants of Parental Perception of Childhood Obesity Model

Table D1. Principal component analysis for maternal factors at birth that account for variance within the children who were a) not obese and b) obese at 6 years

Components	Maternal variables at birth of child within component	Description	Eigen value	Variance %	Cumulative variance %
Non Obese analysis					
1	Household income, age, parity of child, **marital status**	Maternal status	1.9	20.9	20.9
2	How baby fed in first 6 weeks, smoked during pregnancy	Nurturing style	1.5	16.6	37.5
3	Usual number in house, parity	Crowding	1.2	12.8	50.3
4	Acculturation, **highest education qualification**	Acculturation	1.0	11.4	61.7
Obese analysis					
1	Parity of child, age	Maternal history/time effects	2.0	22.3	22.3
2	**Household income**, Acculturation	Social integration	1.4	15.3	37.6
3	Smoked during pregnancy, How baby fed in first 6 weeks	Nurturing style	1.1	12.5	50.1

Note. Variables bolded had a negative association – for marital status 1 was legally partnered, 2 living together, 3 not partnered. For breastfeeding 0 breast 1 combination bottle and breast 3 bottle. All other variables are positively associated with increased number or socio economic status. The order in which the variables are listed show their level of significance, i.e. variables listed first have a higher weighting than variables which follow it

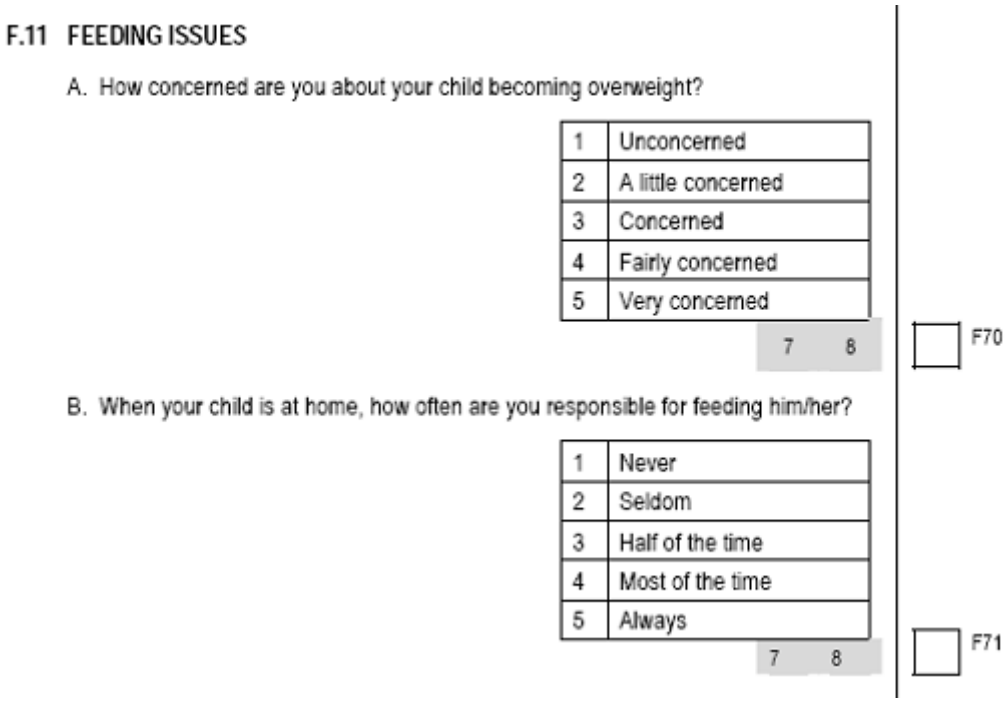
Table E1. Principal component analysis for maternal factors at birth that account for variance within the children who were a. Unconcerned and b. concerned at both four and six years.

