The Socio-demographic Determinants and Nutritional Consequences of Food Insecurity of a Group of New Zealand Children

A thesis presented in partial fulfilment of the requirements for the degree of Masters of Science in Nutritional Science, at Massey University, Albany, New Zealand.

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"When there is not enough money to buy food - our children have to go without eating."

Response of a caregiver to a child participating in the pilot study for the New Zealand Children's Nutrition Survey, 2000.

Abstract

Food security among individuals exists when there is stable access to the kind of adequate, nutritious, safe, and culturally appropriate diet needed to maintain an active, healthy life (Campbell, 1991; Bickel et al., 2000). There is evidence that food insecurity – the lack of such an access - exists among some segments of the New Zealand population (Parnell, 1997; Russell et al., 1999; Parnell et al., 2001). There has been little research into the nutritional impact of food insecurity in New Zealand children.

The purpose of this study was to investigate the effects of socio-demographic and food security status on the nutrition and health of New Zealand children. The sample chosen for this study were a group of 183 children, aged one to 14 years, from Auckland's western suburbs, who participated in the Validation study; part of the pilot for the Children's Nutrition Survey conducted during 2000. Of the 183 children who participated in this study, 60 were Maori, 63 were Pacific and 60 were European.

Demographic, anthropometric and medical history data were obtained during interviews, and dietary data was based on 24-hour recalls and food frequency questionnaires. Statistical analysis, including two-sample t-tests, Kruskal-Wallis, ordinal and binary logistic regressions using the MINITAB 13.31 program (Minitab Inc., 2003), was performed on the data set. Any relationship was considered significant if the p-value was less than 0.05.

This study reported a high prevalence of food insecurity in the sample group, with 39% of all children living in households that sometimes or often did not have enough money to buy food. Household income, the educational status of the food preparer, the occupation of the main provider, the type of dwelling (rented versus owned) and ethnicity were significant predictors of food insecurity in the children in this study ($p < 0.0005$).

Children from food-insecure households and children from low-income households, or children whose main provider was of a low occupational status or receiving a government benefit, or children whose food preparer left school early, or children from large-sized households living in rented homes, all had significantly lower intakes of fruit, vegetables, milk products and protein-rich foods such as meat. Food-insecure preschool children were also significantly more likely not to meet the RDI for nutrients such as vitamin E, calcium and selenium than food-secure preschool children. Most food-insecure school-age children did not meet the recommended values for energy, fibre, riboflavin, vitamin B6, folate, vitamin A and zinc. Poor dietary habits were observed amongst the food insecure, with most eating takeaways on a frequent basis.

Food insecurity was not significantly associated with overweight or obesity, or other measures of health status, in the group of children in this study. However, significantly higher BMI values were reported among food-insecure children, and Maori and Pacific children had higher BMI values than European or Other children. A stronger association was found between BMI and socio-economic status. Children living in low-income households or in rented dwellings, or whose food preparer left school at an early age, had higher median BMI values than children from higher income households or living in households where the home was owned, or whose food preparer had stayed at school for longer or had an undergraduate degree.

An important finding of this study was the high prevalence of food insecurity amongst Pacific children or children whose food preparer was of Pacific ethnicity. However, caution needs to be applied when drawing conclusions from this study, as the sample in the study was not a true representation of the New Zealand population. Some ethnic groups were under-represented, while households from the higher end of the income spectrum were over-represented in the sample chosen for the study. The results of this study are also subjective to limitations associated with the measurement of food insecurity (Blumberg & Bialostosky, 1999; Tarasuk & Beaton, 1999) and dietary assessment methods (Briefel et al., 1997; Gibson, 2002). There are also currently no nation-specific cut-off values for classifying NZ children as obese or overweight. The proposed Children's National Nutrition Survey will determine the prevalence of food insecurity in a random population based sample.

This study provides evidence that food insecurity and low socio-economic status can have a negative impact on the nutritional and health status of NZ children. Its findings provide a strong case for an increased public focus on the nutritional status of Pacific children. Future research is needed to assess the impact of nutritional education programs on food-insecure households with children.

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List of Abbreviations Used

Abbreviation	Full word (s)
ABS	Australian Bureau of Statistics
ADA	American Dietetic Association
AI	Adequate Intake
BMI	Body Mass Index
CDS-PSID	Child Development Supplement of the Panel Study of Income Dynamics
CFSM	Core Food Security Measure
CNS	Children's Nutrition Survey
CPS	Census Bureau's Current Population Survey
CSFII	Continuing Survey of Food Intakes by Individuals
CWHS	California Women's Health Survey
DRI	Dietary Reference Intakes
EAR	Estimated Average Requirement
ECLS	Early Childhood Longitudinal Study
FFQ	Food Frequency Questionnaire
FNB	Food and Nutrition Board
LINZ89	1989 Life in New Zealand National Survey
MRC	Medical Research Council
MOH	Ministry of Health
NFCS	Nationwide Food Consumption Survey
NH	National Health
NHANES I, II, III	First, Second and Third National Health and Nutrition Examination Survey
NNS95	1995 Australian National Nutrition Survey
NNS97	1997 New Zealand National Nutrition Survey
NZ	New Zealand
NZDep96	NZ Deprivation Index 1996
NZSEI-96	NZ Socio-economic Index 1996
PSC	Pediatric Symptom Checklist
%	percent
RDA	Recommended Dietary Allowance
RDI	Recommended Dietary Intake
RNI	Recommended Nutrient Intake
SES	socio-economic status

Abbreviation	Full word (s)
UK	United Kingdom
UL	Tolerable Upper Intake Level
USA	United States of America
USDA	United States Department of Agriculture

1. Introduction

Food has universally been declared a basic human right, yet it is estimated that more than 840 million people in the world do not have enough to eat, despite a global surplus in food production (ADA, 2003). Food security is a growing concern in countries such as the United States of America (USA), Australia and New Zealand. It can be questioned wherever food supply is limited or uncertain, and covers issues of hunger, and food quality and quantity, as well as cultural appropriateness. Alarmingly, the prevalence of food insecurity in developed countries has escalated over the last decade, and is predicted to further increase despite global efforts to make it a public policy issue.

For a household or individual to be food secure it must have access at all times to adequate amounts of food that is sufficiently nutritious, safe and culturally appropriate to maintain an active, healthy life (Campbell, 1991; Bickel et al., 2000). Furthermore, a household or individual can only be food secure if such nutrition can be acquired under socially acceptable means - for example, without having to use food banks.

There is growing evidence that food insecurity is a contributing factor to poor nutrition and health (Cristofar & Basiotis, 1992; Alaimo et al., 2001a,b; Tarasuk, 2001; Dumbauld & Baumrind, 2002). Most research has focused on adults but, as the level of food insecurity worsens in a household, children are likely to become affected. It is well documented that poor nutrition during childhood can impair normal physical and cognitive development, and lead to nutrition-related diseases (ADA, 2003). It is therefore important to consider the impact of food insecurity on the nutritional and health status of the younger generation.

The impact of food insecurity at a household or individual level is measured using specific survey questionnaires that cover the quantitative, qualitative, psychological and social components that define food insecurity, in conjunction with detailed dietary and demographic data. In the last decade, major surveys have been conducted in the United States to measure household food insecurity (Bickel et al., 2000). In New Zealand, adult food insecurity was measured for the first time in the 1997 National Nutrition Survey (Russell et al., 1999). The Ministry of Health is currently funding the 2002 National Children's Nutrition Survey, which will, for the first time, measure food security in New Zealand children.

Risk factors for food insecurity include anything that affects household resources and the ability to obtain and store safe and nutritionally adequate food. Food availability in New Zealand varies with socio-economic status (Russell et al., 1999). Age, ethnicity, income, education, employment status, housing tenure and car ownership have all been reported to influence food choice (Lennernas et al., 1997; Hodges et al., 1998; Russell et al., 1999; Hersey et al., 2001).

There is substantial evidence linking socio-demographic factors to the nutritional status of adults and, to a lesser extent, of children (Pena & Bacallao, 2002). However, a direct relationship between food insecurity and the nutritional and health status of adults or children is still being established.

At the time of starting this thesis, no national data existed on the nutritional or socio-economic status of food-insecure New Zealand children. There was also limited anthropometric data available. Understanding the effects of socio-demographics and food insecurity on the nutritional and health status of these children is vital in accomplishing the government's goal of improving the overall health of New Zealanders.

The purpose of this thesis is to study the effects of household food security and socio-demographic factors on the nutritional status of children participating in Stage 1 (Validation) of the pilot study for the Children's Nutrition Survey (CNS). Consequently, only selected data from the pilot study, covering areas relating to food security, will be extensively analysed for this thesis.

2. Literature review

To study the nutritional and health consequences of food insecurity in children is not an easy task. Firstly, measuring food insecurity in a population is not an exact science and it is only recently that the issue has been precisely defined and that tools for measuring it have been globally accepted (Bickel et al., 2000). Therefore, in order to complete an extensive investigation of the literature of food insecurity, it is also necessary to look at the research that has been carried out on hunger and food insufficiency, which are the traditional descriptions of food inadequacy.

Therefore, the primary aim of this literature review is to:

- Define hunger, food security and food sufficiency
- Explore methods of measuring food insecurity and hunger, as well as nutritional status

There is evidence in the literature to link socio-economic status and health status (Pena & Bacallao, 2002), but there is little evidence linking food insecurity to poor nutritional and health status. Research has mostly been undertaken to link under-nutrition with poor health status, and food insecurity with low socio-economic status.

Therefore, the secondary aim of this literature review is to:

- Review the socio-demographic determinants of food insecurity, hunger and nutritional status
- Determine the prevalence of food insecurity in developed countries, including New Zealand
- Comment on the possible nutritional impact and health consequences of food insecurity in adults and, when literature permits, in children

A computer-based literature search was performed using those scientific databases available to Massey University, New Zealand. Key words employed included: Food security, food insecurity, food sufficiency, hunger and children. These were entered separately and were then combined with the following key words: Food, diet, nutrient, health; and socio-demographic terms such as income, education and so forth. A manual search of the literature was conducted when only the abstracts of papers were electronically available. Relevant textbooks, reports, documents, theses and cited references were manually searched and, if not available in the Massey University library, were inter-loaned from various universities throughout New Zealand and from Griffith University on the Gold Coast, Australia. References were not restricted to certain dates, as the growing incidence of food insecurity in various societies means it is important to consider work performed in the early 1980s when the phrase was first coined. Papers written in languages other than English were not considered, due to translation resource constraints.

2.1 Definitions

The terms hunger, food security, food insecurity and food sufficiency have been employed by researchers and agencies all over the world investigating the effect of food shortages on the individual and the household. Although these terms are related, they are also quite distinct from one another. Their definitions follow:

2.1.1 Hunger

Food sociologists define hunger as: "an inadequacy of dietary intake relative to the kind and quantity of food required for growth, activity, and maintenance of good health" (Whit, 1999). This does not mean a purpose-dieting situation. Although there is no universally accepted definition of hunger, it is widely recognized that the condition is usually involuntary (Dailey, 1996). For the purposes of this thesis, hunger is only related to conditions where there is not enough food, or enough money to buy food. Only the latter is found in developed countries such as the USA and New Zealand, where poverty alone is a major contributing factor to hunger (Pena & Bacallao, 2002). Therefore, if hunger in New Zealand is considered a condition arising from economic constraints, it can be defined as a severe level of food insecurity, rather than a separate entity altogether (Bickel et al., 2000). Hunger is a potential, but not necessary, consequence of food insecurity and can be cyclical, short-term or long-term in its nature (Keenan et al., 2001).

2.1.2 Food security

In the early 1990s, there was a trend away from the term hunger, with opinion moving instead towards the concept of food security, as first proposed by Campbell (1991). Food security has been defined as having sufficient access to nutritionally sound and safe foods via non-emergency food channels (Campbell, 1991). Emergency food channels may include food banks or soup kitchens, or people resorting to stealing to obtain food. One of the first major studies to focus on food security, as opposed to hunger, was led by Olson and Radimer, at the

Cornell University Division of Nutritional Sciences, in the USA (Radimer et al., 1992). They chose the term food insecurity, as they believed the word hunger was better suited to less-developed countries.

Food security takes into consideration environmental factors that influence access to food. In order for food security to exist in communities, there are three conditions to be met: the 'availability', 'affordability' and 'accessibility' of enough food to lead an active, healthy life.

Availability relates to the existence of a range of nutritional foods that are culturally suitable and safe for consumption by all members of the community (Cohen, 1990).

Affordability of food depends on price competitiveness within communities (Cohen, 1990). There have been reports of food prices being higher in lower income districts, which would hinder the ability of a household to be food secure (Cohen, 1990).

Accessibility requires the availability of non-emergency food sources in local communities (Cohen, 1990). Supermarkets are thought to be a major determinant of food security in low-income areas (Cohen, 1990). If they do not exist in these areas, then it is vital that there is an adequate and reliable public transport system in place to allow access to price-competitive food.

Other contributing factors that determine food security in a community include adequate storage and cooking facilities. In low-income households, these are often not ideal and subsequently mean some households must frequently visit food stores and are unable to bulk-buy food items at discounted costs (Cohen, 1990). Socio-demographic variables such as income and educational status may also determine food security.

2.1.3 Food insecurity

Food insecurity occurs in the absence of food security. In developing countries, food insecurity is generally due to lack of available food or poor food distribution (Cohen, 1990). However, in developed countries like the USA and New Zealand, food insecurity is due to a lack of available, affordable and accessible food via non-emergency food sources (Cohen, 1990).

Food insecurity exists at the individual or household level, as well as at the community level. Olson and colleagues were the first to discover that there are different stages of food insecurity (Radimer et al., 1992). The problem appeared first to begin with concern among adults regarding the uncertainty of food availability in the household. In some cases, this progressed to influencing what and how adults ate and, in extreme cases, resulted in some children experiencing hunger (Radimer et al., 1992).

2.1.4 Food sufficiency and food insufficiency

In the basic sense, food sufficiency relates to a situation where there is a sufficient amount of food available to a household (Briefel & Woteki, 1992). However, a food-sufficient household may not be food secure, as it may rely on food insecure practices such as stealing to maintain food sufficiency.

The term food insufficiency refers to an insufficient quantity of food available to a household. Unlike food security, this does not measure the quality of food or how it is obtained. The term food insufficiency is thought to be closer in concept to the term hunger than it is to food insecurity (Alaimo et al., 1998).

2.2 Measuring food insecurity and hunger

Extensive research has been carried out since the late-1980s to develop an accurate and reliable model for measuring food insecurity and hunger in individuals. The complexity with the term food insecurity is that it is not only related to the availability of nutritionally adequate and safe food, but also to acquiring culturally acceptable foods in socially acceptable ways. This latter part of the definition has been more closely monitored and documented, as it is more difficult to measure food safety, nutritional quality, or availability of food under socially accepted circumstances (Keenan et al., 2001).

Measuring food security is a subjective assessment, so determining the indicators of food-related uncertainty and anxiety has been challenging. However, it is vital to be able to measure the prevalence of food insecurity in the population. To this end, several questionnaires have been developed and trialed in large-scale national surveys.

2.2.1 Community childhood hunger identification project (CCHIP)

The prevalence of hunger in society over time has been a difficult topic of study, mainly because there is no universally accepted definition of hunger. Also, it is only recently that indicators for assessing hunger in society have been validated (Kendall et al., 1995, 1996; Frongillo et al., 1997).

One of the first scales designed to measure hunger in households with children was the Community Childhood Hunger Identification Project (CCHIP) (Wehler et al., 1992). The CCHIP hunger index comprises eight questions designed to establish whether a food shortage exists in low-income households with children. An index score of 1 to 4 suggests that the household is at risk of suffering from hunger, whereas a score of 5 or more suggests that the household is exposed only to food shortage.

2.2.2 Radimer/Cornell measure

At about the same time that the CCHIP was being carried out, Cornell University was also developing a national measure of food insecurity and hunger, known as the Radimer/Cornell measure (Radimer et al., 1992). University researchers Olson and Radimer set out in 1987 to define hunger, and to establish a direct and valid indicator of measuring hunger in small populations (Radimer et al., 1992). Their study involved interviewing 32 women with children living in rural and urban areas of New York who had some experience of hunger.

The results revealed that food insecurity is encountered on different levels in different members of a household. Women were found to go without food so that their children had enough to eat. Hunger was also found to exist at two levels: individual and household.

At the individual level, four types of hunger were categorised. The first type, reported by some women, was related to insufficient food intake. A second type was related to the quality of food intake, which the researchers labelled nutritional inadequacy. The third type of hunger encountered was on a psychological level, resulting from the involuntary missing of a meal due to circumstances. The fourth classification of individual hunger was related to a change in normal eating habits.

Hunger on a household level was also found to have four components. The first was related to a reduction in the amount of food available for meal preparation. The second related to poor food quality. The third comprised household uncertainty about the sufficiency of food - that is, whether there was enough food for the household and what to do when that ran out. The fourth component of household hunger was related to households having to obtain food via socially unacceptable ways or emergency food channels (Radimer et al., 1992). In conclusion, hunger was found to embody quantitative, qualitative, psychological and social components.

Following this classification of hunger, Radimer and colleagues (1992) then set out to develop a valid indicator by which hunger could be measured in women and children. A survey was constructed, comprising a set of 30 hunger items, which took into account the two levels and four components of hunger defined above. This was carried out among 189 women who were likely to have experienced hunger, half of them having received food stamps within the previous year (Radimer et al., 1992).

The researchers tested the validity of the 30 hunger items by looking at the relationship between them using factor analysis, and then applying a reliability coefficient to determine the reliability of each item. This resulted in the elimination of 18 items, leaving 12, which were placed into three subscales: the household hunger scale; the women's hunger scale; and the children's hunger scale (Table 2.1). These were found to be a valid and reliable indicator of directly measuring the severity of hunger and food insecurity within a household.

Table 2.1: Hunger items selected for the Radimer/Cornell scale of measuring the severity of hunger and food insecurity (adapted from Radimer et al., 1992).[1]

Household items
The food that I bought just didn't last and I didn't have money to buy more.
I ran out of the foods that I needed to put together a meal and I didn't have money to get more.
Do you worry whether your food will run out before you get money to buy more?
I worry about where the next day's food is going to come from.
Women's items
I can't afford to eat the way I should.
Can you afford to eat properly?
How often are you hungry, but you don't eat because you can't afford enough food?
Do you eat less than you think you should because you don't have enough money for food?
Children's items
I cannot give my child(ren) a balanced meal because I can't afford that.
I cannot afford to feed my child(ren) the way I think I should.
My child(ren) are not eating enough because I just can't afford enough food.
I know my child(ren) are hungry sometimes, but I just can't afford more food.

[1]Response choices to questions were never, hardly ever, sometimes, almost always, always. Response choices to statements were not true, hardly ever true, sometimes true, almost always true, always true.

2.2.3 Third national health and nutrition examination survey (NHANES III)

The term food insufficiency has been used by the United States Department of Agriculture (USDA) in every food survey conducted since 1977 and in the Nationwide Food Consumption Survey (NFCS), as well as in the Continuing Survey of Food Intakes by Individuals (CSFII). The food sufficiency measure provides information about whether a household has enough food to eat at all times during the month. The food insufficiency question appearing in these surveys is shown in Table 2.2.

Table 2.2: Food insufficiency question

Which of the following statements best describes the food eaten in your household:
1. Enough of the kinds of food we want to eat
2. Enough but not always the kinds of food we want to eat
3. Sometimes not enough to eat, or
4. Often not enough to eat

An abbreviated form of this food insufficiency question (Table 2.2) was used by the Third National Health and Nutrition Examination Survey (NHANES III) conducted in the USA between 1988 and 1994. The researchers involved in the NHANES III project omitted the second response category regarding the quality of food consumed, as they chose to focus solely on the adequacy of food availability (Briefel & Woteki, 1992).

The NHANES III questionnaires were designed to obtain sufficient information to measure food sufficiency at individual and household levels (Briefel & Woteki, 1992). To obtain data at the individual level, a 24-hour dietary recall was performed, along with seven questions regarding the frequency of skipping meals. At the household level, questions were focused on perceived food sufficiency, the number of days per month when there was no food or no money to buy food, and reasons for food shortages within the household (Briefel & Woteki, 1992).

2.2.4 Food security supplement

In 1992, the USA Federal Government took on the project of developing a national measure of food insecurity that could be used in future surveys (Klein, 1996). This involved combining the research undertaken in the 1980's by the CCHIP and Cornell University scientists. The outcome was the incorporation of a Food Security Supplement into the Census Bureau's Current Population Survey (CPS), a monthly audit providing information on employment status (Klein, 1996).

The Food Security Supplement chose to limit the definitions of food insecurity and hunger to those conditions only arising from poverty or economic deprivation. It focuses on four key areas that are directly or indirectly related to food security:

- household food expenditures;
- participation in public food assistance programmes;
- coping behaviours to obtain food from emergency sources
- direct indicators of food insecurity and hunger from 12-month and 30-day bases (Klein, 1996; Bickel et al., 2000).

One limitation of the CPS as a measure of food security is that it relies on information collected from household surveys and therefore does not include data on the homeless.

2.2.5 Household food security scale or core food security measure (CFSM)

More recently, the USA Federal interagency Food Security Measurement Project developed a comprehensive core module-based Household Food Security Scale (Bickel et al., 2000). Also known as the Core Food Security Measure (CFSM), it is an 18-item survey that has been created to measure the level of severity of food insecurity and hunger encountered by a household in the last 12 months due to insufficient money for food (Bickel et al., 2000; Derrickson et al., 2000). It was developed using data from the 1995 Census Bureau's Current Population Survey (CPS), and provides a categorical measure of household food insecurity using a Rasch statistical measurement model.

Table 2.3: Questions in the Food Security Scale (Bickel et al., 2000).

Question Number	Question
Q2	"I worried whether our food would run out before we got money to buy more." Was that often, sometimes, or never true for you in the last 12 months?
Q3	"The food that we bought just didn't last, and we didn't have money to get more." Was that often, sometimes, or never true for you in the last 12 months?
Q4	"We couldn't afford to eat balanced meals." Was that often, sometimes, or never true for you in the last 12 months?
Q5**	"We relied on only a few kinds of low-cost food to feed the children because we were running out of money to buy food." Was that often, sometimes, or never true for you in the last 12 months?
Q6**	"We couldn't feed the children a balanced meal because we couldn't afford that." Was that often, sometimes, or never true for you in the last 12 months?
Q7**	"The children were not eating enough because we just couldn't afford enough food." Was that often, sometimes, or never true for you in the last 12 months?
Q8	In the last 12 months, did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?
Q8a	How often did this happen – almost every month, some months but not every month, or in only one or two months?
Q9	In the last 12 months, did you every eat less than you felt you should because there wasn't enough money to buy food?
Q10	In the last 12 months, were you ever hungry, but didn't eat because you couldn't afford enough food?
Q11	Sometimes people lose weight because they don't have enough to eat. In the last 12 months, did you lose weight because there wasn't enough food?
Q12	In the last 12 months, did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food?
Q12a	How often did this happen – almost every month, some months but not every month, or in only one or two months?
Q13**	In the last 12 months, did you ever cut the size of any of the children's meals because there wasn't enough money for food?
Q14**	In the last 12 months, did any of the children ever skip meals because there wasn't enough money for food?
Q14a**	How often did this happen – almost every month, some months but not every month, or in only one or two months?
Q15**	In the last 12 months, were the children ever hungry, but you just couldn't afford more food?
Q16**	In the last 12 months, did any of the children ever not eat for a whole day because there wasn't enough money for food?

** Questions asked only of households with children. Children are defined as persons aged less than 18 years old.

The Food Security Scale is based on the responses to questions 2 to 16, as summarized in Table 2.3. These cover four types of situations that are all related to the broad definition of food insecurity, which encompasses not only the qualitative and quantitative aspects of food supply, but also the psychological and behavioural responses of individuals in a household (Bickel et al., 2000).

The four types of situations covered by the CFSM are:

- Anxiety or perception that the household food supply was inadequate (Q2,3)
- Perceptions that the food eaten by adults or children was inadequate in quality (Q4,5,6)
- Reported instances of reduced food intake or consequences of reduced intake for adults (Q8, 8a, 9, 10, 11, 12, 12a)
- Reported instances of reduced food intake or its consequences for children (Q7,13,14,14a,15,16)

Based on these responses, households can then be placed into one of the four following food security status categories:

1. Food-secure (households with no or minimal evidence of food insecurity).
2. Food-insecure without hunger (households with concerns and adjustments to food management, but with little or no reported reduction in quantity of food intake by household members).
3. Food-insecure with moderate hunger (households in which adults have reduced food intake to the extent that they have experienced hunger).
4. Food-insecure with severe hunger (households in which children have reduced food intake and adults report going whole days with no food owing to a lack of resources) (Bickel et al., 2000).

2.3 Validation of measures of food insecurity and hunger

To date, food insecurity has been more closely studied at the household or individual level, rather than at a community level.

Questionnaire-based measures such as the CCHIP and Radimer/Cornell scales have been found to be valid indicators of food insecurity and hunger in individual households (Frongillo et al., 1997; Frongillo, 1999) and in groups of households in rural counties of the USA (Kendall et al., 1995, 1996; Olson, 1999a). Both scales were found to show good specificity compared with a definitive criterion measure. That is, 63% to 71% of those coded as food secure by this criterion were correctly coded (Frongillo et al., 1997). Also, both scales were reported to feature excellent sensitivity, as 84% to 89% of those coded as food insecure were found to be correctly coded (Frongillo et al., 1997).

The NHANES III version of the food sufficiency question has also been validated, and was found to incorporate excellent specificity, but poor sensitivity, as only a third of respondents were correctly classified. This means it underestimated the prevalence of food insecurity in households (Frongillo et al., 1997).

The CFSM, being a 12-month scale, has been found to be reliable, with a reported reliability coefficient of 0.81 for households with children (Ohls, 1999). Although people are more likely to recall information over the last week than the last year, for food insecurity to be accurately measured, a longer time-frame needs to be considered. Derrickson et al (2000) were the first to validate the CFSM among Asians and Pacific peoples living in Hawaii. Although the sample size was small, at 362, the Hawaii figures were found to fit into the CFSM scale as well as did the national data.

Other researchers have developed a short form of the Household Food Security Scale - a six-item subset - to be used in surveys. However, this has been found to underestimate the prevalence of overall food insecurity and hunger in households (Blumberg & Bialostosky, 1999).

One problem with measures of food insecurity and hunger is that survey data is usually subjective and self-reported, and thus is open to confounding variables. Respondents' perception of food insecurity may be prejudiced by emotional or financial concern (Hampl & Hall, 2002). They may over-report hunger or food insecurity if they feel they need to justify their participation in programmes such as the Food Stamp Program in the USA. Likewise, they may under-report hunger or food insecurity if they feel ashamed to admit their situation, leading to an underestimation of the prevalence of food insecurity and hunger.

2.4 Measuring nutritional status in food-insecure populations

Several studies have aimed to measure the nutritional status of food-insecure participants, yet results are difficult to establish, as short-term exposure to food insecurity is unlikely to greatly impact on the nutritional status of respondents. Such an assessment can be based on dietary intake alone or, more effectively, based on a combination of factors that together provide an indication of nutritional status.

The methods used to determine and assess nutritional status can be based on the following:

- socio-demographic factors
- dietary and nutrient intake
- anthropometry (a measure of physical status)
- laboratory assessment
- clinical assessment (including medical history)

2.4.1 Assessment of socio-economic status

The socio-economic status (SES) of an individual will depend on many factors, including access to wealth, prestige and power. It is usually measured by education, occupation and/or income. Age, gender and ethnicity can also be influential.

The NZ Socio-Economic Index 1996 (NZSEI-96) is based on data from the 1996 census on education, income, age, gender, ethnicity, occupation and full-time work status. This information was then converted into a statistical algorithm to produce a score that is used as a measure of socio-economic status.

There is evidence that excluding the "economically inactive" in the classification of socio-economic status tends to underestimate social differences in mortality, and for this reason that unemployed persons are now included in the NZ SES index (Davis et al., 2003).

Socio-economic deprivation refers to limited access to material and social resources. Deprivation indicators are generally based on national population statistics such as car ownership and housing tenure. In the NZ National Nutrition Survey the socio-economic status of adults was determined by an index of deprivation (Russell et al., 1999). The NZ Deprivation Index (NZDep96) took into account income, access to a telephone, living space and residential address, home ownership, employment, transport, support, and qualifications (Russell et al., 1999). This enabled dietary and food-security data to be linked to the deprivation scores of quartile I to IV of the NZDep96. Quartile I was defined as individuals living in the least deprived areas, with quartile IV being individuals living in the most deprived areas. The deprivation index (NZDep96) was designed to measure deprivation in small areas and thus caution needs to be applied when using this area-based measure of deprivation as a measure of the degree of deprivation for individuals (Salmond & Crampton, 2001).

Although there have been several documented comparisons between low socio-economic status and poor nutrition, the latter is not confined to the former, and hence other measurements of nutrition need to be conducted when assessing the nutritional status of food-insecure people.

2.4.2 Assessment of dietary intake in food-insecure populations

To assess the impact of food insecurity on the nutritional status of a population, data on dietary intake needs to be recorded. Dietary intake can be measured quantitatively; for example by 24-hour recall, 24-hour record-assisted recall and by weighed diet records. Qualitative dietary assessment includes the Food Frequency Questionnaire (FFQ) and the Dietary History method. These approaches obtain an indication of the usual pattern of intake of specific foods or groups of foods, rather than actual nutrient intake.

It is difficult, for several reasons, to quantify the effect of food insecurity on nutritional status. However, the length of time a household is exposed to food insecurity will be a major determining factor.

Food insecurity can be periodic in nature. That is, it may be cyclical, short term or long term. The timing of the assessment of dietary intake in suspected food-insecure populations will dictate whether the results are actually a true representation of the nutritional situation. This raises the point of which dietary intake survey method will best reflect differences in the relationship between food insecurity and nutrient intake, and this may explain those inconsistencies reported between studies of food-insecure populations (Cristofar & Basiotis, 1992; Rose & Oliveira, 1997; Rose, 1999; Tarasuk & Beaton, 1999; Tarasuk, 2001).

The various dietary assessment methods used in food security research, and their advantages and disadvantages, are outlined below.

2.4.2.1 The 24-hour diet recall

The 24-hour diet recall has been the most reported method for measuring the nutritional status of food-insecure populations. Every individual shows a large variability of dietary intake, but this can be partly adjusted for by obtaining multiple 24-hour diet recalls (Jonnalagadda et al., 2000).

The popularity of the 24-hour diet recall method probably relates to its association with high compliance – it features low subject burden, and is relatively cheap and easy to administer. However, its accuracy depends on the ability of respondents to remember what they have eaten and this is likely to be an issue in young children, who also have limited knowledge of food and food preparation.

Another disadvantage in the diet recall, which also makes it open to error, is that it relies on the ability of respondents to estimate food portion sizes. In addition, the use of diet recalls in young children relies on the ability of the adult present at the interview to give a true account of the child's diet, and it is possible they may not mention foods that are rarely consumed (Rockett & Colditz, 1997).

Also, a 'flat slope syndrome' has been reported in 24-hour diet recalls. This relates to subjects under-reporting high intakes and over-reporting low intakes, so as to give the impression of what they consider to be an ideal diet (Gibson, 2002). It is important, too, that subjects are not warned of a 24-hour recall, to avoid them modifying their eating patterns on the record day.

2.4.2.2 Food records

The weighed diet record is considered the gold standard for dietary assessment, as it provides an accurate quantitative account of diet intake across a set timeframe (Gibson, 2002). Unlike the 24-hour diet recall, it does not rely on memory. However, it is expensive and time-consuming, and participants must be motivated and literate, as this method relies on portion sizes being weighed and recorded.

Like repeated 24-hour recalls, replicated weighed food records are the best way to estimate the prevalence of inadequate nutrient intake in at-risk populations. However, the accuracy of this method can also be debated, as respondents may alter their usual dietary habits to improve their intake or reduce the workload of weighing and recording.

2.4.2.3 Dietary history

This method involves an open-ended interview concerning dietary habits and food likes or dislikes, and is usually associated with a 24-hour recall and a food frequency questionnaire. The advantage of the diet history is that it provides an indication of habitual dietary intake, possibly including data from the previous month or year, and will therefore account for daily variation in food intake. However, it is time consuming and prone to error due to respondent memory lapse and inability to accurately estimate portion sizes.

Because of this, the method is unsuitable for the elderly and children younger than 14 years (Gibson, 2002). The maximum time period for accurate data collection is also unclear, with a recall of one month obviously more effective than a longer timeframe (Gibson, 2002).

2.4.2.4 The food frequency questionnaire (FFQ)

The FFQ estimates a person's usual dietary intake over a specified timeframe, providing data on usual food consumption patterns. It has a low subject burden and hence a high compliance rate, being relatively easy and quick to administer, is inexpensive, and can be self-administered or administered by interviewers. The FFQ has been widely used in epidemiological research for ranking individual consumption into general categories of high, medium and low intakes of certain foods (Serdula et al., 2001).

However, as with other dietary assessment methods, the FFQ does have its disadvantages. The level of accuracy has been documented as less than that of other dietary assessment methods. It is inclined to overestimate total energy and nutrient intake and may not provide a true representation of the quantity or variety of food usually eaten during one day (Serdula et al., 2001).

2.4.2.5 Validation of measures of dietary assessment

Large variations in dietary intake are likely to occur between various dietary assessment methods, and therefore, any research tool needs to be validated.

The best way to validate a dietary record is to assess it against a weighed food record conducted over the same time period. There is evidence that dietary history conducted over a long timeframe of six or more months tends to over-estimate group mean intakes when compared to weighed food records. Smaller differences in mean intakes between dietary history and weighed food records have been reported when the former is conducted over a shorter timeframe (Gibson, 2002). However, comparing two dietary methods does not necessarily denote equal validity, as both methods may contain similar errors. Hence, there is a trend for dietary methods to be validated against independent measures, such as biochemical markers. The doubly labeled water method, for example, is used to estimate energy expenditure, but this, too, generates problems in compliance.

The most appropriate methods for assessing dietary intake in older children are likely to be the 24-hour diet recall or the 3-4 day food record. Although children may have difficulty remembering what they ate and may have limited knowledge of how the food was prepared. In young children it is usually the parents who provide the dietary information and most methods would therefore be appropriate. However, it is important to consider that they may not be aware of what their child eats or drinks when they are not in their care.

In summary, the 24-hour recall and dietary histories conducted over a short period of time are reliable indicators of average usual intake for most nutrients in a large population, but not for individuals (Gibson, 2002). A more reliable indicator of all nutrient intakes in individuals, except for vitamins A and C and polyunsaturated fat, is a 7-day weighed dietary record (Gibson, 2002). It has been noted that the 24-hour recall can underestimate mean dietary intakes in the elderly and in children (Briefel et al., 1997). By increasing the number of measurement days, it may be possible to reduce such errors.

2.4.2.6 Assessment of adequacy of nutrient intake

Determining adequate nutrient intake depends on comparisons to Dietary Reference Values. These vary globally due to varying assumptions of bioavailability and differences in dietary eating patterns (Yates, 2001). There is debate in the literature over which reference nutrient values are the most accurate.

In the USA and Canada, nutrient intakes have been traditionally compared to the Recommended Dietary Allowance (RDA). However, RDAs were developed during a time of food shortage, when it was important to define minimum requirements of nutrients to prevent deficiency diseases. Since then, as new scientific knowledge regarding the physiological function of nutrients has become available, the emphasis on RDAs has shifted towards defining the amounts of nutrients needed to optimise physiological functions and reduce the risk of chronic disease, as adopted by the new USA Dietary Reference Intakes (DRIs) (Mertz, 2000).

The DRIs use nutritional indicators of specific physiological functions as criteria for nutrient adequacy. They comprise a set of four reference values to be utilized in assessing and planning the diets of healthy individuals and groups (FNB, 2000).

The DRIs encompass the following:

- Estimated Average Requirement (EAR)

The EAR represents the daily nutrient intake value that would meet the requirements of only 50% of individuals in a certain life stage and gender group. It includes an adjustment for an assumed bioavailability of the nutrient.

The EAR used in the USA and Canada has the same definition as the British EAR.

- Recommended Dietary Allowance (RDA)

The DRI panel has set RDA values to meet the average daily nutrient needs of almost all healthy individuals (97% to 98%) in a certain life stage and gender group. RDA values are set at two standard deviations above the EAR.

- Adequate Intake (AI)

The AI is set instead of a RDA when there is not enough scientific data to allow the EAR of a nutrient to be calculated. It is believed to cover the needs of all individuals in a group, but, due to lack of data, it is not possible to specify with confidence the percentage of individuals included by this intake.

- Tolerable Upper Intake Level (UL)

The UL has been defined as the maximum level of a vitamin or mineral that can be safely taken without any risk of adverse health effects.

The RDAs for nutrients have been set rather high because low intake rather than high intake is generally associated with poor health. However, a different approach has been used for energy intake, where high levels are likely to be detrimental to health. The RDAs for energy are based on estimates of average requirements and not, like other nutrients, on the average requirement plus two standard deviations.

The RDA used in the USA and Canada has the same definition as the Recommended Dietary Intake (RDI) used in Australia and NZ (Truswell, 1993), and the Recommended Nutrient Intake (RNI) used in the United Kingdom (United Kingdom Department of Health, 1991). The RDA, RDI and RNI are designed to cover the needs of groups of healthy individuals whose nutrient requirements vary and so, by definition, exceed the average requirement. They are not suitable for assessing the diets of individuals or for planning diets for groups.

The Australian RDI, adopted also by New Zealand, has not been reviewed since it was published in 1991, and so is in need of an update, and the Australian energy RDI for infants and children has been criticised. Doubly labeled water studies suggest that the USA RDA for energy requirements in children may be too high, and can overestimate infants' energy requirements by 15% and children's by up to 25% (Cryan & Johnson, 1997).

It is difficult to estimate the prevalence of inadequacy of specific nutrients in individuals, because the mean nutrient requirement of each individual is not known, and biochemical and clinical assessments for individuals would need to be conducted. An individual can not be categorised as being deficient or inadequate in a particular nutrient simply because their short-term nutrient intake is below the RDI, RDA or RNI. However the longer the duration of low nutrient intake, the greater the risk of the individual being deficient in that particular nutrient.

In summary, the RDA is not the most appropriate benchmark on which to base dietary adequacy because, by definition, it exceeds the nutrient requirements of about 98% of all individuals in a group, providing normal distribution of the requirement of a nutrient is met. For this reason, the EAR provides a better means of assessing the prevalence of inadequate intake of a nutrient in a group. Based on median intakes, it offers the best estimate of the individuals' real nutrient requirement, and so takes into account the fact that distribution of some nutrient requirements may be skewed. Nutrient inadequacy can be estimated by finding out the number of people with nutrient intakes below the EAR, using the probability approach or the EAR cut-point method. The DRI committee, in its report, emphasises that the RDA is not to be used primarily in assessing or planning the diets of individuals or groups (FNB, 2000).

2.4.3 Anthropometric assessment

Anthropometry refers to the study of the physical size of the body. Its measurements can be used to assess nutritional status by providing data on the amount of body fat and lean muscle mass, and by providing a means of measuring change in body size over time.

Common nutritional anthropometric measurements include weight, height, waist and hip circumference, and the triceps skinfold. Head circumference can provide an indication of severe malnutrition in infancy, and a height-for-age measurement can indicate growth stunting in children (Gibson, 2002).

Anthropometry data provides the best indication of obesity, generally determined by Body Mass Index (BMI). BMI is determined by dividing an individual's weight in kilograms by their height in metres squared (Cole et al., 2000). The BMI values can then be compared to reference values and the prevalence of obesity or being overweight can be determined. Nutritional anthropometry, like other assessment methods, is open to errors, which may arise with poor handling of instruments and inaccuracies in the recording of data.

2.4.3.1 Measuring obesity and overweight in children

Defining obesity and overweight in children of different ages and ethnicity is difficult. Obesity is defined as excess adipose tissue, whereas overweight indicates excess weight for height and does not take into consideration the composition of the body mass (Sherman & Alexander, 1990).

There is currently no universally accepted reference standard for determining overweight and obesity in children. Traditionally, their obesity was estimated from USA reference values based on data from the National Health and Nutrition Examination Survey (NHANES I), and has been defined as a triceps skinfold thickness greater than or equal to the 85^{th} percentile (Sherman & Alexander, 1990). However, the body mass index has been more commonly used as an indication of obesity in several studies, obesity being defined as a BMI greater than or equal to the 95th percentile (Guo et al., 1994; Himes & Dietz, 1994).

In 1999, the International Obesity Task Force stated that children and adolescents should be classified as overweight or obese based on their body mass index (Bellizi & Dietz, 1999). However, there is evidence in the literature that American cut-off BMI values, as a measure of obesity, can probably not be applied to New Zealand children, and that unique cut-off values need to be developed for defining obesity in Pacific children (Lazarus et al., 1995; Salesa et al., 1997).

More recently, Cole and colleagues (2000) have developed international reference values for defining obesity and overweight. Data sets from national surveys conducted in Brazil, Great Britain, Hong Kong, Singapore, the Netherlands and the USA were used to develop centile curves for BMI for children. The data from these international studies was averaged for each centile to pass through the adult cut-off points for BMI at 25 for overweight and 30 for obesity at 18 years of age.

2.4.4 Laboratory assessment

Laboratory assessment, in the form of blood tests, can provide an objective indication of nutritional deficiencies and excesses. However, there are many factors that can influence the results of laboratory tests, such as recent food intake and hormonal status, which will need to be accounted for (Gibson, 2002).

2.4.5 Clinical assessment

Clinical assessment usually involves taking a medical history of the subject, including symptoms and a physical examination, including basic anthropometric measurements such as height and weight. Respondent bias can occur when a medical history is obtained, especially if questions are leading rather than open-ended. A diagnosis of nutritional deficiency cannot be made purely on the results of a clinical assessment. Dietary and socio-demographic data can provide vital clues as to why nutritional problems are occurring.

2.5 Socio-demographic determinants of nutritional status

Socio-economic status is considered one of the main determinants of nutritional status and health (Ministry of Social Development, 2002). Differences in access to wealth will lead to differences in lifestyles and opportunity, and it is generally those with greater wealth and status who have better access to food and healthcare.

The socio-economic factors found to influence child health significantly are low income or poverty, single parenthood, housing tenure, lack of transport, and the educational and employment status of parents (Barwick, 1992). These will impact on the ability of families to obtain and store food.

Although a direct relationship exists between socio-economic disadvantage and poor health, it has been more difficult to determine whether such a relationship exists between poor health and inadequate nutrient intake as a result of socio-economic disadvantage (Parnell et al., 2001).

The 1997 New Zealand National Nutrition Survey (NNS97) was the first major national study to provide information on the relationship between socio-demographics and the dietary habits, food and nutrient intakes of adult New Zealanders (Russell et al., 1999). The NNS97 was a voluntary cross-sectional population study, for which 4,636 New Zealanders, aged 15 years or more and living in selected households, were recruited. Diet and nutrient data was based on 24-hour diet recalls and food frequency questionnaires (Russell et al., 1999). The ethnicity of respondents was recorded under four groups: NZ Maori, Pacific, European and Other, with Asians making a large contribution to this last sector.

In summary, the NNS97 indicated that employment status, ethnicity and area of residence significantly affected the food and nutrient intake of New Zealanders. Maori were over-represented among lower socio-economic New Zealanders and Pacific peoples were generally among the groups with the lowest incomes (Russell et al., 1999).

The NNS97 was conducted in association with the 1996-1997 health survey, together providing data on the nutritional and health status of New Zealanders. A report published by the Ministry of Health (2003) based on both surveys, estimated that poor diet contributed to up to 9,000 deaths per year in NZ. Low vegetable and fruit intakes, and non-optimal BMI, were estimated to be responsible for more than 6% of deaths due to cancer. An increase in fruit and vegetable consumption is thought to reduce the number of ischaemic heart disease deaths per year by 4% to 20%, depending on the age group in question.

Low socio-economic status has been associated with low levels of nutritional knowledge, poor eating habits, inadequate diets and overall poor nutritional status (Mooney, 1990; Kingsey, 1994). Therefore, it seems highly likely that poor diet caused by low socio-economic status is a determinant of poor health.

2.5.1 Nutritional consequences of age, gender, ethnicity and culture

Several trends in eating behaviour connected with age, gender and ethnicity have been documented both overseas and in New Zealand. Cultural practices, including those defined by national, ethnic or religious backgrounds can significantly influence eating patterns and nutritional status.

In the USA, for example, it has been shown that there are ethnic differences in diet and nutrient intake. African American households were found to have lower intakes of carbohydrate, calcium and thiamin than Caucasian or other race households (Adrian & Daniel, 1976).

In New Zealand, the 1997 National Nutritional Survey highlighted age, gender and ethnicity differences concerning food choice, diet and nutrient intake (Russell et al., 1999). Young adults were found to consume more hot chips, mince, luncheon and chicken than older adults (Russell et al., 1999). Energy, fat, carbohydrate and protein intakes generally decrease with age. The lowest calcium and zinc intakes were recorded in individuals aged more than 65 years (Russell et al., 1999). Males were reported to consume bread and cereal foods more frequently, and to eat more packaged chips, drink more soft drinks, cordial, powdered drinks and sports drinks than females (Russell et al., 1999).

Ethnic differences in the NNS97 (Russell et al., 1999) and in the LINZ study (Horwath et al., 1991) showed that Pacific people were least likely to meet the recommendations for fruit and vegetable consumption, compared to Maori, European and other ethnic people (Russell et al., 1999). Maori and Pacific people were less likely than Europeans to trim excess fat off meat (Russell et al., 1999). The LINZ study reported that more Maori used butter or lard to fry meat and vegetables, while non-Maori were more likely to use vegetable oils (Horwath et al., 1991). The mean percent energy gained from fat was significantly higher for NZ Maori females (36%) than NZ European and Others females (34%) (Russell et al., 1999). The same trend was observed in males, with the mean percent energy gained from fat being 37% in NZ Maori males and 35% in NZ European and Others males, but this difference was not significant (Russell et al., 1999). Although it is likely the mean percent of energy from fat was over-estimated, as no adjustments for intra-individual variation were made in this study (Russell et al., 1999). Other ethnic differences noted in the NNS97 included an inadequate calcium intake among young Maori and Maori women (Russell et al., 1999).

These findings are supported by the prior work of Metcalf and colleagues (1998), who undertook a large study involving 5,523 working New Zealand men and women, aged 40 years and over (Metcalf et al., 1998). This project was designed to provide data on the dietary habits of the main ethnic groups living in New Zealand: Maori, Pacific and European. Dietary data was obtained from a quantitative food frequency questionnaire.

Ethnic differences in dietary intake were reported, with Maori women and Pacific men and women consuming greater amounts of total energy per day than European men and women (Metcalf et al., 1998). Also, Maori and Pacific men and women were found to consume more protein, fat, saturated fat and cholesterol, but less fibre, carbohydrate and calcium than European men and women (Metcalf et al., 1998).

Differences in cooking methods, portion sizes and frequency of most foods were also noted (Metcalf et al., 1998). Cooking methods differed with ethnicity, with Maori and Pacific people more likely to use animal fats such as butter and lard for frying foods. Europeans were more likely to use vegetable oils or to microwave foods instead. Pacific men and women consumed less milk and fruit but more chicken than Europeans, while Maori men and women were reported to consume more bread but fewer vegetables per month, compared to European men and women. Maori and Pacific people were found to consume larger portion sizes and to eat most foods more frequently than European respondents.

The study indicates that cultural and ethnic factors may be more important than socio-economic influences such as education or household income (Metcalf et al., 1998). NZ Europeans consumed low fat milk in much larger amounts than non-NZ Europeans. Immigrants and their families may find it difficult or expensive to obtain certain foods and cultural food beliefs may account for ethnic differences observed in food and nutrient intake. However, Maori and Pacific people are more represented among lower socio-economic groups where household income is also a strong predictor of food choice.

These socio-cultural differences in food intake may account for the higher prevalence of obesity in Pacific and Maori people living in New Zealand. Analysis of NNS97 data indicated that 17% of the adult NZ population were obese, and 35% of NZ adults were overweight (Russell et al., 1999). Pacific people and Maori were more likely to be obese than other ethnic groups, with 26% of Pacific men and 47% of Pacific women considered obese, and 27% of Maori men and 27.9% of Maori women classified as obese, as shown in Table 2.4.

Table 2.4: Percentage of NZ adults considered overweight or obese

	NZ Maori		**Pacific peoples**		**NZ European & Others**		**Total population**	
	Male	Female	Male	Female	Male	Female	Male	Female
Overweight(%)	30.0	32.7	59.2	28.8	41.0	29.8	40.4	30.1
Obese (%)	27.0	27.9	26.2	47.2	12.6	16.7	14.7	19.2

Source: Russell et al 1999

Classification: Obese: BMI >29.9 for NZ European and Others; BMI>31.9 for Maori and Pacific peoples.

Overweight: BMI 25-29.9 for NZ European and Others; BMI 26-31.9 for Maori and Pacific peoples.

There is growing concern that Pacific NZ children are more likely than any other ethnic group to have poor health and nutritional status. A small study of a group of 60 Pacific pre-school children, aged 24 to 72 months, living in Dunedin, was conducted by the Department of Human Nutrition in Otago, in conjunction with the Pacific Islander's Advisory Council (Grant et al., 2000). The researchers were alarmed by the high proportion of children who were clinically overweight according to high z-scores for body mass index-for-age and arm-muscle-area-for-age. Sixteen percent of the Pacific Island children were found to be at risk of low vitamin A intake, and 13% were at risk of low calcium intake. Iron and zinc intakes were low in 11% and 10% of the children respectively. The mean percentage of energy from fat was reported to be 31%, and saturated fat contributed to half of this percentage. Fast foods were found to be the major contributor to the energy intake. Also the percentage of energy from sucrose and other free sugars (26%) was found to exceed that recommended by the Nutrition Taskforce (15%).

Concern for the nutritional status of young Pacific Island children living in New Zealand has also been reported in an older group of 10 to 13 year old Tongan and Tokelauan children living in Auckland and Wellington (Bell & Parnell, 1996). Data based on a 24-hour diet recall reported significantly higher fat and protein intake, but lower carbohydrate, calcium, riboflavin, thiamin, niacin, folate and vitamin A, in Tongan and Tokelauan children, compared with non-Pacific children (Bell & Parnell, 1996). Although there are a number of potential sources of error with the 24-hour diet recall method, this study does bring to attention the fact that a high fat intake in Pacific children may predispose them to early onset of heart disease and diabetes later in life.

Gender and ethnic differences have also been noted in the rates of hospitalisation of NZ infants. The rates of infant hospitalisation were higher in males than females, and higher in Maori than non-Maori infants in 1995. Infant mortality in NZ has been strongly associated with low maternal socio-economic and education status, single parent households, Maori ethnicity and a maternal age of 19 years or less (Hodges et al., 1998).

While ethnic differences alone in diet intake have been noted both overseas and in New Zealand, there does appear to be a relationship between ethnicity and household income and employment. According to 1996 NZ Census data, Pacific and Maori children were more likely to be from households on low incomes, while European children were more likely to be from households on high incomes (Hodges et al., 1998). Pacific children and Maori children were more likely than European children to have a parent receiving the unemployment benefit (Hodges et al., 1998). Data from the NZ 1996 census revealed that more Pacific and Maori children than European or Asian children are living in households containing six or more people (Hodges et al., 1998). In 1996, approximately 40%

of Maori and approximately 30% of Pacific children left school without obtaining any formal educational qualifications (Hodges et al., 1998). Thus, the impact of income and education status may be greater than ethnicity.

2.5.2 Nutritional consequences of housing arrangements like home ownership and household size

Statistical analysis of data collected from two large-scale surveys conducted in the USA during 1977 and 1978 found that individual nutrient intake decreased significantly with an increase in household size in low-income households (Chavas & Keplinger, 1983). These results suggest that members of large-sized households on low incomes are more likely to be at nutritional risk.

Residential location has been found to impact on the nutritional status of households. Adrian & Daniel (1976) looked at data on 6,950 households from a national household food consumption survey conducted in the USA, and linked a degree of urbanisation with nutrient intake. Urban and non-farm households were found to have lower intakes of all nutrients, except vitamins A and C, than farm households. This difference may reflect changes in lifestyles and accessibility to a variety of stores, as well as a decline in home food production in urban areas.

However, low-income households tend to be situated in areas of low-cost housing, where there are generally fewer supermarkets and food stores. Convenience and food stores in poverty areas tend to have less variety in types and brands of foods, and a more limited selection of fresh fruit and vegetables, placing further constraints on the ability of low income households to consume nutritionally balanced diets (Hersey, et al., 2001).

There is also evidence that single-headed households are more at risk of nutritional inadequacy than dual-headed households (Basiotis et al., 1983). Dual-headed households were found to consume significantly more calcium than single-headed households, and households headed by a single male were found to consume significantly lower amounts of protein, calcium, iron, riboflavin and thiamin than dual-headed and singe female-headed households (Basiotis et al., 1983).

2.5.3 Nutritional consequences of poverty and low-income

Poverty relates to inequality concerning money and income (Pena & Bacallao, 2002). Poverty also refers to a circumstance in which minimum food is available and there is a lack of certain important material items such as transport, clothing or housing. Poverty has been found to be more prevalent in larger sized households, with many children (Stephens et al., 1995).

In 1997, it was estimated that up to 11% of the NZ population was living in poverty (Parnell, 1997). More NZ children aged 0 to 9 years were found to be from families on low incomes than those aged 10 to 14 years (Hodges et al., 1998). The incidence of poverty was higher among single-parent households, and it was estimated that between 14% and 46% of single-parent households in NZ were living below the bread line (Stephens et al., 1995).

Poverty has been widely associated with poor nutritional status (James et al., 1997), and it is widely accepted that adequate nutrition during childhood is essential for normal physical and mental development (Bronner, 1996). Inadequate nutrition during this crucial time can have detrimental effects on the cognitive development of children (Bronner, 1996; Black, 1998).

Poverty and low socio-economic status in developed countries have been associated with high and low energy intake, iron deficiency, low birth weight babies, a low breastfeeding rate, and low intakes of vegetables and fruit (Montgomery & Kiely, 1996; James et al., 1997; Parnell et al., 2001). Low socio-economic status may constrain the ability to of households to participate in health eating behaviours.

The most referenced study on the nutritional consequences of poverty would be the London study of 200 lone-parent families by Dowler and Calvert (1995). Dietary intake for each lone parent and their child was determined by three-day weighed intake records, an FFQ and an interview. The researchers concluded that poor material circumstances and financial constraints were the primary determinants of poor nutritional status in lone parents, who were often mothers, and occasionally in their children. Pregnant women in low-income households were more likely to have low birth weight babies, and their toddlers had higher saturated fat and sugar intakes, and lower vitamin and mineral intakes. One interesting finding of this study was that nutritional status was not related to food-shopping patterns or food-budgeting skills.

Household income, like other socio-demographic variables, influences food choice and purchase (Hersey et al., 2001). Lack of transport, inflexible working hours and other structural, material and economic factors associated with low household income can be a major barrier to households' ability to provide a nutritionally balanced diet that includes fresh fruit and vegetables (Smith and Baghurst, 1993; Quan et al., 2000).

Household income has generally been found to be a significant factor affecting nutrient consumption in families (Adrian and Daniel, 1976; Davis, 1982; Kaiser et al., 2002). Household consumption of protein, fat, iron, vitamin A and vitamin C were found to initially increase, peak, then decline with increases in income brackets in a study of 6,950 USA households (Adrian and Daniel, 1976). Studies have positively related income to the dietary status of low-income households, but the relationship is not strong and consistent in the literature (Adrian & Daniel, 1976; Davis, 1982; Basiotis et al., 1983). This inconsistency is probably due to the small size of the positive effect being difficult to interpret statistically. More recently, a study of 250 low-income families in London reported significantly lower energy intakes in those in the lowest-income bracket. This finding may be related to underreporting in the lowest income group, or to differences in age, gender and ethnicity (Nelson et al., 2002). Folic acid intake as a percent of the reference EAR intake was found to be significantly lower, by 25-50%, in those in the lowest income group compared to those in the highest income group, as based on four 24-hour recalls (Nelson et al., 2002).

Emmons (1986) studied the nutritional adequacy of diets in 76 low-income American families by collecting 24-hour recalls of dietary data each week for one month. Dietary analyses confirmed that nutrient intake was continuously below the recommended dietary allowances for vitamin B6, vitamin D, vitamin E, iron, calcium, magnesium and zinc. Protein, ascorbic acid, thiamin, niacin, riboflavin, vitamin B12, vitamin A and phosphorus intakes were greatly above the corresponding RDAs in both black and white Americans participating in this study. Unfortunately, only low-income households were included in this study; no comparative data was provided. However, it was noted that the low nutrient intake levels recorded at the beginning of the study were continuously low over the month and at the end of the study. This may indicate that the poor nutritional status of low-income families is continuous, not intermittent (Emmons, 1986).

The USA NHANES III survey (1988 to 1994) reported a higher prevalence of iron deficiency in children aged 1 to 16 years who were from low-income households compared to those from higher-income households (Alaimo et al., 2001c). Infants and children are already at a high risk of developing iron deficiency during periods of rapid growth, and iron deficiency is associated with poor learning ability and psychological development, decreased resistance to infection, and impaired growth (Lozoff et al., 1991; Pollitt, 1993; Walter, 1993). Infants from low-income households are less likely to be breastfed, and this is thought to account for the high incidence of iron deficiency in infants of low-income families (Hodges et al., 1998).

There has been a rapid increase in the number of children in New Zealand experiencing nutritional deficiency over the last two decades. Research by the

Ministry of Social Development (2002) has indicated that children in poor families were considerably more likely to not eat fruit and vegetables than other families not in poverty. Iron deficiency is still the most common nutritional deficiency in young New Zealand children. Iron deficiency in New Zealand children has been researched since the 1960s, and higher rates of iron deficiency have been observed in Maori, Pacific and those living in socially disadvantaged areas (Moyes et al., 1990; Crampton et al., 1994; Wilson et al., 1999). A small New Zealand study conducted in 1991 to 1992, involving infants aged 6 to 36 months living in Porirua, reported iron deficiency in 24% of these infants (Crampton et al., 1994). A study of children aged 13 to 15 years found that 37% of females and 14% of males had iron intakes below 70% of the recommended daily intake (Brinsdon et al., 1993). The work of Wilson and colleagues (1999) was the first to link low family income with a higher prevalence of iron deficiency. It is now realized that income, not ethnicity, is a major determinant in the prevalence of iron deficiency in infants (Dr Clare Wall, personal communication).

Further evidence of the impact of poverty on nutritional status comes from a NZ study of 40 households relying on government benefits (Parnell, 1997). Sub-optimal intakes of some nutrients were reported in women and children participating in this project (Parnell, 1997). This will be further discussed in section 2.7.

2.5.3.1. Poverty and health status

Poverty and insufficient food intake have been associated with impaired growth and high rates of infections in children in developing countries (Bronner, 1996; Kramer-LeBlanc & McMurray, 1998; Pena & Bacallao, 2002). Long-term exposure to poor nutrition has also been associated with a negative impact on growth and motor development rates of children in developed countries (Willis et al., 1997; ADA, 2003).

However, poverty in developed countries has also been linked to obesity (Dietz, 1995; Pena and Bacallao, 2002). Obesity occurs when energy intake exceeds energy expenditure, that is, when individuals are in a state of positive energy balance. A strong inverse relationship between socio-economic status and obesity has been found in women, but the relationship is inconsistent for men and children in developed countries (Townsend et al., 2001). Low-income adults were found to have higher body mass indexes than higher-income adults (Morton and Guthrie, 1997). Non-Hispanic white children aged 8 to 16 years participating in the 1988-1994 NHANES II study were more likely to be obese if from low-income households, (Alaimo et al., 2001b) but this association was not found in children aged 2 to 7 years. The inconsistencies recorded in the literature may in part reflect different BMI cut-offs used to define obesity and the differences in populations studied. Also, in some studies the prevalence of obesity may have been underestimated if BMI calculations were based on self-reported weight and height data, as such data may underestimate weight and overestimate height (Adams et al., 2003).

It is understandable that individuals' energy intake can exceed energy output in developed countries, where lots of inexpensive, energy-dense food products are available and lifestyles are fairly inactive in terms of physical exercise (Baur, 2002; Pena and Bacallao, 2002). But it is not known if high energy intake or high fat intake is the primary cause of the prevalence of obesity observed in socio-economically disadvantaged women and children (Stunkard and Sorenson, 1993). Although obese people are more likely to under-report food intake in studies, the incidence of obesity has been linked to television viewing and increased consumption of sugar-laden soft-drinks in several studies (Gortmaker et al., 1993; Ludwig et al., 2001; Townsend et al., 2001).

Prenatal nutrition, birth weight, rapid weight gain during infancy, genetics and physical inactivity are just some of the factors that may play a role in explaining this phenomenon (Sherman and Alexander, 1990; Townsend et al., 2001).

Considerable attention has been given to the Barker's hypothesis. The incidence of low birth weight is also higher in lower socio-economic groups. It is not known if this is a result of poor nutrient intake during pregnancy, iron deficiency anaemia, alcohol intake, cigarette smoking or low pre-pregnancy weight (Worthington-Roberts & Williams, 2000).

Overseas data indicate obesity levels in children are increasing in many developed countries (Baur, 2002). In Australia, a prospective study of 213 adolescents aged 14 to 15 years found 18% of girls and 21% of boys were obese, as they had BMIs greater than the 90^{th} percentile of reference values (Tienboon et al., 1994). Over the last decade, the prevalence of being overweight has doubled and the prevalence of obesity has more than tripled in Australian children (Baur, 2002) when based on the international cut-off values determined by Cole and colleagues (2000).

There is currently no published national data on the prevalence of obesity or being overweight in New Zealand children. There is evidence from studies conducted at a regional level in New Zealand to suggest an increase in child obesity. An early cohort study, conducted by the Dunedin Multidisciplinary Health and Development team, on 809 15-year-olds found that 7.5% of females and 4.6% of males were overweight or obese (Worsley et al., 1990). The incidence of being overweight or obese was determined using the adult cut-off point of a BMI greater than 25 (Worsley et al., 1990). Although this group of children was thought to comprise a reasonable representation of 15-year-old New Zealanders, Maori and Pacific children were underrepresented at only 2% of the group. High socio-economic groups were overrepresented in the cohort. More recently, Tyrrell and colleagues (2001) have published data reporting obesity in 14.3% of a group of 2,273 Auckland children aged 5 to 11 years recruited in their study. Around 24% of Pacific children, 15.8% of Maori and 8.6% of European children were classified as obese according to the reference standards used in this study. The researchers based their cut-off for obesity on the USA NHANES I reference data; this may have resulted in systematic misclassification, as the data is based on North American children, who may have different growth patterns than New Zealand children. It would have been more ideal to have used BMI cut-offs derived from New Zealand population data. Also, the NHANES I survey data was carried out between 1971 and 1974, so it is likely that it no longer represents population distributions of BMI at certain age groups (Lazarus et al., 1995). The current prevalence of obesity in New Zealand children is now being investigated by researchers involved in the 2002 Children's Nutrition Survey, the results of which are due for publication in late 2003.

There is evidence that childhood obesity can lead to obesity in adulthood, (Guo et al., 1994; Must, 1996) which is strongly associated with an increased risk of chronic diseases including heart disease, diabetes and cancer (Guo et al., 1994; Must, 1996). Lower socio-economic status in childhood has been associated with adult obesity and heart disease (Sherman & Alexander, 1990; Power & Parsons, 2000). The association between childhood obesity, low socio-economic conditions in childhood and increased coronary heart disease risk is not yet fully understood. It is likely to be related to poor fruit and vegetable intake observed in lower socio-economic groups (Kendall and Kennedy, 1998), poor food choices like choosing cheap but fatty cuts of meats (Kramer-LeBlanc & McMurray, 1998) and the increased risk associated with obesity. Psychological and social consequences of childhood obesity have also been reported (Hodges et al., 1998), including documentation of an inverse relationship between weight and self-esteem in adolescents (Baur, 2002).

2.5.4 Nutritional consequences of household food expenditure

There is some evidence to suggest that an increase in food expenditure is associated with better nutritional status of individuals in a household (Davis, 1982). Income has been found to be a major determinant of household food expenditure (Davis, 1982; Nelson et al., 2002). It appears that the total amount of money spent on food increases with higher income, but the proportion of total income that is spent on food and groceries decreases, as observed in Australian households (ABS, 2000). Australian households in the lowest quintile of income spent 20% of their total expenditure on food and non-alcoholic beverages, while the highest quintile income households spent 17% of total expenditure on food and non-alcoholic beverages (ABS, 2000).

Low-income households have a restricted food budget and tend to choose cheaper cuts of meat that are high in fat, and consume full-fat milk and cordial (Russell et al., 1999). Other trends associated with low-income households include cooking meat in lard rather than oil and trimming excess fat off meat less frequently than higher-income individuals (Russell et al., 1999). This situation is further complicated by limited transportation to food stores, poor nutritional knowledge and limited available time to spend on shopping and food preparation (Campbell & Desjardins, 1989; Hersey et al., 2001).

Households on a restricted food budget are likely to buy foods on special or goods that have been discounted (Kempson et al., 2002). Hersey and colleagues (2001) have published their analysis of the food-shopping practices of a stratified random national sample of 2142 people involved in the 1996 National Food Stamp Program Survey in America. A small percentage of food-stamp households shopped in different stores for specials (18%) and the main shopper of half of these food-stamp households (51%) reported to "pretty much every time" search for grocery specials. These specials may be products high in fat or low in nutrients (Hersey et al., 2001). The food management practices of a sample of American families with limited resources have also been studied (Kempson et al., 2002). Some households were reported to dilute infant formula and milk and eat rotten or spoiled foods in order to reduce the household food budget. Such practices are likely to place families under nutritional risk.

Further differences in food shopping practices have been reported in low-income households compared to higher-income households (Morton & Guthrie, 1997).

The 1994 Continuing Survey of Food Intakes by Individuals (CSFII) provided information on the food-purchasing decisions made by 658 women with children (Morton & Guthrie, 1997). Low-income households with children were reported to be more concerned with the price, shelf-life and convenience of foods than higher-income households with children (Morton & Guthrie, 1997). In this study, respondents from low-income households with children were significantly less likely to base their food purchases on nutritional labels than higher-income households with children (Morton & Guthrie, 1997). Low-income households were also significantly less likely to be following low-fat dietary patterns (Morton & Guthrie, 1997). It has been suggested that the higher price of foods that have been modified to be low-fat may in part explain why low-income households were less likely to eat low-fat foods (Morton & Guthrie, 1997).

Household food expenditure is not only influenced by income. Household size is also a known factor (Adrian & Daniel, 1976; ABS, 2000), as larger-sized households face further constraints on financial resources (Davis, 1982).

2.5.5 Nutritional consequences of education status

A 1970s study of the impact of educational status on nutrient intake in the United States found housewives with higher levels of education prepared meals for their families that were more nutritionally balanced (Adrian & Daniel, 1976). The study analysed data from 6,950 households and found that housewives with a higher education level prepared meals that were higher in vitamin C and contained less carbohydrates and fat than housewives with lower education status or who were employed (Adrian & Daniel, 1976). Education status of the household head has been positively associated with nutrient intake in two large-scale surveys conducted in the USA (Chavas & Keplinger, 1983). A college education has been positively associated with fruit consumption in a more recent population-based survey (Devine et al., 1999). There are many factors contributing to this observation, as education level is often linked with income. Households with a higher education level are likely to have a higher household income, and thus be more able to afford fresh produce and low-fat food products. This may explain the lower fat consumption observed in these households.

Nutritional knowledge may have an even more significant impact than general education level on the nutritional status of households (Sherman & Alexander, 1990). Mothers from lower socio-economic status households were found to have lower levels of nutritional knowledge, and a higher incidence of obese children was found in these households than in families with higher socioeconomic status (Sherman & Alexander, 1990). The level of nutritional knowledge in low-income households with children was again compared with the nutritional knowledge of higher-income households with children, by Morton and Guthrie in 1997. Low-income households were significantly less likely to be aware of links between diet and disease, such as health problems associated with inadequate intake of calcium or fibre (Morton & Guthrie, 1997).

2.5.6 Nutritional consequences of employment or occupation status

Data collected from the 1989-1990 Life in New Zealand national survey (LINZ89) revealed a correlation between employment status and food choice. Unemployed adults (15 years or older) were found to consume foods that were cheaper and more traditional than those foods consumed by employed (Horwath et al., 1991). Dietary data was gathered from a subsample of the population surveyed with a 24-hour diet recall and a qualitative food frequency questionnaire. Employed adults were found to consume more regularly foods like steak, wine, speciality cheeses, pate, grapes and avocados. Gender differences were reported, with unemployed men consuming less energy than employed men and unemployed women consuming more energy than employed women. Unemployed women consumed a higher percentage of energy from fat than employed women and had a higher mean BMI (Horwath et al., 1991). Unemployed respondents in this study were more likely to report money as the main reason for changes in diet (Horwath et al., 1991).

Occupation and employment status has been shown to be a stronger predictor of micronutrient intake than income in a study 874 Australian adults (Smith & Baghurst, 1993). A positive linear relationship was found between occupational status and vitamin C, beta-carotene, thiamin, folate, zinc, iron, magnesium and potassium density. However, people in lower occupational status groups were found to consume more retinol than those in higher status groups (Smith & Baghurst, 1993). Similar findings have been reported in the Scottish Heart Health Study, which found that those in higher-ranked occupations consumed more beta-carotene, vitamin C and vitamin E, but less retinol (Bolton-Smith et al., 1991).

A link between social status and intake of certain food groups has also been documented in Australia (Smith & Baghurst, 1993). Social status was determined by the level of occupational prestige, education level and income level of participants (Smith & Baghurst, 1993). Lower social-status groups were found to consume greater amounts of white breads, refined cereal foods and meats than those in higher status groups (Smith & Baghurst, 1993). Greater consumption of fruit, vegetables and wholegrain cereals was found to be responsible for the higher micronutrient intakes observed in higher social-status groups compared to lower social-status groups (Smith & Baghurst, 1993).

There is a growing trend both overseas and in New Zealand for both parents to be in the work force (Johnson et al., 1993; Statistics New Zealand, 1996; Petrie & Wright, 2001). The rate of maternal employment in 1996 for two-parent families with children was 61.3 % (Statistics New Zealand, 1996). Pacific children were more likely than any other ethnic group to have mothers in full-time work, and European children were less likely than other ethnic groups to have mothers in full-time employment (Statistics New Zealand, 1996). Mothers of European children were more likely to be in part-time work than children of other ethnic groups. Although not proven in research, it seems possible that the increase in maternal employment may result in less time being spent in the kitchen preparing meals for the family. Subsequently, it is possible that children may be eating more takeaway foods and convenience foods, which are not nutrient dense (Johnson et al., 1993). An increase in the number of American mothers in employment with children under the age of six has been observed (Johnson et al., 1993) and New Zealand statistics are showing the same trend. A 14% increase in the number of children aged between 1 and 4 years whose mothers were in part-time or full-time employment was observed between 1986 and 1996 (Statistics New Zealand, 1996).

2.6 Prevalence of Food Insecurity

Overall, the prevalence of food insecurity in developed countries appears to be greatly increasing, with the exception of the United States where substantial efforts to reduce levels of food insecurity appear to have resulted in a plateau in the prevalence of food insecurity (Bickel et al., 2000).

2.6.1 Food insecurity in the United States of America

Food insecurity has been extensively researched in the United States, where novel indicators of measuring food insecurity were developed and then introduced into national surveys conducted in 1995, 1996, 1997, 1998, 2000, 2001 and 2002.

In 1995, the United States Department of Agriculture estimated that 12% of households were food insecure, 3.3% were moderately hungry and 0.8% were severely hungry (Carlson et al., 1999; Alaimo et al., 2001b). In households experiencing hunger, a reduction in food intake was observed for both children and adults, but more commonly in adults (Carlson et al., 1999). In 1998, the United States Department of Agriculture estimated that 10% of households were food insecure and about 8% of 12-year-olds in the United States were food insecure (ADA, 1999b; Alaimo et al., 2001c). During 2002, 11% of American households were considered to be food insecure at least some time during the year, while 3.5% of households were food insecure with hunger, according to data obtained from the December 2002 food security survey (Nord et al., 2003).

The average percentage of the total USA population considered to be food insecure, with or without hunger, was 11.3% between 1996 and 1998, compared to an average of 10.8% reported between 2000 and 2002 (Nord et al., 2003). However it is difficult to compare trends in prevalence rates of food insecurity due to differences in the way food insecurity was measured by investigators.

2.6.2 Food insecurity in Australia

It is thought that more than 5% of the general Australian population was food insecure in 1995 (Booth & Smith, 2001; Wood, 2002). The 1995 Australian National Nutrition Survey (NNS95) interviewed 13,800 people aged 16 years and over and found that 5% of respondents were food insecure based on their response to the question *"In the last 12 months, were there any times that you ran out of food and couldn't afford to buy more?"* (Booth & Smith, 2001). This question is similar to one of the questions in the USA 18-item food secure measure, and the validity of this question as a measure of food insecurity in Australia could be questioned. It is perhaps more of an indicator of risk than a measure of food insecurity. In 1996, it was estimated that 630,000 Australian children were living below the poverty line (Booth & Smith, 2001). It should be considered that the Australian NNS95 did not include homeless people in the sample, so this figure is likely to underestimate the true prevalence of food insecurity in Australia. Australians at higher risk of being food insecure were those living in remote areas, Aborigines and Torres Strait Islanders, street drug users and those on low incomes. Single-person households, unemployed people, disabled people, some immigrants, the elderly and young people were also found to be at risk of food insecurity (Booth & Smith, 2001).

2.6.3 Food insecurity in New Zealand

The 1997 National Nutrition Survey (NNS97) provided valuable information on the nutritional status of 4,636 New Zealand adults aged 15 years and above. Food insecurity was reported in 12% to 14% of the adult participants (Russell et al., 1999). A large proportion of respondents (27%) said they limited the types of foods they ate due to lack of money (Russell et al., 1999). The methodology and results of the NNS97 are further discussed in Section 2.7.

Children aged 0 to 14 years represented 23% of the total New Zealand population in 1996 (Statistics New Zealand, 1996). The prevalence of food insecurity in New Zealand children is currently unknown until the results of the National Children's Nutrition Survey are published, but there is evidence in smaller-scale studies to suggest that it does exist.

In 1994, the Public Health Commission funded a survey involving school teachers to try to assess the prevalence of hunger in school children in New Zealand (Food and Nutrition Consultancy Service, 1995). The incidence of perceived hunger was based on the school teacher's estimation of the number of children who went to school without breakfast and/or without lunch. Analysis of the data indicated that 22,600 children (3.4%) did not have enough food to eat at school and 60,000 children (9%) did not have breakfast before attending school. Children from state and state-integrated schools were more likely to experience hunger or go to school without breakfast than children from private schools. Significantly greater percentages of children from secondary schools experienced hunger than children at primary or composite schools. It was noted that more Maori and Pacific children experienced hunger, but no data was recorded on the socio-economic status of children in this study (Food and Nutrition Consultancy Service, 1995). Also, the nutritional status of children perceived as being hungry, compared with those who were not considered hungry, was not explored in this study.

A study of 108 families living in high-poverty areas in Auckland in the early 1990s reported 72% were food insufficient (Hodges et al., 1998). This condition is indicated by the increase in the number of Salvation Army food banks in New Zealand over the last decade (Hodges et al., 1998; Parnell et al., 2001). There is evidence that most of the people relying on food banks have children, (Hodges et al., 1998) and New Zealand children are four times more likely to encounter poverty than the elderly (Ministry of Social Development, 2002). The first Children's National Nutrition Survey, conducted during 2002, will provide information on the incidence of food security in 3000 children aged 5 to 14 years. A pilot for the Children's National Nutrition Survey, involving children aged 1 to 14 years, was conducted in 2000. This was done in two stages. Firstly, a validation study was conducted, in which dietary methods were validated. These were then tested in a pre-testing study. These studies are the first to provide evidence that some New Zealand children are experiencing food insecurity. Of the 121 respondents in the validation study, 15 said they had experienced hunger at some stage in the past week or month due to a household lack of food (Watson et al., 2001). Data from the validation study has been extensively analysed and is presented in the results section of this thesis.

2.6.4 Food insecurity in the United Kingdom

A recent but small study in the United Kingdom has indicated that food insecurity is highly prevalent amongst newly arrived asylum seekers in London (Sellen et al., 2002). This study involved 30 refugee families with children under the age of 5 years, who had been living in the UK for less than 2 years. Information was obtained via questionnaires and childhood hunger was determined by a 10-item version of the Radimer/Cornell food security scale. All 30 households were considered to be food insecure and 60% of the preschool children had experienced hunger at some stage (Sellen et al., 2002). Childhood hunger was linked to those families not receiving benefits. It was also marginally linked to younger parenthood, although the significance of the socio-demographic factors investigated in this study was limited by the small sample size.

2.6.5. Food insecurity in Finland

Data taken from the 1994 Survey on Living Conditions in Finland was used to estimate the prevalence of food insecurity amongst Finnish working adults aged 25 to 64 years (Sarlio-Lahteenkorva & Lahelma, 2001). The sample included 6,506 Finnish men and women, and food insecurity was measured according to responses to the following questions:

1. *"Have you had fears of running out of food before you have money to buy more?"*
2. *"Have you run out of money to buy food?"*
3. *"Have you had too little food due to economic problems?"*
4. *"Have you bought cheaper food than you normally buy?"*
5. *"Have you been without food at least a day due to economic problems?"*

Eleven percent of respondents had run out of money to buy food during the previous 12 months, and 2% had gone without food for at least one day (Sarlio-Lahteenkorva & Lahelma, 2001). Low household income was associated with the incidence of food insecurity, however the five-item indicator of food insecurity in the Finnish population has not been validated.

2.7 Socio-economic status of food-insecure households

There is now a growing body of evidence that lower socio-economic status constrains the ability of households to participate in healthy eating behaviours and increases the risk of exposure to household food insecurity. However, early studies conducted overseas present conflicting results. In the United States, a group of researchers led by Alaimo (1998) set out to establish if there was a relationship between socio-demographic variables and food insufficiency. The researchers analysed data from the NHANES III study, and concluded that food insufficiency was not limited to very low-income persons, certain ethnic groups or unemployed families (Alaimo et al., 1998). This is consistent with the findings of Tarasuk & Beaton, (1999) who reported the incidence of hunger in a group of women to be independent of economic, socio-cultural and behavioural influences. Nevertheless, data from the NHANES III study revealed that food insufficiency was positively related to poverty status, and that in those on low incomes, food insufficiency was associated with being Mexican American, not having health insurance, receiving the Food Stamp Program, being under the age of 60 and belonging to a family whose main provider had not completed high school (Alaimo et al., 1998). Further analysis of the NHANES III data revealed that food-insufficient children were more likely than food-sufficient children to be from low-income households, born to young mothers, or from families where the head of the family was not married, was unemployed, or did not have a high school education (Alaimo et al., 2001c).

The first study in New Zealand to indicate that food insecurity exists in some households was undertaken in 1994 and involved 40 households reliant on Government welfare benefits (Parnell, 1997). The study involved a questionnaire to obtain information on income and expenses, food-buying habits, and concerns about food sufficiency and health. The researcher restricted the study to Caucasian households living in Auckland and Dunedin. This was done for two reasons: Caucasians are the main ethnic group in New Zealand, and the researcher felt it would be difficult to involve a mixed ethnic population in such a small study (Parnell, 1997). These are valid statements, but it is evident from the results of the adult NNS97 that Maori and Pacific people are more at risk of being food insecure. Thus it is important for future research to study and monitor food insecurity in these groups of people.

In Parnell's study (1997), responses to questions on food availability indicated that at least one-third of households frequently did not have enough money to buy food, and 40% had daily concerns about providing their household with food. As a result, two-thirds of households in the study were surviving on a limited variety of foods. The average number of people living in these households was 3.8, and the average number of children was 2.3. The majority of households were headed by a single parent, with only 37% of households having a male partner or spouse. Most of the household shoppers purchased food once every two weeks from a supermarket, and the majority obtained some food from relatives, friends or a food bank (Parnell, 1997). This study was the first to link food insecurity in some New Zealand Caucasian households with low socio-economic status, which in the study was characterized by single-parent households with children who are reliant on Government welfare benefits.

The 1997 New Zealand National Nutrition Survey (NNS97) involved a self-administered qualitative food frequency questionnaire that covered eight questions on household food security (Russell et al., 1999). Measures of food insecurity in New Zealanders had never been validated before, and appropriate food insecurity indicators had to be developed and validated for inclusion in the NNS97. Indicators of food insecurity in the New Zealand adult population used in the NNS97 were developed by Jenny Reid, nutritionist for the Australian and New Zealand Food Authority (Ministry of Health, 1997b; Parnell et al., 2001).

The development of a measure of food insecurity in adult New Zealanders involved four main stages (Ministry of Health, 1997b; Parnell et al., 2001). Firstly, a literature review was conducted in which the main aspects of food insecurity relating to the accessibility of food, as described in other developed countries, was determined. Next, five focus groups of 8 to 16 women and men on low incomes or government benefits were set up, so that issues regarding coping strategies with regards to providing food for their household could be examined. Each focus group included Maori, European, Pacific and other ethnic groups, but it was noted that elderly were underrepresented in the focus groups. Five key issues arose from analysing the experiences of these New Zealanders on low incomes coping with food shortages. The five key issues related to food insecurity, food inadequacy, coping strategies, alternative sources of food and cultural issues. Next, indicator statements to cover these five key issues were developed and reviewed by the National Nutrition Survey Technical Advisory Committee and other researchers. As a result, nine food insecurity statements, designed to provide information on the effect of limited income on food acquisition and the prevalence of food insecurity in New Zealand households, were chosen to be pre-tested on a group of 300 adults aged 15 years and older (Ministry of Health, 1997b; Parnell et al., 2001). Eight of these statements were found to be acceptable to both the interviewer and respondents and were finally included in the NNS97 as presented in Table 2.5. The response options to Statement 1 were, "always, sometimes, never", and response options for Statements 2 through 8 were, "often, sometimes, never".

Table 2.5: Statements 1-8 and corresponding results

Food security statement	Prevalence in NZ	Ethnic, Gender & Quartile differences
I/we can afford to eat properly.	13% (13% sometimes,0% often)	NZ Maori, Pacific > European and Others Females > Males Younger > Aged NZ Dep96 quartile IV > I-III
Food runs out in my/our household due to lack of money.	14% (12% sometimes,2% often)	Pacific > NZ Maori > European and Others Females > Males Younger > Aged NZ Dep96 quartile IV > I-III
I/we eat less because of lack of money.	13% (12% sometimes,1% often)	NZ Maori, Pacific > European and Others Females > Males NZ Dep96 quartile IV > I-III
The variety of food I am (we are) able to eat is limited by a lack of money.	27% (22% sometimes,5% often)	Pacific, NZ Maori > European and Others Males, Females equally affected Younger > Aged NZ Dep96 IV > I-III
I/we rely on others to provide food, and/or money for food, for my/our household when I/we don't have enough money.	7% (6% sometimes,1% often)	Pacific, NZ Maori > European and Others Females > Males Younger > Aged NZ Dep96 IV>I-III
I/we make use of special food grants or food banks when I/we do not have enough money for food.	4% (4% sometimes,0% often) (2% Males, 5% Females)	NZ Maori, Pacific > European and Others Females > Males Younger > Aged NZ Dep96 IV > I, II
I feel stressed because of not having enough money for food.	12% (10% sometimes,2% often)	Pacific, NZ Maori > European and Others Females > Males Younger > Aged NZ Dep96 IV > I
I feel stressed because I can't provide the food I want for social occasions.	13% (11% sometimes,2% often)	NZ Maori, Pacific > European and Others Females > Males Younger > Aged NZ Dep96 IV > I-III

An index of deprivation (NZ Dep96 quartile) was created that took into account eight factors of deprivation: income, access to a telephone, employment, transport, support, qualifications, home ownership and living space (Russell et al., 1999). Results were then split into four categories, quartile I referring to individuals living in the least-deprived areas and quartile IV as individuals living in the most-deprived areas. In summary, the NNS97 provided evidence that food insecurity was more prevalent in deprived, or quartile IV, areas of residence (Russell et al., 1999).

2.7.1 Age, gender, ethnicity and food security status

The literature suggests that food insecurity tends to be more prevalent in households with children (McIntyre et al., 2002), in women (McIntyre et al., 2002; Wood, 2002) and in the elderly population (Alaimo et al., 1998; Lee & Frongillo, 2001; Sahyoun & Basiotis, 2001). Food insecurity has a higher prevalence in ethnic groups that are over-represented among lower socio-economic groups of the population (Russell et al., 1999).

Until recently, efforts to increase food security have been focused at the elderly, as this nutritionally vulnerable group of the population has been known to be exposed to food insecurity (Lee & Frongillo, 2001). However, analysis of the USA NHANES III data and the 1998/1999 Canadian National Population Health Survey found a higher prevalence of food insufficiency and food insecurity in families with children than those aged 60 years and older (Alaimo et al., 1998; McIntyre et al., 2002). More recent analysis of data from the USA Current Population Survey conducted in 1995, 1997 and 1999 has found age to have a nonlinear effect on food insecurity, with older people being less likely to be food insecure or experience hunger than adults under the age of 35 years with families. Adult males were also found to be less likely than females to be food insecure (Opsomer et al., 2003).

In New Zealand, women were more likely than men to be food insecure according to data obtained from the NZ NNS97 (Russell et al., 1999). And in Australia, 58% of those who were food insecure were women, according to the

Australian NNS95 (Wood, 2002). Sixteen percent of the New Zealand women respondents sometimes or often ran out of food in their household due to lack of money (Russell et al., 1999). The NZ NNS97 provided evidence that food insecurity was more prevalent amongst those aged 19 to 24 years and amongst Maori and Pacific people (Russell et al., 1999). The Australian NNS95 reported a higher incidence of food insecurity amongst those aged 16 to 24 years, at 28%, and those aged 25 to 44 years, at 53% (Wood, 2002).

The association between ethnicity and food insecurity may be partly due to language and cultural differences, which may limit food choices and possibly increase household grocery expenditures (Rose, 1999). Studies in the United States have found higher rates of food insecurity in Hispanic households and amongst Spanish-speaking Americans than non-Hispanic or English-speaking Americans (Alaimo et al., 1998; Rose, 1999). The NHANES III study found a higher prevalence of food insufficiency among Mexican Americans and non-Hispanic Black Americans than non-Hispanic White Americans (Alaimo et al., 1998). Analysis of data from the 1985 to 1986 USDA Continuing Survey of Food Intakes found that black individuals were more likely to be food insecure than non-black individuals (Blaylock & Blisard, 1995). Data from three large-scale surveys (CSFII) conducted in 1994, 1995 and 1996 in the USA reported a higher incidence of food insecurity among African-Americans than Caucasians (Townsend et al., 2001). However, after adjusting for income and education, the effect of ethnicity on food insecurity is not likely to be as strong as indicated by these studies.

2.7.2 Housing arrangement and food security status

Homeless people tend to be more frequent clients of food banks, and have been recognized as a particularly nutritionally vulnerable group who are likely to be at risk of food insecurity (Cohen et al., 1992; Booth & Smith, 2001).

It seems logical that an increase in household size would place further constraints on disadvantaged families' ability to provide for their children. Food insecurity has been shown to be statistically associated with larger-sized households with children (Alaimo et al., 1998; Rose, 1999; George & Daga, 2000; Casey et al., 2001; Dunifon & Kowaleski-Jones, 2003), although other studies have not found an association between household size and food insecurity (Blaylock & Blisard, 1995; Sellen et al., 2002). A possible explanation for this is that larger-sized households may include pensioners, who may provide both an extra source of income and nutritional and culinary knowledge that could improve food security to these families. The lack of correlation between household size and food insecurity as reported by Sellen and colleagues (2002) is likely to be due to the small sample size being inadequate to allow statistical analysis.

Housing tenure is known to affect household food security status (Townsend et al., 2001; Vozoris & Tarasuk, 2003). Over half of food-insecure Australians were paying rent and living in socially disadvantaged areas (Wood, 2002).

Several studies have documented relationships between marital status and food security (Alaimo et al., 2001c; McIntyre et al., 2002; Mishra et al., 2002). Single-headed households or single parents with dependent children are more likely to be food insecure. Consistent with this analysis, food insecurity was found to be positively associated with being unmarried according to analysis of the data from the 2000 California Women's Health Survey, (CWHS) where food security was measured using the USDA food security scale (Dumbauld & Baumrind, 2002). This area deserves further research in light of the growing trend of single-headed households in developed countries including New Zealand (Hodges et al., 1998).

2.7.3 Poverty, household income and food security status

In 1997, it was estimated that up to 11% of the New Zealand population was living in poverty (Parnell, 1997). It has been shown that after controlling for socio-economic variables like ethnicity and education, families in poverty are more than 3.5 times more likely to be food insufficient than families with incomes above poverty thresholds (Rose, 1999). In 1999, it was estimated that 42% of American children living in households at or below the poverty line experienced food insecurity (Andrews et al., 1998; Andrews et al., 2000). However, using poverty as an indicator of food insecurity may not be justified, as some food insecure households are not in poverty, and likewise some poverty-stricken households are food secure (Bickel et al., 2000). Results from the 1992 United States Survey of Income and Program Participation (SIPP) found that 53.3% of food-insufficient households were above the poverty threshold (Rose, 1999). It has thus been suggested that the poverty index ratio is not a good indicator of food insecurity, even though food insecurity and hunger arise from constrained financial resources (Rose, 1999; Bickel et al., 2000). Poverty measures generally do not provide concise information about food security status, because they do not take into consideration variations in the cost of housing, food or health care. These factors can lead to short-term food insecurity in some households (Rose, 1999; Bickel et al., 2000).

Income has been well established as an important determinant of food insecurity (Sarlio-Lahteenkorva & Lahelma, 2001; Townsend et al., 2001; Dunifon & Kowaleski-Jones, 2003; Opsomer et al., 2003). New Zealand data from the NNS97 found income to be a risk factor for food insecurity, with 10% of respondents not being able to afford to eat properly and 25% of respondents stating that the variety of foods they ate was limited by income (Russell et al., 1999). Food insufficient children have been found to be more likely than food sufficient children to live in low-income families (Alaimo et al., 2001b; Alaimo et al., 2001c). Data from the NHANES III survey reported that 98.6% of food-insufficient families went without food due to a lack of money (Alaimo et al., 1998). Further analysis of the data collected from the American NHANES III study revealed that 15.8% of children aged between 2 and 7 years who were food insufficient were from low income families. Only 1.8% of food insufficient children in this age group were from middle-income families, and 0.3% were from high-income families (Alaimo et al., 2001b). The same trend was observed in food-insufficient children aged between 8 and 16 years, and the researchers concluded that food insufficiency is more likely to exist in low-income families (Alaimo et al., 2001b).

Although households with small incomes are more likely to be food insecure, food insecurity is not entirely confined to low-income groups (Bickel et al., 2000; Opsomer et al., 2003). George and Daga (2000) studied the prevalence of food insecurity and its associated socio-demographic variables among young children living in Mumbai, India. This was a cross-sectional study involving 122 pre-school children from 450 families selected from a group of 'D-class' hospital employees. At least half of the families were considered food insecure or calorically insecure. Unlike in previous studies, food security was determined by whether the children were calorically secure. A 24-hour recall with a one-day weighed food record was undertaken to determine the calories consumed by children. Ratios of calories consumed to calories recommended were then calculated by the researchers. Food security was defined by the researchers as a ratio of 0.8 and above (George & Daga, 2000). A significant association between per capita monthly income and food security status was reported ($p = 0.01$, odds ratio 2.45). The researchers found that 46% of the preschool children from food-secure households were actually food insecure due to poor calorie intake. This finding of food insecurity among children from food-secure households is a concern that needs to be addressed by further studies.

2.7.4 Household food expenditure and food insecurity

The work by Cristofar and Basiotis (1992) further supports that weekly income and food expenditures are lower in food-insecure households. However, data from the Australian NNS95 indicated that compared to food-secure households, food-insecure households bought more expensive food items, such as ready-to-eat foods, snack foods, soft drinks, meat pies, hamburgers, sausage rolls and refined sweet foods like cakes and pastries, rather than cheaper meat alternatives and fresh produce (Mishra et al., 2002; Wood, 2002). This may suggest that poor budgeting and cooking skills are an underlying cause of food insecurity.

Food-insecure households were more likely to live in rural, poor areas and have to travel further to a supermarket than those living in urban areas (McGrath-Morris et al., 1992). Food-insecure households were more likely to buy groceries from smaller food stores than supermarkets (McGrath-Morris et al., 1992). In the United States, the cost of groceries was reported to be higher, and the range of fresh foods less, in food stores compared with supermarkets (McGrath-Morris et al., 1992). This observation is thought to in part account for the low intake of fresh produce and low intake of vitamin C, iron and vitamin A observed in the diets of the food insecure (McGrath-Morris et al., 1992).

2.7.5 Education and food security status

A link between food insufficiency and educational status was found in the data obtained from the 1977-1978 USA Survey of Food Intake of Individuals and the USA 1988-1994 NHANES III study (Chavas & Keplinger, 1983; Alaimo et al., 1998). Food-insufficient families were more likely to have a family head that did not graduate from high school than food-sufficient families (Chavas & Keplinger, 1983; Alaimo et al., 1998; Alaimo et al., 2001c). The 1985 to 1986 USDA Continuing Survey of Food Intakes, involving low-income women aged 19 to 50 years, reported a lower incidence of food insecurity in women who were more educated (Blaylock & Blisard, 1995). Almost half of Australians classified as food insecure in the NNS95 did not complete secondary school (Wood, 2002).

Recent studies have further supported a link between education and food security status in children. Preschool children with mothers who had a secondary education were significantly more likely to be food secure then children with mothers of a lower education level in India (George & Daga, 2000; (Nnakwe &

Yegammia, 2002). A cross-sectional survey of 239 Mexican-American families with preschool children reported a higher incidence of food insecurity in those families with less education (Kaiser et al., 2002). Data analysis from the USA Current Population Survey conducted in 1995, 1997 and 1999 (Opsomer et al., 2003) and the 2000 California Women's Health Survey (Dumbauld & Baumrind, 2002) found those with lower education levels were more likely to be food insecure.