Components	Maternal variables at birth of child within component	Description	Eigen value	Variance %	Cumulative variance %
Unconcerned analysis					
1	Parity, age, household income, **marital status**	Maternal status	1.9	21.6	21.6
2	Smoked during pregnancy, how baby fed in first 6 weeks	Nurturing style	1.5	17.1	38.7
3	**Highest education qualification,** Usual number in house, acculturation	Crowding/Education	1.2	13.8	52.5
Concerned analysis					
1	Parity of child, age, **marital status**	Maternal history/time effects	1.9	20.6	20.6
2	Usual number in house, smoked during pregnancy	Crowding/Nurturing	1.4	15.8	36.4
3	**Acculturation**	Acculturation	1.1	12.1	48.5
4	How baby fed in first 6 weeks.	Feeding practice	1.0	11.4	59.9

Note. Variables bolded had a negative association – for marital status 1 was legally partnered, 2 living together, 3 not partnered, For breastfeeding 0 breast 1 combination bottle and breast 3 bottle. All other variables are positively associated with increased number or socio economic status

Appendix F

2004 Primary protocol featuring the parental perception question



F.11 FEEDING ISSUES

A. How concerned are you about your child becoming overweight?

1	Unconcerned
2	A little concerned
3	Concerned
4	Fairly concerned
5	Very concerned
7	8

F70

B. When your child is at home, how often are you responsible for feeding him/her?

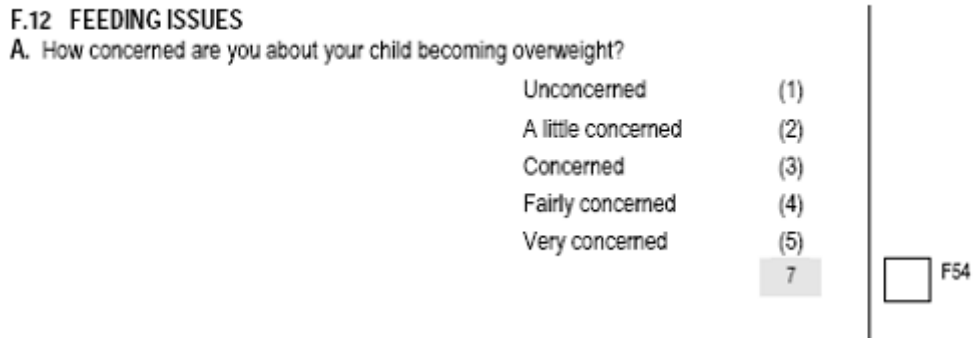
1	Never
2	Seldom
3	Half of the time
4	Most of the time
5	Always
7	8

F71

(Taken from 2004 Primary protocols of the Pacific Island Families Study (PIFS))

Appendix G

2006 Primary protocol featuring the parental perception question



F.12 FEEDING ISSUES

A. How concerned are you about your child becoming overweight?

Unconcerned	(1)
A little concerned	(2)
Concerned	(3)
Fairly concerned	(4)
Very concerned	(5)
	7

F54

(Taken from 2006 Primary protocols of the Pacific Island Families Study (PIFS))

Appendix H

2004 Child Assessment featuring body measurement and anthropometry questions

Pacific Islands Families: Transition to School Study 4 Year Phase Child Assessment — *Office Use Only*

SECTION C: GENERAL MEASUREMENTS

CHILD ID: ☐☐☐☐

*Assessment date:*_____ *Name of Assessor:* _____

INT: All measurements to be done twice.

C.1 Body Measurement

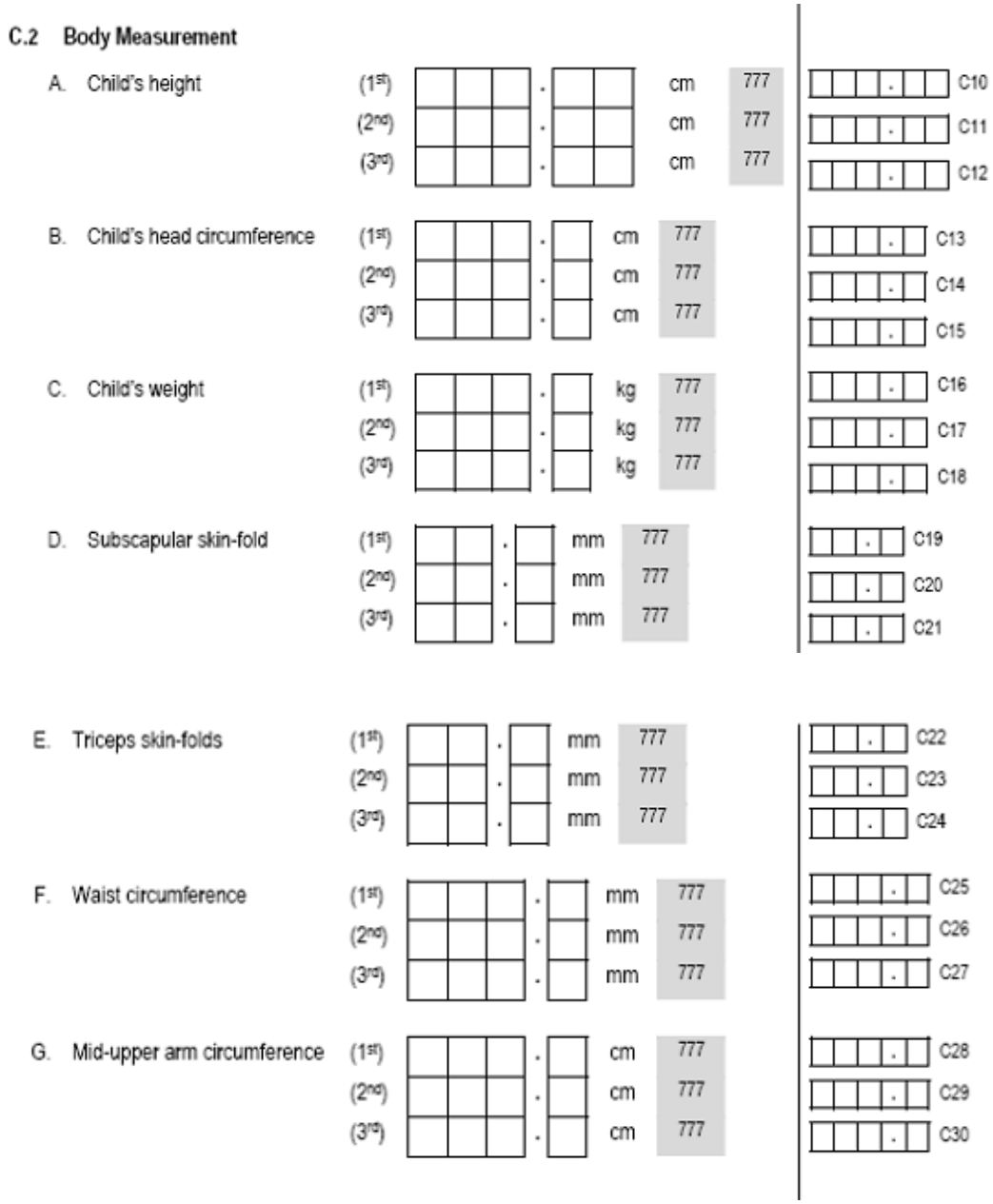
A. Child's height	(1st)	☐☐☐.☐☐	cm	777	☐☐☐.☐☐	C1
	(2nd)	☐☐☐.☐☐	cm	777	☐☐☐.☐☐	C2
B. Child's head circumference	(1st)	☐☐☐.☐	cm	777	☐☐☐.☐	C3
	(2nd)	☐☐☐.☐	cm	777	☐☐☐.☐	C4
C. Child's weight	(1st)	☐☐☐.☐	kg	777	☐☐☐.☐	C5
	(2nd)	☐☐☐.☐	kg	777	☐☐☐.☐	C6
D. Subscapular skin-fold	(1st)	☐☐☐.☐	mm	777	☐☐☐.☐	C7
	(2nd)	☐☐☐.☐	mm	777	☐☐☐.☐	C8
E. Triceps skin-folds	(1st)	☐☐☐.☐	mm	777	☐☐☐.☐	C9
	(2nd)	☐☐☐.☐	mm	777	☐☐☐.☐	C10
F. Waist circumference	(1st)	☐☐☐.☐	mm	777	☐☐☐.☐	C11
	(2nd)	☐☐☐.☐	mm	777	☐☐☐.☐	C12
G. Mid-upper arm circumference	(1st)	☐☐☐.☐	cm	777	☐☐☐.☐	C13
	(2nd)	☐☐☐.☐	cm	777	☐☐☐.☐	C14