Education is not often considered in studies of consumer food practices, and most studies in this area employ other indicators of social class, such as occupation or employment status (Morgan, 1986; Rose and Oliveira, 1997; Begin et al., 1999). There is a lack of literature on the role of education in food-insecure households. More research is needed to find out if factors such as poor budgeting and cooking skills and inadequate storage facilities impact on the ability of food-insecure households to provide nutritionally balanced meals. As food-insecure households tend to be low-income families, a lack of nutritional knowledge in conjunction with limited access to a variety of foods may further contribute to the poor nutritional status observed in food-insecure people. However studies of food-insecure populations in the UK (Dowler & Clavert, 1995), the USA (Radimer et al., 1992) and in Canada (Tarasuk, 2001) report financial restraint rather than lack of nutritional or budgeting knowledge to be the reason behind the poor nutritional status of the food-insecure.

2.7.6 Employment and food security status

A link between household food insecurity and unemployment has been observed in several studies (Kendall et al., 1995; Sarlio-Lahteenkorva & Lahelma, 2001; Dumbauld & Baumrind, 2002). Of those Australians that were classified as food insecure in the NNS95, 16% were unemployed and 30% had a low-income job (Wood, 2002).

2.8 Nutritional status of food-insecure households

Food insecurity has been associated with limited food intake, and thus it is likely that nutrient intakes may suffer (Bell et al., 1998; Tarasuk, 2001). Overall, there is limited research on the nutritional status of food-insecure children. Currently data does not exist on a national level on the nutritional impact of food insecurity in New Zealand children. However, the nutritional impact of food insecurity in the United States has been researched.

2.8.1 Poor diet and nutrient intake

It is difficult to determine accurately if food insecure households consume more or less nutrients than food-secure households, because of the periodic nature of food insecurity and hunger. Food insecurity or hunger may not exist on a regular basis in some households. Hence data taken from interviews may not represent true nutrient intakes if the interview took place shortly after a household experienced a bout of food insecurity or hunger. The methods chosen by researchers may also influence the observation of differences in nutrient intake between food-insecure and food-secure subjects, leading to inconsistencies between studies. This may explain why although most studies report that food-insecure individuals consume fewer nutrients than food-secure individuals (Cristofar & Basiotis, 1992; Rose & Oliveira, 1997; Tarasuk & Beaton, 1999; Tarasuk, 2001), some studies have not reported any significant differences in intakes of certain nutrients (Rose, 1999; Tarasuk & Beaton, 1999). These studies will now be discussed in more detail.

The link between food-insufficiency and nutrient intake in high-risk individuals such as adult women and preschool children was first explored by Cristofar & Basiotis (1992). They analysed data collected on 1,930 children and 3,398 women from the 1985 to 1986 Continuing Survey of Food Intake by Individuals (CSF II). Dietary intake data was obtained by personal interview and a 24-hour dietary recall (Cristofar & Basiotis, 1992). Food-insufficient women had lower mean food intakes for 13 main food groups compared to food-sufficient women

(Cristofar & Basiotis, 1992). The mean food intake of children from food-insufficient households was lower than for children from food-sufficient households. In particular, intake of fruit, vegetables, cream and milk desserts was lower in food-insufficient children. Also, food-insufficient children had lower energy, carbohydrate, dietary fibre, vitamin C, carotene and folic acid intakes than food-sufficient children. However, the early finding of Cristofar and Basiotis (1992) has been criticized by Rose and Oliveira (1997), as it was not based on multivariate analysis and thus is subject to confounding socio-demographic variables that could have affected nutrient intake more than being food-insufficient.

Rose and Oliveira (1997), analysed data taken from the 1989 to 1991 Continuing Survey of Food Intake by Individuals (CSFII). This survey was based on two independent stratified and clustered samples of households encompassing different income groups including low-income groups from various states in the United States. Dietary information was obtained from 1,379 preschool children (1 to 5 years old), 3,764 adult women (aged 19 to 50 years) and 2,215 elderly individuals (aged 65 years and older). Dietary analysis was based on a single 24-hour recall. Households were classified as food insufficient if they answered affirmatively to whether they sometimes or often did not get enough food to eat. The researchers then set up linear and logistic regression models that controlled for confounding variables like ethnicity, age of household head, household size, income, home ownership, education status and participation in food assistance programs in order to determine mean differences in intakes between food-insufficient and food-sufficient individuals (Rose & Oliveira, 1997). Adult women of food-insufficient households were found to have significantly lower weighted mean intakes of energy, protein, calcium, magnesium, vitamins A, E and C, riboflavin, and niacin than adult women of food-sufficient households (p value < 0.05). Food-insufficient women were found to be 1.4 times more likely than food-sufficient women to have energy intakes less than 50% of the recommended energy intake. This is consistent with the low energy intake reported by Cristofar and Basiotis (1992). Logistic regression analysis, however, did not show a significant association between food insufficiency and low protein, calcium or riboflavin in adult women. Food-insufficient women were found to be 1.83 times more likely to have low intakes of vitamin C, 1.61 times more likely to have low intakes of vitamin A, and 1.52 times more likely to have lower intakes of vitamin E (Rose & Oliveira, 1997).

Rose and Oliveira (1997) found that out of the three groups studied, the strongest association between poor nutrient intake and food insufficiency was seen in the elderly group. Elderly individuals of food-insufficient households were significantly more likely to have lower mean intakes of energy, calcium, folate, zinc, and vitamins A, E, B2 and B6. Elderly people from food-insufficient households were nearly three times more likely to have lower intakes of protein and vitamin A than food-sufficient elderly people in this study (Rose & Oliveira, 1997).

The mean intake of vitamin E and zinc in food-insufficient preschoolers was found to be at 71% and 63% of the recommended dietary allowance for these nutrients respectively (Rose & Oliveira, 1997). However, no significant differences in intake of other nutrients were reported among the 1,379 preschoolers from food-insufficient households. This pattern is in agreement with the findings of Cristofar and Basiotis (1992). It has been suggested that mothers may be going without food themselves so that they have enough food to give to their children (Rose & Oliveira, 1997) and this have been reported in other studies (Kempson et al., 2002). Another possible reason for no differences being observed in children's nutrient intake with respect to food security status may be due to reporting errors as the dietary intake was based on a single 24-hour recall and underreporting is a common problem in dietary surveys (Rose & Oliveira, 1997). Although food-insufficient preschoolers were not found to be significantly more likely than food-sufficient preschoolers to consume less than 50% of the RDA for any nutrient, the researchers did report that hardly any of the preschoolers had nutrient intakes below the 50% cut-off (Rose & Oliveira, 1997). This may have produced unstable estimates of adjusted odds ratios.

Nutrient inadequacy has been reported in a small study of 153 women in families living in Toronto, whose reliance on emergency food-relief programs such as food banks was used as an indicator of food insecurity in the study (Tarasuk & Beaton, 1999). These women were classified by degree of food insecurity based on the USA Food Security Module and Radimer/Cornell measure. The food-insecure women living in Toronto were also found to be at an increased risk of vitamin A deficiency and at risk of other nutrient deficiencies like iron and folate (Tarasuk & Beaton, 1999). Tarasuk and Beaton (1999) concluded that the differences in nutrient intake observed between food-insecure women and food-secure women were related to lower food intakes and not to differences in food selection patterns. Nutrient intake was measured by three 24-hour dietary intake recalls.

There is substantial evidence that those who are food insecure tend to have low fruit and vegetable and fibre intake (Smith & Baghurst, 1993; Kendall et al., 1996; Spannaus-Martin et al., 1997; Quan et al., 2000; Kaiser et al., 2002). A significant decline in the frequency of consumption of fruits and vegetables and low intake of associated nutrients (potassium, vitamin C and fibre) was first reported in a small group of food-insecure women living in New York (Kendall et al., 1996). More recent studies in the United States and Canada have shown increasing levels of food insecurity to be associated with declining intake of meats and milk (Tarasuk, 2001; Kaiser et al., 2002). Mexican-American preschool children from food-insecure households were significantly less likely to meet Food Guide Pyramid guidelines than children from food-secure households (Kaiser et al., 2002).

Similar findings have been documented in the research by Parnell (1997). In the study of 40 households receiving Government welfare benefits, up to 40% were at risk of being food insecure (Parnell, 1997). This study involved a series of quantitative 24-hour dietary recalls on the female head of each household and two diet recalls were done on other members of the household. Anthropometric measurements were also recorded. Dietary recall data indicated that adult energy intakes were at the lower level of recommended intakes but percent energy from fat was greatly above recommended levels (Parnell, 1997). Data also indicated that adult females were not meeting the recommended intake of iron and calcium. Calcium intakes were also below recommended levels for all children involved in this study. The number of children participating was unfortunately small, at 87. Households did not meet the recommended daily levels of intake of fruit or dairy products. The majority of women in this study frequently limited their portion size so they could feed their children. The mean body mass index for adult women in this study was 28, which exceeded the average BMI value of 24.7 for New Zealand women. More than 40% of adult women in this study who were on welfare benefits were considered obese (BMI greater than 30) and another 22% were considered overweight (Parnell, 1997). This study was the first to link poor nutritional status and health status in food-insecure New Zealand women (Parnell, 1997).

More recent New Zealand data from the NNS97 indicated that food-insecure adults had low of intakes of several nutrients and poor fruit and vegetable intake (Russell et al., 1999). Those classified as food insecure were more likely to be living in the most deprived areas of residence, a factor that was associated with poorer dietary intake. Reported differences in nutrient intake included very low intakes of vitamin A, riboflavin and dietary fibre observed in those living in the most deprived areas of residence (NZDep96 quartile IV areas) compared to those living in less deprived areas (NZDep96 quartile I areas) (Russell et al., 1999). Individuals living in the most deprived areas of residence had significantly lower median intakes of calcium (males 781mg; females 632mg), folate (males 268 mcg; females 201mcg), glucose (males 18g; females 16g) and fructose (males 19g; females 17g) compared to intakes of calcium (males 885mg, females 733mg), folate (males 287mcg; females 227mcg), glucose (males 25g; females 19g) and fructose (males 27g; females 20g) of those living in the least deprived areas. The low calcium, folate, glucose and fructose intake is likely to reflect poor dairy and fruit intake (Parnell et al., 2001; Russell et al., 1999).

2.9 Health consequences of food insecurity

If food insecurity is associated with poor nutritional status, it seems likely that adverse health outcomes may also be linked to food insecurity. Studies have found food insecurity to be associated with poor health status, but it is also possible poor health status may be a contributing factor to the occurrence of food insecurity, as health problems may limit the ability of individuals to obtain a nutritionally adequate diet (Tarasuk, 2001). It is also possible the relationship between food insecurity and health may be due to a third factor, such as social isolation (Hamelin et al., 1999). Further research is still needed to clarify the relationship between food insecurity and health consequences.

2.9.1 Poor health status

Food insecurity has been associated with poor mental, social and physical health. Women in households receiving charitable food assistance in Toronto who had an activity-limiting chronic health condition or disability were more likely to have been food insecure over the last 30 days or year than women who did not have such health conditions (Tarasuk, 2001).

Food insecurity has also been associated with poor self-rating of health in women in several studies (Cristofar & Basiotis, 1992; Tarasuk, 2001; Dumbauld & Baumrind, 2002; Vozoris & Tarasuk, 2003). There is evidence that food-insufficient households are more likely to have less social support and more likely to feel socially isolated than food-sufficient households (Tarasuk, 2001; Vozoris & Tarasuk, 2003). As with health, it is possible that social isolation further increases the risk of food insecurity in a household as members in that household would not have access to social support networks that could provide food and other resources (Radimer et al., 1990). Alternatively, being food insecure can be socially isolating and precipitate ill health. The link between social support and food security needs to be further explored by researchers.

The results of a recent Canadian study of 3,204 food-insufficient households reported food insufficiency to be significantly associated with major depression and distress (Vozoris & Tarasuk, 2003). However, analyses was based on self-reported measures which introduces a variety of social response biases as food insecure individuals may not answer honestly to some questions.

A higher incidence of poor general health and physical health was recently reported in food-insecure women compared to food-secure women participating in the 2000 California Women's Health Survey (Dumbauld & Baumrind, 2002). Food-insecure women were more likely to suffer health conditions that affected their physical activity and were more likely to engage in behaviours that put them at risk of developing chronic diseases. More food-insecure women smoked cigarettes, engaged in binge drinking, had a non-normal weight and had not had a mammogram than food-secure women (Dumbauld & Baumrind, 2002).

Recent studies have further supported a link between food insecurity and poor health status. A larger-scale study of 210,377 households from 10 provinces in Canada who participated in the 1996-1997 National Population Health Survey (NPHS) reported food insufficiency in 3,204 households (Vozoris & Tarasuk, 2003). Individuals in food-insufficient households were significantly more likely to have multiple chronic medical conditions such as heart disease, diabetes and high blood pressure compared with individuals in food-sufficient households (Vozoris & Tarasuk, 2003). Also food-insufficient individuals were more likely to report to suffer from food allergies than food-sufficient individuals.

Food insecurity and persistent hunger have been reported to lead to poor health in children (Alaimo et al., 2001c). The USA NHANES III survey revealed that after controlling for age and poverty status, food-insufficient children were more likely than food-sufficient children to suffer from headaches and stomach aches, and preschool food-insufficient children had more colds per annum (Alaimo et al., 2001c).

Several associations between food insecurity and physical, mental and social health have been made in the literature. It is possible that household food insecurity predisposes individuals to poor health, but the opposite could also be true and well-controlled longitudinal studies are needed in order to understand why this relationship exists.

2.9.2 Impaired growth

There is evidence that children from families in poverty are at greater risk of impaired growth and delayed cognitive development (Brown & Pollitt, 1996; Willis et al., 1997). The link between food insecurity and growth in children in developed countries is not clear. A cross-sectional study of low-income Mexican-American children did not find any significant differences in weight and height status by level of food insecurity. However, this study was only carried out for one season of the year (Kaiser et al., 2002). It is possible that short exposures to food insecurity are unlikely to have a negative impact on growth.

Well-controlled longitudinal studies are required in order to establish if food insecurity can affect growth in children. Winicki and Jemison (2003) combined data from the Early Childhood Longitudinal Study (ECLS) with data from the 18-item food security module to see if food security had an effect on the physical size of children. No significant differences were found in height, weight or body mass index between food-insecure and food-secure children over the relatively short course of one year (Winicki & Jemison, 2003). It has been suggested that perhaps anthropometric measures are not good indicators of food insecurity, and the course of one year is too short to observe any effect (Winicki & Jemison, 2003). Because of the cyclic nature of hunger that can occur in food-insecure households, severe under-nutrition is unlikely to manifest unless the child is exposed to long and extended periods of food insecurity. Anthropometric measures are therefore unlikely to be significant in this population in this study.

2.9.3 Poor cognitive, academic and psychosocial development

It is plausible that food insecurity and under-nutrition can have a detrimental effect on the academic performance or learning behaviour of children (Alaimo et al., 1998; Olson, 1999b; Alaimo et al., 2001a). Hungry children find it harder to concentrate, which would negatively impact learning development (Winicki & Jemison, 2003). Hunger has been associated with poor psychological well-being in children (Murphy et al., 1998). In a study of 204 children from low-income families, hunger was assessed using the CCHIP scale and psychosocial problems were measured using The Pediatric Symptom Checklist (PSC) (Murphy et al., 1998). The PSC is designed to provide information on the psychological well-being of the child. For example, the parent may be asked if the child fights with other children or has difficulties with school teachers. Responses are rated with "never" being coded as zero and "often" being a two. Children that were classified as hungry or at risk of hunger had significantly higher mean PSC scores (Murphy et al., 1998).

The issue of whether or not food insecurity affects the school performance of children has been explored over the years, but most studies have been poorly designed. Most of the evidence comes from USA school meal programmes that were implemented shortly after the Second World War with the aim of improving school performance by alleviating hunger. Implementing school breakfast programmes has been found to positively affect student performance (Worobey & Worobey, 1999). An early evaluation of the American school meal programmes has provided some evidence that children who do not eat breakfast are more unsettled and disruptive in class, but all children in these programmes received meals, not just the economically deprived children (Read, 1973). In support of this finding, improvements in academic performance and a decrease in absenteeism and school tardiness were observed in a group of American children from low-income families who participated in a school breakfast program (Meyers et al., 1989). However, the validity of this research has been questioned as participation in this breakfast programme was voluntary and not random.

Food insecurity has been linked to emotional and psychological problems in children (Kleinman et al., 1998). Few studies have directly measured the effect of food insecurity on the academic development of children, but this is a growing area of research. Results from a recent study indicated that food-insufficient American children were more likely to have failed a grade at school and demonstrated lower arithmetic scores than food-sufficient children (Alaimo et al., 2001a). The relationship between food insecurity and academic achievement has recently been studied by Winicki and Jemison (2003). They were the first to combine longitudinal data with the 18-item food security module. Winicki and Jemison (2003) looked at data from the Early Childhood Longitudinal Study (ECLS) which involved 21,260 children attending kindergartens in 1998. At the start of the study, the average math score of children classified as food insecure was less than that obtained by food-secure children. Also, the average gain in math score for the year was greater for children living in food-secure households than children from food-insecure households (Winicki & Jemison, 2003).

Data from around 5,000 families participating in the 1997 Child Development Supplement of the Panel Study of Income Dynamics (CDS-PSID) has been analysed to see if there is a relationship between food insecurity and child well-being (Dunifon & Kowaleski-Jones, 2003). Food insecurity was measured using the 18-item USDA scale. Child well-being was assessed in three ways: the presence of health limitations affecting school performance or daily activities, behavioural problems, and cognitive ability or math and reading abilities. Food-insecure children were more likely to have health limitations affecting their ability to attend school than children from food-secure households. A significant correlation was found between children with health limitations and the number of hospital stays. An increase in level of household food insecurity was associated with decreased levels of positive behaviour based on the results of the Behavioural Problems Index, which considers the child's interaction with peers, bullying behaviour, moodiness and destructive behaviour. Unlike other studies food insecurity was not shown to significantly affect children's cognitive test scores and the researchers commented that this may be due to the very low percentage of respondents experiencing hunger as a result of food insecurity (Dunifon & Kowaleski-Jones, 2003). Food insufficiency in American adolescents has also been recently associated with depressive disorders and suicidal behaviours (Alaimo et al., 2002).

2.9.4 Obesity

Despite the growing amount of literature on childhood obesity, a consistent relationship between food insecurity and obesity in children does not appear to exist. Food-insecure children determined by the Radimer/Cornell scale tended to be more overweight than children from food-secure families, but no significant differences were found in the BMIs of the two groups of Mexican-American children (Kaiser et al., 2002).

Two different age trends in the incidence of obesity in food-insufficient American children have emerged from data collected in the 1988-1994 NHANES III study (Alaimo et al., 2001b). Food-insufficient girls aged 2 to 7 years were 1.6 times less likely to be overweight than food-sufficient girls of the same age group. The inverse relationship was observed in food-insufficient older girls. Food insufficient girls aged 8 to 16 years were 3.5 times more likely to be overweight than food-sufficient girls (Alaimo et al., 2001b). It should be noted that the term "food insufficiency" is thought to be closer to the term "hunger" than the term "food insecurity" and this observation may not have occurred had the children been categorized on food-security status. A disadvantage in analysing the NHANES III data is that sample sizes of children in different age groups were small.

Data on American children taken from the 1994-1996 CSFII reported that similar percentages of children in food-insufficient or food-sufficient low-income households were obese or underweight (Casey et al., 2001). Children from high-income food-sufficient households consumed more calories and total carbohydrates but had a lower cholesterol intake than children in low-income food-insufficient households (Casey et al., 2001). It was also noted that children from low-income food-insufficient households spent more time watching television and ate fewer helpings of fruit than children from high-income food-sufficient households (Casey et al., 2001). In this study, the 85th percentile was chosen as the BMI cut-off value. The CSFII survey may have underestimated the prevalence of food insufficiency as only one question was used to determine food insufficiency, compared to an 18-item scale used in other surveys to determine food security. In support of this idea a lower prevalence of food insufficiency is reported in CSFII 1994-1996 survey data compared to other national surveys around that time (Alaimo et al., 1998).

A stronger association between food insecurity and obesity in adult women has been reported in several studies (Olson, 1999b; Alaimo et al., 2001b; Adams et al., 2003). Adams and other researchers (2003) randomly selected a sample of 8,169 women aged 18 years or older from the 1998-1999 California Women's Health Survey and interviewed these women by telephone (Adams et al., 2003). Food insecurity was based on responses to four questions taken from the USA Household Food Security Module and obesity was defined as a BMI of equal to or greater than 30kg/m^2 (Adams et al., 2003). The four-question subset has not been validated, but the investigators found that food insecurity was significantly associated with increased risk of obesity, particular in Asians, Blacks and Hispanics, the risk being less for non-Hispanic Whites (Adams et al., 2003). These findings are consistent with results from another USA study (Townsend et al., 2001) and a Canadian study (Vozoris & Tarasuk, 2003), both of which found overweight women were more likely to be food insecure. However, no association was found between obesity and food insecurity in men in these studies. In a large-scale Canadian study, food-insufficient men were more likely to be underweight and normal weight than food-sufficient men (Vozoris & Tarasuk, 2003). An association between thin people and food insecurity has also been reported in Finland (Sarlio-Lahteenkorva & Lahelma, 2001).

Townsend and colleagues (2001) combined data from the 1994, 1995 and 1996 Continuing Survey of Food Intakes by Individuals (CSFII) to provide a data set of 4,537 women and 5,004 men. In this study, 52% of the 86 women who were moderately food insecure and 41% of the 966 women reporting mild food insecurity were considered overweight. The strong association between food insecurity and excess weight in women still remained after adjusting for socio-demographic and lifestyle variables like exercise, time spent watching television and percentage of dietary energy as fat ($p < 0.0001$). Food insecurity was not found to be statistically related to energy intake from dietary fat or saturated fat (Townsend et al., 2001). Although this study has the advantage of recruiting a large sample size, food insecurity (mild, moderate or severe) was determined by responses to the USDA food insufficiency question, and it is possible that subjects may have been incorrectly classified as to their food insecurity. More recent CSFII studies have employed the 18-item Core Food Security Module, which has been validated and found to be a more reliable indicator of food insecurity.

The relationship between food insecurity and obesity may be a paradoxical one. There are several proposed mechanisms by which food insecurity may cause obesity. Firstly, food-insecure individuals are more likely to eat cheaper foods, which are often high in energy, calories and fat. This could lead to a positive energy balance and obesity (Cristofar & Basiotis, 1992; Dietz, 1995; Rose & Oliveira, 1997; Alaimo et al., 2001b). Diets of food-insecure women and children have been found to be lower in fruit, vegetables and a variety of nutrients compared to women and children who are food secure (Olson, 1999b; Rose, 1999; Casey et al., 2001). Another proposed mechanism is that food-insecure individuals may go through episodes where there is little food, and so tend to overindulge when food becomes available. This also may lead to a high energy intake and weight gain (Emmons, 1986; Dietz, 1995; Polivy, 1996; Alaimo et al., 2001b; Townsend et al., 2001; Kaiser et al., 2002; Kempson et al., 2002). These bingeing behaviours may contribute to childhood obesity in food-insecure households.

2.10 Summary

From this review of the literature, it is clear that food insecurity is an area of concern in developed countries including New Zealand. There is substantial evidence linking low socio-economic status with food insecurity, and poor dietary intake with low socio-economic status, both overseas and in New Zealand adults (Russell et al., 1999). To a lesser extent, comparisons between diet intake and food insecurity have been made in children. Adequate nutrition during childhood is important not only for proper development and prevention of deficiency diseases, but also in the prevention of obesity and obesity-related diseases.

Future research should aim directly at testing whether the diets of food-insecure children are of poor quality and whether poor diets are related to low socio-economic status and poor health status. The latest research points to poor food choices or physiological adaptations in response to intermittent food shortages, as an explanation for the increased rates of obesity and excess weight, observed in food-insecure individuals. It is therefore important to investigate not only if food-insecure children have poor nutritional status, but also if there is a relationship between food insecurity and poor health status in New Zealand children.

3. Aim of the Study

This study investigated the effect of socio-demographic factors and food security status on the nutritional and health status of New Zealand children aged 1 to 14 years participating in the Validation study for the Children's Nutrition Survey (CNS).

Data from the Validation study was chosen because it is a large data set covering many areas of nutritional interest to this study including information on socio-demographics, dietary and nutrient intake, dietary habits and eating patterns, food security, anthropometrics and medical history of 183 children. This data set has not been extensively analysed with respect to food security status. The purpose of this study is to investigate the relationship between these areas of nutritional interest and provide an indication of the nutritional and health status of a group of food-insecure children living in New Zealand.

Aim 1: The primary aim of the study was to determine the effect of socio-demographic factors on the nutritional and health status of children aged 1 to 14 years.

Objectives:

- To describe the socio-demographic status of children in this study
- To investigate if there is a relationship between socio-demographic factors and *dietary intake* by looking at the number of servings of the main food groups (fruit, vegetables, protein-rich foods, cereals, breakfast cereals, breads and milk products)
- To investigate if there is a relationship between socio-demographic factors and *nutrient intake* by looking at macronutrient and micronutrient intake and compare these nutrient intakes to the age related recommended dietary intake values for individual nutrients
- To investigate if there is a relationship between socio-demographic factors and *specific dietary eating patterns* by looking at the frequency of

consumption of: takeaways, school canteen food, and certain types of foods

- To compare socio-demographic variables with the health and physical status of children

Aim 2: The secondary aim was to determine if there was a relationship between socio-demographic variables and food security status.

Objectives:

- To determine the prevalence of food-insecure children
- To describe the socio-demographic status of food-insecure children

Aim 3: The final aim was to determine if there was a relationship between food security status and the nutritional and health status of subjects.

Objectives:

- To compare the *dietary intake* of food-insecure with food-secure children
- To compare the *nutrient intake* of food-insecure with food-secure children
- To compare *specific dietary eating patterns* of food-insecure with food-secure children
- To describe the physical and health status of food-insecure children

4. Methodology

4.1. Pilot of the Children's Nutrition Survey (CNS)

The Ministry of Health contracted to Auckland UniServices Limited to undertake the pilot for the Children's Nutrition Survey (CNS). The CNS was intended to provide information on the nutritional status of New Zealand children and to identify sections of the childhood population whose diet many be inadequate. The results of the CNS will help policy makers formulate health goals and targets for New Zealand children and develop specific recommendations for Maori and Pacific children as well as recommendations regarding food eating habits for children in general.

UniServices organized for researchers from Massey University, Auckland University and Auckland University of Technology to develop the content of the pilot survey for the CNS. The pilot study consisted of the Validation study followed by the Pre-Testing Study.

4.1.1 Validation study

The aim of the Validation Study was to determine the most accurate dietary recall method for determining dietary intake in children aged 1 to 14 years. This involved validating the 24-hour recall and the 24-hour record assisted recall against a 4-day weighed food record in children aged 1 to 4 years and against doubly labeled water for energy intake in children aged 5 to 14 years. A single self-administered qualitative food frequency questionnaire (FFQ) was developed that covered the total energy intake of Maori, Pacific and European children aged 1 to 14 years. The FFQ was designed to include foods, beverages commonly consumed by all ethnic groups participating in the study. Questionnaires were developed to provide data on food security and these questions covered access to food, security of food supply, decision making regarding purchase and consumption of food and incidence of hunger in children.

4.1.2 Pre-testing study

Once the feasibility and acceptability of the dietary intake methods was determined these methods then needed to be tested in both urban and rural settings. The main aim of the Pre-testing study was to trial all research methods to be used in the National Survey such as the 24-hour recall, food frequency questionnaire, interviewing techniques and blood and urine sample collection in order to help determine the sample size for the proposed CNS.

4.1.3 Chosen data set for this study: the Validation study

The Validation study was chosen for analysis in this study as the data set obtained from this first part of the pilot was a more complete data set than the data set available from the Pre-testing study which was missing sections. Time did not permit for the analysis of the data from the Pre-Testing study as extensive analysis and data checking was performed on the Validation data set. Selected data from the Validation Study was used in this study to investigate the effect of household food security status and socio-demographic factors on the nutritional status and health status of children aged 1 to 14 years.

4.1.3.1 Subjects in the Validation study

Children aged 1 to 4 years were recruited from preschools, crèches and kohanga reo in Auckland. Children aged 5 to 14 years were recruited from Auckland schools and the Auckland community. Children that were hospitalized, children of overseas diplomats, overseas visitors or immigrants living in New Zealand for less than a year, or children living in off-shore islands were excluded from participating in this study (Watson et al., 2001). Quota sampling was used to ensure different ethnic groups were covered and to provide the sample size needed in order to compare energy intakes for different dietary research methods. Three hundred and twenty-three children were recruited from the Western suburbs of Auckland. The study sample chosen was 183 children, 91 children were aged 1 to 4 years (30 Maori, 31 Pacific, 30 European boys and girls equally), and 92 children were aged 5 to 14 years (30 Maori, 32 Pacific, 30 European boys and girls equally).

The Validation study was approved by the Auckland Ethics Committee. Written consent was obtained from parents or caregivers of all children participating in the study and also where possible from the child participating in the study. Ethical permission was obtained to use the doubly labeled water in children aged 5 to 14 years. The study was supported by consultation with different ethnic groups. The Kaitiaki group was formed to provide assistance with issues of Maori interests and the Pacific Island Food and Nutrition Action Group (PIFNAG) also provided assistance with Pacific issues.

4.1.3.2 The data collection interviews

The interviews were structured and well planned (Table 4.1). Children eligible for the study were allocated an interviewer of the same ethnicity as the child, and the interviewer then arranged appointments to visit the child's home. On the first visit a general questionnaire was administered to either the parent or main caregiver of the child. This questionnaire obtained information on demography, food and eating habits and use of dietary supplements. Appropriate 24-hour recalls were administered to obtain data on energy and nutrient intake. The caregivers were left with a FFQ and diet record for collecting weighed diet records.

On the second visit to the home of the child a general questionnaire was administered covering medical history and physical activity of the child. Anthropometric data was also obtained (skinfolds, weight, height, circumference measurements). The interviewer administered another 24-hour dietary recall and a food security and socioeconomic questionnaire. Four-day weighed diet records and food frequency questionnaires were collected in children aged 1 to 4 years.

In the children aged 5 to 14 years a doubly labeled water dose was administered and three urine samples were taken over the space of 3 weeks. Bio-impedence and resting metabolic rate was measured on the second visit to 5 to 14 year olds.

Table 4.1: Order of interviews and collection of data in the Validation study

Preschoolers (1 to 4 year olds)	**Day 1**	Introduction to study and consent obtained
		General questionnaire (demography)
		Appropriate 24-hour recall administered
		Food habits and dietary supplement questionnaire
		Diet record for the 24-hour recall handed out and explained
		FFQ explained and handed out
		Tutor parent/caregiver on collecting weighed diet records
		Phone contact between visits to check-up and assist parent with records
	Day 8 or 9	General questionnaire (medical history, physical activity)
		Administer appropriate 24 hour dietary recall
		Food security and socioeconomic questionnaire
		Check and collect four day weighed diet record
		Check and collect FFQ
		Weight, height, circumferences and skinfolds measured
		Food voucher and gift for the family left
School-age (5 to 14 year olds)	**Visit 1: Home**	Introduction to study and consent obtained
		General questionnaire (demography)
		Appropriate 24 hour recall administered
		Food habits and dietary supplement questionnaire
		Weight, height measured
		Diet record for the 24-hour recall handed out and explained
		FFQ explained and handed out
		Urine sample collected or jar left
	Visit 2: Home	Baseline urine sample collected
		Doubly labeled water dose given
		Bio-impedance measured
		Resting metabolic rate measured
		Second urine sample collected (5 hours later)
	Visit 3: 10 days later	Medical and physical activity questionnaire
		Appropriate 24-hour recall administered
		Food security and socioeconomic questionnaire
		Collect 3rd urine sample
		Check and collect FFQ
		Circumferences and skinfolds measured
		Food voucher and gift for the family left

4.1.3.3 Food list database

Foods and beverages from the 24-hour diet recall were analysed using data from the NZ Crop and Food Nutrient Composition Database (Athar et al., 2001). A multiple-pass 24-hour recall direct data-capture program was specially designed by the original investigators of this study (Watson et al., 2001) to incorporate foods consumed by the children into a computer food list database. The food list was altered to include foods commonly eaten by children according to A.C. Nelson national supermarket sales of foods eaten by this age group. Consultation with Maori and Pacific groups resulted in the addition of new foods to this data base. This food database enabled identification of items consumed by the children to be matched to the NZ Crop and Food Nutrient Composition Tables (Athar et al., 2001).

4.1.3.4 Validation results

The Bland Altman analysis was used to validate the 24-hour recall and the 24-hour record assisted recall against the 4-day weighed diet record in the 1 to 4 year age group. The format of the 4-day diary was based on dairies used in other studies of children conducted in New Zealand. The mean and standard deviations for nutrient intakes obtained from the 24-hour recalls and 4-day weighed diet records were calculated and a paired t-test were performed to establish whether the two means were statistically different. Data from the 24-hour recall overestimated macronutrient and energy intake by 3% but the Record Assisted Recall method overestimated actual intakes by 9% in the Validation study (Watson et al., 2001). It has been noted that the intra-individual variability between the 24-hour recall and record assisted recall was of similar size.

In the 5 to 14 year age group the Bland Altman analysis was used to validate energy intake from a single 24-hour recall compared to the record assisted recall against total energy expenditure determined by doubly labeled water. The doubly labeled water method is considered to be the ideal reference method for validating dietary question methods (Bandini et al., 1997). The 24-hour recall underestimated energy intake by about 23% and the recall assisted recall underestimated energy intake by 15% (Watson et al., 2001; Ministry of Health, 2002). Again it was noted that the intra-individual variability between the two dietary methods was of similar size.

The validation study provided evidence that both the 24-hour recall and the 24-hour record assisted recall were appropriate dietary methods for assessing dietary intake. It was decided in this study to use the dietary data obtained from the 24-hour recall as this was the dietary method used by the National Nutrition Survey of adults conducted in 1997 (Russell et al., 1999).

4.1.3.5 The questionnaires

Prior to administration of the questionnaires to participants all questions in the various questionnaires were checked by focus groups for ethnic sensitivity and ease of understanding. The questionnaires were also reviewed by members of the Kaitiaki Group and Pacific Island Food and Nutrition Action Group (PIFNAG). The questionnaires relevant to this study are presented in Appendices 1, 2, 4, 5, 7, 8.

In this study, response variables for some of the questions in the questionnaires were re-categorized into fewer response variables in order for statistical analysis to be possible as often there were no subjects in some categories and very few responses in other categories. Also in order to perform ordinal logistic regression analysis on the socio-demographic and dietary intake data, the order of some of the responses had to be rearranged into ascending order.

4.2. Data analyses

Only the data from the Validation study covering the aims and the objectives of this study were chosen for statistical analysis. Data on demography, dietary intake, nutrient intake, dietary habits and eating patterns, anthropometrics and medical history and food security were chosen for analysis.

4.2.1 Analysis of demographic data

For the purpose of this study *socio-demographic factors* investigated included:

- Age of child

The study included data on 91 children aged 1 to 4 years (preschool children) and 91 children aged 5 to 14 years (school-age children).

- Sex of child

The study included data on 92 male and 91 female children.

- Ethnicity of the child

The study included data on children belonging to Maori, Pacific people, European, Indian and Asian ethnic groups.

- Ethnicity of the food preparer

The study included data on the ethnicity of the food preparer of the children and the country of birth of the food preparer.

- Housing arrangement

Data on accommodation ownership was available.

- Household size

Data was available on the number of people in a household or family.

- Household income

Data was available on the combined yearly income before tax from all sources of households.

- Household food expenditure

Data was available on the amount of money spent on food and groceries each week in households.

- Educational status of food preparer

Data was available on the years of schooling of the food preparer.

- Occupation status of the household

Data was available on the type of occupation of the food preparer and the main provider and included data on those adults receiving a benefit.

The socio-demographic questions specific to this study are presented in Appendix 1.

4.2.1.1 Categorisation of data on ethnicity

Data was collected on which ethnic group the child belonged to. The first response or in the case of more than one ethnic group being identified, the ethnic group to which the child considered to belong most to was considered the 'main ethnicity' by the researchers of the validation study and by this study. If more than one ethnic group was identified then this was also recorded. As there are a lot of children in this study that identified as belonging to more than one ethnic group it was decided to take this into consideration in this study. Children were then classified according to whether they had identified Maori or Pacific as an ethnic group. Responses were grouped into two variables – "any Maori" and "any Pacific Island".

In this study the ethnicity of the child was grouped into four main categories: Maori, Pacific, European and Other. Pacific people included those who identified themselves as either: Cook Island Maori, Tongan, Niuen, Fijian, Tokelauan or Samoan. This is the same classification as used by Statistics New Zealand. Asian and Indian children were classified as 'Other' in this study. It was decided to have a separate 'Other' category as Asian and Indian communities have different eating patterns, and sample size was too small to have a separate Asian and Indian ethnic category.

4.2.1.2 Classification of household income

Due to the small number of households being in the three lowest income categories listed in Table 4.2, it was decided to merge these into one category as shown in Table 4.2.

Table 4.2: Total annual household income (from all sources)

Total Annual Household Income	Code	Regrouped New Code
$5,000 – 10,000	5	20
$10,001 – 20,000	10	20
$20,001 – 30,000	20	20
$30,001 – 40,000	30	30
$40,001 – 50,000	40	40
$50,001 or more	50	50

4.2.1.3 Classification of occupation status

In this study the occupation status of the main provider was coded according to 1996 Census Occupation Index (Davis et al., 2003). Occupations were allocated a code between 1 and 9 and due to a significant number of main providers being on the benefit it was decided to code these responses as 10 as shown in Table 4.3 below.

Table 4.3: Allocated coding of occupation status of main providers in the Validation study

Code	Occupation
1	Legislators and senior officials
2	Professionals
3	Technicians and associate professionals
4	Clerks
5	Service workers and shop and market sales workers
6	Skilled agricultural and fishery workers
7	Craft and related trades workers
8	Plant and machine operators and assemblers
9	Elementary occupations
10	Benefit (not employed)

For statistical purposes it was decided to split the data into two main occupation status groups; high occupation status and low occupation status. Main providers coded between 1 and 4 were considered to be of high occupation status, whereas those coded 5 to 9 were considered to be of low occupation status and a separate category was given for those on the benefit (10). Fifty-two percent of the validation data were coded as high occupation status leaving 48% in the low occupation status group which are similar figures to that obtained by the 1996

New Zealand Census (Statistics New Zealand, 1996). According to the 1996 census, 54% of the New Zealand population are considered to be of high occupational status, while 46% are of low occupational status. Hypothesis testing found no significant difference between the proportion of respondents in the high occupation status group in the study compared to Census data for the NZ population ($p = 0.569$). Hence it is justified to use this division of 'high' and 'low' occupation groups in this study.

4.2.2 Analysis of nutritional status data

For the purpose of this study the determination of the *nutritional status* of children was based on the data collected on the dietary and nutrient intake, dietary habits and eating patterns.

The *dietary intake* encompasses all FFQ data on the number of daily or weekly servings of the main food groups: fruit, vegetables, protein products, cereals, breakfast cereals, breads, and milk products (Appendix 2).

The *nutrient intake* data encompasses macronutrient and micronutrient intake from the results of the 24-hour recall method, the chosen dietary method for this study. The nutrient intake data was compared to the Australian Recommended Dietary Intakes (RDI) (Appendix 3a) as these values are given in the Ministry of Health Food and Nutrition Guidelines for Healthy Infants and Toddlers (MOH, 2000) and in the Ministry of Health Guidelines for Healthy Children (MOH, 1997a) as well as in the Ministry of Health Food and Nutrition Guidelines for Healthy Adolescents (MOH, 1998). For some nutrients like Energy and Protein, the United Kingdom Dietary Reference Values (Appendix 3b) were chosen as a comparison instead of the Australian RDI values. This was done for two reasons; firstly the Australian RDIs are currently being updated and secondly the age bands for the UK Estimated Average Requirement (EAR) values fitted better with the age group of the validation data set. The NZ diet in some ways can be considered similar to the UK diet in terms of animal product intake.

As the recommended intake values are sufficient to cover the needs of almost all healthy individuals it was decided to also calculate the nutrient intake data as a percentage of the RDI or EAR rather than just observing if intake was below or above the RDI or EAR values.

The *dietary habits and eating patterns* (Appendix 4) encompasses FFQ questions asked regarding the frequency of consumption of takeaways, school canteen food, home packed lunches (food bought from home and eaten at school), certain types of foods and the addition of salt to children's meals. Data was also collected on the extent to which children influenced the food purchasing decisions made by the adult of food preparer (Appendix 5).

4.2.3 Analysis of anthropometric data

The *physical status* of the children was considered in this study. This involved the calculation of body mass indexes from the anthropometric data on the weight and height values for individuals. It was decided to then categorize children as overweight or obese on the result of their BMI values according to BMI cut-off values recommended by International Standards (Appendix 6). Although the validation study contained data on the skinfolds of subjects, it was decided to not use the skinfolds of the triceps and subscapular as indicators of obesity as the corresponding reference chart was published in 1974 and is for American White Americans and thus is not a good standard for measuring obesity in New Zealand children of different ethnic groups.

4.2.4 Analysis of medical history data

For the purpose of this study the *health status* of the children was determined based on the results of the questionnaires under the medical history section of the Validation Study. The medical history section includes data on the frequency of hospital admissions, the presence of chronic medical conditions, prescription medications, including whether the child is currently taking antibiotics (refer to Appendix 7 for questions).

4.2.5 Analysis of food security data

The *food security status* of the children was determined by the responses to questions on whether there is enough money to buy food in the last four weeks and the reported incidence of hunger in the last month (Appendix 8). It was decided to analyse responses to these two food security questions separately rather than combine responses under one category. This is because the 'hunger' question is an indicator of food insecurity on a personal or child's level, while the 'enough money to buy food' question is a household indictor of food insecurity. Household food security status was determined by the response to the question on whether there is sometimes or often not enough money to buy food in the last 4 weeks.

4.3. Statistical analysis

Statistical analysis was performed on the data set from the Validation study in order to investigate the significance of any relationships between socio-demographic variables, household food security status, health status and physical status of children aged 1 to 14 years. A relationship was considered statistically significant if a p value of less than 0.05 was obtained.

The statistical package used was MINITAB 13.31 (Minitab Inc., 2003). Statistical advice and assistance was obtained from Dr Barry McDonald, Massey University, Albany, New Zealand.

4.3.1 Statistical analysis of socio-demographic data

The description of the socio-demographic data of the children in this study was achieved by descriptive statistics and analysis of cross tabulations using Chi-square for hypothesis tests.

4.3.2 Socio-demographic determinants of dietary intake

Chi-square tests for cross tabulations were performed on the dietary intake data to look for trends in the frequency of consumption of main food groups such as fruit intake with socio-demographic variables. Ordinal Logistic Regression was performed to check for significance between ordered categorical socio-demographic variables and dietary intake data. When a significant association was found, data were plotted on a chart graph or box plot for a clearer representation of trends.

4.3.3 Socio-demographic determinants of nutrient intake

The nutrient intake data was compared with socio-demographic variables using Kruskal-Wallis test. The nutrient intake data was expressed firstly as above or below the age corresponding recommended dietary intake (RDI), or estimated average requirement (EAR) for the nutrients energy and protein. The percentages of children above or below the RDI or EAR for a given nutrient, with respect to socio-demographic variables, were analysed using Chi-square tests for cross tabulations and p-values were recorded in summary tables.

Two-sample t-tests were used to compare the mean nutrient intakes as a percentage of the RDI or EAR with respect to the socio-demographic variables age, sex, dwelling type, education status and household size. For the socio-demographic variables - ethnicity of the child and food preparer, annual household income, household food expenditure and occupation status of the household, one-way ANOVA was utilized to calculate the mean nutrient intakes as a percentage of the corresponding RDI or EAR and descriptive statistics to calculate the standard error of these means. The results were checked using non-parametric tests.

The percentage of total energy from fat, carbohydrate, sugars, saturated, polyunsaturated and monounsaturated fatty acids were calculated based on standard conversion factors. To calculate the mean of these nutrients as a percentage of total energy required splitting the data into preschool and school age data and then performing one-way ANOVA and Kruskal-Wallis tests to look for significant differences with respect to socio-economic status.

4.3.4 Socio-demographic determinants of dietary eating patterns

Chi-square tests for cross tabulations and Ordinal Logistic Regression were performed to look for any significant relationships between the dietary eating patterns data and socio-demographic variables.

4.3.5 Socio-demographic determinants of food insecurity

Comparisons between socio-demographic variables and food security status were made using Binary Logistic Regression and two-sample t-tests. Descriptive statistics and cross tabulations were performed to look for trends.

4.3.6 Nutritional status of food-insecure children

The nutrient intake data was compared for food-secure and food-insecure children using descriptive statistics, Kruskal-Wallis tests and two-sample t-tests. The percentages of children above or below the RDI or EAR for a given nutrient with respect to food security status were calculated using Chi-square tests for cross-tabulations. Cross tabulations, Ordinal and Binary Logistic Regression were performed on the dietary intake data, nutrient intake data and dietary eating patterns data, to look for any significant trends with regards to being food-insecure.

4.3.7 Health and physical status of the children

To investigate the effect of socio-demographic variables, nutrition and food security status on the health and physical status of the children in this study the following statistical methods were performed: Kruskal-Wallis, Cross tabulations, Ordinal and Binary Logistic Regression.

5. Results

The data analysed in this study was collected during the Validation study, as part of the pilot for the Children's National Nutrition Survey. The Validation study provided data on demography, diet, anthropometry, medical history and food security of a group of New Zealand children aged 1 to 14 years. The results of the statistical analysis performed on this data are presented in this section.

The effects of socio-demographic and food security status on the nutrition and health of the children from the Validation study are presented under three main sections:

- Socio-demographic determinants of the nutritional and health status of the children.
- Socio-demographic status of the food-insecure children.
- Nutritional status of the food-insecure children.

The nutritional status of the children was determined from three sources: the dietary intake of main food groups from the FFQ, the nutrient intake from the 24-hour recall and the dietary eating patterns from the questionnaire data. The dietary intake, nutrient intake and specific dietary eating patterns of the food-insecure children were compared with that of the food-secure children.

The anthropometric and medical history data provided an indication of the physical and health status of the children in this study.

In this section 'children' refers to the subjects participating in the Validation study, and not to children in the general population.

5.1 Socio-demographic and physical characteristics of the children

One hundred and eighty-three children aged 1 to 14 years living in the Western suburbs of Auckland, New Zealand, participated in the Validation study. The age, gender and ethnic characteristics of these children are presented in Table 5.1.

Table 5.1 Numbers of children recruited by ethnic group, age and gender

Ethnicity	Age band (years)	Males	Females
European/Others	1	3	3
	2	4	4
	3	4	4
	4	4	4
	5-6	3	3
	7-8	3	3
	9-10	3	3
	11-12	3	3
	13-14	3	3
Maori	1	3	3
	2	4	4
	3	4	4
	4	5	3
	5-6	3	3
	7-8	3	3
	9-10	3	3
	11-12	3	3
	13-14	3	3
Pacific	1	3	3
	2	4	4
	3	4	5
	4	4	4
	5-6	4	3
	7-8	3	4
	9-10	3	3
	11-12	3	3
	13-14	3	3

Of the 183 children recruited for this study, 92 were male and 91 were female. Ninety-one children were aged 1 to 4 years and 92 children were aged 5 to 14 years. Sixty of the children were Maori, 63 were Pacific and 60 were European or 'Other' ethnicity. In this study, 'Other' was considered a separate ethnic group to European, and not combined as previously done by researchers (Watson et al., 2001). Six children were classified as 'Other' because they were of Indian or

Asian ethnicity, and these children represented 3% of the total population in the sample. There were a large number of children who identified with more than one ethnic group, in particular Maori and Pacific, as evident in Table 5.2.

Table 5.2: Percent of children having Maori or Pacific heritage

Children with any Maori ancestors	38
Children with any Pacific ancestors	42

This study was designed to provide nutritional data on the three main ethnic groups living in NZ. It was intended to recruit equal proportions of Maori, Pacific and European children for this study. The split in ethnic groups in this study is not indicative of the children population of NZ. According to 1996 NZ Census data on children aged 0 to 14 years, 60% are European, 24% are Maori, 7% are Pacific and 5% are Asian (Hodges et al., 1998).

The mean of the three measurements taken for weight (kg) and height (m) were calculated, and then the median of the mean weight and mean height for each age group were calculated and presented in Table 5.3.

Table 5.3: Physical characteristics of children in the Validation study

Age	**Weight (kg)**		**Height (meters)**	
(Years)	**Median**	**Range**	**Median**	**Range**
1	12.9	10.8 - 14.2	0.85	0.79 - 0.90
2	15.0	13.7 - 17.4	0.93	0.90 - 0.98
3	17.8	16.0 - 19.1	1.01	0.97 - 1.05
4	19.4	17.7 - 22.0	1.07	1.02 - 1.10
5	20.7	19.3 - 21.2	1.13	1.09 - 1.14
6	23.8	22.8 - 30.4	1.19	1.15 - 1.26
7	28.5	24.7 - 30.3	1.24	1.19 - 1.31
8	31.8	28.5 - 37.6	1.33	1.27 - 1.43
9	33.9	30.0 - 44.3	1.42	1.31 - 1.47
10	39.9	34.9 - 45.7	1.43	1.41 - 1.45
11	45.7	34.3 - 56.3	1.48	1.44 - 1.56
12	56.8	37.2 - 67.5	1.49	1.46 - 1.62
13	53.9	47.2 - 71.1	1.61	1.54 - 1.65
14	66.8	57.0 - 88.3	1.68	1.58 - 1.74

Forty-two percent of all children in this study were classified as overweight and 17% were considered obese according to the age-adjusted BMI cut-off values obtained from international studies (Appendix 6).

5.1.1 The health status of the children

The majority of the children had good health status according to the indicators used in this study as presented in Table 5.4 and Appendix 7. Only 18 of the 183 children had a chronic medical condition or disability. Twelve of the children had asthma, four had ear infections or hearing loss, and one child had a thyroid problem.

Table 5.4: The health status of the children

Medical History	Percent (number) of children
Hospital admissions	8 (15)
Taking medication	12 (22)
Taking antibiotics	7 (12)
Medical condition	10 (18)

5.2 Characteristics of the household

In the preschool children, the adult attending the interview was responsible for preparing the child's food in 95.6% of the cases. In the school-age group, 89% of the adults attending the interview were responsible for preparing the child's food. Ninety-five percent of the adults present at the interview were parents, and all but three of the adults present lived in the same house as the child. The main provider also prepared the family meals in 33 households.

5.2.1 Sex and ethnicity

The majority of adults present at the interview were female (85.7%) and the ethnicity of the food preparer was almost equally distributed between the three main ethnic groups (Table 5.5).

Table 5.5: Ethnicity of the food preparer

Ethnicity of the Food Preparer	Percent (number)
Maori	26 (46)
Pacific	35 (63)
European	36 (65)
Other (Indian, Asian)	3 (5)

The majority of food preparers (64%) were born in New Zealand, 27% were born in the Pacific Islands and 6% were born in the United Kingdom. No equivalent data on the sex or ethnicity was provided for the main financial providers for the children in this study.

5.2.2 Education status

Thirty-five percent of the food preparers for preschool children, and 24% of the food preparers for school-age children had left school at the age of 15 or before. Further analysis of the data revealed that 29.6% of the food preparers attended school to at least year 12, and had received a further qualification after leaving school; while 9.9% did not receive a further qualification or degree after year 12. This is similar to the data obtained by Statistics New Zealand (1996) which found that 33% of adults had post-school qualifications. In this study, the main provider and the food preparer for the preschool children had received more education than the main provider and the food preparer for the older children aged 5 to 14 years (Table 5.6). The mean years of schooling was found to be less for food preparers of Pacific origin.

Table 5.6: Educational background of the food preparer and main provider

Years of Schooling	% of Total 1 – 4.9 year olds		% of Total 5 - 14 year olds	
	Food Preparer	Main Provider	Food Preparer	Main Provider
Not stated	16.5	35.2	11.9	36.9
Five	9.9	4.4	4.3	3.3
Five to ten	25.3	23.1	19.6	12.0
Ten to twelve	20.9	11.0	53.3	34.8
More than twelve	27.5	26.4	10.8	12.0
Obtained further education after schooling	60.5	55.9	43.5	36.9
Obtained qualifications after schooling	63.5	66.7	44.6	39.1

5.2.3 Occupation status

Almost 90% of the main providers in this study were considered to be in paid employment (Table 5.7). The employment data in this study needs to be approached with caution, as 30 respondents did not provide information on the employment status of the main provider, thus it is possible that the percent of unemployed may be higher than that obtained.

Table 5.7: Employment status of the household

	Percent (number) in paid employment	Percent (number) not in paid employment or receiving a benefit
Main Provider*	89.5 (137)	10.5 (16)
Food Preparer**	52 (85)	48 (79)

* 30 entries were missing for the main provider.

** 19 entries were missing for the food preparer.

The occupation status of the household was based on the occupation status of the main provider, as often the food preparer was not in employment, as evident in Table 5.7. If the main provider was also the food preparer, then the occupation status of the household was based on that of the food preparer (Table 5.8). The most common occupation status were the 'Professionals' group, and this is the second highest rating occupation, according to classifications used by Statistics New Zealand (1996).

Table 5.8: Occupational classification of the household

Occupation category of the household	Code	Percent of total (Count)
Legislators and senior officials	1	11 (18)
Professionals	2	22 (36)
Technicians and associate professionals	3	7 (12)
Clerks	4	7 (12)
Service workers and shop and market sales workers	5	18 (29)
Skilled agricultural and fishery workers	6	1 (2)
Craft and related trades workers	7	16 (26)
Plant and machine operators/assemblers	8	9 (14)
Elementary occupations	9	1 (2)
Benefit (not employed)	10	7 (11)

For statistical analyses the occupation of the main provider was given a code (1 to 10) as used by Statistics New Zealand (1996). The occupation status of the household was then placed into either a 'High', 'Low' or 'Benefit' category (Table 5.9).

Table 5.9: Main occupation group of the household

Combined Occupation Status of Household	Code	Percent (Count) of House-Holds	Percent (Count) in High Income Group ($50,001 or more)	Percent (Count) in Low Income Group (≤20,000)	Percent (Count) of Maori children	Percent (Count) of Pacific children	Percent (Count) of European children	Percent (Count) of 'Other'* children
High	1-4	48 (78)	68 (38)	18 (4)	24 (19)	17 (13)	51 (40)	8 (6)
Low	5-9	45 (73)	27 (15)	59 (13)	21 (15)	62 (45)	18 (13)	0 (0)
Benefit	10	7 (11)	5 (3)	23 (5)	27 (3)	45 (5)	27 (3)	0 (0)

*'Other' children being Indian or Asian children.

Almost half of the households in this study were classified as 'low' occupation status, and 7% of families were receiving a domestic purposes benefit as their source of income (Table 5.9). Although not significant, differences were noted in the occupation status of households of different incomes. Higher income households were more likely to have a higher occupation status and lower income households were more likely to be of low-occupation status (Table 5.9). A higher percentage of Pacific children than Maori, European or 'Other' children were found to have a parent on the benefit (Table 5.9). The 1996 NZ Census reported a total of 41.2% of Maori children, 37.8% of Pacific children and 13.8% of European children did not have a parent in paid work.

5.2.4 Housing arrangement and household size

The majority of households (61%) had one or two children, 16% of households had three children, while only 9% of households had four or five children.

The majority of children lived in a house owned by the family as shown in Table 5.10. The majority of children were from two-parent families, but 17% of preschoolers and 15% of school-age children lived alone with one parent (Watson et al., 2001). Around 25% of preschool and school-age children lived in households comprising six or more people.

Table 5.10: Accommodation and household details of the children (data taken from Watson et al., 2001).

	1- 4.9 year olds (% of total)	5 - 14 year olds (% of total)
Accommodation Type		
Townhouse/house	84.4	95.6
Flat/unit	15.6	4.3
Accommodation Ownership		
Owned	60.7	48.9
Rented (Housing NZ/Council)	14.6	23.9
Rented (Privately)	21.3	26.1
Living with relatives	1.1	1.1
Other	2.2	-
Number of People in Household		
2	16.8	15.4
3	23.6	11.0
4	19.1	25.3
5	15.7	23.1
6	12.4	16.5
7	6.7	4.4
8 or more	5.6	4.4

Fifty-six percent of all households contained five or less people, and 44% of all households contained six or more people. Households of six or more people were more likely to have Pacific children (49%) than Maori (30%) or European (20%) children ($p = 0.001$). This is in agreement with 1996 Census data, which report more Pacific and Maori children than European or Asian children are living in households containing six or more people (Hodges et al., 1998).

Significant ethnic disparities in home ownership were found in this study. Home ownership was the highest among European food preparers (54%) than Maori food preparers (26%), or Pacific food preparers (19%) ($p < 0.0005$). Census data has documented lower rates of home ownership in Maori households than non-Maori households (Statistics New Zealand, 1996).

5.2.5 Household income

A large number of households in this study were in the higher income bracket of earning $50,000 or more per annum as evident in Table 5.11. In 2001 the median annual household income for all multi-person New Zealand households was just under $40,000 (Statistics New Zealand, 2001).

Table 5.11: Total annual household income from all sources

Total annual household income	Percent of total subjects
$5,000 – 10,000	4
$10,001 – 20,000	11
$20,001 – 30,000	15
$30,001 – 40,000	16
$40,001 – 50,000	16
$50,001 or more	38

Food preparers who were of Pacific ethnicity were more represented in the lower income groups and European and Maori food preparers were more represented in the higher income groups (Table 5.12).

Table 5.12: Ethnicity and income bracket of the food preparer

Ethnicity of food preparer	% in lower income bracket (< $30,000/annum)	% in higher income bracket (>$50,000/annum)
Maori	11	23
Pacific	77	9
European	11	64
Other (Indian, Asian)	0	4

5.2.6 Household food expenditure

The amount of money spent on food or groceries per week by the household was recorded. The majority of households were found to spend more than one hundred dollars per week as evident in Table 5.13. A significant relationship was found between household size and household food expenditure ($p = 0.003$). An increase in household size was associated with higher food expenditures independent of ethnicity, and this relationship was still significant after controlling for income.

Table 5.13: Household weekly expenditure on food and groceries

Household food expenditure ($ per week)	Percent (number) of households
Less than 100	12 (19)
101 – 150	37 (59)
151 – 200	32 (51)
More than 201	19 (30)

Pacific children were more likely to be from households that spend $100 or less on groceries per week than Maori or European children ($p = 0.030$).

5.3 Socio-demographic determinants of nutritional status

The nutritional status of the children in this study was determined by three ways:

- Dietary intake from analysis of the main food groups from the food frequency questionnaire (FFQ).
- Nutrient intake (macronutrients and micronutrients) from the 24-hour dietary recalls.
- Specific dietary eating patterns from the FFQ.

5.3.1 Socio-demographic determinants of dietary intake

The dietary intake data covered the frequency of consumption of fruit, vegetables, protein foods, cereals, breakfast cereals, breads and milk products.

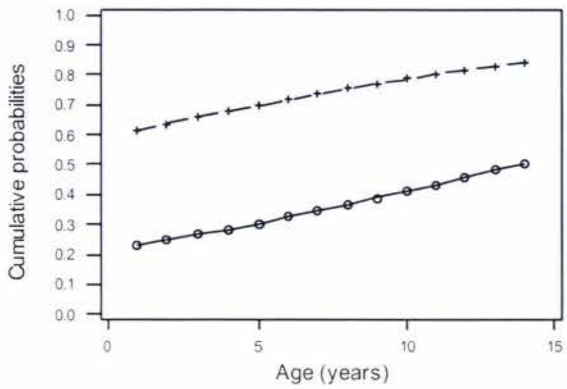
5.3.1.1 Fruit consumption

The number of helpings of fruit a child consumed per day was recorded. Fruit included fresh, frozen, canned, preserved or stewed fruit. Fruit juice was not included as a fruit helping.

5.3.1.1.1 Age

Age was found to be a significant predictor of fruit consumption by children in this study ($p = 0.008$). As the children got older they consumed significantly fewer helpings of fruit per day as evident in Figure 5.1 and Figure 5.2.

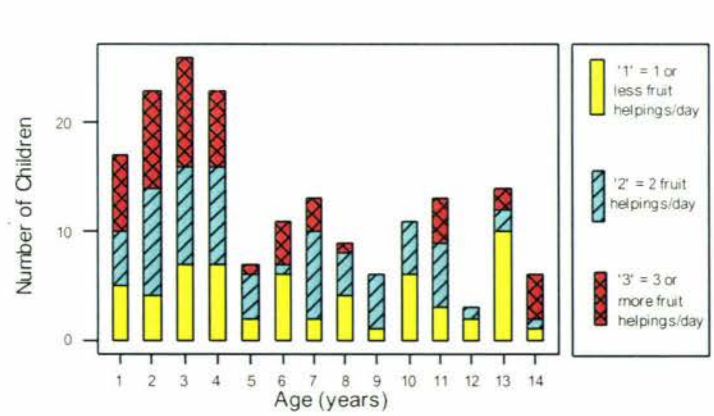
Figure 5.1: Relationship between fruit helpings and age of child



The area under the solid line (o) corresponds to the proportion of children consuming 1 or less than 1 fruit helping a day which increases with age. Area under the dashed line (+) corresponds to children consuming 2 fruit helpings a day. Area over the dashed line (+) corresponds to the proportion of children consuming 3 or more than 3 fruit helpings a day which declines with age.

This trend was confirmed by the finding that 63% of the children who consumed 3 or more helpings of fruit per day were aged 1 to 4 years (p value = 0.028). The older children (5 to 14 years) represented 62% of the total who consumed 1 or less than 1 helping of fruit a day (p = 0.028).

Figure 5.2: Number of children in each fruit helping group by age of child



5.3.1.1.2 Gender

The gender of the child was not found to be a significant predictor of fruit consumption in the children in this study ($p = 0.464$).

5.3.1.1.3 Ethnicity of child

It was found that significantly more Pacific children are eating 1 or less than 1 helping of fruit per day than European, NZ Maori or 'Other' children ($p < 0.0005$) as evident in Table 5.14. Ordinal Logistic regression confirmed that children with "any Pacific" origin consumed less fruit than children with "any Maori" ancestors ($p < 0.0005$). When controlling for income, there was still the tendency for Pacific children to eat less fruit; but taking into account income meant there was less variation between these two ethnic groups.

Table 5.14: Ethnicity of child and fruit consumption

	Percentage of children who consumed -		
Ethnicity of Child	**1 or less than 1 fruit helping a day**	**2 fruit helpings a day**	**3 or more fruit helpings a day**
Maori	20%	43%	37%
Pacific	57%	29%	14%
European	18%	45%	37%
Other	33%	33%	33%

5.3.1.1.4 Ethnicity of the food preparer

Children whose food preparer was of Pacific ethnicity significantly consumed fewer servings of fruit per day than children of food preparers of any other ethnic group ($p < 0.0005$) (Table 5.15). After adjusting for income the differences in children's fruit consumption between food preparers of different ethnic groups became more significant.

Table 5.15: Ethnicity of the food preparer and fruit consumption

	Percentage of their children who consumed -		
Ethnicity of Food preparer	**1 or less than 1 fruit helping a day**	**2 fruit helpings a day**	**3 or more fruit helpings a day**
Maori	20%	37%	44%
Pacific	56%	31%	13%
European	22%	45%	34%
Other	40%	40%	20%

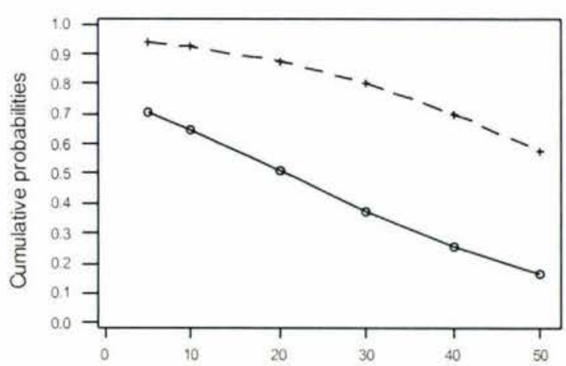
5.3.1.1.5 Housing arrangement and household size

A significant relationship was found between the type of dwelling and consumption of fruit in children ($p < 0.020$). Those children who are living in households where the home is owned, consumed more helpings of fruit per day, than those living in rented homes (Housing NZ/Council), or with relatives ($p = 0.001$). But this trend was explained by income. The size of the household alone did not significantly affect fruit consumption in children ($p = 0.193$).

5.3.1.1.6 Household income

Household income was a highly significant predictor of the number of fruit servings consumed by children ($p < 0.0005$), and this significance was not influenced by the number of people living in a household.

Figure 5.3: Relationship between fruit helpings and income



Area under the solid line (o) corresponds to the proportion of children consuming 1 or less than 1 fruit helping a day, which declines with income. Area under the dashed line (+) corresponds to children consuming 2 fruit helpings a day. Area over the dashed line (+) corresponds to the proportion of children consuming 3 or more than 3 helpings of fruit a day, which increases with income.

As Figure 5.3 demonstrates, children from higher household incomes are more likely to be eating more than three helpings of fruit per day, and less likely to be eating one serving of fruit per day. The majority of children (80%) in the lowest income bracket were found to consume one or less than one helping of fruit per day. In comparison 39% of children from the highest income bracket consumed 3 or more helpings of fruit per day.

5.3.1.1.7 Food expenditure

Ordinal Logistic Regression confirmed a significant relationship between household food expenditure, family size and fruit consumption ($p < 0.0005$). Children from households that spend more money on food per week, consumed more servings of fruit per day ($p = 0.001$). This relationship was still significant after controlling for household size, and the sex and age of the child.

Figure 5.4: Relationship between fruit helpings and amount spent on food per week after controlling for household size

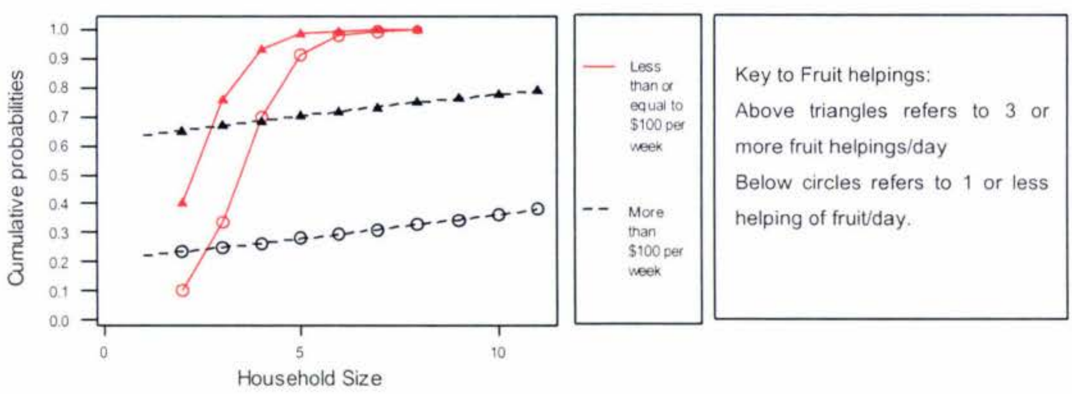


Figure 5.4 shows several trends. The rapidly rising solid (red) curves represent children from households that spend one hundred dollars or less on groceries per week. As the number of people in a household increases, there is an increase in the number of people consuming 1 or less helping of fruit per day. This trend is most rapid in households that spend less money on food per week. For households consisting of five members, 90% of children consumed 1 or less helping of fruit per day. The dashed (black) lines represent children from households that spend more than one hundred dollars per week on groceries. It appears to be less variation in the number of fruit servings consumed by children, in households spending more money on food, as the number of people in a household increased.

5.3.1.1.7.1 Food expenditure and ethnicity

When controlling for household food expenditure, household size and household income, Pacific children still ate significantly less fruit than Maori children ($p < 0.0005$). The same trend was observed for children of Pacific and Maori food preparers.

5.3.1.1.8 Educational status of the food preparer

Children whose food preparer went to school for longer consumed significantly more helpings of fruit per day ($p < 0.0005$).

5.3.1.1.9 Occupation status of the household

A significant relationship was observed between consumption of fruit and the occupation status of the household. The number of fruit helpings consumed by children decreased as the occupation status of the household decreased ($p < 0.0005$). Also children from households on the benefit significantly consumed less helpings of fruit than children from households not on the benefit ($p < 0.0005$).

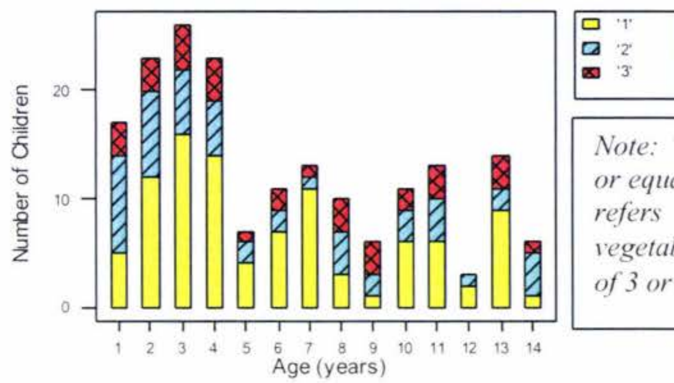
5.3.1.2 Vegetable consumption

The number of daily helpings of vegetables a child consumed was recorded. Vegetables included fresh, frozen, and canned. Vegetable juice was not included as a vegetable helping.

5.3.1.2.1 Age

There is no significant difference in vegetable consumption between children aged under five years of age and children aged over five years of age ($p = 0.643$), nor was there any trend when actual age was considered ($p = 0.817$). It appears that the proportion of children in the vegetable helping categories is similar throughout the different age groups as shown in Figure 5.5.

Figure 5.5: Number of children in each vegetable consumption group by age



Note: '1' refers to consumption of less than or equal to 1 serving of vegetables a day; '2' refers to consumption of 2 servings of vegetables a day; '3' refers to consumption of 3 or more servings of vegetables a day.

5.3.1.2.2 Gender

Sex was not found to be a significant predictor of vegetable consumption in the children according to Ordinal Logistic Regression analysis ($p = 0.233$).

5.3.1.2.3 Ethnicity of the child

A significantly greater proportion of Pacific children (77%) were eating one or less than one helping of vegetables per day ($p < 0.0005$). More European children were eating 3 or more helpings of vegetables per day than NZ Maori, Pacific or Other children. The significance was confirmed by ordinal logistic regression ($p = 0.02$).

5.3.1.2.4 Ethnicity of the food preparer

Children whose food preparers were of European ethnicity consumed more helpings of vegetables per day than any other ethnic group. Children whose food preparers were Pacific significantly consumed fewer helpings of vegetables per day than other ethnic groups ($p < 0.0005$).

5.3.1.2.5 Housing arrangement

Children living in households where the home was owned significantly consumed more helpings of vegetables than children living in rented homes ($p < 0.0005$).

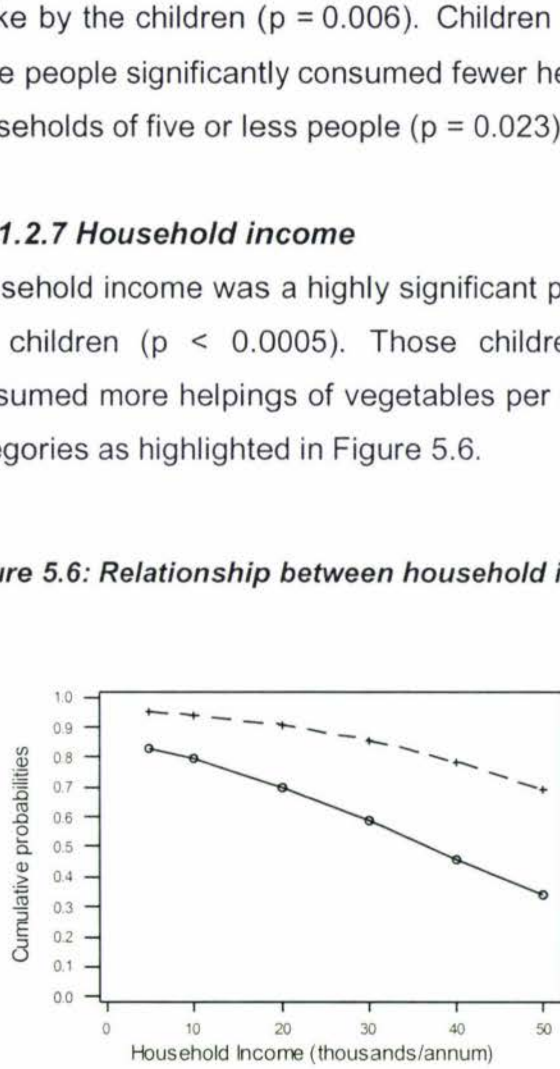
5.3.1.2.6 Household size

An increase in household size was significantly associated with lower vegetable intake by the children ($p = 0.006$). Children from households consisting of six or more people significantly consumed fewer helpings of vegetables than children of households of five or less people ($p = 0.023$).

5.3.1.2.7 Household income

Household income was a highly significant predictor of vegetable consumption in the children ($p < 0.0005$). Those children from higher income categories consumed more helpings of vegetables per day than children from lower income categories as highlighted in Figure 5.6.

Figure 5.6: Relationship between household income and vegetable helpings



Area under the solid line (o) corresponds to the proportion of children consuming 1 or less than 1 vegetable helping a day which decreases with higher incomes. Area under the dashed line (+) corresponds to children consuming 2 vegetable helpings a day. Area over the dashed line (+) corresponds to proportion of children consuming 3 or more than 3 vegetable helpings a day which increases with higher incomes.

5.3.1.2.8 Food expenditure

Children from households that spend more money on food and groceries per week ate more helpings of vegetables per day, than children from households that spend less money on groceries ($p < 0.0005$). This significance was still observed after controlling for total household size. After controlling for food expenditure, a significant difference was still observed in vegetable consumption amongst NZ Maori and Pacific children ($p = 0.006$) and between NZ Maori and European children ($p = 0.013$). Regardless of household food expenditures, Maori and European children ate more helpings of vegetables per day than Pacific children. Ethnicity was found to be a stronger predictor of vegetable consumption than food expenditure and household size ($p < 0.0005$).

5.3.1.2.9 Education status of the food preparer

Children whose food preparer went to school for longer consumed significantly more helpings of vegetables per day ($p < 0.0005$).

5.3.1.2.10 Occupation status of the household

Children from households of high-occupation status were found to consume slightly more vegetable helpings than children from low-occupation status households but the association was not strong ($p = 0.053$). Again ethnicity was found to have a stronger effect than occupation status on vegetable consumption ($p < 0.0005$).

5.3.1.3 Consumption of foods rich in protein

To determine the frequency of consumption of foods rich in protein the number of helpings of meat, chicken, fish, seafood, eggs, dried beans, nuts and lentils a child consumed each day was recorded.

5.3.1.3.1 Age and gender

The age and sex of the child was not found to be a predictor of consumption of protein foods in children (p values 0.461 and 0.234 respectively). It was noted that the older children were more likely to be consuming 3 to 4 helpings a day than the preschool group.

5.3.1.3.2 Ethnicity of the child

Ordinal Logistic regression failed to find a significant and direct relationship between the ethnicity of the child and consumption of protein foods ($p = 0.846$). Pacific children were significantly more likely than Maori children to be consuming less than one daily helping of protein ($p = 0.003$). It appeared that more Pacific children make up the proportion of children consuming three to four protein helpings per day, but numbers were small in this category ($n = 10$) and hence no significant difference was found.

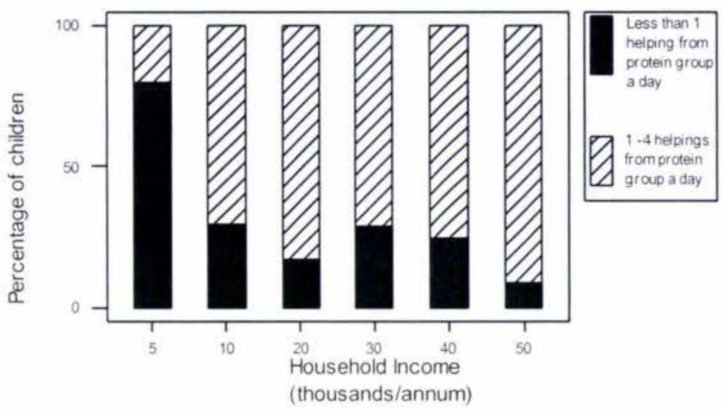
5.3.1.3.3 Ethnicity of the food preparer

The majority of children (69%) consuming less than one helping of protein products per day had a food preparer of Pacific ethnicity. More children whose food preparer were European (44%) ate one to two protein helpings per day and 50% of the children eating three to four protein helpings per day had Pacific food preparers. The only significant difference was observed between Maori and Pacific food preparers. Children of Pacific food preparers ate less protein products than children of Maori food preparers ($p = 0.014$).

5.3.1.3.4 Household income

Income was found to be a significant predictor of servings of protein foods consumed by children in the Validation study ($p = 0.035$).

Figure 5.7: Relationship between household income and consumption of protein



The majority of children in the lowest income bracket consumed less than one helping from the 'protein food group' per day (Figure 5.7). Children in the higher income brackets daily consumed more helpings from the 'protein group'.

5.3.1.3.5 Household food expenditure

The more a household spent on groceries per week the more helpings of protein foods consumed by the children (p = 0.011). This relationship remained significant when allowing for household size (p = 0.005). After adjusting for food expenditure and household size, Pacific children still significantly consumed fewer helpings of protein products than children of any other ethnicity (p = 0.001).

5.3.1.3.6 Education status of the food preparer

Children whose food preparer went to school for longer consumed significantly more helpings of protein foods per day (p = 0.012).

5.3.1.3.7 Occupation status of the household

Children from households that are on a benefit, were more likely to be consuming fewer helpings of protein products per day, than children from households not on the welfare system, but this observation was not significant (p = 0.119).

5.3.1.4 Cereal (complex carbohydrate) consumption

The determination of frequency of cereal consumption was based on the number of helpings of noodles, pasta or rice consumed by children on a weekly basis. One helping of cereals was defined as one cup of cooked noodles, pasta or rice.

5.3.1.4.1 Age and gender

The age and sex of the child had no effect on the helpings of cereal consumed per week by the children (p values 0.961 and 0.852 respectively).

5.3.1.4.2 Ethnicity of the child

The ethnicity of the child had a marginally significant effect on the consumption of cereal ($p = 0.060$). Children with Pacific relatives were more likely to be eating fewer helpings of cereals per week than children without Pacific relatives ($p = 0.016$). When controlling for income, the effect of being Pacific was slightly less significant ($p = 0.021$).

5.3.1.4.3 Ethnicity of the food preparer

A significant relationship between the ethnicity of the food preparer and children's consumption of cereals was found ($p < 0.0005$). Children whose food preparer were classified as European or 'Other' were more likely to be consuming more helpings of cereal per week than children of Pacific or Maori food preparers.

5.3.1.4.4 Household income

It appears that an increase in household income is associated with an increase in cereal consumption. However household income was not a strong predictor of cereal consumption in children ($p = 0.058$).

5.3.1.4.5 Education status of the food preparer

Children whose food preparer went to school for longer consumed significantly more helpings of cereals per week ($p = 0.019$).

5.3.1.4.6 Occupation status of the household

The occupation status of the household had a significant effect on cereal consumption in the children ($p = 0.030$). Children from high-occupation status households consumed significantly more helpings of cereal per week than children from low-occupation status or benefit households ($p = 0.033$).

5.3.1.5 Breakfast cereal consumption

One helping of breakfast cereals was defined as one cup of cereal or two weetbix. The majority of children consumed weetbix, cornflakes or rice bubbles. The significant associations found between socio-demographic variables and frequency of consumption of breakfast cereals per day will be discussed in this section.

5.3.1.5.1 Age and gender of child

School-age children were significantly more likely than preschool children to be consuming three or more helpings of breakfast cereal per day ($p = 0.026$).

5.3.1.5.2 Ethnicity of child

The ethnicity of the child had a significant effect on consumption of breakfast cereals ($p = 0.001$). Pacific children consumed significantly more helpings of breakfast cereal per day than Maori children ($p = 0.012$) and European or Other children ($p < 0.005$). Almost half of the children who usually ate weetbix, cornkflakes or rice bubbles were of Pacific ethnicity, whereas European children were more likely to be consuming Nutrigrain, Coco pops, Honey Puffs or Fruity Bix.

5.3.1.5.3 Ethnicity of the food preparer

Children whose food preparers were Pacific, consumed more helpings of breakfast cereals per day than other ethnic groups ($p = 0.038$).

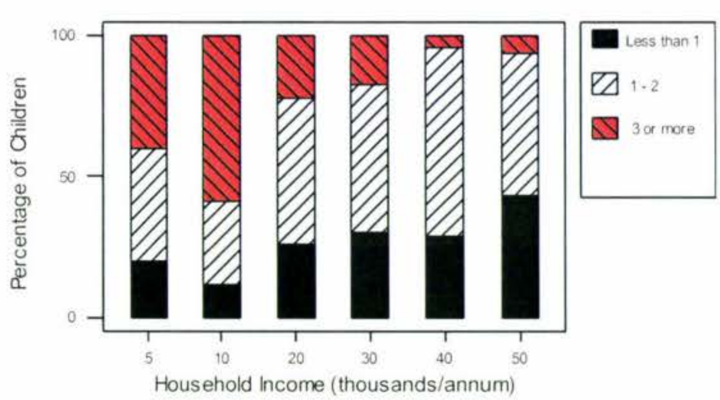
5.3.1.5.4 Housing arrangement

Children living in households where the home was owned, consumed fewer helpings of breakfast cereals per day than children living in rented homes or with relatives (p = 0.042). But this trend was accounted for by income.

5.3.1.5.5 Household income

Children from lower income households consumed more helpings of breakfast cereal per day than children from higher income households (p < 0.0005). Children from higher income households were more likely than children from lower income households to be consuming less than one helping of breakfast cereal per day.

Figure 5.8: Relationship between household income and helpings of breakfast cereals per day



Household income was also found to be a significant predictor of the type of breakfast cereal usually consumed by children (p = 0.003). Children from higher household incomes were less likely to be eating weetbix and cornflakes and more likely to be eating NutriGrain, Coco Pops and Fruity Bix.

5.3.1.5.6 Education status

Children whose food preparer went to school for longer consumed significantly fewer helpings of breakfast cereals per day ($p = 0.016$). After controlling for household income, the education status of the food preparer was not significant ($p = 0.004$ for income; $p = 0.846$ for education status).

5.3.1.6 Bread consumption

One helping of bread was defined as one medium slice of bread, or one roll, or one small pita bread. A few significant associations were found between socio-demographic variables and bread consumption.

5.3.1.6.1 Household food expenditure

The more a household spent on groceries per week; the more servings of bread consumed by the children ($p = 0.021$). This relationship remained significant when allowing for household size ($p = 0.050$).

5.3.1.6.2 Education and occupation status

Children whose food preparer went to school for longer consumed significantly fewer servings of bread per day ($p = 0.034$). A significant relationship was found between high-occupation status households and low-occupation status households with respect to bread consumption ($p = 0.020$). Children from high-occupation status households consumed significantly fewer servings of bread than children from lower occupation households ($p = 0.021$).

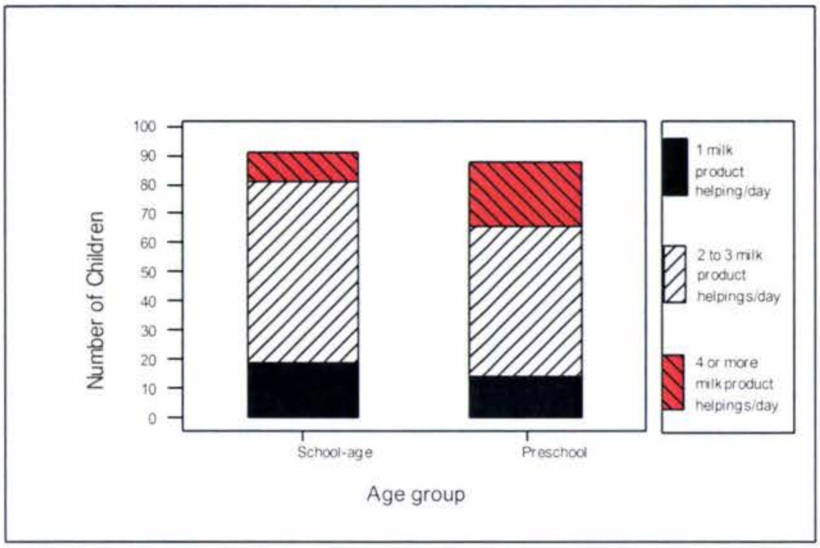
5.3.1.7 Milk products consumption

To determine the milk product consumption in children the caregiver was asked to report how many helpings of milk, yoghurt, dairy food, icecream and cheese their child usually consumes each day.

5.3.1.7.1 Age and gender

As demonstrated in Figure 5.9, preschool children were more likely to consume four or more daily helpings of milk products than school-age children (p = 0.034).

Figure 5.9: Number of children in each milk product category



The data suggested that more boys than girls consumed four or more helpings of milk products per day (p = 0.034).

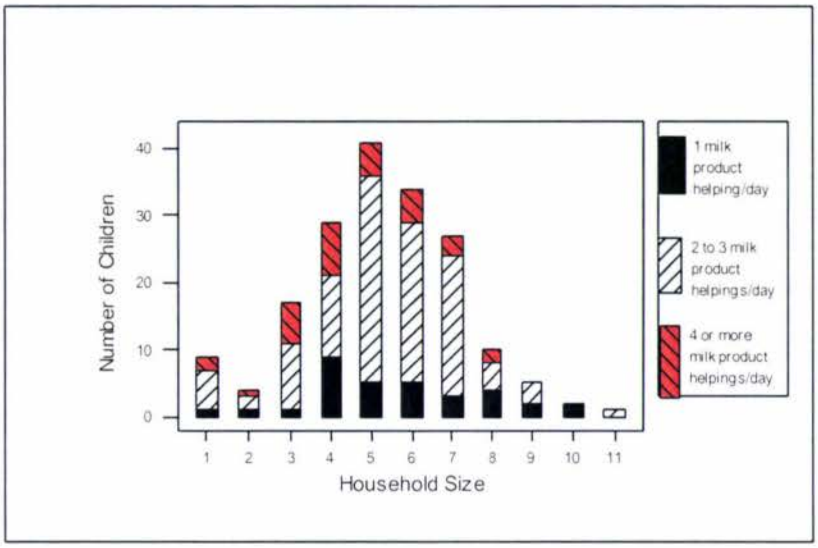
5.3.1.7.2 Ethnicity of the child

No significant difference in milk product consumption between European and Maori or European and 'Other' children was found. Pacific children consumed significantly fewer daily helpings of milk products than European children (p = 0.011).

5.3.1.7.3 Household size

An increase in household size was associated with significantly lower milk product intakes in the children in this study (p = 0.016). This is illustrated by Figure 5.10, which shows the number of children from each household size. In larger sized households a greater proportion of children are in the lowest consumption category of one helping of milk product per day.

Figure 5.10: Number of children in each milk product category against number in household



5.3.1.7.4 Household income and food expenditure

No clear relationship between household income and milk product consumption was found. After controlling for total household size, children from households that spend more money on food and groceries per week, ate more helpings of milk products than children from households that spend less money on groceries (p = 0.052).

5.3.1.7.5 Education and occupation status

Children whose food preparer went to school for longer, consumed more, but not significantly more helpings of milk products per day (p = 0.210). The occupation status of the household did not have a strong effect on children's milk product consumption. There was a suggestion that children from households of high-occupation status consumed more helpings of milk products than children from low-occupation status households or households receiving the benefit. But this was not significant ($p = 0.278$).

5.3.2 Socio-demographic determinants of nutrient intake in children

Food and beverages from the 24-hour recalls were electronically matched to food composition data in order to calculate the nutrient intake. The nutrient intake data was compared to socio-demographic data and the results have been presented in this section. The macronutrients have been presented first, followed by the micronutrient data.

5.3.2.1 Socio-demographic determinants of macronutrient intake

The intake of the macronutrients Energy (MJ) and protein (g) were compared to the United Kingdom Estimated Average Requirements (EAR) (Appendix 3b). Fat, carbohydrate and sugar intake were calculated as a percent of the total energy intake. Due to the lack of specific recommended values for fibre intake in children, the fibre intake of children in this study was compared to the recommended fibre intake[1] for children set by the American Health Foundation (ADA, 1999a).

5.3.2.1.1 Energy intake

Pacific children were more likely than children of any other ethnicity to not meet the EAR for energy intake ($p = 0.003$). An increase in education status of the household was positively associated with more children meeting the EAR for energy ($p = 0.001$). The majority of children (61%) living in higher income households met the EAR for energy; whereas the majority of children living in lower income households (67%) did not meet the EAR for energy (Table 5.16).

5.3.2.1.2 Protein intake

The mean protein intake as a percent of the EAR was significantly higher in preschool children and in males compared to school-age children ($p < 0.0005$)

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[1] Recommended Fibre intake for children: Age plus 5 grams of fiber per day (ADA, 1999a).

and girls (p = 0.039) as shown in Table 5.17. Maori children had the highest mean protein intake as a percent of the EAR, than children of any other ethnic group (p = 0.027). Low-occupation status of households and low-household income were significantly associated with lower mean protein intake as percent of the EAR (p = 0.026; p = 0.008 respectively).

5.3.2.1.3 Total fat intake (as a percent of total energy intake)

Age was found to marginally influence fat intake with school-age children recording a higher fat percentage (35%) than preschool children (32%) (p = 0.055). Preschool children from households that spend more money on food per week consumed a higher proportion of energy from total fat (32%) than children from households spending less money on food (26%) (p = 0.045) as evident in Table 5.18a. No significant relationship was found between socio-demographic variables and percent of total energy intake as fat in school-age children (Table 5.18b).

5.3.2.1.4 Carbohydrate intake (as a percent of total energy intake)

The mean contribution to daily energy from carbohydrate was slightly higher for preschool children (53%) than school-age children (50%), but this was not significant (p = 0.083). Female school-age children had a significantly higher percent of total energy from carbohydrate than male school-age children (p = 0.032) as evident in Table 5.19b.

5.3.2.1.5 Sugar intake (as a percent of total energy intake)

Preschool children living in low-income households had a lower mean percent energy from sugar (22%), than preschool children living in higher income households (28%) (p = 0.017) as presented in Appendix 9. Preschool children from high-occupation status households consumed a significantly higher proportion of energy from total sugars (27%), than children from low-occupation status households (23%). The mean contribution to daily energy from sugars was significantly lower for Pacific school-age children (19%) than for Maori (23%), or

European (26%), or Other school-age children (24%). School-age girls had significantly higher sugar intakes as a percent of total energy (26%) than school-age boys (20%).

5.3.2.1.6 Fibre intake

Children of Pacific or Other food preparers were significantly more likely than children of Maori or European food preparers to not meet the recommended intake for fibre ($p = 0.042$). Children in higher income households were significantly more likely to meet recommended fibre intakes than children living in lower income households ($p = 0.006$). Preschool children have a higher fibre intake than school children ($p < 0.0005$). The figures for fibre are presented in Appendix 10.