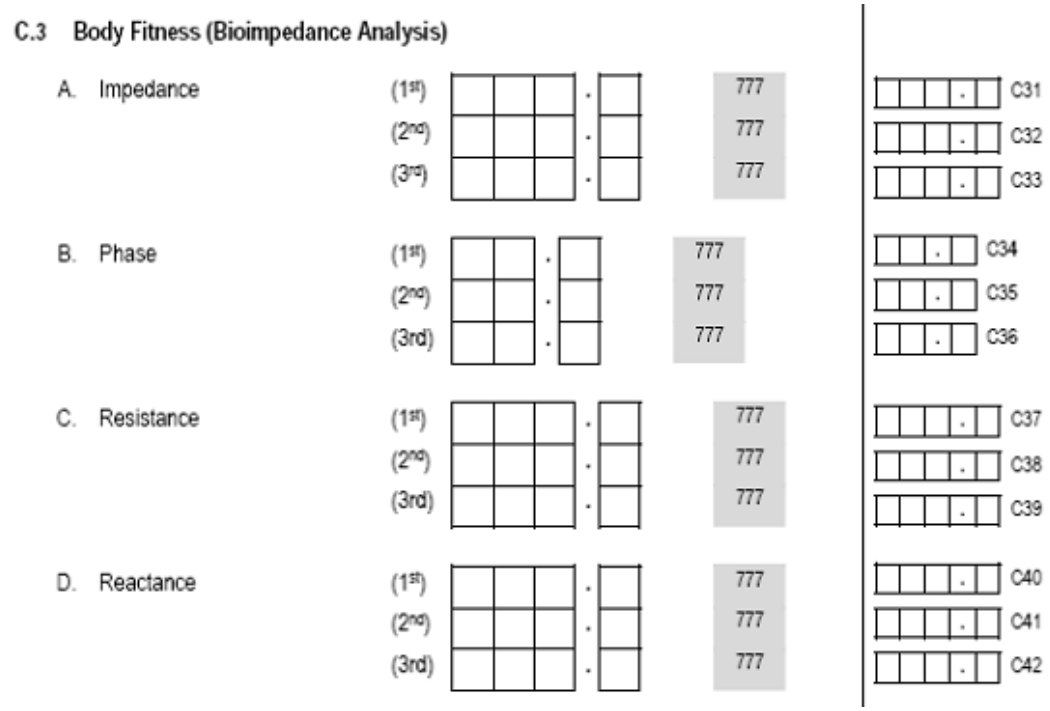
Now Do Vision Questionnaire Followed By Vision Test On Computer

(Taken from 2004 Child Assessments of the Pacific Island Families Study (PIFS))

Appendix I

2006 Child Assessment featuring body measurement and anthropometry questions





(Taken from 2006 Child Assessments of the Pacific Island Families Study (PIFS))

Appendix J

Methodology of literature review

Methodology of literature review included a stepwise process to ensure recent available literature on the thesis topic was searched. In order to investigate Pacific parental perceptions of overweight and obesity in Pacific children, key words were used in conjunction with each other or independently and entered in to the Scopus data base. References of the retrieved results were also pursued when the articles were related to the thesis topic. The following key words were used;

Child, infant or paediatric, obesity, excess weight, overweight, weight status, parent perception, parent or mother, maternal, father or paternal perception or misperception, recognition, Pacific or Polynesian and perception, obesity or excess weight or overweight or weight status and body or "body image".

Articles were then selected if they included assessments of the perception of parents on their child’s weight, including both quantitative and qualitative based studies. The search included articles which contained studies involving various ethnic groups, of any geographic location, and where children in the studies were under the age of fifteen. Most of the studies also had to be published within the past 5 years and in the English language.