Table 5.16: The effect of socio-demographic variables on energy intake

		Percentage (Numbers) Who are -		p-value for difference in proportions	Mean energy intake as a % of EAR (Standard Error)	p-value for difference in means
		Below EAR	Above EAR			
Age	Preschool	49% (44)	51% (45)	0.426	109.6 (5.0)	0.405
	School-age	55% (52)	45% (42)		104.0 (4.5)	
Sex	Male	52% (48)	48% (44)	0.938	108.8 (5.2)	0.534
	Female	53% (48)	47% (43)		104.6 (4.2)	
Main Ethnicity of Child	Maori	39% (20)	61% (31)	**0.003**	124.62	**0.003**
	Pacific	70% (46)	30% (20)		95.53	
	European	43% (26)	57% (34)		106.18	
	Other	67% (4)	33% (2)		81.32	
Ethnicity of the Food Preparer	Maori	39% (18)	61% (28)	**0.003**	122.31	**0.008**
	Pacific	71% (45)	29% (18)		94.93	
	European	45% (29)	55% (36)		105.58	
	Other	60% (3)	40% (2)		82.03	
Dwelling	Owned	44% (44)	56% (55)	**0.017**	112.6 (4.3)	0.062
	Rented	62% (51)	38% (31)		99.7 (5.3)	
Household size	5 or less	45% (46)	55% (57)	0.292	105.8 (4.5)	0.755
	6 or more	53% (42)	48% (38)		107.9 (5.0)	
Annual Household income	< $30,000	67% (30)	33% (15)	**0.009**	95.15	**0.010**
	$30,001 to $40,000	67% (16)	33% (8)		97.98	
	$40,001 to $50,000	71% (17)	29% (7)		84.24	
	$50,001 or more	39% (22)	61% (34)		115.71	
Household expenditure	Less than or equal $100/wk	74% (14)	26% (5)	0.109	86.19	0.081
	More than $100/wk	54% (76)	46% (64)		104.94	
Mean years of schooling of food preparer (se)		9.3 (0.34)	10.9 (0.31)	**0.001**	-	
Occupation status of household	High	51% (40)	49% (38)	0.145	109.43	0.060
	Low	63% (46)	37% (27)		94.85	
	Benefit	36% (4)	64% (7)		119.28	

Table 5.17: The effect of socio-demographic variables on protein intake

		Percentage (Numbers) Who are -		p-value for difference in proportions	Mean protein intake as a % of EAR (Standard Error)	p-value for difference in means
		Below EAR	Above EAR			
Age	Preschool	2% (2)	98% (87)	0.695	400 (17)	0.000
	School-age	3% (3)	97% (91)		300 (21)	
Sex	Male	1% (1)	99% (91)	0.170	378 (23)	0.039
	Female	4% (4)	96% (87)		319 (17)	
Main Ethnicity of Child	Maori	2% (1)	98% (50)	NS	412 (36)	0.027
	Pacific	2% (1)	98% (65)		306 (18)	
	European	3% (2)	97% (58)		348 (22)	
	Other	17% (1)	83% (5)		296 (50)	
Ethnicity of the Food Preparer	Maori	0% (0)	100% (46)	NS	399 (36)	0.069
	Pacific	2% (1)	98% (62)		306 (19)	
	European	5% (3)	95% (62)		344 (22)	
	Other	20% (1)	80% (4)		280 (59)	
Dwelling	Owned	1% (1)	99% (98)	0.114	367 (16)	0.141
	Rented	5% (4)	95% (78)		322(25)	
Household size	5 or less	5% (5)	95% (98)	0.046	355 (17)	0.624
	6 or more	0% (0)	100% (80)		341 (24)	
Annual Household income	< $30,000	4% (2)	96% (43)	NS	291(22)	0.008
	$30,001 to $40,000	0% (0)	100% (24)		302 (27)	
	$40,001 to $50,000	8% (2)	92% (22)		290 (31)	
	$50,001 or more	0% (0)	100% (56)		407 (33)	
Household expenditure	Less than or equal $100/wk	5% (1)	95% (18)	NS	285 (25)	0.211
	More than $100/wk	3% (4)	97% (136)		346 (18)	
Mean years of schooling of food preparer (se)		10.2 (1.1)	10.0 (0.25)	0.869	-	
Occupation status of household	High	3% (2)	97% (76)	NS	384 (25)	0.026
	Low	3% (2)	97% (71)		302 (18)	
	Benefit	0% (0)	100% (46)		303 (34)	

Table 5.18a: The effect of socio-demographic variables on fat intake as a percent of energy intake in preschoolers

		Mean fat intake as a % of total energy intake (Standard Error)	p-value for difference in means
Sex	Male	33 (1)	0.408
	Female	31 (1)	
Main Ethnicity of Child	Maori	34 (2)	0.558
	Pacific	31 (2)	
	European	32 (2)	
	Other	32 (3)	
Ethnicity of the Food Preparer	Maori	32 (2)	0.799
	Pacific	31 (2)	
	European	33 (2)	
	Other	35 (1)	
Dwelling	Owned	31 (2)	0.414
	Rented	33 (1)	
Household size	5 or less	32 (1)	0.737
	6 or more	33 (1)	
Annual Household income	< $30,000	31 (2)	0.915
	$30,001 to $40,000	31 (3)	
	$40,001 to $50,000	30 (2)	
	$50,001 or more	32 (1)	
Household expenditure	Less than or equal $100/wk	26 (4)	0.045
	More than $100/wk	32 (1)	
Occupation status of household	High	31 (1)	0.483
	Low	31 (2)	
	Benefit	35 (3)	

Table 5.18b: The effect of socio-demographic variables on fat as a percent of energy intake in school-age children

		Mean fat intake as a % of total energy intake (Standard Error)	p-value for difference in means
Sex	Male	37 (2)	0.094
	Female	33 (1)	
Main Ethnicity of Child	Maori	36 (2)	0.335
	Pacific	36 (1)	
	European	32 (1)	
	Other	39 (6)	
Ethnicity of the Food Preparer	Maori	37 (3)	0.279
	Pacific	36 (2)	
	European	33 (1)	
	Other	39 (6)	
Dwelling	Owned	33 (1)	0.069
	Rented	37 (1)	
Household size	5 or less	35 (1)	0.608
	6 or more	34 (2)	
Annual Household income	< $30,000	35 (2)	0.867
	$30,001 to $40,000	34 (2)	
	$40,001 to $50,000	32 (3)	
	$50,001 or more	35 (3)	
Household expenditure	Less than or equal $100/wk	35 (2)	0.924
	More than $100/wk	34 (1)	
Occupation status of household	High	35 (2)	0.945
	Low	35 (1)	
	Benefit	33 (2)	

Table 5.19a: The effect of socio-demographic variables on carbohydrate as a percent of energy intake in preschool children

		Mean carbohydrate intake as a % of total energy intake (Standard Error)	p-value for difference in means
Sex	Male	52 (2)	0.432
	Female	54 (1)	
Main Ethnicity of Child	Maori	51 (2)	0.371
	Pacific	55 (2)	
	European	54 (2)	
	Other	47 (4)	
Ethnicity of the Food Preparer	Maori	54 (2)	0.319
	Pacific	55 (2)	
	European	52 (2)	
	Other	43 (1)	
Dwelling	Owned	53 (1)	0.488
	Rented	54 (2)	
Household size	5 or less	53 (1)	0.835
	6 or more	53 (2)	
Annual Household income	< $30,000	54 (3)	0.854
	$30,001 to $40,000	53 (3)	
	$40,001 to $50,000	56 (2)	
	$50,001 or more	53 (2)	
Household expenditure	Less than or equal $100/wk	60 (4)	0.059
	More than $100/wk	53 (1)	
Occupation status of household	High	54 (1)	0.915
	Low	54 (2)	
	Benefit	52 (3)	

Table 5.19b: The effect of socio-demographic variables on carbohydrate as a percent of energy intake in school-age children

		Mean carbohydrate intake as a % of total energy intake (Standard Error)	p-value for difference in means
Sex	Male	48 (2)	**0.032**
	Female	53 (2)	
Main Ethnicity of Child	Maori	49 (3)	0.382
	Pacific	49 (2)	
	European	53 (2)	
	Other	49 (7)	
Ethnicity of the Food Preparer	Maori	48 (3)	0.243
	Pacific	49 (2)	
	European	53 (2)	
	Other	49 (7)	
Dwelling	Owned	52 (2)	0.291
	Rented	49 (2)	
Household size	5 or less	50 (1)	0.923
	6 or more	51 (2)	
Annual Household income	< $30,000	50 (2)	0.961
	$30,001 to $40,000	52 (2)	
	$40,001 to $50,000	51 (3)	
	$50,001 or more	51 (3)	
Household expenditure	Less than or equal $100/wk	49 (3)	0.654
	More than $100/wk	51 (1)	
Occupation status of household	High	50 (2)	0.804
	Low	51 (2)	
	Benefit	53 (4)	

5.3.2.2 Socio-demographic determinants of micronutrient intake in children

The micronutrients analyzed included folate, riboflavin, thiamin, niacin, vitamins A, C, E, B12, B6 and calcium, magnesium, zinc, selenium, phosphorus and iron. Only the nutrients found to be significantly related to socio-demographic variables will be commented on in this section. Tables for iron, calcium and folate have been presented in this section. The tables for the other micronutrients have been presented in Appendices 11 to 22.

5.3.2.2.1 Iron

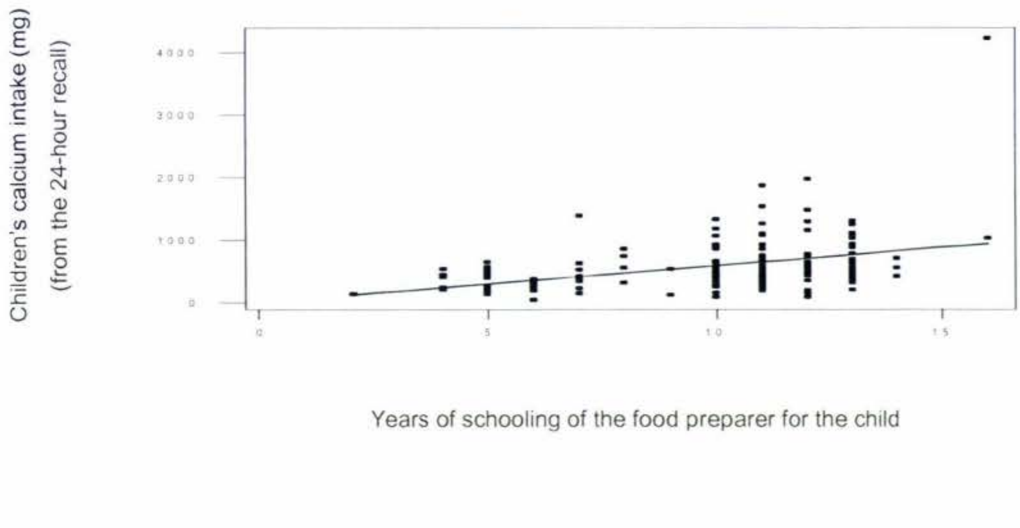
Maori children (93%) were significantly more likely than European (68%), Pacific (65%) or Other (60%) children to meet the RDI for iron ($p = 0.004$), as evident in Table 5.20. Children whose food preparer was Maori were also significantly more likely to meet the RDI for iron ($p = 0.019$). Household income and years of schooling of the food preparer, did not significantly predict children's iron intake (Table 5.20). When considering mean iron intakes as a percent of the RDI, school-age children had higher iron intakes than preschool children ($p = 0.037$) and boys had higher iron intakes than girls ($p = 0.032$).

5.3.2.2.2 Calcium

Maori children had the highest median intake of calcium, followed by European children ($p < 0.0005$). The majority of Pacific children (91%) had calcium intakes below the RDI for calcium ($p = 0.001$) (Table 5.21). Children whose food preparer went to school for longer, had significantly higher calcium intakes ($p <0.0005$) as evident in Table 5.21 and Figure 5.11. All children living in households that spent one hundred or less than one hundred dollars per week on groceries, had calcium intakes below the RDI for calcium ($p = 0.015$). Children living in higher income households had higher median intakes of calcium ($p= 0.001$). But the significance of the effect of income was lost when years of schooling of the food preparer was added to the regression analysis equation ($p = 0.697$).

Preschool children were more likely than school-age children to reach the age adjusted RDI for calcium (p = 0.036) (Table 5.21). The mean intake of calcium for children living in high-occupation status households was found to be at 93% of the RDI; while for children living in low-occupation status households the mean intake of calcium was at 61% of the RDI (p = 0.003). Children living in households where the home was owned had higher mean intakes of calcium as a percent of the RDI (92%) than children living in rented homes (67% of RDI) (p = 0.007).

Figure 5.11: Relationship between calcium intake and education status of the food preparer



5.3.2.2.3 Folate

Binary Logistic Regression found that children from high-occupation status households were more likely to meet the RDI for folate, than children living in low-occupation status households (p < 0.0005). This was confirmed by cross tabulation which found that 64% of those children not meeting the RDI for folate were from low-occupation status households (p = 0.002). Half of Pacific children had folate intakes below the RDI (p= 0.017) as evident in Table 5.22. Children whose food preparer went to school for longer, had significantly higher intakes of folate than children whose food preparer went to school for a shorter period of time (p = 0.003). The mean folate intake as a percent of the RDI increased with increasing household incomes (p = 0.003).

5.3.2.2.4 Vitamin B12

Significant differences were observed in vitamin B12 intake with respect to the ethnicity of the food preparer for the child (p = 0.043) as shown in Appendix 11. Forty percent of children whose food preparer was Other, and 19% of children whose food preparer was Pacific, had vitamin B12 intakes below the RDI. One third of children whose food preparer was European had vitamin B12 intakes below the RDI for vitamin B12.

5.3.2.2.5 Vitamin B6

Preschool children were significantly more likely to meet the age-adjusted RDI for vitamin B6 than school-age children (p = 0.006). There was a significant difference in vitamin B6 intake with varying household income and occupation status (Appendix 12). Children living in low-income households and in low-occupation status households had significantly lower intakes of vitamin B6 than children living in high-income and in high-occupation status households (Appendix 12). Around half of Pacific children did not meet the RDI for B6 (p = 0.013).

5.3.2.2.6 Riboflavin

A greater proportion of preschool children than school-age children are meeting the RDI for riboflavin as evident in Appendix 13. Children living in the highest income households were significantly more likely to meet the RDI for riboflavin than children living in lower income households (p = 0.039). Pacific and Other children were more likely than Maori or European children to not meet the RDI for riboflavin (p =0.010). Children living in high-occupation status households had higher mean riboflavin intakes, as a percent of the riboflavin RDI, than children living in low-occupation status households or households receiving the benefit ($p < 0.0005$). The type of dwelling also significantly influenced riboflavin intake. Children living in owned homes had higher riboflavin intakes than children living in rented homes ($p < 0.0005$). The mean intake of riboflavin of children from low-household food budgets was found to be at 97% of the RDI; while the mean intake was at 142% of the RDI for children living in households than spend more money on food per week ($p = 0.020$).

5.3.2.2.7 Thiamin

A third of all school-age children had thiamin intakes below the RDI for thiamin as evident in Appendix 14. Children from higher income or high-occupation status households were significantly more likely to meet the thiamin RDI, than children from lower income households ($p = 0.009$) or low-occupation status households ($p = 0.004$). The more money spent on groceries per week, the higher the intake of thiamin consumed by children ($p = 0.010$).

5.3.2.2.8 Niacin

The ethnicity of the child and food preparer as well as the occupation status of the household was found to have a significant effect on the mean niacin intake, as a percent of the RDI for niacin (Appendix 15). Pacific and Other children had a lower mean niacin intake as a percent of the RDI, than Maori or European children (Appendix 15). A decline in occupation status from high to low was significantly associated with a lower mean percent RDI niacin intake (Appendix 15).

5.3.2.2.9 Magnesium

Preschool children were significantly more likely to meet the RDI for magnesium than school-age children as shown in Appendix 16. Children living in high-income households were more likely to have higher intakes of magnesium than children from low-income households ($p = 0.009$). When considering mean magnesium intakes, as a percent of the RDI for magnesium, Pacific children had significantly lower intakes than Maori or European children ($p = 0.028$). Children living in high-occupation status households had higher magnesium intakes than children living in low-occupation status households ($p = 0.007$). Home ownership was associated with higher magnesium intakes as evident in Appendix 16.

5.3.2.2.10 Vitamin E

Pacific children were least likely than children of any other ethnic group to meet the RDI for Vitamin E ($p = 0.030$) as shown in Appendix 17. Children whose food preparer went to school for longer, had higher intakes of vitamin E ($p = 0.005$). The majority (84%) of children in low-occupation status households had intakes of vitamin E below the RDI for vitamin E ($p = 0.004$). Children living in owned homes were more likely to meet the RDI for vitamin E than children living in rented homes (Appendix 17). The mean vitamin E intake for children from the highest income households was at 107% of the RDI for vitamin E, whereas for children from the lowest income group, intake was at 70% of the RDI ($p < 0.0005$).

5.3.2.2.11 Vitamin C

Higher vitamin C intakes were recorded for children whose food preparer went to school for longer ($p = 0.049$). More boys than girls did not meet the RDI for vitamin C ($p = 0.006$). Pacific and Other children had lower mean vitamin C intakes as a percent of the RDI than European or Maori children ($p = 0.009$) as demonstrated in Appendix 18.

5.3.2.2.12 Vitamin A

Half of the girls and a third of the boys in this study had vitamin A intakes below the age-adjusted RDI for vitamin A ($p = 0.021$). A third of all preschool children and half of school-age children had vitamin A intakes below the age-adjusted RDI for vitamin A ($p = 0.026$). Children living in homes that were owned had significantly higher vitamin A intakes, than children living in rented homes (Appendix 19). Vitamin A intakes, as a percent of the RDI, were significantly higher for children living in the highest income households, compared to children living in the lowest income category households ($p = 0.010$).

5.3.2.2.13 Zinc

Data from Appendix 20 shows that a greater proportion of preschool children (75%) than school-age children (51%) had zinc intakes above the age-adjusted RDI for zinc ($p = 0.001$). There was a significant difference between ethnic groups in the percentage of children with zinc intakes below the RDI for zinc, and when considering mean zinc intakes as a percent of the zinc RDI (Appendix 20). Maori children were more likely than children of any other ethnic group to have zinc intakes above the RDI for zinc ($p = 0.020$).

5.3.2.2.14 Selenium

The age of the child was the only significant socio-demographic variable to have an effect on selenium intake in the children in this study ($p = 0.032$). Forty percent of preschool children and 26% of school-age children had selenium intakes above the selenium RDI as evident in Appendix 21.

5.3.2.2.15 Phosphorus

More preschool children than school-age children had phosphorus intakes above the age-adjusted RDI for phosphorus ($p = 0.043$). Children living in households where the home was owned were significantly more likely to meet the RDI for phosphorus, than children living in rented homes (Appendix 22). Children living in high-occupation status households had significantly higher mean phosphorus intakes, as a percent of the phosphorus RDI, than children living in low-income or benefit households ($p = 0.005$). Children living in higher income households, and in households that spent more money on food per week, had significantly higher intakes of phosphorus ($p < 0.000$; 0.010 respectively). As the total number of people in a household increased there was an increased chance of the child meeting the RDI for phosphorus ($p = 0.050$). Children who had phosphorus intakes above the RDI had food preparers who went to school for longer ($p <$

0.0005). A greater proportion of Pacific children than children of any other ethnic group did not meet the RDI for phosphorus ($p = 0.002$).

Table 5.20: The effect of socio-demographic variables on iron intake

		Percentage Who are - Below RDI	Above RDI	p-value for difference in proportions	Mean iron intake as a % of RDI (Standard Error)	p-value for difference in means
Age	Preschool	28	72	0.578	140 (7)	0.037
	School-age	24	76		164 (9)	
Sex	Male	25	75	0.704	165 (10)	0.032
	Female	27	73		140 (7)	
Main Ethnicity of Child	Maori	10	90	**0.019**	178 (13)	**0.046**
	Pacific	33	67		142 (9)	
	European	32	68		145 (10)	
	Other	33	67		118 (13)	
Ethnicity of the Food Preparer	Maori	7	93	**0.004**	186 (14)	**0.005**
	Pacific	35	65		136 (9)	
	European	32	68		143 (9)	
	Other	40	60		116 (15)	
Dwelling	Owned	22	78	0.150	155 (10)	0.576
	Rented	32	68		148 (7)	
Household size	5 or less	30	70	0.177	143 (7)	0.086
	6 or more	21	79		164 (10)	
Annual Household income	< $30,000	36	64	0.697	147 (13)	0.970
	$30,001 to $40,000	38	63		137 (13)	
	$40,001 to $50,000	25	75		147 (17)	
	$50,001 or more	29	71		145 (11)	
Household expenditure	Less than or equal $100/wk	47	53	0.082	127 (17)	0.282
	More than $100/wk	28	72		148 (7)	
Mean years of schooling of food preparer (se)		9.4 (0.47)	10.3 (0.28)	0.119	-	-
Occupation status of household	High	26	74	0.614	157 (9)	0.262
	Low	33	67		136 (9)	
	Benefit	27	73		148 (25)	

Table 5.21: The effect of socio-demographic variables on calcium intake

		Percentage Who are -		p-value for difference in proportions	Mean calcium intake as a % of RDI (Standard error)	p-value for difference in means
		Below RDI	**Above RDI**			
Age	Preschool	69	31	**0.036**	86 (6)	0.196
	School-age	82	18		75 (7)	
Sex	Male	71	29	0.133	86 (8)	0.235
	Female	80	20		75 (5)	
Main Ethnicity of Child	Maori	59	41	**0.001**	109 (12)	**<0.0005**
	Pacific	91	9		54 (4)	
	European	72	28		86 (7)	
	Other	83	17		66 (13)	
Ethnicity of the Food Preparer	Maori	67	33	**0.009**	103 (12)	**<0.0005**
	Pacific	90	10		55 (5)	
	European	68	32		88 (6)	
	Other	80	20		69 (15)	
Dwelling	Owned	68	32	**0.011**	92	**0.007**
	Rented	84	16		67	
Household size	5 or less	75	25	0.816	78 (5)	0.604
	6 or more	76	24		83 (8)	
Annual Household income	< $30,000	91	9	**0.003**	56 (6)	**<0.0005**
	$30,001 to $40,000	83	17		58 (7)	
	$40,001 to $50,000	92	8		66 (10)	
	$50,001 or more	64	36		101 (10)	
Household expenditure	Less than or equal $100/wk	100	0	**0.015**	41 (5)	**0.006**
	More than $100/wk	76	24		81 (5)	
Mean years of schooling of food preparer (se)		9.6 (0.28)	11.8 (0.33)	**<0.0005**	-	-
Occupation status of household	High	73	27	0.119	93 (8)	**0.003**
	Low	86	14		61 (5)	
	Benefit	73	27		68 (8)	

Table 5.22: The effect of socio-demographic variables on folate intake

		Percentage Who are -		p-value for difference in proportions	Mean folate intake as a % of RDI (Standard error)	p-value for difference in means
		Below RDI	Above RDI			
Age	Preschool	29	71	0.194	169 (12)	0.095
	School-age	38	62		142 (10)	
Sex	Male	30	70	0.322	162 (11)	0.398
	Female	37	63		148 (11)	
Main Ethnicity of Child	Maori	25	75	**0.011**	174 (13)	**0.002**
	Pacific	50	50		122 (9)	
	European	30	70		182 (18)	
	Other	68	33		91 (11)	
Ethnicity of the Food Preparer	Maori	24	76	**0.017**	164 (11)	**0.004**
	Pacific	51	49		122 (9)	
	European	32	68		183 (17)	
	Other	60	40		95 (13)	
Dwelling	Owned	21	79	**<0.0005**	180 (11)	**<0.0005**
	Rented	49	51		120 (8)	
Household size	5 or less	34	66	0.313	162 (11)	0.288
	6 or more	41	59		146 (11)	
Annual Household income	< $30,000	51	49	0.098	110 (8)	**0.003**
	$30,001 to $40,000	42	58		140 (15)	
	$40,001 to $50,000	50	50		143 (25)	
	$50,001 or more	29	71		188 (18)	
Household expenditure	Less than or equal $100/wk	47	53	0.462	110 (9)	0.078
	More than $100/wk	39	61		156 (9)	
Mean years of schooling of food preparer (se)		9.0 (0.43)	10.6 (0.27)	**0.003**	-	-
Occupation status of household	High	26	74	**<0.0005**	183 (14)	**<0.0005**
	Low	56	44		116 (7)	
	Benefit	27	73		163 (39)	

5.3.3 Socio-demographic determinants of dietary eating patterns

The dietary eating patterns of the children were investigated. This included the frequency of consumption of:

- takeaways
- school canteen foods
- foods from local shops
- certain types of foods

The findings of statistically significant relationships between socio-demographic factors and specific dietary eating patterns have been presented in this section.

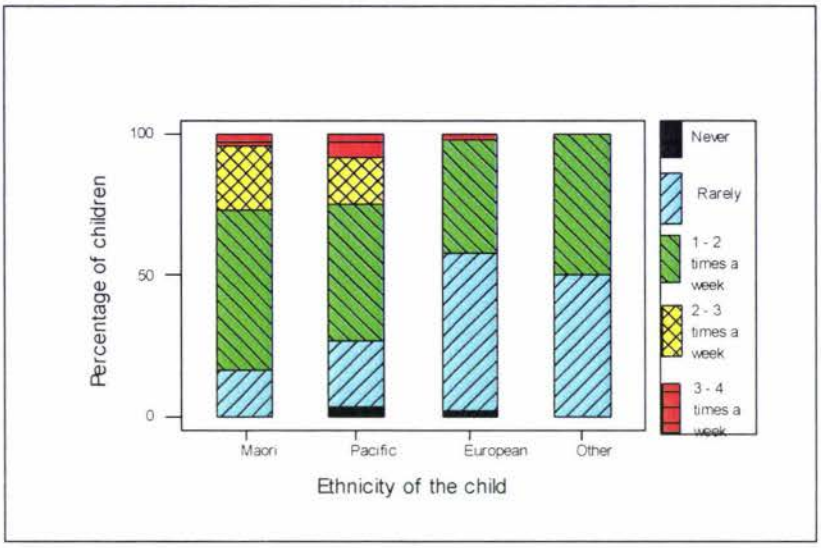
5.3.3.1 Takeaways consumption

A total of 48% of children consumed takeaways once or twice a week. In this study, 13.5% of preschoolers and 21.3% of school-age children consumed takeaways two to four times a week.

5.3.3.1.1 Ethnicity of the child and their food preparer

A significant relationship was found between the ethnicity of the child and the frequency of consumption of takeaways ($p < 0.0005$). Maori and Pacific children were more likely to consume takeaways two to three times a week than European children ($p < 0.0005$). No significant difference in consumption of takeaways was found between European and 'Other' children ($p = 0.692$).

Figure 5.12: Frequency of takeaway consumption by children of different ethnic groups



Children of Maori or Pacific food preparers ate more takeaways per week than children of European or Other food preparers ($p < 0.0005$).

5.3.3.1.2 Household size

Children who 'never' consume takeaways were more likely to be from smaller sized households of five or less people ($p = 0.040$). The opposite trend was observed in children who more frequently consume takeaways. About half of the children that consumed takeaways 'once to twice a week' or 'two to three times a week' were from larger sized households of six or more people. Of the children who frequently consumed takeaways, that is three to four times per week, 56% were from households of five or less and 44% were from households of six or more people ($p = 0.040$).

5.3.3.1.3 Household income and food expenditure

Household income and the amount of money spent on food per week by the household were not significantly linked to the frequency of consumption of takeaways ($p = 0.157$).

5.3.3.1.4 Education and occupation status

Children whose food preparer went to school for longer were significantly less likely to consume takeaways per week (p = 0.002). Children from low-occupation or benefit households consumed takeaways significantly more times per week than children from high-occupation status households (p = 0.001).

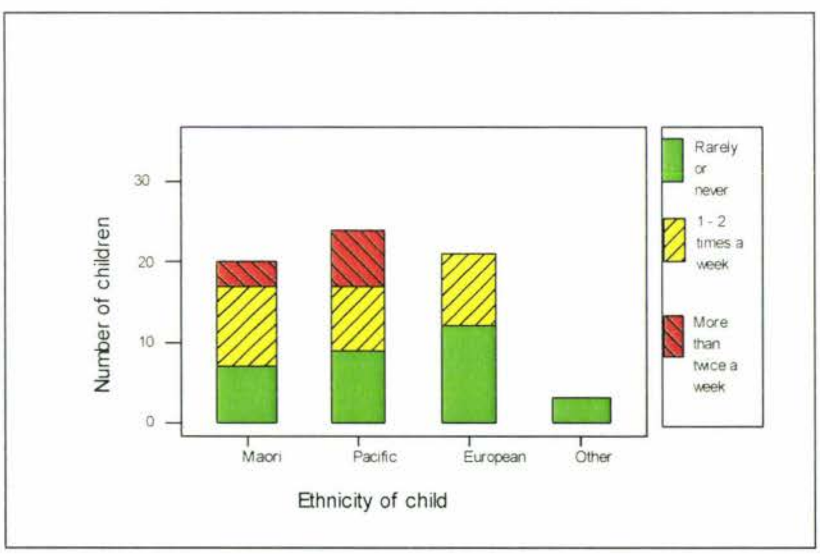
5.3.3.2 Consumption of food from the school canteen

Fifteen percent of school-age children in this study bought food from the school canteen more than twice a week.

5.3.3.2.1 Ethnicity of the child and their food preparer

Maori and Pacific children were more likely than European children to often consume food from the school canteen (p = 0.021) as evident in Figure 5.13.

Figure 5.13: Frequency of eating at school canteen by children of different ethnic groups



Children who most often bought food from the school canteen were more likely to have a Pacific food preparer (p = 0.041). Of the children that bought food from the school canteen more than twice a week; 60% had a Pacific food preparer, 40% had a Maori food preparer and none of the children had a European or Other food preparer.

5.3.3.2.2 Household income

Household income was found to have a significant effect on the frequency of consumption of food from the school canteen ($p = 0.005$). Children from high-income households were more likely to never or rarely buy food from the school canteen.

5.3.3.2.3 Education status of the food preparer

Children whose food preparer went to school for longer were less likely to have consumed food from the school canteen ($p = 0.047$).

5.3.3.3 Purchasing food from the local shops

Children from higher income households consumed food least frequently from local shops than children from lower income households ($p = 0.043$). Children whose food preparers were Maori or Pacific were significantly more likely to eat food bought from the local shops, than children of European food preparers ($p < 0.0005$). Children whose food preparer went to school for longer were significantly least likely to eat food bought from the local shops ($p = 0.002$).

5.3.3.4 Consumption of certain types of foods

The consumption of several specific types of foods were analysed with respect to socio-demographic status but only the consumption of milk and white bread will be presented in this section.

5.3.3.4.1 Full-fat versus reduced-fat milk

A total of 76% of all children consumed full-fat milk and not reduced-fat milk. Pacific and Maori children were significantly more likely to consume full-fat milk than European children who were significantly more likely to consume reduced-fat milk ($p = 0.002$). Children living in households where the house is owned were significantly more likely to be consuming reduced-fat milk than children living in rented homes ($p = 0.005$). Children living in higher income households were significantly more likely to be consuming reduced-fat milk as opposed to full-fat milk ($p = 0.020$). An increase in the years of schooling of the food preparer was associated with children consuming reduced-fat milk over full-fat milk ($p = 0.022$).

5.3.3.4.2 White bread versus wholemeal bread

Pacific children were significantly more likely than Maori or European children to eat white bread ($p = 0.004$). European children were significantly more likely than Pacific children to consume wholemeal or grain breads ($p = 0.004$). Children whose food preparer was Pacific, were significantly more likely to consume white bread than children whose food preparer were European, Maori or Other ($p = 0.008$). Children living in low-income households and low-occupation status households were significantly more likely to be consuming white bread than children of high-income ($p = 0.004$) or high-occupation status households ($p < 0.0005$). Children of food preparers who went to school for longer were significantly more likely to consume wholemeal or grain breads than white bread ($p < 0.0005$).

5.4 Socio-demographic determinants of the physical status of children

The physical status of children in this study was determined from the anthropometric data. Obesity and overweight classifications were based on the international cut-off values published by Cole and colleagues (2000) and presented in Appendix 6.

In this study, a greater proportion of school-age children were classified as overweight or obese than preschool children; however age was not a significant factor as shown in Table 5.23.

Table 5.23: Percentage of overweight and obese preschool and school-age children

Age-group Of the child	Percent Overweight	p value for difference in proportions	Percent Obese	p value for difference in proportions
Preschool	36	0.139	16	0.714
School-age	47		18	

After controlling for age, gender was not a significant predictor of BMI, but Pacific girls were significantly more likely to be overweight than Pacific boys as evident in Table 5.24.

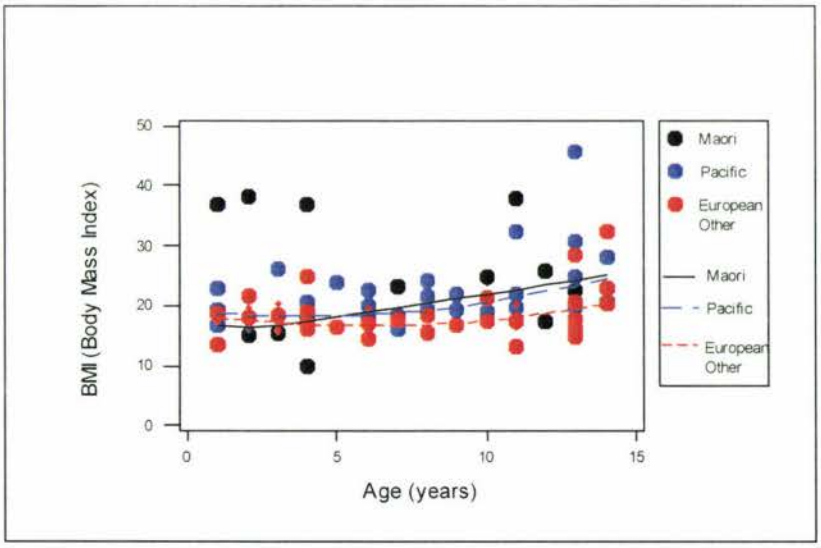
After accounting for the relationship between BMI and age there was still a significant difference between European or Other children, and Pacific or Maori children. Figure 5.14 displays the relationship between ethnicity and BMI as the lowess smoother which provides a type of running average for each ethnic group. Higher BMI values were recorded for Maori and Pacific children as demonstrated by the higher curves for Maori and Pacific on Figure 5.14.

Table 5.24: Percent of all children considered overweight or obese in each ethnic and gender category

	Maori		Pacific		European		Others		All children	
	M	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Percent of children in category who are overweight	48	33	25	52	50	34	100	75	41	42
p value for difference between males and females	0.283	0.283	**0.030**	**0.030**	0.254	0.254	-	-	0.908	0.908
Percent of children in category who are obese	15	8	13	26	21	17	0	50	15	19
p value for difference between males and females	0.473	0.473	0.179	0.179	0.739	0.739	-	-	0.485	0.485

N.B. M = male, F = female. For classification of overweight and obese refer to Appendix 6.

Figure 5.14: Relationship between BMI and age for each ethnic group - showing lowess smoother for each ethnic group

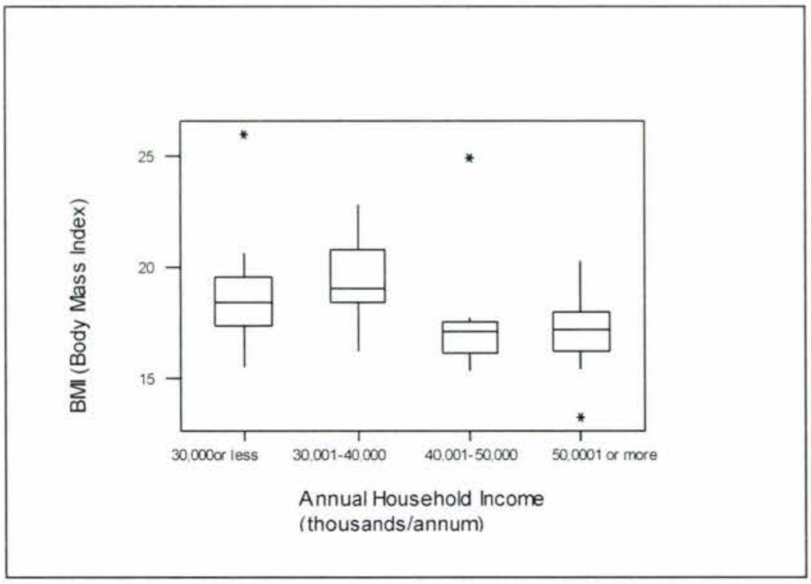


5.4.1 Preschool children

In this section, the preschool children have been considered separately to the school-aged children. Regression analysis of the weights of preschool children did not show any significant difference in body measurements with respect to gender or ethnicity of the child. Yet significant differences were noted in the median BMI of preschool children of different ethnic groups (p = 0.005) (Table 5.25). The median BMI was higher for Other (19.8) and Pacific (18.5) than European (17.5) and Maori (16.6) preschool children. The same trend was observed when comparing the ethnicity of the food preparer. Children of Pacific and Other food preparers had a higher median BMI than children of European or Maori food preparers (p = 0.005) (Table 5.25).

Regression analysis found the education status of the food preparer, annual household income, and the type of dwelling, to have a significant effect on the BMI of preschool children (Table 5.25). An increase in the years of schooling of the food preparer was associated with a decrease in the median BMI of preschool children (p = 0.052). Children living in higher income households had significantly lower BMI scores as evident in Table 5.25 and Figure 5.15.

Figure 5.15: Relationship between household income and BMI for preschool children



Preschool children from households, that spend more than a hundred dollars per week on groceries, had a significantly lower median BMI than preschool children from households that spend less than a hundred dollars per week on groceries (p = 0.024). Children living in rented homes had a slightly higher median BMI than children living in households where the home was owned (p = 0.045).

Table 5.25: Socio-demographic determinants of body mass index in preschoolers

Socio-demographic variable		Median BMI (Body Mass Index)	p value for difference in median BMI
Ethnicity of the child	Maori	16.6	**0.005**
	Pacific	18.5	
	European	17.5	
	Other	19.8	
Ethnicity of the food preparer	Maori	16.8	**0.005**
	Pacific	18.4	
	European	17.3	
	Other	18.1	
Household income	$30,000 or less	18.5	**0.001**
	$30,001-40,000	19.0	
	$40,001-50,000	17.0	
	$50,001 or more	17.0	
Dwelling	Owned	17.5	**0.045**
	Rented	18.0	
Household food expenditure	Less than or equal to $100 per week	19.2	**0.024**
	More than $100 per week		
Occupation status of the Household	High	17.5	0.082
	Low	18.1	
	Benefit	16.5	
Household size	Less than 6	17.5	0.484
	More than 6	17.7	

5.4.2 School-age children

In this section, the physical status of school-age children has been analysed with respect to socio-demographic status.

Significant differences in weight due to ethnicity were observed in the school age children ($p < 0.001$). On average Maori and Pacific children were significantly heavier than European children in the study ($p = 0.007$). It is possible that the mean weight calculated in the 11 to 14 year age group, would be skewed by the weights of two Maori and one Pacific girl, with a maximum body weight of 141.2 kilograms. However this trend was still significant when the three outlier weights were deleted.

Maori and Pacific children also had significantly higher median BMI values than European and Other children ($p < 0.0005$), (Table 5.26). The ethnicity of the food preparer for the children had a significant effect on the BMI of school-age children. Children of Maori food preparers had the highest median BMI (Table 5.26). The median BMI of school-age children from low-income households was significantly higher than the median BMI of school-age children living in high-income households ($p = 0.010$), as evident in Table 5.26 and Figure 5.16. The median BMI was higher for school-age children living in larger sized households consisting of six of more people than children living in households or less than six people ($p = 0.028$).

Figure 5.16: Relationship between household income and BMI for school-age children

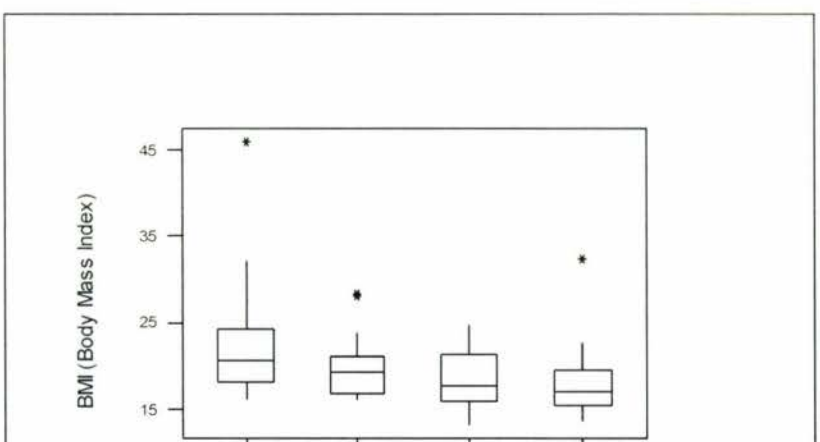


Table 5.26: Socio-demographic determinants of body mass index in school-age children

Socio-demographic variable		Median BMI (Body Mass Index)	p value for difference in median BMI
Ethnicity of the child	Maori	22.3	**<0.0005**
	Pacific	19.7	
	European	17.1	
	Other	15.2	
Ethnicity of the food preparer	Maori	22.6	**<0.0005**
	Pacific	19.7	
	European	17.4	
	Other	15.2	
Household income	$30,000 or less	20.6	**0.010**
	$30,001-40,000	19.2	
	$40,001-50,000	17.7	
	$50,001 or more	17.0	
Dwelling	Owned	17.7	0.118
	Rented	19.4	
Household food expenditure	Less than or equal to $100 per week	20.7	0.096
	More than $100 per week	18.9	
Occupation status of the Household	High	17.8	0.077
	Low	19.4	
	Benefit	20.7	
Household size	Less than 6	17.7	**0.028**
	More than 6	19.9	

5.5 Socio-demographic determinants of the health status of children

The ethnicity of the child was not found to significantly influence the number of hospital admissions, the chances of having a medical condition, or the likelihood of taking prescription medication. However, the trend in the sample was for more Pacific children to be taking medication and taking antibiotics than Maori, European or Other children. Of all the children taking antibiotics, 67% were Pacific and 33% were European ($p = 0.015$). Although the data set was too small to allow for statistical comparisons to be made regarding ethnicity, seven out of the 12 children with a long term medical condition or disability were of Pacific background.

Children from high-occupation status households were significantly less likely than children from low or benefit households to be taking prescription medication ($p < 0.0005$) as evident in Table 5.27.

Table 5.27: Occupation status and children taking medication

Occupation status of the Household	% of children taking medication
High	3
Low	22
On Benefit	18

The occupation status of the household was also found to significantly predict whether a child had a long term medical condition or disability. The majority of children with a chronic medical condition (76%) were from low-occupation status households ($p = 0.020$).

5.6 Main findings of the socio-demographic determinants of the nutritional and health status of children participating in this study

Comparing the socio-demographic status with the nutritional status of the children has produced a number of interesting findings. A summary of the main significant findings has been presented below:

5.6.1 Socio-demographic status

Overall Pacific children were more likely to be from low-socio-economic status households. The key findings are:

- Pacific households had the lowest median annual income
- 62% of Pacific children were from low-occupation status households
- A greater proportion of Pacific children (45%) than Maori (27%), European (27%) or Other (0%) children had a parent on a benefit
- The mean years of schooling were the lowest for Pacific food preparers
- Lower rates of home ownership in Pacific households (19%) than in Maori households (26%) or European households (54%)
- 49% of larger sized households (six or more people) were Pacific families
- 68% of households that spend $100 or less on groceries per week have Pacific children

5.6.2 Dietary intake

Household income was the strongest predictor of dietary intake in children of all ethnic groups, particularly in Pacific children. Overall Pacific children and children from low-socio-economic status households had the poorest dietary intake.

5.6.2.1 Fruit and Vegetable Intake

- Preschool children daily consumed more fruit than School-age children
- Pacific children had the lowest daily intake of fruit and vegetables
- Children of Pacific food preparers ate fewer helpings of fruit and vegetables than children of Maori, European or Other food preparers
- Children living in larger sized households ate fewer helpings of vegetables

- Children from low-income households ate fewer helpings of fruit and vegetables than children from high-income households
- Children whose food preparer went to school for longer ate more servings of fruit and vegetables
- Children from households that spend more money on food per week ate more servings of fruit and vegetables
- Children from low-occupation status households or households on the benefit ate fewer helpings of fruit and vegetables per day than children from high-occupation status households

5.6.2.2 Protein-rich foods (meat, chicken, beans and lentils)

- Children of Pacific food preparers ate fewer helpings of protein foods than children of Maori, European or Other food preparers
- Children from low-income households ate fewer helpings of protein foods than children from high-income households
- Children from households that spend more money on food per week ate more servings of protein foods
- Children whose food preparer went to school for longer ate more servings of protein foods

5.6.2.3 Cereals, breads and breakfast cereals

- Children whose food preparer went to school for longer ate more servings of cereals per week
- Children from low-occupation status households or households on the benefit ate fewer helpings of cereals, but more servings of bread per day, than children from high-occupation status households
- Pacific children ate more helpings of breakfast cereals per day than children of any other ethnic group
- Children from low-income households ate more helpings of breakfast cereals per day than children from high-income households

5.6.2.4 Milk products (milk, yoghurt and cheese)

- Boys consumed more dairy products per day than girls
- Children living in larger sized households ate fewer helpings of milk products

5.6.3 Nutrient intake

Higher intakes of most nutrients were associated with home ownership, higher income households, higher education and occupation status households. Overall calcium and Vitamin E intake was below the recommended levels in most groups of children. Only significant associations have been reported in this summary.

5.6.3.1 Energy and protein intake

- Pacific and Other children had the lowest mean energy intakes (as % of EAR)
- Maori children had the highest mean protein intake (as % of EAR)

5.6.3.2 Total sugars and fibre Intake

- School-age girls had higher sugar intakes as a percent of total energy (26%) than school-age boys (20%)
- Preschool children from high-income households had higher mean sugar intakes as a percent of total energy (28%) than preschool children from low income households (22%)
- Pacific children lowest mean sugar intakes
- Poor fibre intake and low energy intake in children from low-income households compared to children from high-income households
- Children of Pacific or Other food preparers had lowest fibre intake

5.6.3.3 Iron and calcium

- Boys had higher mean iron intakes as percent of the RDI than girls
- Lowest iron intakes in Pacific and Other children
- Highest iron intakes in Maori children

- The majority of school-age children (82%) and Pacific children (91%) did not meet the RDI for calcium
- Lower calcium intakes in children living in rented homes than children living in owned homes
- The majority (91%) of children living in low-income households did not meet the RDI for calcium
- All of children from households that spend the least amount of money on food did not meet Calcium RDI
- Mean calcium intakes as a percent of the RDI was lower for children from low-occupation or benefit households than children from high-occupation status households

5.6.3.4 B vitamins intake

- Pacific and Other children had lower folate intakes than Maori or European children
- Higher education and occupation status households and home ownership was associated with higher folate, vitamin B6, thiamin and riboflavin intakes
- Children from higher income households had higher thiamin intakes than children from low-income households
- Pacific and Other children had lowest vitamin B6 and riboflavin intakes

5.6.3.5 Vitamin E intake

- Vitamin E intake was the lowest in Pacific and Other children, the majority not meeting the RDI
- Higher vitamin E intakes were associated with home ownership, higher income households, higher education and occupation status households

5.6.3.6 Zinc and selenium intake

- Preschool children were more likely to meet the RDI for zinc than school-age children

- A large proportion of children across all socio-demographic groups had selenium intake below recommended levels
- Preschool children were more likely than school-age children to meet the RDI for Selenium

5.6.4 Specific dietary eating patterns

- Maori and Pacific children were more likely that European or Other children to eat takeaways 2 to 3 times a week
- Children from low-occupation or benefit households consumed more takeaways per week than children from high-occupation status households
- Children of parents who went to school for longer consumed takeaways less often than children of parent who left school at an early age
- Maori and Pacific children were more likely to 'often; consume food from the school canteen than European children
- Children of parents who went to school for longer or from high-income households were less likely to consume food from the school canteen
- Children were least likely to eat food bought from local shops if they had highly educated European parents on higher incomes
- More Maori or Pacific children drank full-fat milk and ate white bread than European children, who drank more reduced-fat milk and ate more wholemeal bread
- Children from low-socio-economic status households (low-income, rented homes, low-education status of parents) were more likely to drink full-fat milk than reduced-fat milk and more likely to eat white bread rather than wholemeal bread

5.6.5 Physical and health status

- 42% of all children were classified as overweight and 17% were considered obese

- Maori and Pacific children had higher mean BMI values than European or Other children
- Pacific girls more likely to be overweight than Pacific boys
- Lower median BMI values recorded for children whose parents went to school for longer, or had higher incomes
- Homeownership was associated with lower median BMI values
- Children from larger sized households had higher median BMI values
- Association found between low-occupation status and those who had a chronic medical condition or taking prescription medicines
- Trend for more Pacific children to be taking medication or to have a chronic medical condition

5.7 Prevalence of food insecurity

Food insecurity was determined by affirmative responses to questions regarding the incidence of hunger, or having no money to buy food in the last month (Appendix 8). Children were classified as being from "food-insecure households" if they were from households that sometimes or often did not have enough money to buy food. In this study 10% (16) of the children were reported to have felt hungry in the last month. When hungry, six out of these 16 children went to a relative for food and five went nowhere. Thirty-nine percent (68) of the children were from households that 'sometimes' or 'often' did not have enough money to buy food in the last month. The majority of households, who did not have enough money to buy food, were reported to have obtained food from relatives (Table 5.28). It should be noted that 29 respondents did not answer the question regarding hunger, and 68 respondents did not answer the question regarding having enough money to buy food.

Table 5.28: Ways by which food was obtained by households who did not have enough money to buy food

Outcome of exposure to food insecurity	Percent of food-insecure households
Obtained food from food banks	4
Adults went without food	4
Children went without food	2
Obtained food from neighbours	24
Obtained food from relatives	75

5.7.1 Relationship between hunger and insufficient money to buy food

Ordinal Logistic Regression indicated a significant relationship between those who do not have enough money to buy food and those who experienced hunger in the last month (p value < 0.0005). Seventy-five percent of those who had felt hungry in the last month sometimes did not have enough money to buy food.

5.8 Socio-demographic status of food-insecure children

In this section, the socio-demographic characteristics of the food-insecure children were compared to that of the food-secure children.

5.8.1 Age and gender

More older children than younger children were exposed to food insecurity as shown in Table 5.29, but this difference was not significant.

Table 5.29: Food insecurity in the children in this study

Food-insecure	1-4 year olds % of Total (count)	5-14 year olds % of Total (count)	p-value
Felt hungry	31 (5)	69 (11)	0.348
Sometimes or often not enough money to buy food	44 (30)	56 (38)	0.318

Significantly more boys (43) than girls (25) were from food-insecure households ($p = 0.015$), and more boys (11) than girls (5) felt hungry, but this was not found to be significant ($p = 0.101$) as evident in Table 5.30.

5.8.2 Ethnicity of the child and their food preparer

More Pacific children than children of any other ethnicity were reported to have felt hungry in the last month, but this was not found to be significant (Table 5.30). A significant association was found between ethnicity and children from food-insecure households ($p < 0.0005$). Eighty-two percent of Pacific, 13% of Maori and 4% of European children were from food-insecure households.

Children from food-insecure households, and children who had felt hungry in the last month, were significantly more likely to have a food preparer of Pacific ethnicity (Table 5.30). The majority of food-insecure children had a food preparer born in the Pacific Islands ($p <0.0005$).

5.8.3 Housing details

The majority of food-insecure children (71%) lived in rented accommodation from Housing New Zealand or the NZ Council (Table 5.30). Food-insecure children were significantly more likely to be living in larger sized households of six or more people ($p = 0.001$).

5.8.4 Household income

Annual household income was found to be a highly significant predictor of whether there was enough money to buy food in households (p value < 0.0005). Around 80% of children from low-income households (earning under 30,000 dollars per annum), were from food-insecure households (Figure 5.17).

Figure 5.17: Relationship between income and whether there is not enough money to buy food

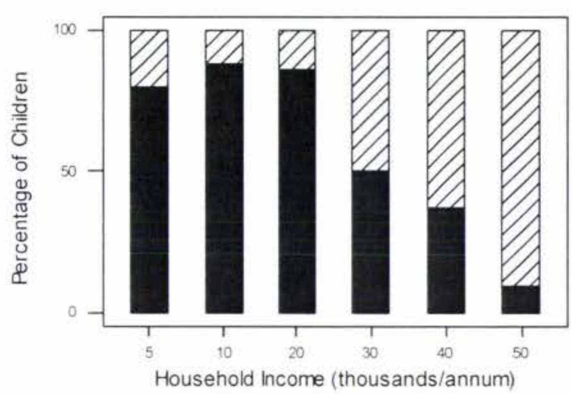


Chart graph showing ■ = Sometimes or often not have enough money to buy food; □ = Never not have enough money to buy food. Household annual income ($) code: 5 = Less than or equal to $10,000; 10 = 10,001-20,000; 20 = 20,001-30,000; 30 = 30,001-40,000; 40 = 40,001-50,000; 50 = 50,001 or more.

5.8.5 Household food expenditure

A large proportion of food-insecure children (74%) were from households that spend one hundred or less than one hundred dollars per week (Table 5.30).

5.8.6 Education and occupation status

The mean years of schooling of food preparers was significantly less in food-insecure households, as evident in Table 5.30. Food insecurity was significantly associated with low-occupation status households (Table 5.30).

Table 5.30: Socio-demographic status of food-insecure and food-secure children

Socio-demographic variable		Percent (count) who are in households that are - Food insecure sometimes or often not enough money to buy food	Food-secure Never not enough money to buy food	*p-value for difference in proportions*	Percent (count) who - Felt hungry in the last month	Not felt hungry in the last month	*p-value for difference in proportions*
Sex	Male	47 (43)	53 (48)	**0.015**	15 (11)	85 (65)	0.101
	Female	29 (25)	71 (60)		6 (5)	94 (73)	
Main ethnicity of child	Maori	18 (9)	82 (40)	**<0.0005**	7 (3)	93 (41)	*
	Pacific	87.5 (56)	12.5 (8)		22 (11)	78 (38)	
	European	5 (3)	95 (54)		4 (2)	96 (54)	
	Other	- (0)	100 (6)		- (0)	100 (5)	
Ethnicity of the Food Preparer	Maori	21 (9)	79 (33)	**<0.0005**	10 (4)	90 (35)	*
	Pacific	89 (55)	11 (7)		22 (10)	78 (36)	
	European	6 (4)	94 (59)		3 (2)	97 (58)	
	Other	0 (0)	100 (5)		- (0)	100 (5)	
Country of Birth of Food preparer	European countries	7 (1)	93 (13)	**< 0.0005**	8 (1)	92 (11)	**0.009**
	New Zealand	20 (22)	80 (87)		6 (6)	94 (96)	
	Pacific countries	88 (45)	12 (6)		24 (9)	76 (29)	
Dwelling	Owned	21 (20)	79 (74)	**< 0.0005**	4 (4)	96 (86)	**0.003**
	Rented	60 (48)	40 (32)		19 (12)	81 (50)	
Household size	5 or less	28 (27)	72 (70)	**0.001**	9 (8)	91 (83)	0.435
	6 or more	52 (41)	48 (38)		13 (8)	87 (55)	
Household income	20	86 (38)	14 (6)	**< 0.0005**	23 (7)	77 (24)	**0.041**
	30	50 (12)	50 (12)		19 (4)	81 (17)	
	40	38 (9)	63 (15)		13 (3)	87 (20)	
	50	9 (5)	91 (49)		2 (1)	98 (45)	
Household expenditure	$100 or less	74 (14)	26 (5)	**0.003**	27 (4)	73 (11)	0.069
	More than $100	38 (52)	62 (84)		10 (12)	90 (104)	
Mean years of schooling of food preparer (se)		7.76 (0.36)	11.64 (0.19)	**< 0.0005**	8.33 (0.89)	10.32 (0.27)	**0.047**
Occupation status of household	High	16 (12)	84 (62)	**< 0.0005**	4 (3)	96 (67)	*
	Low	66 (48)	34 (25)		18 (10)	82 (46)	
	Benefit	45 (5)	55 (6)		25 (2)	75 (6)	

** = no p-value obtained from cross-tabulations.*

5.9 Nutritional status of food-insecure children

The nutritional status of food-insecure children was determined from the data on dietary intake, nutrient intake, and specific dietary eating patterns. Food security status involved looking at those children who reported hunger, followed by those children living in food-insecure households - where there is sometimes or often not enough money to buy food.

5.9.1 Dietary intake of food-insecure children

Dietary intake was determined by the frequency of consumption of foods from the main foods groups: fruit, vegetables, protein-type foods, cereals, breakfast cereals, bread and milk products.

5.9.1.1 Fruit consumption

Children who felt hungry, were more likely to have fewer helpings of fruit per day than children who did not report hunger, but this trend was not significant ($p = 0.131$). Children from food-insecure households, who 'often' do not have enough money to buy food, were significantly more likely to eat less fruit than children from food-secure households ($p < 0.005$). Income was a strong predictor of fruit consumption in those who did not have enough money to buy food ($p < 0.0005$). The total number of persons living in household was not found to be a significant predictor of fruit consumption when looking at both income ($p = 0.937$), and not having enough money to spend on food ($p = 0.183$).

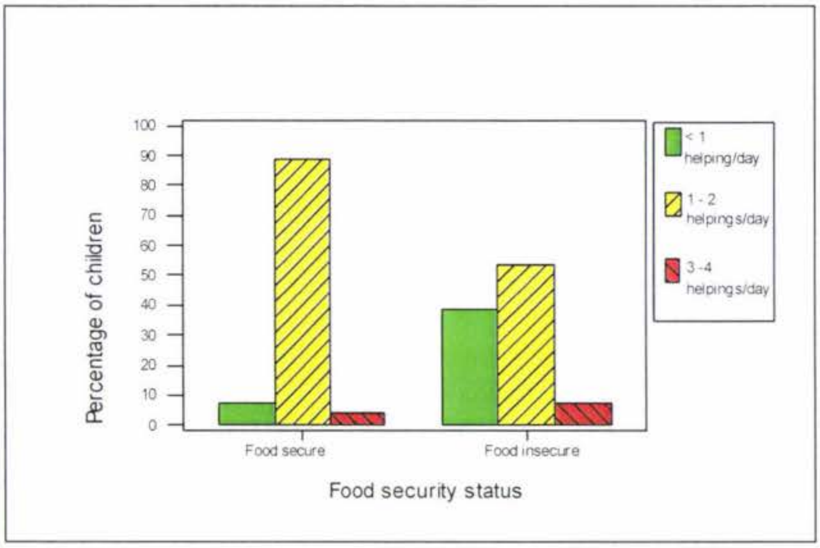
5.9.1.2 Vegetable consumption

No significant relationship was found between the incidence of hunger and consumption of vegetable helpings in the children ($p = 0.513$). However, a significant relationship between consumption of vegetable helpings and household food security status was found ($p < 0.0005$). Children living in food-insecure households consumed fewer helpings of vegetables per day than children living in food-secure households ($p < 0.0005$).

5.9.1.3 Consumption of foods rich in protein

It appeared that hunger was associated with a lower consumption of protein-type foods such as meats, but no significant relationship was found between consumption of protein products and the incidence of hunger in children ($p = 0.262$). A significant relationship was observed between the consumption of protein foods and household food security status ($p < 0.0005$). Overall food-insecure children were found to consume fewer helpings of protein foods per week than food-secure children ($p<0.0005$) (Figure 5.18).

Figure 5.18: Protein-foods consumption and food security status



5.9.1.4 Cereal Consumption

Children who had felt hungry over the last month, were found to consume fewer helpings of cereals per week, than children who were not hungry, but this relationship was only marginally significant ($p = 0.062$). Children from food-insecure households were significantly more likely to consume fewer helpings of cereals per week than food-secure children ($p = 0.005$). Of those children who consumed less than one helping of cereals per week, 92% were from food-insecure households ($p = 0.001$) as evident in Table 5.31.

Table 5.31: The food security status of the household and cereal consumption

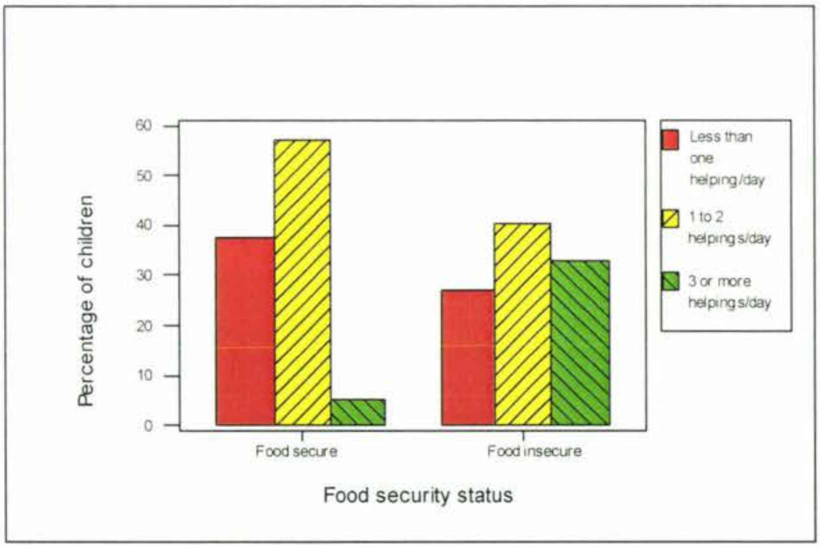
Food Security Status*	Percent (count) of children who weekly consumed -			
	Less than one helping of cereals	One to two helpings of cereals	Three to four helpings of cereals	Five or more helpings of cereals
Food-insecure	92 (11)	41 (22)	34 (23)	30 (12)
Food-secure	8 (1)	59 (32)	66 (44)	70 (28)

*Based on whether there was sometimes or often not enough money to buy food in the household.

5.9.1.5 Breakfast cereal consumption

Children who had experienced hunger over the last month, were significantly more likely to consume fewer helpings of breakfast cereal per day than children not hungry ($p = 0.018$). A different picture was observed with children living in food-insecure households (Figure 5.19). Children from food-insecure households were significantly more likely to be eating three or more helpings of breakfast cereal per day than children from food-secure households ($p<0.0005$).

Figure 5.19: Breakfast cereal consumption and food security status



5.9.1.6 Bread consumption

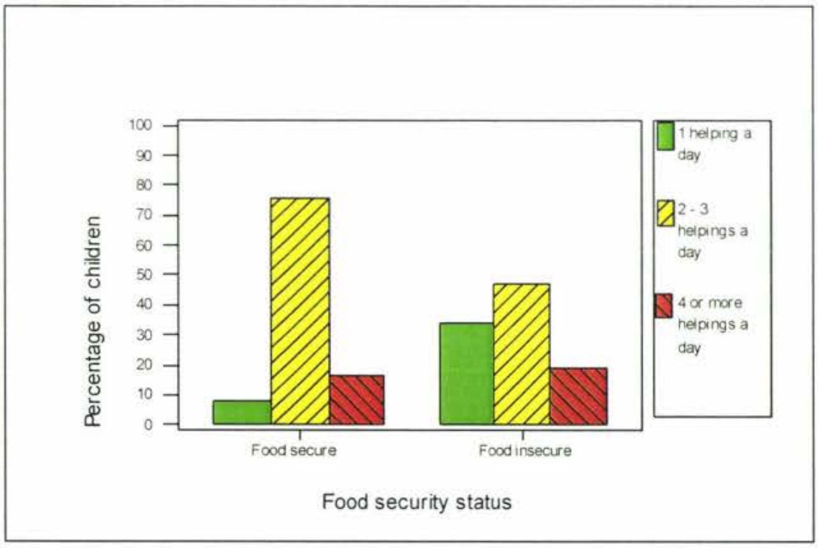
No significant relationship was found between bread consumption and incidence of hunger (p = 0.535) or household food security status (p = 0.378).

5.9.1.7 Milk products consumption

The majority (92%) of children, who consumed three helpings of milk products per day, had never felt hungry in the last month. The data suggested that children who had felt hungry in the last month, consumed fewer helpings of milk products per day, than children who did not report hunger, but this tend was not significant (p = 0.258).

A significant relationship was found between milk product consumption and children living in food-insecure households. Of those children who daily consumed only one serving of milk product, 74% were from food-insecure households (p <0.0005) (Figure 5.20). Food-insecure children were significantly more likely to consume fewer helpings of milk products per day than food-secure children (p = 0.009).

Figure 5.20: Milk product consumption and food security status



5.9.2 Nutrient intake of food-insecure children

The nutrient intakes of both preschool and school-age children were investigated with respect to food security status. The food security status of the children was determined by the incidence of hunger and food-insecure households that sometimes or often did not have enough money to buy food. In this study, the term 'food-insecure children' refer to children living in food-insecure households.

5.9.2.1 Preschool children

No significant differences were found in the nutrient intake of preschool children reporting hunger compared to those not reporting hunger. The results of the statistical analysis of selected nutrient intakes of food-insecure preschool children are presented in Table 5.32 and Appendix 23. Food-insecure preschool children had significantly lower median daily intakes than food-secure preschool children for the nutrients: riboflavin ($p = 0.0066$), vitamin B6 ($p = 0.018$), folate ($p = 0.000$), vitamin E ($p = 0.009$), betacarotene ($p = 0.030$), potassium ($p = 0.007$), magnesium ($p = 0.025$), calcium ($p = 0.000$), phosphorus ($p = 0.009$), and lactose ($p = 0.007$). Further differences in nutrient intake between food-insecure and food-secure preschoolers which approached significance were found for vitamin C ($p = 0.066$) and protein ($p = 0.066$), of which mean intakes were lower in food-insecure preschool children.

5.9.2.2 School-age children

No significant relationship was found between nutrient intake and the incidence of hunger in school-age children. Regression analysis found food-insecure school-age children to be eating on daily an average of 1210 kilojoules less than food-secure school-age children (Table 5.33). Food-insecure school-age children were also found to significantly consume less carbohydrate, total sugars, vitamin C, folate, beta-carotene, vitamin A, potassium, calcium, glucose, fructose, sucrose, maltose, and drink less water than food-secure school-age children (Table 5.33). A more complete list of nutrient intakes has been presented in Appendix 24.

Table 5.32: Selected nutrient intake of food-secure versus food-insecure preschool children (under 5 years)

Nutrient (data from 24 hr recall)	Food Security Status**	Mean	Median	Standard Deviation	Standard Error of Mean	Min	Max	p-value* for median
Energy (kJ)	0	6133	5552	2523	337	913	13114	0.306
	1	5577	5021	2335	426	1602	11656	0.306
Protein (g)	0	53	51	21	2.8	8	109	0.066
	1	45	41	17	3.2	9	81	0.066
Fat (g)	0	56	47	31	4.2	5	169	0.375
	1	49	43	26	4.8	5	104	0.375
Carbohydrate(g)	0	191	181	80	10.8	35	433	0.562
	1	181	184	78	14.2	71	402	0.562
Fibre (g)	0	12	12	5	0.7	2.8	25	0.503
	1	12	11	6	1.2	4.6	32	0.503
Riboflavin (mg)	0	1.6	1.6	0.7	0.1	0.5	3.3	**0.006**
	1	1.1	1.0	0.5	0.1	0.1	2.4	**0.006**
Niacin Equivalents (mg)	0	22.0	20	9	1.2	4.9	49	0.095
	1	18.6	17	8	1.4	3	35	0.095
Vitamin C (mg)	0	104	84	91	12.1	9	415	0.066
	1	71	44	80	14.6	7	329	0.066
Vitamin E (mg)	0	5.3	4.7	2.9	0.4	0.5	14	**0.009**
	1	3.7	3.4	2.1	0.4	0.4	9	**0.009**
Vitamin B6 (mg)	0	1.1	1.1	0.4	0.1	0.2	2	**0.018**
	1	0.9	0.8	0.5	0.1	0.3	2	**0.018**
Vitamin B12 (mcg)	0	3.5	3.1	4.4	0.6	0.1	33	0.126
	1	2.5	2.3	1.4	0.3	0.8	7	0.126
Total Folate (mcg)	0	195	161	130	17	37	683	**0.000**
	1	117	101	61	11	41	338	**0.000**
Beta carotene (mcg)	0	1219	671	1412	189	51	7481	**0.030**
	1	1159	391	3184	581	45	17414	**0.030**
Vitamin A (mcg)	0	561	485	380	51	83	1769	0.123
	1	501	381	582	106	57	3222	0.123
Potassium (mg)	0	2073	2080	652	87	516	3095	**0.007**
	1	1700	1451	903	165	408	4057	**0.007**
Magnesium (mg)	0	196	196	69	9	52	375	**0.025**
	1	172	145	92	17	56	473	**0.025**
Calcium (mg)	0	716	666	339	45	115	1481	**0.000**
	1	470	359	402	73	46	1986	**0.000**
Phosphorus (mg)	0	976	999	380	51	199	2072	**0.009**
	1	784	751	396	72	125	2080	**0.009**
Iron (mg)	0	8.5	8.0	3.7	0.5	1.3	22	0.644
	1	8.1	7.4	4.3	0.8	0.6	19	0.644
Lactose (g)	0	18	16	11	1.5	0.0	43	**0.007**
	1	12	8	13	2.3	0.0	56	**0.007**

**Food security status is defined by whether there is sometimes or often not enough money to buy food (food-insecure = 1) or never not enough money to buy food (food-secure = 0).

* p-values for medians were obtained by Kruskal-Wallis analysis.

Table 5.33: Selected nutrient intake of food-secure versus food-insecure school-age children (over 5 years)

Nutrient (data from 24 hr recall)	Food security status**	Mean	Median	Standard Deviation	Standard Error of Mean	Min	Max	p-value* (median)
Energy (kJ)	0	8646.0	7889	3837	532	2964	20706	**0.039**
	1	7436.0	6291	3248	527	4206	18109	**0.039**
Protein (g)	0	76.0	64	47	6.5	22	261	0.319
	1	62.0	60	25	4.0	27	147	0.319
Fat (g)	0	81.2	67	60	8.4	14	383	0.890
	1	73.5	62	42	6.8	33	242	0.890
Carbohydrate (g)	0	261	232	105	14.5	104	559	**0.017**
	1	220	191	107	17.3	67	457	**0.017**
Water (ml)	0	1473	1356	615	85.3	267	3127	**0.001**
	1	1069	1043	389	63.1	315	2080	**0.001**
Total Sugar (g)	0	129	127	63	8.7	30	282	**0.001**
	1	90	77	59	9.6	15	245	**0.001**
Vitamin C (mg)	0	113	102	90.1	12.5	6.1	387	**0.004**
	1	61	35	51.4	8.3	1.9	175	**0.004**
Vitamin B6 (mg)	0	1.6	1.4	1.3	0.2	0.2	7	0.068
	1	1.4	0.9	1.6	0.3	0.3	8	0.068
Total Folate (mcg)	0	215	199	121	16.7	47	605	**0.030**
	1	168	142	107	17.4	51	494	**0.030**
Beta Carotene (mcg)	0	2354	1129	2776	385	62	11979	**0.003**
	1	1373	380	2285	371	31	9266	**0.003**
Vitamin A (mcg)	0	787	625	644	89	65	2972	**0.029**
	1	540	393	428	69	27	1687	**0.029**
Potassium (mg)	0	2730	2607	1446	200	411	7347	**0.046**
	1	2153	1888	1003	163	1069	5240	**0.046**
Calcium (mg)	0	756	562	676	94	124	4238	**0.029**
	1	475	444	241	39	95	1180	**0.029**
Iron (mg)	0	11.2	9.4	6.6	0.9	2.6	31	0.732
	1	10.6	9.2	5.9	1.0	3.4	25	0.732
Glucose (g)	0	21.3	19.4	13.4	1.9	2	56	**0.005**
	1	14.0	9.5	11.8	1.9	1	51	**0.005**
Fructose (g)	0	23.2	19.3	16.5	2	2	83	**0.011**
	1	15.2	13.0	12.5	2	1	53	**0.011**
Sucrose (g)	0	66.7	58.3	36.3	5	15	164	**0.005**
	1	48.0	37.6	37.3	6	4	161	**0.005**
Maltose (g)	0	4.9	3.4	4.7	0.7	0	28	**0.031**
	1	3.0	2.4	2.1	0.3	0	8	**0.031**

** Food security status is defined by whether there is sometimes or often not enough money to buy food (food-insecure = 1) or never not enough money to buy food (food-secure = 0).
*p- values of medians were obtained by Kruskal-Wallis analysis.

School-aged children living in food-insecure households had significantly lower mean percent of total energy intake from sugar (p = 0.002). School-age children living in food-insecure households had a marginally significant higher mean percent energy from total fat than food-secure school-age children (Table 5.34). No significant relationship was found between food security status and the mean percent energy from total carbohydrate or protein (Table 5.34). The mean percent of energy derived from saturated, mono-unsaturated or poly-unsaturated fat was also analysed with respect to food security status, but no significant relationship was found.

Table 5.34: Mean contribution of nutrients to daily energy intake and food security status

Mean % of energy from a nutrient	**Age of child**	**Food-insecure** because sometimes/often not enough money to buy food	**Food-secure** as never not enough money to buy food	p-value for difference in means	**Food-insecure** because felt hungry in the last month	**Food-secure** because not felt hungry in the last month	p-value for difference in means
Mean % of energy from total sugars (se)*	Preschool	24 (2)	26 (1)	0.289	21 (3)	26 (1)	0.222
	School-age	19 (1)	26 (1)	**0.002**	21 (2)	24 (1)	0.264
Mean % of energy from total fats (se)*	Preschool	31 (2)	33 (1)	0.402	29 (6)	33 (1)	0.594
	School-age	37 (2)	33 (1)	0.066	34 (2)	35 (1)	0.912
Mean % of energy from carbohydrate (se)*	Preschool	55 (2)	52 (1)	0.231	55 (5)	53 (1)	0.584
	School-age	48 (2)	52 (2)	0.089	51 (3)	50 (1)	0.731
Mean % of energy from protein (se)*	Preschool	17 (2)	17 (1)	0.972	22 (6)	17 (1)	0.412
	School-age	16 (1)	16 (1)	0.710	18 (2)	16 (1)	0.437

* se = standard error

5.9.2.3 Nutritional adequacy of the diets

The median of the nutrient intakes expressed as a percent of the age-adjusted recommended values for food-insecure and food-secure children are presented in Table 5.35a and 5.35b. The median energy intake of school-age children living in food-insecure households was 80% of the age adjusted energy EAR, whereas children living in food-secure households had a median percent energy intake of 104% of the age adjusted energy EAR ($p = 0.011$) as shown in Table 5.35a. School-age children living in food-insecure households also had significantly lower median protein intakes (as a percent of the age adjusted protein EAR), compared with children from food-secure households ($p=0.050$). All children however had median protein intakes above the recommended values. Preschool children who had experienced hunger in the last month had significantly lower median protein intakes as a percent of the EAR ($p = 0.032$). The median fibre intake, as a percent of the age-adjusted recommended fibre intake, for food-insecure school-age children was 92%, while for food-secure school-age children it was 104% ($p = 0.029$).

In general, children from food-insecure households had significantly lower median intakes as a percent of the RDI for most of the Vitamin B group than children from food-secure households (Table 5.35a). School-age children from food-insecure households had median riboflavin, vitamin B6 and folic acid intakes below the RDI for these nutrients, while school-age children from food-secure households met the RDI for these nutrients (Table 5.35a).

Children living in food-insecure households were significantly more likely to have calcium intakes below the age-adjusted RDI values, than children living in food-secure households (Table 5.35b). The median calcium intake as a percent of the RDI was 47% for food-insecure preschool children, while for food-secure children it was 94% ($p < 0.0005$). Magnesium and phosphorus median intakes, as percent of the RDI, were significantly lower in food-insecure children, than in food-secure children (Table 5.35b).

The median vitamin A intake, as a percent of the age-adjusted Vitamin A RDI, was 71% for food-insecure school-age children compared to 129% for food-secure school-age children ($p = 0.012$). The majority of all children did not meet the RDI for vitamin E. The median vitamin E intake, as a percent of the RDI, was lower in food-insecure children (64% for preschool, 65% for school-age) compared to food-secure children (90% for preschool, 77% for school-age). The median vitamin C intake, as a percent of the age-adjusted Vitamin C RDI, was lower for children living in food-insecure households and for children who had reported hunger. However, only preschool children reporting hunger had median vitamin C intakes below the age-adjusted RDI values, as evident in Table 5.35a.

Table 5.35a: Macronutrient and vitamin Intakes as a percent of the recommended dietary intakes for food-insecure and food-secure children

Median nutrient intake as a percent of the age adjusted recommended value for a given nutrient**		In households that are -		*p-value for difference in median percent RDIs*	In children who have -		*p-value for difference in median percent RDIs**
		Food insecure sometimes or often not enough money to buy food	**Food-secure** Never not enough money to buy food		**Felt hungry in the last month**	**Not felt hungry in the last month**	
Energy	Preschool	91	108	0.180	59	107	**0.046**
	School-age	80	104	**0.011**	102	94	0.793
Protein	Preschool	336	400	0.069	239	393	**0.032**
	School-age	217	273	**0.050**	249	268	0.425
Fibre	Preschool	132	153	0.485	76	155	0.104
	School-age	92	104	**0.029**	107	100	0.852
Thiamin	Preschool	238	231	0.717	166	236	0.571
	School-age	105	162	**0.019**	170	151	0.601
Riboflavin	Preschool	119	192	**0.001**	115	176	0.325
	School-age	89	104	**0.034**	107	97	0.921
Niacin	Preschool	159	194	0.107	130	189	0.257
	School-age	158	194	0.144	172	188	0.881
Vitamin B6	Preschool	134	168	**0.016**	95	164	**0.010**
	School-age	97	135	**0.027**	120	109	0.583
Vitamin B12	Preschool	200	239	0.176	141	235	0.150
	School-age	187	170	0.595	174	192	0.793
Folate	Preschool	101	162	**<0.0005**	97	156	**0.034**
	School-age	96	134	**0.007**	133	118	0.861
Vitamin C	Preschool	148	278	0.066	71	286	**0.005**
	School-age	118	340	**0.004**	105	207	0.231
Vitamin A	Preschool	110	162	0.117	91	139	0.089
	School-age	71	129	**0.012**	85	115	0.550
Vitamin E	Preschool	64	90	**0.006**	36	85	0.068
	School-age	65	77	0.064	70	75	0.462

** Recommended values refer to Australian Recommended Dietary Intakes for all nutrients except for energy and protein, in which case the UK Estimated Average Requirements were used. The fibre recommended intakes were based on the American Health Foundation of age plus 5 grams (ADA, 1999a).

* Tests are unreliable due to small sample size reporting hunger

Table 5.35b: Mineral intakes as a percent of the recommended dietary intakes for food-insecure and food-secure children

Median nutrient intake as a percent of the age adjusted recommended value for a given nutrient**		**In households that are -**		*p-value for difference in median percent RDIs*	**In children who have -**		*p-value for difference in median percent RDIs**
		Food insecure sometimes or often not enough money to buy food	**Food-secure** Never not enough money to buy food		**Felt hungry in the last month**	**Not felt hungry in the last month**	
Calcium	Preschool	47	94	**<0.0005**	27	92	**0.009**
	School-age	52	64	**0.012**	71	60	0.411
Magnesium	Preschool	164	223	**0.023**	90	216	**0.027**
	School-age	106	139	**0.007**	153	133	0.627
Phosphorus	Preschool	127	181	**0.015**	80	163	**0.011**
	School-age	109	128	**0.026**	133	120	0.425
Iron	Preschool	124	133	0.644	85	136	0.228
	School-age	133	155	0.230	154	152	0.718
Zinc	Preschool	128	139	0.697	79	139	0.218
	School-age	95	106	0.256	101	109	0.418
Selenium	Preschool	85	88	0.986	81	82	0.389
	School-age	62	78	0.200	84	73	0.575

** Recommended values refer to Australian Recommended Dietary Intakes for all nutrients except for energy and protein, in which case the UK Estimated Average Requirements were used. The fibre recommended intakes were based on the American Health Foundation of age plus 5 grams (ADA, 1999a).

* Tests are unreliable due to small sample size reporting hunger

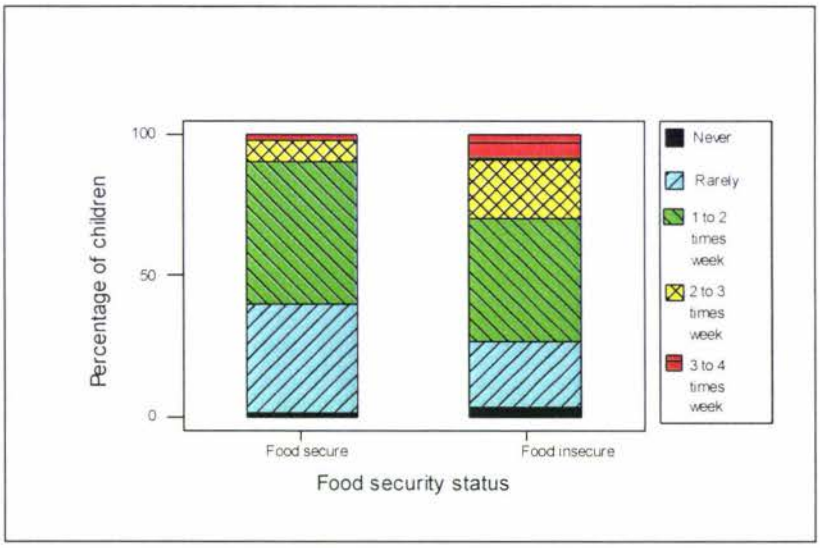
5.9.3 Dietary habits and eating patterns of food-insecure children

In this section, statistically significant relationships between household food security status and specific dietary eating patterns have been presented.

5.9.3.1 Consumption of takeaways

Food-insecure children were significantly more likely to be frequently consuming takeaways per week than food-secure children ($p = 0.003$) as shown in Figure 5.21. During times of food shortages; 13% of food-insecure households bought takeaways, 11% bought hot chips and 21% bought soft drinks.

Figure 5.21: Frequency of consumption of takeaways with respect to food security status

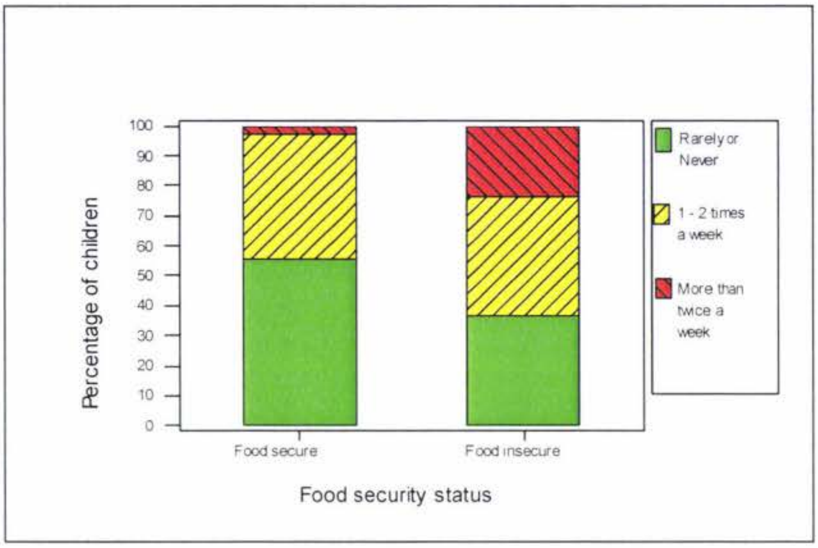


Spearman correlation found a significant relationship between the frequency of takeaway consumption and fruit consumption. Those children eating takeaways more frequently per week also consumed fewer helpings of fruit per day ($p = 0.013$).

5.9.3.2 Consumption of food from the school canteen

Children from food-insecure households were significantly more likely to frequently consume food from the school canteen, than food-secure children ($p = 0.032$) as shown in Figure 5.22.

Figure 5.22: Frequency of consumption of food from the school canteen with respect to food security status



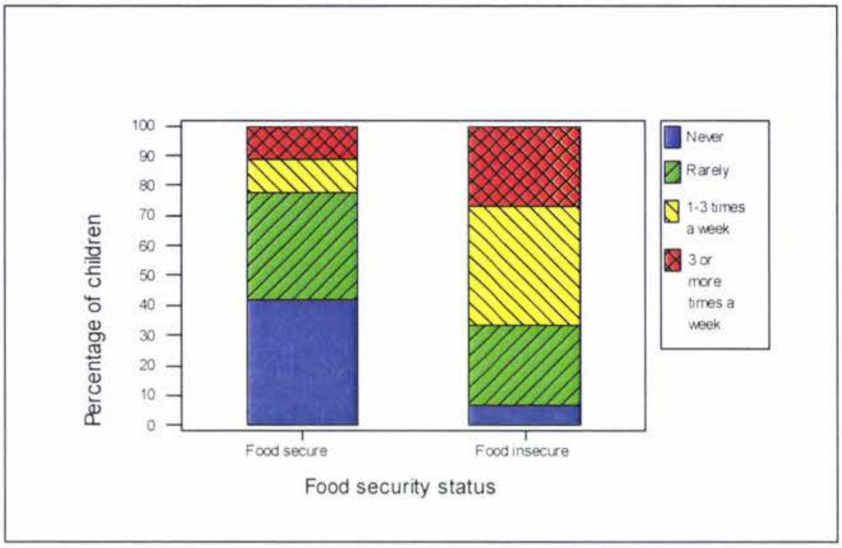
5.9.3.3 Consumption of certain types of foods

Children living in food-insecure households were significantly more likely to consume full-fat milk than reduced fat milk (p = 0.020). Children living in food-insecure households were significantly more likely to be consuming white bread than food-secure children (p = 0.004).

5.9.3.4 Purchasing of food from local shops

Children from food-insecure households were significantly more likely to regularly consume food bought from the local shops, than food-secure children (p < 0.0005). The majority of children (88%) who never consume food bought from the local shops were from food-secure households (p = 0.001) as evident in Figure 5.23.

Figure 5.23: Percentage of children eating food bought from local shops with respect to food security status



5.9.3.5 Consumption of food on the way home from school

Of the children who were reported to eat on the way home from school, 61% were from food-insecure households and 39% were from food-secure households (p = 0.015).

5.9.3.6 The influence of children on food purchases

Children from food-insecure households had a greater influence over parent's general food buying decisions than children of food-secure households. Parents of food-insecure households rated the influence of their children when buying groceries as very important, while the majority of parents of food-secure households stated their children did not have an important influence on food buying decisions. This trend was found across all the main food groups as shown in Table 5.36.

Table 5.36: Adult perception of influence of children when buying groceries

Food type	Percent (count) of adults who consider influence of children to be very important in		p-value for difference in proportions
	Food-secure households	Food-insecure households	
Dairy products	23% (12)	77% (41)	<0.0005
Fruit & vegetables	29% (17)	71% (42)	<0.0005
Bread, cereals, pasta & rice	17% (10)	83% (49)	<0.0005
Meat, fish, chicken, eggs, dried beans etc	16% (9)	83% (46)	<0.0005
Snack foods & drinks	38% (15)	62% (24)	0.027
Takeaways	44% (14)	56% (18)	0.016

5.10 Physical and health status of food-insecure children

Thirty-eight percent of overweight children and obese children were from food-insecure households (Table 5.37). No significant differences were observed between food-insecure and food-secure children with respect to health status. In fact, more food-secure children had been admitted to hospital and had been diagnosed as having a medical condition than food-insecure children (Table 5.37). A significant association was found between BMI and children living in food-insecure households ($p < 0.0005$). The median BMI was higher in food-insecure children (19.1) than food-secure children (17.4).

Table 5.37: Physical & health status of food-insecure and food-secure children

Physical and Health Status Indicators		**Percent (count) who are in households that are -**			**Percent (count) who -**		
		Food insecure sometimes or often not enough money to buy food	**Food-secure** Never not enough money to buy food	***p-value for difference in proportions***	**Felt hungry in the last month**	**Not felt hungry in the last month**	***p-value for difference in proportions***
Overweight	Yes	38 (26)	62 (42)	0.985	15 (19)	85 (53)	0.237
Obese	Yes	38 (11)	62 (18)	0.962	11 (3)	89 (25)	0.963
Hospital Admissions	Yes	33 (5)	67 (10)	0.659	18 (2)	82 (9)	0.379
	No	39 (63)	61 (98)		10 (14)	90 (129)	
Medical condition	Yes	35 (7)	65 (13)	0.723	- (0)	100 (17)	0.137
	No	39 (61)	61 (95)		12 (16)	88 (121)	
Taking Medication	Yes	50 (11)	50 (11)	0.242	7 (1)	93 (14)	0.619
	No	37 (57)	63 (97)		11 (15)	89 (124)	
Taking Antibiotics	Yes	50 (6)	50 (6)	0.402	13 (1)	88 (7)	*
	No	38 (62)	62 (102)		10 (15)	90 (131)	

* = no p-value obtained from cross-tabulations

5.11 Main findings of the nutritional status of food-insecure children participating in this study

In general, more significant associations were found between nutritional factors and household food security status, than between nutrient intake and prevalence of hunger in children. Statistical analysis on those reporting hunger was unreliable due to the small sample size. A summary of the main significant findings with respect to household food security status has been presented below:

5.11.1 Prevalence and socio-demographic determinants of food insecurity

- 10% of children in this study had felt hungry in the last month
- 39% of children in this study were from food-insecure households - that sometimes or often did not have enough money to buy food in the last month
- More boys (47%) than girls (29%) were from food-insecure households
- More Pacific (82%) than Maori (13%), European (4%) or Other (0%) children were from food-insecure households
- The majority of food-insecure children had a food preparer that was born in the Pacific Islands (88%)
- Food-insecure children were significantly more likely to live in rented accommodation and larger sized households of six of more people
- 80% of children from the lowest income households were food-insecure
- 74% of children from households that spend $100 or less were from food-insecure households
- 66% of children from low-occupation status households were food-insecure
- The mean years of schooling of the food preparer for food-insecure children was about 4 years less than that of the food preparer for food-secure children

5.11.2 Dietary intake of food-insecure

- Food-insecure children consumed fewer helpings of fruit, vegetables, milk products and protein-rich foods per day, and fewer helpings of cereals per week than food-secure children
- Food-insecure children consumed more helpings of breakfast cereals per day than food-secure children

5.11.3 Nutrient intake of food-insecure

- Food-insecure children had significantly lower median intakes of important nutrients like folate, beta-carotene and calcium than food-secure children
- When median nutrient intakes were considered as a percent of the RDI, food-insecure preschool children did not meet the recommended values for vitamin E, calcium and selenium intake
- Food-insecure school-age children did not meet the recommended values for energy, fibre, riboflavin, vitamin B6, folate, vitamin A and zinc

5.11.4 Specific dietary eating patterns of food-insecure

- Food-insecure children more frequently ate takeaways and food from the school canteen per week than food-secure children
- Food-insecure children were more likely to drink full-fat milk and eat white bread
- Food-secure children were more likely to drink reduced-fat milk and eat wholemeal bread
- Food-insecure children were more likely to regularly eat food bought from local shops and eat on the way home from school than food-secure children
- Food-insecure children had a stronger influence over parent's general food buying decisions than children of food-secure households

5.11.5 Physical and health status of food-insecure

- 38% of overweight and 38% of obese children were from food-insecure households
- No significant association was found between food security status and the physical and health status of children in this study

6. Discussion

The purpose of this study was to investigate:

- The effect of socio-demographic factors on the nutritional and health status of children aged 1 to 14 years participating in the Validation study; part of the pilot for the Children's Nutrition Survey.
- To determine if there was a relationship between socio-demographic variables and food security status.
- To compare the nutritional and health status of food-insecure children with food-secure children.

Food insecurity and low-socio-economic status were found to be significantly associated with low nutrient intakes, as well as poor dietary habits. This study provides evidence to support the growing concern that Pacific NZ children are more likely than children of any other ethnic group to have poor nutritional and health status. Pacific children were more likely to be from low-socio-economic and food-insecure households than Maori, European or Other children. There was also a trend in the sample for more Pacific children to have a chronic medical condition. Overall food-insecure children were not found to be worse off than food-secure children in terms of physical or health status. The results from this study yielded interesting findings. However the sample used in the Validation study for the pilot of the Children's Nutrition Survey was not a national representative sample. It is thus important these results are validated by future research involving a random population-based sample. The data for this thesis was written and first examined prior to the publication of the National Children's Nutrition Survey (CNS) in November 2003. Therefore it was felt inappropriate to compare data from the Validation study to the data from the CNS.

6.1 Socio-demographic status of children

In this study nutritional comparisons were made between 91 preschool (aged 1 to 4 years) and 92 school-age children (5 to 14 years). This age differentiation chosen for this study was not representative of the New Zealand population.

National data from the 1996 Census showed that 27% of NZ children were aged 1 to 4 years and 66% were aged 5 to 14 years (Hodges et al., 1998). In this study, preschool children were more likely than school–age children to be living in owned homes and to be from higher income, occupation and educated status households. National census data has reported younger children, less than 10 years of age, were more likely to be from lower ends of the income spectrum than children aged 10 to 14 years (Hodges et al., 1998; Krishnan et al., 2002).

A recent report published by the Ministry of Social Development (Krishnan et al., 2002) found Pacific people to have overall lower living standards than other major ethnic groups in New Zealand. This finding is similar to that reported in this study. Pacific children were more likely to live in low-socio-economic households than Maori, European or Other children ($p < 0.0005$). In this study, low-socio-economic households included low-income and low-occupation status households, rented dwellings, and households whose food preparer had no post-school education. Pacific food preparers were reported to obtained on average four to five less years of education than Maori, European or Other food preparers ($p = 0.003$).

A major limitation with interpreting data from the Other ethnic group is related to the small number of subjects in this group ($n = 6$). Although Asian and Indian children were not recruited for this study, there is limited available nutritional data on these communities living in New Zealand. It was for this reason, that Asian and Indian children were removed from being classified as European, as done by the original investigators of the Validation study (Watson et al., 2001), and instead were classified as Other for the purpose of this thesis. However, Asian and Indian children were greatly underrepresented in this study, and this posed a major limitation when comparing the nutritional status of children of different ethnic groups. This needs to be addressed in future studies as there is a rapidly growing Asian and Indian community in New Zealand, and given the high prevalence of poverty found in these communities.

The results of this study cannot be generalized to the New Zealand children population, as the sample of children was not taken randomly from the North and South Island of New Zealand. All of the 183 children in this study resided in the Western suburbs of Auckland. Thus the results of this study can only be generalized to other New Zealand children of the same age and from this specific demographic area.

In this study, household size was found to be a significant determinant of household food expenditure, as documented by other studies (Adrian & Daniel, 1976; Davis, 1982; ABS, 2000). Of concern is the high proportion of households of size eight to ten people who only spent 101 to 150 dollars on food and groceries per week.

The socio-economic status of the household was determined by the occupation status of the main provider, since the data did not cover the eight dimensions of deprivation used to indicate socio-economic status by the NNS97 (Russell et al .,1999). The over-representation of households in the higher occupation groups can be partly accounted for by the large proportion of respondents (14%) who would not answer questions regarding the main provider's occupation. It is possible that some of these respondents who did not answer were on a government benefit. This would explain the apparent bias in the sample towards higher occupation groups. In this study, more Pacific children than children of any other ethnic group had a parent receiving a government benefit. About half of the Pacific children, and 27% of Maori and European children had a parent receiving a government benefit. These figures do not correspond to NZ Census data, which found 41.2% of Maori children, 37.8% of Pacific children and 13.8% of European children had a parent not in paid work (Statistics New Zealand, 1996).

In this study, Pacific households had considerably lower median annual incomes than Maori, European or Other households and this is consistent with the findings of the NNS97 (Russell et al., 1999). However in this study, both European and Maori households were more represented in the higher income groups, while other NZ studies report Maori to be over-represented among low-income or low-occupation status households (Russell et al., 1999). When considering the income distribution of participants in this study, it is important to consider the large proportion of households in the higher income bracket and the small proportion representing the lower income groups. As respondents were asked to volunteer information on personal matters such as income, the accuracy of such data could not be checked. Also it was noted that 34 participants did not respond to the annual income question which also may explain the larger than expected proportion of high-income households.

6.2 Socio-demographic determinants of nutritional status of children

The nutritional status of the children in this study was determined by their dietary and nutrient intake and specific dietary eating patterns. It could be argued that the nutritional status could have been more clearly defined if biochemical and clinical data, as well as dietary data of individuals were obtained (Chavas & Keplinger, 1983). Biochemical and clinical data were not collected in this study due to financial constraints.

The results of this study are subject to the limitations of food-recall dietary methods. The dietary intake data was obtained via the food frequency questionnaire (FFQ) and nutrient intake data was obtained from the 24-hour recalls. The advantages and disadvantages of these dietary methods will be commented on in the following sections discussing dietary and nutrient intake.

6.2.1 Dietary intake

This study provided evidence that low-socio-economic status is significantly associated with poorer dietary intake, which supports the findings of studies conducted overseas (Mooney, 1990; Kingsey, 1994). Children living in rented dwellings, low-income or low-occupation status households, or whose food preparer did not have post-school qualifications, all consumed significantly fewer daily helpings of fruit and vegetables than children living in households where the home was owned, or from higher income or higher occupation status households, or whose food preparer went to school for longer ($p < 0.0005$). This finding has also been reported in international studies (Smith & Baghurst, 1993; Quan et al., 2000) and in adult studies in NZ (Parnell, 1997; Russell et al., 1999). It is possible that fruit and vegetable intake were slightly underestimated in this study, as the fruit and vegetable content of some mixed dishes may not have been included in the analysis of dietary intake. The advantage of the FFQ is that it takes into consideration the day-to-day variation in food consumption observed in children. Although a study by Baranowski and colleagues (1991) found the FFQ to greatly overestimate fruit and vegetable consumption in Third-grade students.