Appendix K

Maternal variables

Acculturation = accult

The acculturation variable used was measured at six weeks (baseline) postpartum. There were four categories 1= assimilators, 2 = segregation, 3 = integrator and 4 = marginal. The variable indicates the mothers' level of cultural alignment between their own culture and or the New Zealand culture. Maternal acculturation, measured by an abbreviated version of the General Ethnicity Questionnaire, and selected infant and maternal health risk indicators measured 6 weeks postpartum. Using the bi-directional model of Berry(Statistics New Zealand, 2007), the acculturation variable describes four distinct categories for respondents depending on whether the acculturation strategy is freely adopted by the individual, or imposed by the dominant culture using two scales; one concentrating on New Zealand cultural involvement (NZACCULT) and one capturing Pacific cultural involvement (PIACCULT). Each of the respondents was individually scored on both the NZACCULT and PIACCULT scales and allocated to one of the categorical classes dependent on whether their individual score fell above or below the median of the full group on each of these scales. Berry(Statistics New Zealand, 2007) defined these categories as: Separationalist (Low New Zealand cultural involvement – High Pacific cultural involvement); Integrator (High New Zealand – High Pacific); Assimilationalist (High New Zealand – Low Pacific); Marginal (Low New Zealand –Low Pacific). (Berry, 2003)

Relationship to child = t2p6

The variable indicates the relationship of the primary caregiver to that of the child, measure taken at two years. The variable was explored to ensure that the primary parent was the biological mother, to ensure the potential to search for any relationship between biological mother's weight status and child's weight status.

1=Birth mother, 2=Adoptive mother, 3=Foster mother, 4= other, 9=Missing

Mothers age = agecat2

Mothers age, measured a 6 weeks post partum, year 2000. Four age group categories = 1=<20, 2=20--29, 3=30--39, 4= 40+

Mothers ethnicity = ethmo2

Mothers major ethnicity measured at six weeks postpartum = 1 = Samoan, 2 = Cook Island, 3= Niuean, 4=Tongan, 5 = Other Pacific, 6 = Non Pacific Island

Mothers' ethnicity = ethmo3

Mother's major ethnicity measured at six weeks postpartum, five categories. 1=Samoan, 2=Cook Island, 3=Tongan, 4=Other Pacific, 5=Non Pacific Island. The Niuean ethnic group was combined with the other pacific category due to low numbers. The other pacific and non-pacific categories also had low numbers. The major ethnic groups had sufficient numbers to generate statistically reliable findings include the Samoan, Cook Island and Tongan ethnic groups.

Marital status = marital2

Mother marital status taken at 6 weeks postpartum**.** 1= Partnered, legally married, 2 = Partnered, de facto, 3 = Non-partnered. The labels of the variables were later simplified to 1 = married, 2 = partnered, 3 = single.

Education = educat

Mothers highest educational qualification at six weeks postpartum 0 = No formal qualifications, 1=Secondary school qualification, 2=Post school qualification

Household income = inc_cat2

House hold income categorised in to four income brackets, measured at 6 weeks postpartum. 1 = $0 - $20,000, 2 = $20,001 - $40,000, 3 = >$40,000, 4 = Unknown

Parity categorised = pari_cat

Number of children mother has had prior to the child, measure taken at baseline. 1=1, 2=2 - 4, 3 = 5+, 9 = Unknown

Usual number in house = nohoucat

Variable indicates the number of individuals usually in the house, measure taken at baseline (six weeks postpartum). 1 = 2 - 4, 2 = 5 - 7, 3 = 8 or more.

Smoking status = j23_25re

Measure assessing the mothers smoking status during pregnancy, taken at base line (six weeks postpartum). 0=No, 1=Yes

Concern = t4pf70, t6pf54

Likert scale question assessing parents' level of concern with regards to their child becoming overweight. "How concerned are you about your child becoming overweight?" Question assessed at 4 years (t4pf70) and 6 years (t6pf54), five levels of concern. 1=Unconcerned, 2=A little concerned, 3=Concerned, 4= Fairly concerned, 5=Very concerned, 7=Don't know, decline, 8=Not applicable, 9=Missing

Parents (mothers body mass index (BMI) measure)

At six years mothers' body size (waist circumference, height and weight) measured to calculate BMI as part of the PIF: PAC supplementary study.

Appendix L

Child variables

Sex

Sex of the child recorded at base line. 1 = male 2 = female

Infant feeding = t0pd1

Breast feeding was recorded 6 weeks after birth. How the baby was feed in the first 6 weeks

0 = only with breast milk, 1 = Combination of breast and formula (or other) milk, 2 = only with formula or other bottle milk, 3 = other, 7 = don’t know, decline, 9=Missing