Nevertheless, the strong association between low-socio-economic status and poor fruit and vegetable intake observed in this study and others needs to be considered in future health policies. It is interesting to note that the school-age children consumed significantly fewer helpings of fruit and milk products per day than the preschool children ($p = 0.008$ (fruit); $p = 0.034$ (milk products). This may be partly related to peer pressure to eat 'trendy' foods such as packaged foods and soft drinks, as reported in several studies (Shepherd & Dennison, 1996; Shepherd, 1999; Bissonnette & Contento, 2001). The low consumption of milk products by the older children in this study has also been documented in other developed countries (Weaver, 2000). In this study boys consumed more helpings of milk products per day than girls ($p = 0.034$). This gender difference has also been observed in other studies (Brinsdon et al., 1993). It is thought that some young women may perceive milk products to be high in fat and for this reason restrict their intake of milk products (Gibbons, 2002).

The ethnicity of the child and food preparer was found to significantly impact on the dietary intake of children. A high proportion of Pacific children, and children of

Pacific food preparers, consumed fewer helpings of fruit and vegetables per day than European, Maori or Other children ($p < 0.0005$). Under-reporting of dietary intake was found to be higher amongst Pacific children and among 11 to 14 year old girls in this study (Watson et al., 2001). Perhaps this is an indication that more culturally sensitive probes need to be developed for specific use amongst Pacific children and future studies may need to take this into consideration.

Children from lower income households consumed significantly fewer daily helpings of protein-rich foods such as meat than children from higher income households ($p = 0.035$). Children whose food preparer had a post-school qualification, consumed significantly more daily servings of protein-rich foods, than children whose food preparer did not have a post-school qualification ($p = 0.012$).

A different trend was observed between socio-demographic status and consumption of breads and breakfast cereals. Children from higher income households, or households where the home was owned, all consumed significantly fewer helpings of breakfast cereals per day than children from low-income households ($p < 0.0005$), or rented homes ($p = 0.042$). Children from low-occupation status households or households on the benefit, all consumed significantly more servings of breads, than children from high-occupation status households ($p = 0.021$). Children whose food preparer went to school for longer consumed fewer servings of bread ($p = 0.034$) and breakfast cereals ($p = 0.016$). This may suggest that children from lower socio-economic status households are filling up on bread and breakfast cereals instead of fruit and vegetables. A poor nutrient-dense diet, comprised manly of low-cost carbohydrate-rich foods, was observed in a group of homeless children living in the USA (DuRousseau et al., 1991).

6.2.2 Nutrient intake

Pacific children and children from lower income households consumed significantly less energy, protein, and fibre than all other children in this study. Maori children had the highest mean protein intake. Although not significant, it appeared that children living in lower socio-economic status households had higher fat intakes. School-age children living in rented homes were reported to consume a higher percent of energy from total fats, than children living in owned homes ($p = 0.069$). These observations, with the exception of low protein intake in Pacific children, are consistent with the findings of smaller studies conducted in low-socio-economic groups living in New Zealand (Bell & Parnell, 1996; Parnell, 1997; Metcalf et al., 1998). Metcalf and colleagues (1998) found Pacific and Maori adults ate more protein than European adults, and high protein as well as high fat intakes, were found in a group of Pacific children aged 10 to 13 years (Bell & Parnell, 1996).

It is important to consider that although the dietary methods used in this study have been validated (Ministry of Health, 2002), they tended to overestimate nutrient intake in preschool children by 3%, and underestimate energy intake by about 23% in the school-age group (Ministry of Health, 2002). Self-reporting of intake has been associated with errors (Baranowski et al., 1991). Relying on children's cognitive ability to remember what they have eaten is likely to result in under- and over-reporting, as well as errors relating to the estimation of portion sizes. It is possible that gender, ethnicity or weight status could influence recall validity in older children and in caregivers. A study has found Caucasian and Mexican-American mothers tended to under-report energy and nutrient intakes, while African-American mothers tended to over-report nutrients (Baranowski et al., 1991).

The nutrient intake was based on data obtained from the 24-hour recall. However, the 24-hour recall may not provide an accurate account of an individual's diet. The high day-to-day and weekend-to-day variation in diet intake observed in young children (Serdula et al., 2001) may not have been corrected for in the 24-hour recalls analysed in this study. The 24-hour recall only provides an account over one day, which may not be a 'typical' day. Perhaps dietary intake based on a 4-day weighed diet records is a better indication of habitual food intake.

In the younger children, caregivers were responsible for providing data for 24-hour recalls. The caregivers were informed of when the second 24-hour recall was to be administered, and it is possible that this may have resulted in a change in children's eating patterns. It is plausible that caregivers may have paid particular attention to ensuring their children ate a balanced and varied diet during the 24-hour recording period, thus providing a different diet to the normal diet consumed by their children.

Overall the children's intake of total sugars was the main contributor to their total energy intake, especially for the preschool children from the highest income households. This high percent of daily energy intake provided by sugars has also been documented in another study of NZ preschool children (Grant et al., 2000). These observations may be of concern given the increased risk of dental caries associated with high sugar intake (Glinsmann et al., 1986). Pacific school-age children had lower mean sugar intakes as a percent of total energy (19%) than Maori (23%), European (26%) or Other (24%) children in this study. This is probably related to the low fruit intake observed in the Pacific children.

Iron deficiency in infants and children is common in developed countries and is related to poor dietary iron intake (Wilson et al., 1999). In this study, iron intake was found to be within the recommended levels, and overall boys had significantly higher mean iron and zinc intakes as a percent of the RDI than girls. This may be related to the lower energy and protein intake recorded for girls participating in this study. Other studies conducted in NZ have also found girls to have lower iron intakes than boys (Brinsdon et al., 1993). This may be of concern to adolescent girls, as the onset of menses will further increase iron

requirements. This study did not provide data on children's knowledge of the importance of iron rich foods nor did it involve a biochemical assessment of iron status and this may need to be considered in future studies. Unlike previous studies conducted in NZ (Wilson et al., 1999), household income did not have a significant effect on the iron intake in the children in this study.
Overall, calcium intake was below recommended levels for the majority of children in this study. This finding supports the low calcium intakes reported by other NZ studies (Brinsdon et al., 1993; Parnell, 1997). This is a major health concern, as it is vital children and adolescents consume enough calcium in order to achieve peak bone mass, and thus reduce the risk of developing osteoporosis in late adulthood (MacKerras, 1995). Although not explored in this study, globally there appears to be a trend for teenagers to drink soft drinks in preference to milk, at a time when it is crucial they achieve peak bone mass (Hodges et al., 1998; Wham & Worsley, 2001). It is also alarming to note that soft drinks are cheaper to buy than milk-based drinks, which may explain the low consumption of dairy products observed in the children from low-household incomes. In this study, school-age children were more likely to not meet the RDI for calcium (82%) than preschool children (69%). Pacific children had the highest prevalence of inadequate calcium intake, while Maori children were more likely to meet the recommended values ($p = 0.001$). Pacific children had the lowest mean calcium intake at 54% of the RDI, followed by Other (66% of RDI), then European (86% of RDI) while Maori children had the highest mean calcium intake (109% of RDI). Children from low-socio-economic status households (rented homes, low-income, low-occupation, low-education status and lower food expenditure households) had the lowest calcium, magnesium and phosphorus intakes.

In general, the children from the higher income, educated and occupation status households had the highest intakes of folate, vitamin B6, thiamine and riboflavin. This is in support of the finding of Nelson et al. (2002), who report folic acid intake to be significantly lower in those in the lowest income group. This may be of national concern considering 29% of all NZ children were living in very low income families (income below 60% of the median) according to data from the 2001 NZ Social Report (Ministry of Social Development, 2002).

In this study, the percentage of children with low vitamin B intakes varied significantly with ethnicity. Pacific and Other children had the lowest folate, vitamin B6 and riboflavin intakes. Half of the Pacific children, about a third of the European children and a quarter of the Maori children did not meet the RDI for folate. Pacific children were also reported to have the lowest vitamin C intakes. The low vitamin C and folic acid intakes observed in the Pacific children are not surprising given the low intake of fruit and vegetables observed in this study, particularly amongst the Pacific children. The low vitamin C intake in the Pacific children may place them at an increased risk of developing iron deficiency, as vitamin C is known to assist in iron absorption (Bates, 1997). Folic acid is important for cell division and growth during childhood (MOH, 1998). The low folate intake observed is also of future concern. As adults, if these female participants do not improve their food choices, they may be at an increased risk of having an infant with a neural tube defect (Smithells et al., 1976).

Vitamin E intakes were low – with over a half of all children not meeting the RDI for vitamin E. The mean vitamin E intake, as a percent of the RDI, was lower for Other (61%) and Pacific (74%) than for European (99%) or Maori (122%) children. Higher vitamin E intakes were associated with higher income, education and occupation status households. Homeownership was significantly associated with higher intakes of vitamin E, A, C and B vitamins.

Selenium intakes were generally low for all children in this study. Low selenium intakes have also been noted in NZ adults (Russell et al., 1999) and this is likely to be attributed to the low selenium content of NZ soils and hence fruit and vegetables (Duffield & Thomson, 1999). The study found significantly more preschool children (40%) met the RDI for selenium than school-age children (26%).

An important limitation of this study is that nutrient intake was based on the Australian Recommended Dietary Intakes (RDIs), which are currently under review, and are unlikely to provide an accurate indication of nutritional adequacy in New Zealand children. Currently the most appropriate reference standard for estimating an individual's requirement is likely to be the Estimated Average Requirement (EAR) values. The EARs are median requirements and unlike the RDAs they take into account that the distribution of requirement for some nutrients may be skewed.

In this study, the nutritional adequacy of the children's diets was based on the Australian RDIs, except for energy and protein intake, which were based on the United Kingdom's EAR values. An over-representation of micronutrient deficiencies may have occurred from using the RDI values to determine micronutrient adequacy among the children. This is exemplified by the nutrient requirements for iron. The EAR for iron for 1 to 3 year old children is 5.3 mg per day (United Kingdom Department of Health, 1991), but the RDI for iron for the same age group is 6 to 8 mg per day (MOH, 2000). Thus a higher proportion of children aged 1 to 3 years who were classified by this study as not meeting the RDI for iron, may in fact had a diet adequate in iron intake, based on the EAR for iron.

In hindsight it would have been better to base all of the nutrient adequacy calculations on the EAR values. Although the Ministry of Health recommends the continued use of the Australian RDIs, it is the opinion of Tasman-Jones (1995) that due to improved economy and selection of foods, the RDI values are no longer relevant or useful for establishing the nation's nutrition status. The RDI values should be viewed as the minimum requirement to prevent deficiency in practically all of the population. In general, the RDIs for children have been interpolated from information on infants or adults and consider the amount of a nutrient needed to maintain normal growth rates. There is now an evolving debate over the amount of nutrient needed by people for optimal health and physiological function, and the amount required to maintain maximum body stores of that particular nutrient (Rosenberg, 1994; Combs, 1996).

6.2.3 Specific eating patterns

Children from low-occupation or education status households or of Pacific ethnicity, were significantly more likely to frequently consume takeaways and food from school canteens, and were more likely to eat low fibre foods and drink full-fat milk. The trend for Pacific children to be frequently consuming takeaways has also been documented in other studies (Grant et al., 2000). Fast foods were the major contributor to higher percentages of energy intake from fat in a group of 60 Pacific preschool children living in Dunedin (Grant et al., 2000).

6.3 Socio-demographic determinants of physical and health status

The nutrition-related health of children in this study was determined from anthropometric measures and from the medical history obtained during the interviews. An alarming large proportion of children in this study were classified as overweight and obese, according to the International BMI cut-off values determined by Cole and colleagues (2000). There is currently no national data on the prevalence of obesity in NZ children. The percentage of overweight (42%) and obese (17%) children in this study is similar to the percentage of overweight (35%) and obese (17%) adults reported in the NZ NNS (Russell et al., 1999). More recently, an Auckland study found 14.3% of 5 to 11 year olds were obese based on cut-off values (95^{th} percentile) as used by the USA NHANES I (Tyrrell et al., 2001). Some caution needs to be applied to this study, as cut-off values were based on North American children and hence may not be suitable for NZ children. As the sample obtained for the Validation study is not a true representation of the NZ population, and as there are currently no specific standards for assessing overweight and obesity in New Zealand children and adolescents, the findings of this thesis must also be approached with caution. It is possible that the prevalence of obesity may have been misclassified in this study, as the international cut-off values may not be specific for New Zealand children. It has been suggested in the literature that unique cut-off values need to be developed in order to define overweight and obesity in Pacific children (Salesa et al., 1997). In this study, no significant differences in the prevalence of obesity or being overweight were found between children of different ethnic groups.

Nevertheless, this study found some significant associations between socio-demographic factors and BMI values. Maori and Pacific children had higher BMI values than European and Other children, while Pacific girls were more likely to be overweight than Pacific boys. This gender difference observed in Pacific children was the opposite of that found in Pacific adults participating in the NNS97 (Russell et al., 1999). Pacific male adults were more likely to be overweight, but less likely to be obese, than Pacific female adults (Russell et al., 1999). Fifteen percent of male children and 19% of female children were considered obese in this study, but this is in contrast to Australian studies which report a higher incidence of obesity in boys compared to girls (Tienboon et al., 1994; Wilcken et al., 1996). Children from lower socio-economic status households (low-income, low-education status, rented households) had higher median BMI values than children from higher socio-economic status households. These observations follow the same trends observed in the adults participating in the NNS97 (Russell et al., 1999).

Childhood obesity is a major public health problem in developed countries including New Zealand. There is evidence that children who are overweight during adolescence are likely to be overweight as adults, which poses a major risk of mortality from all causes including coronary heart disease (Must et al., 1992; Must, 1996; Must & Strauss, 1999).

It is interesting to note that a significant association was found between children from low-occupation status households and those children with a chronic medical condition ($p = 0.020$) or taking prescription medicines ($p < 0.0005$). Overseas

studies have linked poor health status of children from low-income households or families headed by single mothers (Montgomery & Kiely, 1996).
However, no medical records were obtained in this study to verify the medical history obtained from the interviews, and to some part the accuracy of this section was dependent on the skill of the interviewer. Some of the medical data obtained was not complete. In some cases the type of medication was not specified and some of the responses had to be re-coded, for example, one child taking thyroxine and two children taking asthma medication were not classified by their caregiver or the interviewer as having a medical condition.

Nevertheless, the trend in the data was for more Pacific children than children of any other ethnic group to have a chronic medical condition or to be taking medication. These results further suggest that Pacific children are more likely to have poorer nutritional and health status than other ethnic children. Perhaps Pacific children need to be selectively targeted in future health promotion goals and targets. However, a potential problem with this sample set is that the participants that volunteered may have been more concerned about their children's health, and hence more willing to partake in this study. This would cause a selection bias effect, as perhaps caregiver willingness to participate may be related to the health status of children in the different ethnic groups.

6.4 Prevalence of food insecurity

It is important to measure and monitor the prevalence of food insecurity in the New Zealand children population, in order to access the impact it can have on the nutrition and health status of children. Thirty-nine percent of children participating in this study were from food-insecure households that sometimes or often did not have enough money to buy food in the last month. This figure is considerably higher than the 14% of adults classified as food-insecure by the 1997 National Nutrition Survey (Russell et al., 1999). The figure obtained in this study is also considerably higher than that reported overseas. In the United States of America, 11% of households were considered food-insecure at some

stage during 2002 (Nord et al., 2003), while 5% of the Australian adult population were considered food-insecure in 1995 (Booth & Smith, 2001).
Ten percent of children in this study had felt hungry over the last month, which is higher than the 3.5% reported in food-insecure households over 2002 in the USA (Nord et al., 2003).

The accuracy of determining food security in this study could be questioned, as this was based on hunger experiences occurring over a relatively short time frame of one month. The USA 18-item Core Food Security Measure covers hunger experiences by the household within the last 12 months (Bickel et al., 2000; Derrickson et al., 2000). The prevalence of food insecurity and hunger in households may have been underestimated by limiting responses to experiences over the last month, rather than the last year. Another potential problem with measures of food insecurity and hunger is that survey data is subjective and self-reported, and thus is open to confounding variables. It is important to consider that the perception of food insecurity may be prejudiced by emotional or financial concern of individuals. This may result in some subjects over-reporting or under-reporting hunger or food insecurity.

In this study, a very small percent (4%) of food-insecure households obtained food from food banks and the majority (75%) went to relatives. This suggests that data based on food banks is not a good indicator of the prevalence of food insecurity in NZ children. This is consistent with other research, in which only a third of food-insecure families used food assistance programs such as food banks or soup kitchens (Vozoris & Tarasuk, 2003).

6.5 Socio-demographic status of food-insecure children

This study found household food insecurity to be significantly related to several socio-demographic variables, including household income and education status, as identified by other articles in the literature (Alaimo et al., 2001c; Townsend et al., 2001; Dunifon & Kowaleski-Jones, 2003). In this study, household food insecurity was significantly associated with being male (47%), Pacific (87.5%), having a Pacific food preparer (89%), larger sized families of six or more (52%), living in rented homes (60%), low-income households (66%), families spending $100 or less per week on groceries (74%), low-occupation status households (66%), children of food preparers born in the Pacific Islands (88%) and low-education status of food preparer. The mean years of schooling of the food preparer of food-insecure children was about 4 years less than that of the food preparer of food-secure children. This study showed a clear association between food insecurity and ethnicity, with 87.5% of Pacific children, 18% of Maori and 5% of European children being food-insecure ($p = 0.0005$).

It is not possible to compare these results to that of other groups of food-insecure children living in New Zealand because the results of the 2002 Children's National Nutrition Survey has not yet been published. A few similarities and differences were noted in the socio-demographic profile of the food-insecure children in this study and the food-insecure adults in the NNS97 (Russell et al., 1999). In support of the findings of this study, food insecurity was more prevalent amongst Pacific and Maori adults, low-income households, and in the most deprived areas of residence (Russell et al., 1999). Unlike the children in this study, about a half of the Maori and Pacific adults in the NNS97 experienced food insecurity. The lower rates of food insecurity among Maori children compared to Pacific children observed in this study may in part be related to the over-representation of Maori in the higher income households. This study found income to be a major determinant of food insecurity in children and this is in support of the findings of NZ adults in the NNS97 (Russell et al., 1999).

In this study 15% of school-age children lived alone with one parent. It would have been interesting to investigate the nutritional status of children of single-parent households, if a larger sample size had been recruited for this study. The USA NHANES III study found food-insufficient children to be more likely than food-sufficient children to be from families where the head of the family was not married (Alaimo et al., 2001c).

Statistical analysis on those children reporting hunger was unreliable due to the small sample size of 16. Nevertheless, the socio-demographic profile of children reporting hunger differed from the profile of children who did not report hunger. This study found the incidence of hunger to be significantly related to those children living in rented homes, or lower income households and children of food preparers with fewer years of schooling or born in the Pacific Islands.

The results of the 2002 CNS will provide a more accurate indication of the prevalence of food insecurity in NZ children as the sample recruited is a more representative sample of children living in NZ.

6.6 Nutritional status of food-insecure children

The results of the nutritional status of food-insecure children are subject to the limitations regarding the periodic nature of food insecurity and hunger. It is possible, that the timing of the collection of the dietary data may have influenced conclusions drawn in this study. If dietary data was obtained several months after a household experienced a bout of food insecurity or hunger, it may provide an inaccurate picture of the nutritional status of those at risk of food insecurity. This raises the issue of the suitability of 24-hour recalls for obtaining information on dietary intake in food-insecure individuals and may explain inconsistencies reported between studies of food-insecure populations (Cristofar & Basiotis, 1992; Rose & Oliveira, 1997; Rose, 1999; Tarasuk & Beaton, 1999; Tarasuk, 2001).

It is possible that some caregivers in the food-insecure households are limiting their portion size in order to feed their children, as previously noted in overseas studies (Tarasuk & Beaton, 1999) and in a NZ study (Parnell, 1997). Although there is no evidence this is occurring among the families recruited for this study, it is important to consider the findings of this study may not provide an accurate picture of the nutritional status of the food-insecure children.

6.6.1 Dietary intake

In this study, the food-insecure children consumed fewer daily helpings of fruit, vegetables, milk products and protein-rich foods such as meat, than the food-secure children. These findings are in support of those documented by American and Canadian studies (Tarasuk, 2001; Kaiser et al., 2002). American preschool children from food-insecure households were also significantly less likely to meet Food Guide Pyramid guidelines (Kaiser et al., 2002).

In this study, food-insecure children consumed more helpings of breakfast cereals per day than food-secure children ($p < 0.0005$). This finding may suggest breakfast cereals are being used as a 'filler' food in the food-insecure households, although consumption of cereals such as rice and pasta was significantly less in food-insecure households ($p = 0.005$). It is plausible that the popularity of breakfast cereals in food-insecure households may be related to the ease of use of such packaged goods, especially among caregivers with limited time and cooking skills.

6.6.2 Nutrient intake

The incidence of hunger was not significantly related to the children's nutrient intake. The small number of children reporting hunger may account for these results not being significant.

For the purposes of this study, children from households that sometimes or often did not have enough money to buy food were considered food-insecure. Food insecurity was significantly associated with lower micronutrient intake in both the preschool and school-age children.

Food-insecure preschool children had significantly lower median intakes of folate ($p < 0.0005$), riboflavin ($p = 0.006$), vitamin B6 ($p = 0.018$), beta-carotene ($p = 0.030$), vitamin E ($p = 0.009$) and calcium ($p < 0.0005$) than food-secure preschool children. When median nutrient intakes were considered as a percent of the RDI over half of the food-insecure preschool children did not meet the recommended intake values for vitamin E and selenium. Poor vitamin E intakes were also reported in a group of food-insufficient American preschoolers (Rose & Oliveira, 1997).

In the school-age children, food insecurity was associated with lower intake of some macronutrients as well as several micronutrients. Food-insecure school-age children had significantly lower median intakes of energy ($p = 0.039$), carbohydrate ($p = 0.017$), total sugars ($p = 0.001$), vitamin C ($p = 0.004$), folate ($p = 0.030$), beta-carotene ($p = 0.003$), vitamin A ($p = 0.029$), potassium ($p = 0.046$), calcium ($p = 0.029$) than food-secure school-age children. Low calcium intakes in a small group of food-insecure children have also been reported in a previous NZ study (Parnell, 1997).

Differences in nutrient intake between food-secure and food-insecure populations have been documented in several studies in the USA (Cristofar & Basiotis, 1992; Rose & Oliveira, 1997). A group of food-insufficient children living in the USA were also reported to have lower intakes of energy, carbohydrate, dietary fibre, vitamin C, beta-carotene and folic acid than food-sufficient children (Cristofar & Basiotis, 1992).

The RDI values are intended to ensure that 95% of the population will not be deficient in a particular nutrient. Hence, if dietary intake of a nutrient falls below the RDI value, this may not equate to inadequate intake of that nutrient. However nutrient intakes below 75% of the RDI may indicate nutritional inadequacy in a diet (Block et al., 1988). Food-insecure school-age children in this study had median intakes of vitamins A, E, calcium and selenium below 75% of the corresponding RDI values.

The results of this study suggest food-insecure children, like children from low-income households, have lower fibre intakes and consume a smaller mean percent of energy intake from total sugars, than food-secure or children from higher income households. The low fruit and vegetable intake among children from food-insecure or low-income households is likely to account for the observed low intakes of vitamins A, Bs and E as well as folate, fibre and total sugar intake. Globally there is a lack of nutritional data on school-age children experiencing food insecurity.

The results of this study are subject to the limitations of the food-recall dietary methods as previously discussed. Preschool children eat a small amount of food and inaccurate assessment of portion size by caregivers may result in large errors in the estimation of nutrient intake. This may account for the observation that food-insecure school-age children had lower intakes of more nutrients than food-insecure preschool children.

6.6.3 Specific dietary eating patterns

In this study, more food-insecure than food-secure children frequently consumed takeaways or food from the school canteen or food bought from local shops ($p = 0.003$; $p = 0.032$; $p < 0.0005$, respectively). It is possible that eating more meals away from home is contributing to the low fruit and vegetable intake observed amongst the food-insecure children in this study. Food-insecure households in the USA were reported to buy food from small food stores rather than from supermarkets, and this observation was thought to contribute to the low intake of fresh produce, and low intake of nutrients like vitamin C, observed in these food-insecure households (McGrath-Morris et al., 1992). Local shops and takeaway food outlets generally offer a limited variety of fresh produce, but it is not known if this is the reason why the food-insecure children in this study did not eat the recommended daily servings of fruit and vegetables. However this study did provide evidence that children who frequently consumed takeaways were significantly more likely to consume fewer helpings of fruit per day ($p = 0.013$).

This study also indicated that food-insecure children are significantly more likely to drink full-fat milk and eat white bread, while food-secure children are more likely to drink reduced-fat milk and eat wholemeal bread. These observations may in part explain why the food-insecure children had poorer dietary and nutrient intake than the food-secure children.

Of interest, was that food-insecure children had a stronger influence over parent's food buying decisions for all food groups (fruit, vegetables, dairy products, cereals, meat, snack foods, takeaways) than children of food-secure households. It is plausible the food-insecure households have more concerns about buying food their children will eat and which will not be wasted. Food-insecure households may buy popular snack foods over fresh produce, as they know their children will eat these foods.

6.7 Physical and health status of food-insecure children

Several international studies have associated food insecurity with poor mental and physical health in adults (Kleinman et al., 1998; Tarasuk, 2001; Dumbauld & Baumrind, 2002; Vozoris & Tarasuk, 2003). Food insecurity and hunger have also been associated with poor health status and destructive behaviour in American children (Murphy et al., 1998; Olson, 1999b; Alaimo et al., 2001c; Winicki & Jemison, 2003).

However, in this study household food insecurity was not significantly associated with poorer health status among the children. In fact, a higher proportion of food-secure children had been hospitalised or had a chronic medical condition, than food-insecure children. It is possible that respondent bias may have occurred when obtaining a medical history from caregivers. Caregivers from food-insecure households may have withheld medical information about their child. The higher report rate of medical conditions among children from food-secure households may be related to the socio-economic status of the caregiver. Caregivers of food-secure children had a higher education status and higher household income than caregivers of food-insecure children, and this may be related to better access to health care and hence increased physician use and rates of diagnosis. It is possible that food-insecure households have poorer access to health care, as they may live further away from medical centres, or have problems regarding transportation costs or medical costs, and hence may be less likely than food-secure households to take their children to the doctor or to a hospital. There is evidence that NZ children from households exposed to the lowest level of economic living standard are least likely to attend a doctor or dentist than children from households not under financial constraint (Krishnan et al., 2002). This may in part explain the higher incidence of hospital admissions among food-secure children compared to food-insecure children.

Higher rates of obesity have been reported among food-insecure or low-income adults (Vozoris & Tarasuk, 2003) and this relationship has been observed to a lesser extent in food-insecure children (Alaimo et al., 2001b). The association between food insecurity and obesity is stronger in adult women (Olson, 1999b; Alaimo et al., 2001b; Adams et al., 2003). In contrast to previous work conducted overseas, food insecurity was not significantly associated with being overweight or obese in the group of children in this study. More recently, researchers in the USA have reported similar percentages of obesity and underweight in children from food-insufficient or food-sufficient households (Casey et al., 2001). The discrepancy among international literature may be partly explained by the use of different tools to measure food insecurity and obesity.

In this study food-insecure children had significantly higher median BMI values (19.1) than food-secure children (17.4). About 40% of food-insecure children were overweight, and 17% were obese, which are quite high figures. This may be partly due to poor dietary choices or lack of physical activity; the latter was not analysed in this study. Future studies may need to investigate if there is an association between diet, physical inactivity and incidence of obesity in food-insecure children. Marginally significant higher fat intakes (as a percent of total energy) were found in the food-insecure school-age children participating in this study ($p = 0.066$). Interestingly, food-insecure children were more frequent consumers of takeaways; yet energy and carbohydrate intake tended to be lower in the food-insecure children, as has been noted in international studies (Casey et al., 2001). Food insecure children may be exposed to episodic periods of food shortages that may result in children over-eating when food becomes available. This bingeing behaviour is thought to be contributing to the high incidence of obesity among food-insecure households (Emmons, 1986; Dietz, 1995; Polivy, 1996; Alaimo et al., 2001b; Kaiser et al., 2002; Kempson et al., 2002). Dietary intake data based on a single 24-hour recall, as done so in this study, is unlikely to provide any indication of bingeing behaviour.

6.8 Limitations of the study

The main limitation of this study was that the sample chosen was not representative of the NZ population and so the results can not be generalised to all NZ children, but only to children aged 1 to 14 years from the Western suburbs of Auckland.

Asian and Indian children were greatly underrepresented in this study and this posed a major limitation when comparing the nutritional status of children of different ethnic groups. European and Maori children were over-represented in the higher income groups and there was an under-representation of children from households from the two lowest income groups. The income and employment data needs to be approached with caution, as 34 participants did not respond to the annual income question, and 30 did not respond to the employment status question; which may explain the larger than expected proportion of higher income households in this study.

Another major limitation of this study, is related to the tools used to measure food insecurity and nutritional and health status:

- The estimated prevalence of food insecurity is subject to error because the indicators of food security status used in this study are not validated and the hunger 'indicator' of food insecurity is open to misinterpretation by participants. Also children may be exposed to food insecurity on a regular basis or an intermittent basis, and so measures of food insecurity that cover the last month may under-represent food-insecure populations. Food security measures that are based on a 12-month scale may provide a better indication of household food security status. Also measuring food insecurity in children relies on caregivers providing information that is honest and accurate. It is possible that some caregivers from food-insecure households may not want to provide details of their situation; perhaps for fear that social workers may remove their children from their care.
- The 24-hour recall may not be the most appropriate dietary method for assessing the diets of food-insecure children. The high day-to-day and weekend-to-day variation in dietary intake observed in young children, and the periodic nature of food insecurity, may mean that the day chosen for the 24-hour recall may not be a 'typical' day. Perhaps dietary intake based on a 4-day weighed diet records and repeatedly conducted over a long period of time provides a better indication of habitual food intake and nutritional status. Self-reporting of intake has been associated with errors and it may be more ideal to also obtain biochemical and clinical indices of nutritional or health status. The Children's National Nutrition Survey will be looking at biochemical data, which is likely to provide a better picture of the nutritional status of food-insecure children. Also nutrient inadequacy in this study was based on the Australian Recommended Dietary Intakes that are currently being reviewed, as they are out of date.

- There are currently no nation-specific cut-off values for classifying NZ children as obese or overweight. Also health status based on responses to the questions on medical history is open to respondent bias.

6.9 Recommendations for future research in New Zealand

Recommendations for future NZ studies in the field of food insecurity in children can be made based on the findings of this study and of those reported in the literature review:

1. It is important to recruit a larger population sample that is representative of the main ethnic groups living in New Zealand. As there is a rapidly growing Asian and Indian community in New Zealand, and given the high prevalence of poverty found in these communities, it is important to recruit children from these ethnic groups. The population chosen must also be representative of different levels of socio-economic status and not over- or under-represent income groups in New Zealand. Attention needs to be directed to children from low-income households as NZ children are more likely to live in households in the lower bracket of the income distribution (Ministry of Social Development, 2002).
2. Measuring food insecurity requires addressing the four components of the definition of food security; the quantitative component which relates to having access to a sufficient quantity of food, then the qualitative component which relates to nutritional adequacy of diets and considers cultural factors, the psychological component relates to anxiety about obtaining food, and finally the social component regarding the acquisition of food. It is thus difficult to incorporate all four components that define food insecurity into questionnaire-based surveys, especially when the subjects are children. Measures of food insecurity in NZ children need to be validated and the level of severity of food insecurity may also need to be determined. A good model is the USA 18-item Core Food Security Module. In this study food insecurity was determined by responses to a

question relating to the availability and sufficiency of food, it does not however, measure food safety or adequacy of nutritious diets.

3. Nutritional status needs to also include biochemical status in order to determine iodine, iron and zinc status in children.
4. The development of nation-specific cut-off values for determining levels of obesity and overweight in NZ children is crucial.
5. Physical activity was not analysed in this study with respect to food security status, socio-demographic status or health status. It is plausible that physical inactivity may have contributed to the high BMI values obtained in this study, and this needs to be addressed in future research.
6. Pacific children in this study were more likely to be from food-insecure or low-income households. This vulnerable group needs to be targeted for intervention. There is currently a lack of data on the impact of socio-economic factors and food insecurity on the nutritional and health status of Pacific people in New Zealand.
7. Future studies may also need to determine if the poor diets of food-insecure populations are directly related to low income, lack of transport to shops, inadequate cooking and storage facilities, poor nutritional and culinary knowledge or lack of social support.
8. Research is needed to assess the impact of nutritional education programs on food-insecure households with children.
9. Intervention programs that improve food security to NZ children need to be developed and evaluated. Such programmes could provide free or subsidised food or food vouchers to food-insecure households.

6.10 Successful food security programs

Many government food-assistance programs have been undertaken in the USA to improve the nutritional and health status of food-insecure populations. The two main programs are the Food Stamp Program and the Special Supplemental Food Program for Women, Infants and Children (WIC) (Splett, 1994; Basiotis &

Kramer-LeBlanc, 1998). Such programs provided food stamps or vouchers valid for use in supermarkets and local food stores.

However these programs have been criticised by some, who feel that these programs do not take into consideration the cultural suitability of foods (Splett, 1994). It is possible that participants of these programs may feel socially alienated from those who do not need to rely on food vouchers (Gundersen & Oliveira, 2001). Also, these programs do not motivate or educate families on how to obtain a nutritional adequate diet on a limited budget, and as a result some families may become dependent on such programs (Splett, 1994).

Perhaps a better solution in the author's opinion may be to improve economic conditions that restrict an individual's ability to obtain food. This may involve providing opportunities for individuals to earn an income to buy food. However, increasing household incomes does not necessarily equate to households obtaining a more nutritional balanced diet. An advantage of the food stamp program is that certain vouchers can be allocated for fruit and vegetables and milk products and so this may indirectly educate individuals of what constitutes a balanced diet.

An assessment of the Connecticut food stamp program in the USA, found preschool children from low-income families that received food stamps were more likely to be food-secure than low-income children who did not receive food stamps (Perez-Escamilla et al., 2000). Preschool children from households participating in the Food Stamp and WIC programs had significantly higher intakes of iron and zinc than preschool children not receiving food assistance (Rose et al., 1998). The Food Stamp and WIC programs have also contributed to the decline in iron deficiency in the USA in these vulnerable groups of the population (Rose et al., 1998; Perez-Escamilla et al., 2000).

Over the years there have been a number of Child Nutrition Programs set up which include the school breakfast and milk programs. These programs provide food directly to the children and have been relatively successful both overseas (Worobey & Worobey, 1999) and in New Zealand (Bulford & Alexander, 2001). It could be argued that these programmes only provide a temporary solution to food security problems. It is without doubt, that poor nutrition during childhood has detrimental efforts on cognitive development and children should be targeted for nutrition intervention. Preschools and secondary schools seem logical places for nutritional education promotion and intervention. Of course it is also important to raise nutritional awareness of caregivers and parents.

6.11 Recommendations for improving food security to NZ children

The Ministry of Health have identified food insecurity as a significant nutrition and health issue for New Zealand children (Hodges et al., 1998). For households to be food secure requires year round access to a variety of safe, nutritious and culturally acceptable foods. Households under financial restraint and at risk of food insecurity will need to not only have access to sufficient resources to purchase and produce adequate food, but will also need support to ensure the nutritional well-being of all family members. Such support will need to have an appreciation of the distinct cultural food habits that may need modification. Community food and nutrition education programs need to cover the many aspects of food insecurity, including food safety, knowledge of affordable nutritious foods and culturally acceptable foods. Such programs may have to target attitudes and beliefs certain cultures may have regarding some food and cooking practices, and people may need to be motivated to take on healthy eating practices.

Underlying food insecurity are important socio-economic and political issues. A successful intervention to improve food insecurity is likely to rely on the co-ordination of economic policies with nutritional educational strategies. Politicians, economists and nutritionists must work together to form food security policies. Without economic security, nutrition security cannot exist.

Poor nutritional status in this study was significantly associated with Pacific households, low-income households, low-occupation status, low-household food budgets, large household sizes, rented accommodation, and food preparers with the least years of education. Improving economic security of households will depend on government efforts to assist the unemployed. Perhaps efforts need to be strengthened to assist in the primary, secondary and post-secondary education of children, who are our future, as this may be the only way of breaking the poverty cycle. Equally as important to improving economic security, is providing nutritional education and support programmes. Such nutritional education programs may involve not only teaching about the benefits of a nutritious meal, but also how to prepare a nutritious diet and how to food budget.

Perhaps a community-based approach to improving food insecurity would be the most effective. Vulnerable groups of the population such as those living in high poverty areas could be targeted for funded food assistance programs and nutrition education programs. About a third of NZ schools provide some type of assistance to children, but this is unlikely to reach all children at risk of nutritional inadequacy. Support networks within the extended family and in the community that target food security need to be built and promoted. The collaboration of local council bodies with other government agencies could address issues such as the lack of public transport to supermarkets in high-poverty areas and possibly local fresh produce markets could be set up on a weekly basis in these areas. The key to achieving food security will depend on the successfulness of such programs to change dietary behaviour amongst low-income or food-insecure populations and perhaps this may involve the effective use of the media to promote food insecurity awareness.

The results of this study provide a basis for the development of public food security goals and highlight areas that nutrition education programs could target:

1. A large proportion of food-insecure children in this study frequently consumed food from takeaway outlets or school-canteens. These may be places to target for nutrition intervention or education programmes.
2. The low fruit and vegetable intake among the majority of children, in particular the food-insecure, low-income households is of public concern. Health promoters in conjunction with the government may need to address this issue. Cost is generally an issue regarding the ability of households under financial restraint to afford fresh produce. Perhaps there needs to be community awareness on growing fresh produce, assuming households have some land to do so. For those households that do not have a garden, community gardens in low-income neighbourhoods could be set up and sections could be rented for a small fee, which could include seedlings, the use of gardening tools and a lesson on gardening. This has been tested in small, low-income towns in the USA, and has been very effective at building social networks (Vozenilek, 1998).
3. The low calcium intake in the majority of children in this study is also of public concern, and has been reported in other NZ studies. Government policies may need to be established so to reduce the cost of milk, an excellent source of calcium for growing children and adolescents. There also needs to be a campaign to make milk 'trendy' for children, and perhaps soft drinks in school canteens could be replaced with milk drinks.
4. Educational programmes that target food-insecure children or children from low socio-economic status households will need to consider the strong ethnic influence on diet intake in an ethnically diverse culture such as in New Zealand.
5. There is a strong case for an increased public focus on the nutritional status of Pacific children. It is time to shift government agencies focus towards providing food assistance to food-insecure groups of the population, and evaluating such interventions.

7. Conclusion

Food insecurity is a significant nutrition and health issue for New Zealand children. The Ministry of Health have recognised the need to determine the prevalence of food insecurity among NZ children and to identify vulnerable groups (Hodges et al., 1998). Over a third of all children in this study were from households that sometimes or often did not have enough money to buy food. This study suggests that food insecurity exists on a large scale in certain groups of the population, in particular among Pacific children. The results of this study provided strong evidence of the nutritional impact of food insecurity and socio-economic status on a group of NZ children.

The socio-demographic profile of food-insecure households differed considerably from the profile of food-secure households. Food-insecure children in this study were more likely to be from low socio-economic households and this has been well documented in overseas literature (Rose & Oliveira, 1997; Alaimo et al., 1998; Russell et al., 1999; Townsend et al., 2001; Dumbauld & Baumrind, 2002). In this study, it was shown that children from low-income, low-occupation status households and whose food preparer received less years of schooling, were at the greatest risk of being food-insecure.

Pacific children were more likely to be from low-income or food-insecure households and were at the greatest risk of poor nutritional and health status than Maori, European or Other children. However, the sample of children in this study was not a national representative sample, and so it is important to validate these results with further research involving a random population-based sample of children.

Nevertheless, this study identified several areas of nutritional concern among children aged 1 to 14 years living in the Western suburbs of Auckland. Food insecurity and low-socio-economic status were found to be significantly associated with poorer dietary intake of fruit, vegetables, milk products and protein-rich foods such as meat. Lower nutrient intakes in particular fibre, folate, B vitamins, vitamin E, beta-carotene and calcium were reported for the children from food-insecure or low-socio-economic households. Poor dietary habits such as frequent consumption of takeaways and food from the school canteen were observed among the children from food-insecure or low-socio-economic households. Adequate nutrition during childhood is vital to ensure the demands of growth and development are met (ADA, 1999a, 1999b). The low calcium intake reported amongst the majority of children in this study is of public concern given the importance of calcium for bone growth throughout childhood.

The method of dietary assessment used in this study was the 24-hour recall. This was validated against a 4-day weighed diet record in the preschool group, and energy intake in the school-age group was validated against the doubly labelled water method. The 24-hour recall tended to overestimate nutrient intake in preschool children by 3% and underestimate energy intake by about 23% in the school-age group (Ministry of Health, 2002). Dietary intake of certain food groups like fruit and vegetables were determined from the FFQ, which has been found to overestimate nutrient intake in other studies (Baranowski et al.,1991; Taylor & Goulding, 1998). Thus the results of this study are subject to the limitations associated with the dietary assessment methods.

The long-term health consequences of food insecurity in children are not clear, but there is evidence in the literature linking food insecurity with obesity and poor health in children (Kleinman et al., 1998; Alaimo et al., 2001b; Winicki & Jemison, 2003). This study did not provide evidence of a statistically significant association between obesity and other measures of health status with food insecurity. However household food insecurity and low-socio-economic status was associated with significantly higher body mass indices among the children in this study. The most important finding of this study was the high prevalence of Pacific children who were food-insecure, had a chronic medical condition and were overweight. Overweight is an independent risk factor for chronic diseases such as heart disease and diabetes. Fruit and vegetables are an excellent source of nutrients and the low intake observed may place food-insecure populations at a greater risk of developing chronic medical conditions in adulthood.

The findings of this study provide a strong case for an increased public health and nutrition focus on children from low-socio-economic families living in Auckland. More research is needed to further understand and determine the influence of nutritional education programs and food assistance programs, such as the USA Food Stamp program, on food-insecure households living in New Zealand. It is time now for politicians, economists and nutritionists to collaborate on policies to improve food security to children who are our future.

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9. Appendices

Appendix 1

Socio-demographic questionnaire

1. Name of adult at interview (deleted from data set to ensure confidentiality)
2. Sex of adult at interview
3. Relationship of adult to child

    Parent

    Sibling

    Step parent

    Grandparent

    Uncle/Auntie

    Cousin

    Unrelated

4. Adult lives at same address as child?

    Yes

    No

5. Adult at interview main preparer of child's food?

    Yes

    No

6. If NO to Question 5, relationship of main food preparer to child

    Parent

    Sibling

    Step parent

    Grandparent

    Uncle/Auntie

    Cousin

    Unrelated

7. If No to Question 5, food preparer lives at same address as child?

    Yes / No

8. Sex of child

    Male

    Female

9. Child's date of birth

10. Age of child (years)

11. Which ethnic groups does child belong to?

    1st group: __________

    2nd group: __________

    3rd group: __________

    4th group: __________

12. Is child descended from person of Maori descent (did you have a Maori birth parent, grandparent or great-grandparent?)

    Yes

    No

    Don't know

13. If YES to Question 12, what is name(s) of child's iwi (tribe)?

14. What type of place does child live in most of the time?

    House/townhouse

    Flat/unit

    Hostel

    Garage

    Caravan

    Sleep-out

    Other (specify)

15. Is this place rented or owned?

    Rented privately

    Rented (Housing NZ/Council)

    Owned

    Living with relatives

    Other (specify)

16. How many rooms are used for sleeping?

17. More than five household members in dwelling?

    Yes

    No

18. What is the combined yearly income before tax from all sources (including wages, benefits, accommodation supplement) of all your household?

    Loss
    $0-$5,000
    $5,001-$10,000
    $10,001-$20,000
    $20,001-$30,000
    $30,001-$40,000
    $40,001-$50,000
    $50,001 or more
    Don't know

19. How much money does your household usually spend each week on FOOD and GROCERIES (i.e. at supermarket, dairy, takeaway, petrol station)?

    $1-$50
    $51-$100
    $101-$150
    $151-$200
    $201 +
    Don't know

20. Who usually prepares child's food?
21. Country of birth of food preparer
22. Which ethnic groups does food preparer belong to? (Answer as many as you need to)

    Group1: __________
    Group 2: __________
    Group 3: __________

23. How many years of secondary school did food preparer complete?
24. Did food preparer get further education after leaving school?

    Yes / No

25. If YES to Question 24, did food preparer get any further qualifications after left school?

Yes / No

26. If YES to Question 25, what type of qualification?

Certificate

Diploma

Degree

Other (specify)

27. Describe the present (or last) paid job of food preparer?

28. Which of the following best describes present position of the main food preparer?

Homemaker (without pay)

Paid employee

Self employed

Employer of others

Family business/farm

Domestic purposes benefit

Unemployment benefit

Sickness benefit

Other benefit

Other

29. Who is the main person who pays for the things for the child? (who is the main provider for the child?)

30. Does the main provider live in your child's home?

Yes / No

31. How many years of secondary school did the main provider complete?

32. Did the main provider get further education after leaving school?

Yes / No

33. Did the main provider get any qualifications after leaving school?

Yes / No

34. If YES to Question 33, what type of qualification?

Certificate

Diploma

Degree

Other (specify)

35. Describe the present (or last) paid job of the main provider?

36. Which of the following best describes present position of the main provider?

    Homemaker (without pay)

    Paid employee

    Self employed

    Employer of others

    Family business/farm

    Domestic purposes benefit

    Unemployment benefit

    Sickness benefit

    Other benefit

    Other

Appendix 2

Food group consumption questionnaire

Fruit consumption

To determine the children's fruit consumption the caregiver was asked how many helpings of fruit (fresh, frozen, canned, preserved or stewed) their child usually consumes each day. A helping was defined as the amount of fruit that would fit into the palm of a hand and fruit juice was not included as a fruit helping. Answers were categorised into the following options:

- Doesn't eat fruit
- Less than one helping each day
- One helping each day
- Two helpings each day
- Three or more helpings each day

For statistical purposes, it was decided to combine option 2 and 3 and ignore those who did not respond. Responses were then categorised into the following options for this study:

- Less than or equal to one helping of fruit a day
- Two helpings of fruit a day
- Three or more helpings of fruit a day

Vegetable consumption

To determine then children's vegetable consumption the caregiver was asked to report how many helpings of vegetables (fresh, frozen, canned) their child usually consumes each day. A helping was defined as the amount of vegetable that would fit into the palm of a hand and vegetable juice was not included as a vegetable helping. Answers were categorised into the following options:

- Doesn't eat vegetables
- Less than one helping each day
- One helping each day
- Two helpings each day

- Three helpings each day
- Four or more helpings each day

For statistical purposes, responses were then re-categorised into the following options:

- Less than or equal to one helping of vegetable a day
- Two helpings of vegetables a day
- Three or more helpings of vegetables a day

<u>Protein type foods consumption</u>

To determine the children's consumption of foods rich in protein, the caregiver was asked to report how many helpings of meat, chicken, fish, seafood, eggs, dried beans like baked beans, nuts and lentils their child usually consumes each day. One helping of protein products was defined as half a tin or ¾ a cup of baked beans or 2 slices of cooked meat or 2 chicken drumsticks or 1 leg of chicken or ¾ cup of mince or casserole or 1 medium fillet of fish or 5 medium mussels or 3 kina or 1 medium steak or 1 egg or 1 sausage.

Responses were placed into the following categories:

- Doesn't eat those
- Less than one helping each day
- One to two helpings a day
- Three to four helpings a day
- Five or more helpings each day

In this study, these responses were then further categorised into:

- Less than one helping a day
- One to two helpings a day
- Three to four helpings a day

Complex carbohydrate/cereal consumption

To determine the children's cereal consumption, the caregiver was asked to report how many helpings of noodles, pasta or rice their child usually consumes each week. One helping of cereals was defined as 1 cup of cooked rice/pasta/noodles.

Responses were placed into the following categories:

- Doesn't eat cereals
- Less than one helping a week
- One to two helpings a week
- Three to f our helpings a week
- Five to six helpings a week
- Seven or more helpings a week

In this study, these responses were re-cateogorised into the following:

- Less than one helping a week
- One to two helpings a week
- Three to four helpings a week
- Four or more helpings a week

Breakfast cereal consumption

To determine the children's breakfast cereal consumption the caregiver was asked to report how many helpings of breakfast cereals their child usually consumes each day. One helping of breakfast cereals was defined as 1 cup of cereal or 2 weetbix.

Responses were placed into the following categories:

- Doesn't eat breakfast cereals
- Less than one helping each day
- One to two helpings a day
- Three to four helpings a day

- Five to six helpings a day
- Seven or more helpings a day

In this study, responses were categorised into the following:

- Less than one helping each day
- One to two helpings a day
- Three or more helpings a day

Bread consumption

To determine children's bread consumption, the caregiver was asked to report how many slices or rolls of bread (or toast or pita) their child usually consumes each day. One helping of bread was defined as 1 medium slice of bread or 1 roll or 1 small pita bread.

Responses were placed into the following categories:

- Doesn't eat bread
- Less than one helping each day
- One to two helpings a day
- Three to f our helpings a day
- Five to six helpings a day
- Seven or more helpings a day

In this study, responses were categorised into the following:

- Less than two or two helpings a day
- Three to four helpings a day
- Five or more helpings a day

Milk products consumption

To determine milk and milk product consumption in children the caregiver was asked to report how many helpings of milk, yoghurt, dairy food, icecream and cheese their child usually consumes each day. One helping of milk and milk products was defined as 1 cup of milk or 1 pottle of yoghurt or 2 scoops of icecream or 2 slices of cheese.

Responses were placed into the following categories:

- Doesn't eat milk and milk products
- One helping each day
- Two helpings each day
- Three helpings each day
- Four helpings each day
- Five or more helpings each day

In this study responses were re-categorised into the following responses:

- 1 helping a day
- 2 to 3 helpings a day
- 4 or more helpings a day

Appendix 3a

Australian Recommended Dietary Intakes (NH & MRC, 1991)

Nutrient	1-3 years	4-7 years	8-11 years (Boys)	8-11 years (Girls)	12-15 years (Boys)	12-15 years (Girls)
Vitamin A (mcg retinol equivalents)	300	350	500	500	725	725
Thiamin (mg)	0.5	0.7	0.9	0.8	1.2	1.0
Riboflavin (mg)	0.8	1.1	1.4	1.3	1.8	1.6
Niacin (mg niacin equivalents)	10	12	15	15	20	18
Vitamin B6 (mg)	0.6-0.9	0.8-1.3	1.1-1.6	1.0-1.5	1.4-2.1	1.2-1.8
Total folate (mcg)	100	100	150	150	200	200
Vitamin B12 (mcg)	1.0	1.5	1.5	1.5	2.0	2.0
Vitamin C (mg)	30	30	30	30	30	30
Vitamin E (mg alpha tocopherol equivalents)	5.0	6.0	8.0	8.0	10.5	9.0
Zinc (mg)	4.5	6.0	9	9	12	12
Iron (mg)	6-8	6-8	6-8	6-8	10-13	10-13
Magnesium (mg)	80	110	180	160	260	240
Calcium (mg)	700	800	800	900	1200	1000
Phosphorus (mg)	500	700	800	800	1200	1200
Selenium (mcg)	25	30	50	50	85	70
Potassium (mg)	980-2730	1560-3900	1950-5460	1950-5460	1950-5460	1950-5460
Sodium (mg)	320-1150	460-1730	600-2300	600-2300	920-2300	920-2300

Appendix 3b

United Kingdom Dietary Reference Values for Energy and Protein (United Kingdom Department of Health, 1991).

Estimated Average Requirement (EAR) for Energy and Protein for children:

Age	Sex	EAR for Energy (MJ/day)	EAR for Protein (g/day)
1 to 3 years	Male	5.15	11.7
	Female	4.86	11.7
4 to 6 years	Male	7.16	14.8
	Female	6.46	14.8
7 to 10 years	Male	8.24	22.8
	Female	7.28	22.8
11 to 14 years	Male	9.27	33.8
	Female	7.92	33.1

Appendix 4

Dietary habits and eating patterns questionnaire

Takeaways consumption

To determine the children's consumption of takeaways, the caregiver was asked to report the frequency by which takeaways (bought Fish and Chips, McDonalds, KFC etc) are consumed by their children.

Responses were placed into the following categories:

- 1-2 times a week
- 2-3 times a week
- 3-4 times a week
- Rarely
- Never

For statistical purposes, these responses were then placed in the following order:

- Never
- Rarely
- 1 to 2 times a week
- 2 to 3 times a week
- 3 to 4 times a week

School canteen consumption

How often eat food bought from school canteen?

- Daily
- 3-4 times a week
- 2-3 times a week
- 1-2 times a week
- Rarely
- Never

Responses were categorised into:

- Rarely/Never

- 1-2 times a week
- Often (more than twice a week)

Home packed lunches

How often eat food brought from home at school?

- Daily
- 3-4 times a week
- 2-3 times a week
- 1-2 times a week
- Rarely
- Never

Responses were recategorised into:

- Always
- 3 -4 times a week
- Less than 3 times a week

Consumption of food from local shops

How often eat food bought from local shops?

- Daily
- 3-4 times a week
- 2-3 times a week
- 1-2 times a week
- Rarely
- Never

Responses were re-grouped into:

- Never
- Rarely
- 1-3 times a week
- 3 or more times a week

Consumption of food on way home from school

Yes

No

Don't know

Certain types of foods:

Milk

What type of milk does your child have most?

Whole or powdered whole milk

Standard, homogenized milk

Reduced fat

Trim milk

Super Trim

Skim milk or low fat powdered milk

Calci Trim

Milk straight from cow (e.g. if you live on a farm)

Soy milk

Bought flavoured milk e.g. Primo

Other (specify)

For the purposes of this study, these responses were then grouped into the following options:

Full-fat milk

Reduced fat milk

Bread

What type(s) of bread does your child eat most?

White

White – high fibre

Grain breads e.g. Molenburg, Vogels

Wholemeal (brown bread)

Other (specify)

Type of spread

What types of spread does your child use most?

Butter or home-made butter

Butter and margarine blend

Margarine

Addition of salt

Is salt usually added to your child's food during cooking?

Yes

No

Don't know

Do you add salt to your child's food when s/he is eating?

Usually

Sometimes

Rarely

Never

Appendix 5

Food purchasing decision questionnaire

Child to answer:

Do you usually (yes or no) go shopping with your parents for:

- Dairy products/milk/yoghurt/cheese
- Fruit and Vegetables
- Breads, cereals, pasta, rice
- Meat, fish, chicken, eggs, dried beans/peas/lentils
- Snack foods and drinks
- Takeaways

Child to answer:

What choice do you have about the buying of the above foods?

- Lots
- Some
- Very little
- None

Appendix 6

International cut-off points for body mass index (BMI) for overweight and obesity in children.

Overweight and obesity in children is defined by having a body mass index (BMI) of 25 and 30 kg/m^2 at age 18, respectively. The figures below are taken from Cole and colleagues (2000).

Age (years)	Overweight (BMI 25kg/m^2)		Obese (BMI 30kg/m^2)	
	Males	Females	Males	Females
2	18.4	18.0	20.1	20.1
3	17.9	17.6	19.6	19.4
4	17.6	17.3	19.3	19.1
5	17.4	17.1	19.3	19.2
6	17.6	17.3	19.8	19.7
7	17.9	17.8	20.6	20.5
8	18.4	18.3	21.8	21.6
9	19.1	19.1	22.8	22.8
10	19.8	19.9	24.0	24.1
11	20.6	20.7	25.1	25.4
12	21.2	21.7	26.0	26.7
13	21.9	22.6	26.8	27.8
14	22.6	23.3	27.6	28.6

Appendix 7

Medical history questionnaire

Adult to answer:

1. Does child currently have a long term (> 6 months) medical condition or disability?

   Yes

   No

2. If YES to Question 1, please specify

   ____

3. Has child been admitted to hospital in the last 12 months?

   Yes

   No

4. If YES to Question3, please specify reasons for admission

   ____

5. Is child currently taking any pills or medicines prescribed by doctor?

   Yes

   No

6. If YES to Question 5, please specify name or type of medication

   ____

For the purpose of this study, responses to Question 6 were organized into the following category (7).

7. Is child taking antibiotics?

   Yes

   No

Appendix 8

Food security questionnaire

Child to answer if they wish:

1. Have there been times in the last month when you have felt hungry?

    Yes

    No

    Don't know

2. If YES to Question 1, where did you go for food?

    Friend

    Neighbour

    Relation

    School

    Shop

    Nowhere

    Other

3. What food/drink do you *have* if you feel hungry at home?

    ____

4. What food do you *buy* if you feel hungry when you are away from home?

    ____

5. If there is not enough food for all family members who gets the first choice of what is available?

    Children

    Boys

    Father

    Girls

    Grandparents

    Mother

All share

Other (specify)

Not applicable

Don't know

Adult to answer:

6. On a scale of 1-5 with 1 being not very important and 5 of vital importance, when buying food for your children how IMPORTANT are each of the following:

   Is the food healthy?

   Will the children eat it?

Adult to answer:

7. On a scale of 1-5 with 1 being not very important and 5 very important, when buying food for your children how much influence do the children have in deciding what to buy for each of the following:

   Dairy products

   Fruit and vegetables

   Breads, cereals, pasta, rice

   Meat, fish, chicken, eggs, dried beans/peas/lentils

   Snack foods and drinks

   Takeaways

Adult to answer:

8. Have there been times in the last month when there wasn't sufficient money to buy all the food needed for all family members?

   Often

   Sometimes

   Never

   Don't know

In this study it was decided to classify those respondents who 'often' or 'sometimes' do not have enough money to buy food, as 'food-insecure households'.

9. What foods did you buy if there wasn't sufficient money to buy all the food needed for all family members?

   ____

10. How did you decide which foods were the most important to buy? (Place in rank order – 1 = most important)

    Cost
    Is the food filling
    Taste
    Whether children will eat the food

11. When there is insufficient food, where do you get food from:

    Foodbank
    Adults go without
    Children go without
    Church
    Friends
    Neighbours
    Relatives
    Other

Appendices 9 - 10

Tables of data showing the relationship between socio-demographic variables and the following nutrients:

Appendix 9a: Sugar intake as a percent of energy intake for preschool children

Appendix 9b: Sugar intake as a percent of energy intake for school-age children

Appendix 10: Fibre intake in children

Appendix 9a

The effect of socio-demographic variables on sugar intake in preschool children

Socio-demographic Variable		Mean sugar intake as a % of total energy intake (Standard Error)	p-value for difference in means
Sex	Male	24 (1)	0.180
	Female	27 (1)	
Main Ethnicity of Child	Maori	26 (1)	0.377
	Pacific	24 (2)	
	European	27 (2)	
	Other	23 (4)	
Ethnicity of the Food Preparer	Maori	27 (2)	0.398
	Pacific	24 (2)	
	European	26 (1)	
	Other	19 (1)	
Dwelling	owned	27 (1)	0.222
	Rented	24 (2)	
Household size	5 or less	25 (1)	0.812
	6 or more	26 (1)	
Annual Household income	< $30,000	22 (2)	**0.017**
	$30,001 to $40,000	23 (1)	
	$40,001 to $50,000	25 (2)	
	$50,001 or more	28 (1)	
Household expenditure	Less than or equal $100/wk	23 (2)	0.429
	More than $100/wk	26 (1)	
Occupation status of household	High	27 (1)	**0.045**
	Low	23 (1)	
	Benefit	26 (4)	

Appendix 9b

The effect of socio-demographic variables on sugar intake in school-age children

Socio-demographic Variable		Mean sugar intake as a % of total energy intake (Standard Error)	p-value for difference in means
Sex	Male	20 (1)	**0.007**
	Female	26 (1)	
Main Ethnicity of Child	Maori	25 (2)	**0.023**
	Pacific	19 (1)	
	European	26 (1)	
	Other	24 (6)	
Ethnicity of the Food Preparer	Maori	23 (2)	**0.006**
	Pacific	19 (1)	
	European	26 (1)	
	Other	24 (6)	
Dwelling	owned	25 (1)	0.077
	Rented	21 (1)	
Household size	5 or less	23 (1)	0.982
	6 or more	23 (2)	
Annual Household income	< $30,000	22 (2)	0.812
	$30,001 to $40,000	24 (2)	
	$40,001 to $50,000	23 (3)	
	$50,001 or more	24 (2)	
Household expenditure	Less than or equal $100/wk	18 (2)	0.071
	More than $100/wk	24 (1)	
Occupation status of household	High	22 (1)	0.756
	Low	23 (1)	
	Benefit	23 (3)	

Appendix 10

The effect of socio-demographic variables on fibre intake in children

Socio-demographic Variable		Percentage (Numbers) Who are - Below*	Above*	p-value	Mean fibre intake as a % of recommended intake*	p-value for mean
Age	Preschool	19% (17)	81% (72)	**0.000**	161.7	**0.000**
	School-age	50% (47)	50% (47)		108.2	
Sex	Male	34% (31)	66% (61)	0.716	138.2	0.426
	Female	36% (33)	64% (58)		130.1	
Main Ethnicity of Child	Maori	29% (15)	71% (36)	0.098	143.9	0.262
	Pacific	45% (30)	55% (36)		127.1	
	European	27% (16)	73% (44)		137.9	
	Other	50% (3)	50% (3)		93.4	
Ethnicity of the Food Preparer	Maori	24% (11)	76% (35)	**0.042**	145.1	0.245
	Pacific	46% (29)	54% (34)		126.8	
	European	29% (19)	71% (46)		137.5	
	Other	60% (3)	40% (2)		88.6	
Dwelling	Owned	29% (29)	71% (79)	0.087	144.7	**0.021**
	Rented	41% (34)	59% (48)		121.2	
Household size	5 or less	33% (34)	67% (69)	0.527	134.8	0.902
	6 or more	37.5% (30)	62.5% (50)		133.5	
Annual Household income	< $30,000	42% (19)	58% (26)	**0.006**	122.5	0.087
	$30,001 to $40,000	42% (10)	58% (14)		125.1	
	$40,001 to $50,000	54% (13)	46% (11)		111.9	
	$50,001 or more	18% (10)	82% (46)		147.3	
Household expenditure	Less than or equal $100/wk	42% (8)	58% (11)	0.503	113.0	0.226
	More than $100/wk	34% (48)	66% (92)		132.7	
Mean years of schooling of food preparer (se)		9.4 (0.42)	10.4 (0.28)	0.061	-	
Occupation status of household	High	31% (24)	69% (54)	0.352	139.9	0.058
	Low	41% (30)	59% (43)		118.4	
	Benefit	27% (3)	73% (8)		156.3	

* The recommended fibre intake chosen is that of the American Health Foundation which is set at a minimal level of fibre intake as age + 5 grams (ADA, 1999a).

Appendices 11 - 22

Tables of data showing the relationship between socio-demographic variables and the following micronutrients:

Vitamin B12	**Appendix 11**
Vitamin B6	**Appendix 12**
Riboflavin	**Appendix 13**
Thiamin	**Appendix 14**
Niacin	**Appendix 15**
Magnesium	**Appendix 16**
Vitamin E	**Appendix 17**
Vitamin C	**Appendix 18**
Vitamin A	**Appendix 19**
Zinc	**Appendix 20**
Selenium	**Appendix 21**
Phosphorus	**Appendix 22**

Appendix 11
The effect of socio-demographic variables on Vitamin B12 intake

Socio-demographic variable		Percentage Who are - Below RDI	Above RDI	p-value for difference in proportions	Mean vitamin B12 intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	13	87	**0.027**	288 (39)	0.928
	School-age	27	73		283 (40)	
Sex	Male	14	86	**0.039**	302 (39)	0.551
	Female	26	74		268 (41)	
Main Ethnicity of Child	Maori	16	84	0.511	362 (66)	0.335
	Pacific	18	82		279 (53)	
	European	25	75		234 (26)	
	Other	33	67		220 (69)	
Ethnicity of the Food Preparer	Maori	9	91	**0.043**	373 (73)	0.224
	Pacific	19	81		281 (55)	
	European	29	71		228 (25)	
	Other	40	60		166 (53)	
Dwelling	Owned	16	84	0.117	261 (19)	0.389
	Rented	26	74		315 (59)	
Household size	5 or less	21	79	0.663	238 (19)	0.086
	6 or more	19	81		345 (59)	
Annual Household income	< $30,000	13	87	0.131	393 (102)	0.173
	$30,001 to $40,000	37.5	62.5		180 (31)	
	$40,001 to $50,000	29	71		229 (46)	
	$50,001 or more	23	77		275 (32)	
Household expenditure	Less than or equal $100/wk	16	84	0.447	188 (32)	0.281
	More than $100/wk	24	76		297 (36)	
Mean years of schooling of food preparer (se)		9.9 (0.55)	10.0 (0.27)	0.804	-	-
Occupation status of household	High	21	79	0.110	274 (26)	0.574
	Low	27	73		314 (64)	
	Benefit	0	100		187 (19)	

Appendix 12
The effect of socio-demographic variables on Vitamin B6 intake

Socio-demographic Variable		Percentage Who are - Below RDI	Above RDI	p-value for difference in proportions	Mean vitamin B6 intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	22	78	0.006	162 (8)	0.657
	School-age	41	59		155 (14)	
Sex	Male	32	68	0.834	159 (12)	0.916
	Female	33	67		158 (11)	
Main Ethnicity of Child	Maori	20	80	**0.013**	199 (18)	**0.003**
	Pacific	45	55		128 (9)	
	European	27	73		163 (15)	
	Other	50	50		105 (16)	
Ethnicity of the Food Preparer	Maori	17	83	**0.007**	199 (20)	**0.004**
	Pacific	46	54		128 (10)	
	European	29	71		163 (14)	
	Other	60	40		94 (15)	
Dwelling	Owned	24	76	**0.008**	182 (12)	**0.001**
	Rented	43	57		130 (10)	
Household size	5 or less	33	67	0.801	149 (9)	0.223
	6 or more	31	69		170 (15)	
Annual Household income	< $30,000	49	51	**0.004**	128 (15)	**0.013**
	$30,001 to $40,000	37.5	62.5		142 (19)	
	$40,001 to $50,000	50	50		112 (14)	
	$50,001 or more	18	82		180 (15)	
Household expenditure	Less than or equal $100/wk	47	53	0.264	121 (16)	0.207
	More than $100/wk	34	66		152 (9)	
Mean years of schooling of food preparer (se)		8.9 (0.41)	10.6 (0.28)	**0.001**	-	-
Occupation status of household	High	26	74	**0.049**	179 (14)	**0.010**
	Low	44	56		126 (10)	
	Benefit	45	55		138 (25)	

Appendix 13
The effect of socio-demographic variables on Riboflavin intake

Socio-demographic Variable		Percentage (Numbers) Who are - Below RDI	Above RDI	p-value for difference in proportions	Mean riboflavin intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	20	80	**<0.0005**	166 (8)	**<0.0005**
	School-age	51	49		122 (8)	
Sex	Male	37	63	0.801	149 (9)	0.342
	Female	35	65		138 (8)	
Main Ethnicity of Child	Maori	24	76	**0.010**	178 (13)	**<0.0005**
	Pacific	48	51		110 (7)	
	European	30	70		154 (11)	
	Other	67	33		121 (25)	
Ethnicity of the Food Preparer	Maori	17	83	**0.001**	180 (12)	**<0.0005**
	Pacific	49	51		108 (7)	
	European	34	66		149 (11)	
	Other	80	20		115 (30)	
Dwelling	Owned	23	77	**<0.0005**	164 (8)	**<0.0005**
	Rented	51	49		119 (9)	
Household size	5 or less	38	62	0.565	146 (8)	0.629
	6 or more	34	66		140 (9)	
Annual Household income	< $30,000	42	58	**0.039**	117 (9)	**0.001**
	$30,001 to $40,000	54	46		106 (11)	
	$40,001 to $50,000	50	50		125 (15)	
	$50,001 or more	25	75		170 (13)	
Household expenditure	Less than or equal $100/wk	53	47	0.153	97 (11)	**0.020**
	More than $100/wk	36	64		142 (7)	
Mean years of schooling of food preparer (se)		9.2 (0.37)	10.6 (0.30)	**0.004**	-	-
Occupation status of household	High	31	69	0.070	163 (10)	**<0.0005**
	Low	48	52		112 (7)	
	Benefit	27	73		133 (22)	

Appendix 14
The effect of socio-demographic variables on Thiamin intake

Socio-demographic Variable		Percentage Who are - Below RDI	Above RDI	p-value for difference in proportions	Mean thiamin intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	16	84	**0.007**	254 (15)	**0.001**
	School-age	33	67		186 (13)	
Sex	Male	24	76	0.831	228 (15)	0.339
	Female	25	75		209 (13)	
Main Ethnicity of Child	Maori	18	82	0.063	255 (20)	0.154
	Pacific	35	65		206 (18)	
	European	22	78		206 (15)	
	Other	0	100		173 (29)	
Ethnicity of the Food Preparer	Maori	11	89	**0.012**	263 (19)	0.057
	Pacific	37	63		208 (19)	
	European	26	74		201 (16)	
	Other	0	100		150 (20)	
Dwelling	Owned	15	85	**0.001**	236 (13)	0.063
	Rented	37	63		197 (15)	
Household size	5 or less	26	74	0.563	211 (12)	0.424
	6 or more	22.5	77.5		228 (17)	
Annual Household income	< $30,000	47	53	**0.009**	206 (23)	0.777
	$30,001 to $40,000	29	71		188 (22)	
	$40,001 to $50,000	25	75		205 (24)	
	$50,001 or more	16	84		222 (19)	
Household expenditure	Less than or equal $100/wk	53	47	**0.010**	176 (28)	0.251
	More than $100/wk	24	76		214 (12)	
Mean years of schooling of food preparer (se)		9.1 (0.44)	10.4 (0.28)	**0.019**	-	-
Occupation status of household	High	15	85	**0.004**	222 (14)	0.198
	Low	40	60		194 (16)	
	Benefit	27	73		261 (61)	

Appendix 15
The effect of socio-demographic variables on Niacin intake

Socio-demographic Variable		Percentage Who are - Below RDI	Above RDI	p-value for difference in proportions	Mean niacin intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	8	92	0.196	198 (9)	0.488
	School-age	14	86		209 (12)	
Sex	Male	7	93	0.055	218 (11)	0.054
	Female	15	85		189 (10)	
Main Ethnicity of Child	Maori	6	94	NS	239 (17)	**0.025**
	Pacific	11	89		185 (11)	
	European	15	85		198 (13)	
	Other	17	83		167 (20)	
Ethnicity of the Food Preparer	Maori	4	96	NS	241 (17)	**0.014**
	Pacific	11	89		181 (11)	
	European	15	85		197 (13)	
	Other	20	80		161 (23)	
Dwelling	Owned	8	92	0.162	214 (10)	0.094
	Rented	15	85		189 (12)	
Household size	5 or less	12	88	0.723	203 (10)	0.861
	6 or more	10	90		205 (12)	
Annual Household income	< $30,000	13	87	0.343	188 (15)	0.226
	$30,001 to $40,000	21	79		179 (19)	
	$40,001 to $50,000	17	83		169 (20)	
	$50,001 or more	7	93		215 (15)	
Household expenditure	Less than or equal $100/wk	21	79	0.235	173 (23)	0.302
	More than $100/wk	11	89		199 (9)	
Mean years of schooling of food preparer (se)		4.8 (0.68)	10.0 (0.26)	0.746	-	-
Occupation status of household	High	8	92	0.239	220 (13)	**0.034**
	Low	16	84		177 (10)	
	Benefit	9	91		194 (29)	

Appendix 16
The effect of socio-demographic variables on Magnesium intake

Socio-demographic Variable		Percentage Who are - Below RDI	Above RDI	p-value for difference in proportions	Mean magnesium intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	8	92	**<0.0005**	219 (10)	**<0.0005**
	School-age	28	72		145 (7)	
Sex	Male	22	78	0.190	186 (10)	0.432
	Female	14	86		176 (9)	
Main Ethnicity of Child	Maori	12	88	0.368	205 (11)	**0.028**
	Pacific	24	76		161 (12)	
	European	17	83		187 (12)	
	Other	17	83		128 (14)	
Ethnicity of the Food Preparer	Maori	9	91	NS	199 (11)	0.066
	Pacific	25	75		161 (12)	
	European	18	82		188 (12)	
	Other	20	80		122 (15)	
Dwelling	Owned	9	91	**<0.0005**	198 (9)	**0.006**
	Rented	29	71		160 (10)	
Household size	5 or less	19	81	0.580	182 (9)	0.933
	6 or more	16	84		180 (11)	
Annual Household income	< $30,000	31	69	**0.009**	154 (15)	**0.015**
	$30,001 to $40,000	17	83		166 (15)	
	$40,001 to $50,000	37.5	62.5		151 (16)	
	$50,001 or more	9	91		206 (12)	
Household expenditure	Less than or equal $100/wk	26	74	0.524	138 (13)	0.061
	More than $100/wk	20	80		181 (8)	
Mean years of schooling of food preparer (se)		9.0 (0.49)	10.0 (0.27)	0.102	-	-
Occupation status of household	High	13	87	0.102	200 (10)	**0.007**
	Low	26	74		152 (11)	
	Benefit	27	73		180 (27)	

Appendix 17
The effect of socio-demographic variables on Vitamin E intake

Socio-demographic Variable		Percentage Who are - Below RDI	Above RDI	p-value for difference in proportions	Mean vitamin E intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	67	33	0.834	91 (6)	0.411
	School-age	66	34		99 (8)	
Sex	Male	65	35	0.676	96 (7)	0.813
	Female	68	32		94 (6)	
Main Ethnicity of Child	Maori	55	45	**0.030**	122 (12)	**<0.0005**
	Pacific	79	21		74 (5)	
	European	62	38		99 (8)	
	Other	83	17		61 (12)	
Ethnicity of the Food Preparer	Maori	57	43	0.104	115 (13)	**0.005**
	Pacific	78	22		74 (5)	
	European	65	35		100 (7)	
	Other	80	20		61 (14)	
Dwelling	Owned	59	41	**0.009**	108 (7)	**0.001**
	Rented	77	23		79 (6)	
Household size	5 or less	66	34	0.833	94 (6)	0.799
	6 or more	67.5	32.5		96 (7)	
Annual Household income	< $30,000	80	20	**0.026**	70 (5)	**<0.0005**
	$30,001 to $40,000	75	25		75 (9)	
	$40,001 to $50,000	87.5	12.5		67 (9)	
	$50,001 or more	59	41		107 (8)	
Household expenditure	Less than or equal $100/wk	74	26	0.695	68 (10)	0.085
	More than $100/wk	69	31		90 (5)	
Mean years of schooling of food preparer (se)		9.6 (0.29)	11.0 (0.39)	**0.005**	-	-
Occupation status of household	High	60	40	**0.004**	108 (8)	**0.001**
	Low	84	16		71 (4)	
	Benefit	55	45		91 (15)	

Appendix 18
The effect of socio-demographic variables on Vitamin C intake

Socio-demographic Variable		Percentage Who are - Below RDI	Above RDI	p-value for difference in proportions	Mean vitamin C intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	31	69	0.468	314 (31)	0.882
	School-age	27	73		308 (27)	
Sex	Male	38	62	**0.006**	294 (32)	0.418
	Female	20	80		327 (26)	
Main Ethnicity of Child	Maori	20	80	0.054	401 (44)	**0.009**
	Pacific	41	59		236 (29)	
	European	25	75		327 (35)	
	Other	17	83		198 (44)	
Ethnicity of the Food Preparer	Maori	22	78	0.141	378 (45)	**0.007**
	Pacific	40	60		222 (28)	
	European	25	75		350 (36)	
	Other	20	80		174 (44)	
Dwelling	Owned	24	76	0.143	357 (30)	**0.014**
	Rented	34	66		255 (27)	
Household size	5 or less	29	71	0.956	343 (31)	0.059
	6 or more	29	71		269 (23)	
Annual Household income	< $30,000	42	58	0.147	231 (38)	0.112
	$30,001 to $40,000	37.5	62.5		293 (51)	
	$40,001 to $50,000	33	67		220 (37)	
	$50,001 or more	21	79		336 (35)	
Household expenditure	Less than or equal $100/wk	47	53	0.128	167 (44)	**0.036**
	More than $100/wk	30	70		299 (22)	
Mean years of schooling of food preparer (se)		9.3 (0.45)	10.4 (0.28)	**0.049**	-	-
Occupation status of household	High	26	74	0.309	320 (30)	0.338
	Low	37	63		262 (31)	
	Benefit	27	73		340 (74)	

Appendix 19
The effect of socio-demographic variables on Vitamin A intake

Socio-demographic Variable		Percentage Who are - Below RDI	Percentage Who are - Above RDI	p-value for difference in proportions	Mean vitamin A intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	34	66	**0.026**	172 (16)	0.582
	School-age	50	50		159 (18)	
Sex	Male	34	66	**0.021**	184 (18)	0.115
	Female	51	49		146 (16)	
Main Ethnicity of Child	Maori	35	65	0.622	186 (23)	0.356
	Pacific	47	53		139 (19)	
	European	42	58		180 (22)	
	Other	50	50		132 (41)	
Ethnicity of the Food Preparer	Maori	41	59	0.835	178 (25)	0.464
	Pacific	48	52		138 (20)	
	European	40	60		179 (21)	
	Other	40	60		147 (47)	
Dwelling	Owned	35	65	**0.047**	189 (18)	**0.032**
	Rented	50	50		139 (15)	
Household size	5 or less	42	58	0.919	177 (17)	
	6 or more	43	58		150 (16)	0.251
Annual Household income	< $30,000	53	47	0.431	120 (14)	**0.010**
	$30,001 to $40,000	46	54		126 (15)	
	$40,001 to $50,000	50	50		116 (19)	
	$50,001 or more	37.5	62.5		201 (26)	
Household expenditure	Less than or equal $100/wk	47	53	0.754	107 (15)	0.122
	More than $100/wk	44	56		168 (14)	
Mean years of schooling of food preparer (se)		9.5 (0.36)	10.4 (0.32)	0.060	-	-
Occupation status of household	High	37	63	0.079	181 (20)	0.055
	Low	55	45		124 (12)	
	Benefit	36	64		156 (32)	

Appendix 20
The effect of socio-demographic variables on Zinc intake

Socio-demographic Variable		Percentage Who are - Below RDI	Percentage Who are - Above RDI	p-value for difference in proportions	Mean zinc intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	25	75	**0.001**	153 (9)	**0.009**
	School-age	49	51		121 (9)	
Sex	Male	32	68	0.113	154 (10)	**0.004**
	Female	43	57		119 (6)	
Main Ethnicity of Child	Maori	20	80	**0.020**	165 (14)	**0.032**
	Pacific	41	59		128 (10)	
	European	47	53		124 (10)	
	Other	50	50		109 (14)	
Ethnicity of the Food Preparer	Maori	13	87	**0.001**	167 (14)	**0.018**
	Pacific	43	57		125 (10)	
	European	49	51		123 (9)	
	Other	60	40		107 (17)	
Dwelling	Owned	32	68	0.109	142 (8)	0.270
	Rented	44	56		128 (10)	
Household size	5 or less	38	62	0.823	132 (8)	0.455
	6 or more	36	64		142 (10)	
Annual Household income	< $30,000	49	51	0.871	120 (12)	0.285
	$30,001 to $40,000	46	54		113 (12)	
	$40,001 to $50,000	42	58		129 (18)	
	$50,001 or more	41	59		147 (13)	
Household expenditure	Less than or equal $100/wk	58	42	0.156	101 (14)	0.102
	More than $100/wk	41	59		135 (7)	
Mean years of schooling of food preparer (se)		9.8 (0.39)	10.2 (0.30)	0.449	-	-
Occupation status of household	High	35	65	0.238	142 (10)	0.339
	Low	48	52		124 (10)	
	Benefit	36	64		121 (16)	

Appendix 21
The effect of socio-demographic variables on Selenium intake

Socio-demographic Variable		Percentage Who are - Below RDI	Percentage Who are - Above RDI	p-value for difference in proportions	Mean selenium intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	60	40	**0.032**	102 (7)	0.741
	School-age	74	26		98 (11)	
Sex	Male	68	32	0.714	100 (8)	0.994
	Female	66	34		100 (10)	
Main Ethnicity of Child	Maori	59	41	0.181	127 (20)	0.065
	Pacific	67	33		95 (8)	
	European	77	23		83 (7)	
	Other	50	50		85 (19)	
Ethnicity of the Food Preparer	Maori	65	35	0.394	124 (21)	0.117
	Pacific	62	38		99 (9)	
	European	75	25		83 (7)	
	Other	60	40		72 (18)	
Dwelling	Owned	65	35	0.385	101 (10)	0.817
	Rented	71	29		98 (9)	
Household size	5 or less	67	33	0.942	99 (9)	0.913
	6 or more	67.5	32.5		100 (10)	
Annual Household income	< $30,000	69	31	0.806	95 (12)	0.604
	$30,001 to $40,000	62.5	37.5		95 (7)	
	$40,001 to $50,000	75	25		75 (11)	
	$50,001 or more	66	34		98 (11)	
Household expenditure	Less than or equal $100/wk	58	42	0.387	93 (6)	0.775
	More than $100/wk	68	32		99 (8)	
Mean years of schooling of food preparer (se)		9.9 (0.29)	10.3 (0.42)	0.349	-	-
Occupation status of household	High	63	37	0.389	111 (13)	0.452
	Low	71	29		92 (8)	
	Benefit	55	45		95 (14)	

Appendix 22
The effect of socio-demographic variables on Phosphorus intake

Socio-demographic Variable		Percentage Who are - Below RDI	Above RDI	p-value for difference in proportions	Mean phosphorus intake as a % of RDI (Standard error)	p-value for difference in means
Age	Preschool	23	77	0.577	164 (10)	0.080
	School-age	26	74		142 (7)	
Sex	Male	18	82	**0.043**	167 (8)	**0.034**
	Female	31	69		141 (9)	
Main Ethnicity of Child	Maori	10	90	**0.002**	189 (15)	**<0.0005**
	Pacific	39	61		124 (7)	
	European	20	80		158 (10)	
	Other	33	67		124 (19)	
Ethnicity of the Food Preparer	Maori	9	91	**0.001**	180 (16)	**0.004**
	Pacific	41	59		125 (8)	
	European	20	80		160 (9)	
	Other	40	60		124 (24)	
Dwelling	Owned	13	87	**<0.0005**	167 (7)	**0.014**
	Rented	39	61		136 (10)	
Household size	5 or less	30	70	**0.050**	152 (7)	0.793
	6 or more	17.5	82.5		155 (11)	
Annual Household income	< $30,000	40	60	**<0.0005**	128 (10)	**0.003**
	$30,001 to $40,000	46	54		121 (11)	
	$40,001 to $50,000	37.5	62.5		130 (14)	
	$50,001 or more	9	91		177 (13)	
Household expenditure	Less than or equal $100/wk	53	47	**0.010**	122 (11)	**0.046**
	More than $100/wk	24	76		152 (7)	
Mean years of schooling of food preparer (se)		8.2 (0.50)	10.7 (0.24)	**<0.0005**	-	-
Occupation status of household	High	19	81	0.077	172 (11)	**0.005**
	Low	36	64		128 (7)	
	Benefit	27	73		141 (16) (16)	

Appendix 23
Nutrient intake of food-secure and food-insecure preschool children

Nutrient (data from 24-hr recall)	Food Security Status**	Mean	Median	Standard Deviation	Standard Error of Mean	Min	Max	p value* (median)
Energy (kJ)	0	6133	5552	2523	337	913	13114	0.306
	1	5577	5021	2335	426	1602	11656	0.306
Protein (g)	0	53	51	21	2.8	8	109	0.066
	1	45	41	17	3.2	9	81	0.066
Fat (g)	0	56	47	31	4.2	5	169	0.375
	1	49	43	26	4.8	5	104	0.375
Carbohydrate(g)	0	191	181	80	10.8	35	433	0.562
	1	181	184	78	14.2	71	402	0.562
Saturated Fat (g)	0	26	21	16	2.1	3.0	76	0.332
	1	22	20	12	2.3	2.3	51	0.332
Monounsaturated Fat(g)	0	18	16	10	1.3	1	52	0.431
	1	16	14	9	1.7	1	42	0.431
Polyunsaturated Fat (g)	0	6	5	5	0.6	0.4	24	0.731
	1	6	5	4	0.8	0.4	18	0.731
Fibre (g)	0	12	12	5	0.7	2.8	25	0.503
	1	12	11	6	1.2	4.6	32	0.503
Total Sugar (g)	0	97	80	52	7.0	18	213	0.186
	1	82	69	48	8.8	19	240	0.186
Cholesterol (mg)	0	174	138	149	19.9	3.9	819	0.544
	1	171	145	99	18.1	11.5	404	0.544
Thiamin (mg)	0	1.4	1.3	0.7	0.1	0.4	3.6	0.744
	1	1.3	1.4	0.8	0.2	0.1	3.1	0.744
Riboflavin (mg)	0	1.6	1.6	0.7	0.1	0.5	3.3	**0.006**
	1	1.1	1.0	0.5	0.1	0.1	2.4	**0.006**
Niacin Equivalents (mg)	0	22.0	20	9	1.2	4.9	49	0.095
	1	18.6	17	8	1.4	3	35	0.095
Vitamin C (mg)	0	104	84	91	12.1	9	415	0.066
	1	71	44	80	14.6	7	329	0.066
Vitamin D (mcg)	0	2.1	1.8	1.8	0.3	0.0	11	0.500
	1	2.1	1.8	1.5	0.3	0.0	6	0.500
Vitamin E (mg)	0	5.3	4.7	2.9	0.4	0.5	14	**0.009**
	1	3.7	3.4	2.1	0.4	0.4	9	**0.009**
Vitamin B6 (mg)	0	1.1	1.1	0.4	0.1	0.2	2	**0.018**
	1	0.9	0.8	0.5	0.1	0.3	2	**0.018**
Vitamin B12(mcg)	0	3.5	3.1	4.4	0.6	0.1	33	0.126
	1	2.5	2.3	1.4	0.3	0.8	7	0.126
Total Folate(mcg)	0	195	161	130	17	37	683	**0.000**
	1	117	101	61	11	41	338	**0.000**
Betacarotene (mcg)	0	1219	671	1412	189	51	7481	**0.030**
	1	1159	391	3184	581	45	17414	**0.030**
Retinol (mcg)	0	357	252	272	36	11	1406	0.420
	1	308	303	242	44	43	1274	0.420
Vitamin A (mcg)	0	561	485	380	51	83	1769	0.123
	1	501	381	582	106	57	3222	0.123
Sodium (mg)	0	2019	1825	1094	146	203	5352	0.147
	1	1713	1426	1030	188	353	3896	0.147
Potassium (mg)	0	2073	2080	652	87	516	3095	**0.007**
	1	1700	1451	903	165	408	4057	**0.007**
Magnesium (mg)	0	196	196	69	9	52	375	**0.025**
	1	172	145	92	17	56	473	**0.025**
Calcium (mg)	0	716	666	339	45	115	1481	**0.000**
	1	470	359	402	73	46	1986	**0.000**
Phosphorus (mg)	0	976	999	380	51	199	2072	**0.009**
	1	784	751	396	72	125	2080	**0.009**
Iron (mg)	0	8.5	8.0	3.7	0.5	1.3	22	0.644
	1	8.1	7.4	4.3	0.8	0.6	19	0.644
Zinc (mg)	0	7.5	6.7	3.8	0.5	1.1	18	0.828
	1	7.4	6.6	3.9	0.7	1.7	19	0.828
Manganese (mcg)	0	2094	1934	961	128	420	5715	0.835
	1	2094	1959	1064	194	384	5125	0.835
Copper (mg)	0	3.0	0.8	8	1.1	0.1	47	0.221
	1	4.5	0.7	17	3.2	0.3	94	0.221
Selenium (mcg)	0	26	22	13	1.8	4.0	60	0.942
	1	28	23	18	3.3	12	112	0.942
Glucose (g)	0	16	12	12	1.6	0.5	62	0.538
	1	13	11	9	1.6	2.2	41	0.538
Fructose (g)	0	17	14	14	1.9	0.3	68	0.174
	1	13	11	9	1.7	3.0	45	0.174
Sucrose (g)	0	44	35	31	4.2	4.8	120	0.690
	1	39	35	29	5.2	1.4	134	0.690
Lactose (g)	0	18	16	11	1.5	0.0	43	**0.007**
	1	12	8	13	2.3	0.0	56	**0.007**
Maltose (g)	0	2.9	2.3	2.5	0.3	0.1	13	**0.047**
	1	3.8	3.1	2.9	0.5	0.2	12	**0.047**

**Food security status is defined by –
whether there is sometimes or often not enough money to buy food (food-insecure = 1) or
never not enough money to buy food (food-secure = 0).

* p-values for medians were obtained by Kruskal-Wallis analysis.

Appendix 24
Nutrient intake of food-secure and food-insecure school-age children

Nutrient (data from 24-hr recall)	Food security status**	Mean	Median	Standard Deviation	Standard Error of Mean	Min	Max	p-value* (median)
Energy (kJ)	0	8646.0	7889	3837	532	2964	20706	**0.039**
	1	7436.0	6291	3248	527	4206	18109	**0.039**
Protein (g)	0	76.0	64	47	6.5	22	261	0.319
	1	62.0	60	25	4.0	27	147	0.319
Fat (g)	0	81.2	67	60	8.4	14	383	0.890
	1	73.5	62	42	6.8	33	242	0.890
Carbohydrate (g)	0	261	232	105	14.5	104	559	**0.017**
	1	220	191	107	17.3	67	457	**0.017**
Saturated fat (g)	0	36	29	31	4.3	7	206	0.941
	1	33	28	22	3.5	10	123	0.941
Monounsaturated Fat(g)	0	27	22	20	2.8	5	118	0.967
	1	25	21	15	2.4	9	80	0.967
Polyunsaturated Fat (g)	0	10	8.6	6	0.9	1	30	0.111
	1	8	5.8	5	0.9	2	21	0.111
Fibre (g)	0	16	14.9	7	1.0	6	38	0.085
	1	14	11.3	7	1.2	6	37	0.085
Total Sugar (g)	0	129	127	63	8.7	30	282	**0.001**
	1	90	77	59	9.6	15	245	**0.001**
Cholesterol (mg)	0	288	184	534	74.1	27	3880	0.689
	1	264	171	282	45.8	44	1539	0.689
Thiamin (mg)	0	1.7	1.3	1.2	0.2	0.5	8	0.131
	1	1.4	1.0	1.1	0.2	0.4	5	0.131
Riboflavin (mg)	0	1.8	1.5	1.1	0.2	0.3	5	0.096
	1	1.3	1.1	0.7	0.1	0.3	3	0.096
Niacin equivalents (mg)	0	32	26.6	17.5	2.4	7.9	81	0.311
	1	28	22.6	16.0	2.6	9.5	72	0.311
Vitamin C (mg)	0	113	102	90.1	12.5	6.1	387	**0.004**
	1	61	35	51.4	8.3	1.9	175	**0.004**
Vitamin D (mcg)	0	2.4	1.5	2.8	0.4	0.1	14	0.382
	1	2.1	1.2	2.3	0.4	0.0	8	0.382
Vitamin E (mg)	0	8.1	6.3	5.8	0.8	1.5	28	0.211
	1	6.6	5.5	5.9	0.9	1.8	36	0.211
Vitamin B6 (mg)	0	1.6	1.4	1.3	0.2	0.2	7	0.068
	1	1.4	0.9	1.6	0.3	0.3	8	0.068
Vitamin B12 (mcg)	0	3.9	2.7	4.1	0.6	0.4	20	0.369
	1	5.3	3.0	8.3	1.4	0.6	48	0.369
Total Folate (mcg)	0	215	199	121	16.7	47	605	**0.030**
	1	168	142	107	17.4	51	494	**0.030**
Beta Carotene (mcg)	0	2354	1129	2776	385	62	11979	**0.003**
	1	1373	380	2285	371	31	9266	**0.003**
Vitamin A (mcg)	0	787	625	644	89	65	2972	**0.029**
	1	540	393	428	69	27	1687	**0.029**
Sodium (mg)	0	3216	2642	2487	345	859	15240	0.200
	1	2373	2220	1031	167	477	4438	0.200
Potassium (mg)	0	2730	2607	1446	200	411	7347	**0.046**
	1	2153	1888	1003	163	1069	5240	**0.046**
Magnesium (mg)	0	238	235	97	13	70	475	0.148
	1	221	188	126	21	105	682	0.148
Calcium (mg)	0	756	562	676	94	124	4238	**0.029**
	1	475	444	241	39	95	1180	**0.029**
Phosphorus (mg)	0	1257	1104	777	108	347	4830	0.125
	1	1026	914	494	80	378	2450	0.125
Iron (mg)	0	11.2	9.4	6.6	0.9	2.6	31	0.732
	1	10.6	9.2	5.9	1.0	3.4	25	0.732
Zinc (mg)	0	10.6	8.1	7.7	1.1	3.7	40	0.659
	1	9.5	7.7	6.1	1.0	3.5	38	0.659
Selenium (mcg)	0	44.3	30.0	42.5	5.9	10	262	0.954
	1	38.9	32.5	25.5	4.1	7	102	0.954
Glucose (g)	0	21.3	19.4	13.4	1.9	2	56	**0.005**
	1	14.0	9.5	11.8	1.9	1	51	**0.005**
Fructose (g)	0	23.2	19.3	16.5	2	2	83	**0.011**
	1	15.2	13.0	12.5	2	1	53	**0.011**
Sucrose (g)	0	66.7	58.3	36.3	5	15	164	**0.005**
	1	48.0	37.6	37.3	6	4	161	**0.005**
Lactose (g)	0	13.6	10.8	13.0	1.8	0	62	0.400
	1	9.8	9.7	7.3	1.2	0	32	0.400
Maltose (g)	0	4.9	3.4	4.7	0.7	0	28	**0.031**
	1	3.0	2.4	2.1	0.3	0	8	**0.031**

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never not enough money to buy food (food-secure = 0).
*p- values of medians were obtained by Kruskal-Wallis analysis.