AN INVESTIGATION OF FRUIT AND VEGETABLE INTAKES IN WHANGAREI SCHOOLCHILDREN.

DO 5+ A DAY EDUCATIONAL RESOURCES MAKE A DIFFERENCE?

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ABSTRACT

Fruits and vegetables contain a multitude of nutritive and non-nutritive substances that are beneficial for good health. The Ministry of Health (MOH) recommends consumption of at least five servings of fruits and vegetables daily. This is to enhance wellbeing and to maximise the potential protection against the chronic diseases with which low intakes of these specific foods are associated (MOH, 2003a). The 2002 National Children's Nutrition Survey (CNS02), however, reported that large numbers of New Zealand's young people are eating less than these recommendations (MOH, 2003b). Effective strategies to increase fruit and vegetable intakes in this population group are required.

Numerous school-based programmes specifically designed to increase the intake of fruit and vegetables have been implemented in America and the United Kingdom with mixed results (Perry et al, 1998; Reynolds et al, 2000; DOH, 2002; Edmunds & Jones, 2003). In New Zealand, the national 5+ A Day campaign encourages people to consume the targeted amounts of fruits and vegetables every day and has been introduced into numerous child early learning centres and primary schools throughout the country (United Fresh, 2003). Evaluation of this programme is necessary to determine its effectiveness, to identify areas for improvement, and to provide current updates, which may aid the development of health education policies.

The present study aimed to determine what, if any, difference the 5+ A Day resource material provided to primary schools makes on the dietary intakes and nutritional knowledge of children who are exposed to these resources (intervention) compared to those who are not (control). Children were recruited from five Whangarei primary schools (2 controls, 3 interventions). Data on dietary intake, nutritional knowledge and physical activity were collected from children using a food frequency questionnaire (FFQ) and a knowledge/physical activity questionnaire (CNKQ). Parents or guardians of the children

also completed a questionnaire similar to the CNKQ, which included questions about shopping and barriers to increasing fruit and vegetable intakes.

The findings of this study show that Whangarei children are consuming fruit and vegetables above MOH recommendations. Intakes of fruits and vegetables and nutrition knowledge do not differ significantly between control and intervention groups. Children who did receive the specific 5+ A Day resources, however, are more aware of a connection between food and certain health conditions i.e. general health, heart disease and cancer. The 5+ A Day message is well recognised by both children and parents regardless of whether or not the school was registered to receive 5 + A Day resources. It is likely that the widespread promotion of the programme via various channels of communication has contributed to enhanced awareness and reported intakes of fruit and vegetables. Additionally, the intensity to which health and nutrition activities are delivered in school, the degree to which environmental changes are made to increase the availability of fruit and vegetables, and the involvement of parents and the wider community are issues that may influence whether or not children increase their intake of these foods.

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ETHICS AND CONFIDENTIALITY

Ethical approval for this study was obtained in May 2003 from the Massey University Human Ethics Committee.

LIST OF ABBREVIATIONS

ATBC	Alpha-Tocopherol Beta-Carotene Cancer Prevention Study
BMD	Bone mineral density
BMI	Body mass index
CARET	Beta Carotene & Retinol Efficacy Trial
CNKQ	Child nutrition knowledge questionnaire
CHD	Coronary heart disease
CNS02	The National New Zealand Children's Nutrition Survey 2002
CTL	Control
CVD	Cardiovascular disease
DILQ	Day in the Life of Questionnaire
DOH	Department of Health (British)
EX	Children who exercised regularly outside of school
FAO	Food & Agriculture Organisation of the United Nations
FEV_1	Forced expiratory volume in one second
FEV_{25-75}	Forced expiratory flow between 25% and 75% of forced vital capacity
FFQ	Food frequency questionnaire
FVC	Forced vital capacity
INT	Intervention
Hcy	Homocysteine
HPFS	Health Professionals Follow-up Study
MI	Myocardial Infarction
MOH	Ministry of Health
NHANES I	National Health and Nutrition Examination Survey I
NEX	Children who did not exercise regularly outside of school
NHS	Nurses Health Survey
NW	Non-overweight/normal weight children

OO	Overweight/obese children
OR	Odds Ratio
PNKQ	Parent nutrition knowledge questionnaire
PE	Parent/guardian of a child from a school registered to receive 5+ A Day resources
PNE	Parent/guardian of a child from a school not registered to receive 5+ A Day resources
RR	Relative Risk
WHO	World Health Organisation

1. INTRODUCTION

Fruits, vegetables, chronic disease and dietary intervention

Worldwide, low fruit and vegetable intake is among the top ten risk factors contributing to mortality, causing an estimated 2.7 million deaths each year (WHO, 2002). The New Zealand Ministry of Health has estimated that low fruit and vegetable intake accounts for over 860 (13%) of all deaths a year (MOH, 1999). Similarly in Australia low fruit and vegetable intake, defined as fewer than five servings of fruit or vegetables per day, is among the top five risk factors for disease burden following tobacco smoking, physical inactivity, obesity and high blood cholesterol (Mathers et al, 2001).

It is widely believed that an increased consumption of fruit and vegetables will benefit health, providing protection from and reducing the burden of many non-communicable diseases. For this reason, many national and international organisations encourage all individuals to consume at least five portions or 400grams of fresh fruit and vegetables daily (MOH, 2003a; WHO/FAO, 2003; The American Cancer Society Advisory Committee on Diet, Nutrition and Cancer Prevention, 1996). The impact of fruit and vegetables, or their particular constituents, will be discussed further in relation to a number of chronic diseases including cardiovascular disease (CVD), cancer, and bone health.

1.1 Cardiovascular disease

Fruits and vegetables are rich sources of many vitamins, minerals, fibre and other bioactive compounds. Much of the literature that has examined the link between diet and CVD risk has focused on associations with specific constituents in fruit and vegetable foods, particularly vitamin C, β-carotene, and folate, though more recently some attention has been paid to dietary patterns high in fruit and vegetables foods also.

1.1.1 Vitamin C protection against stroke and coronary heart disease

Vitamin C is present in many vegetables and fruits, specific sources include broccoli, cabbage and other green leafy vegetables, tomatoes, capsicums and kumara, strawberries, black currents, citrus fruits and kiwifruit. Vitamin C plays a role in the production of bones and blood vessels and in the formation of collagen, is involved in brain and nerve function, and is a potent antioxidant (Thurnham, 2000). Epidemiological research concerning the association of vitamin C with cardiovascular disease has produced conflicting results. Some prospective cohort studies have shown that, particularly for stroke incidence and mortality, vitamin C status may be associated with reduced risk. In a British cohort of 730 elderly men and women aged over 65 years at baseline and followed up for 20 years from 1973-4, mortality from stroke was found to be highest in those with the lowest vitamin C concentrations (Gale et al, 1995). Subjects whose vitamin C intake was in the top third of the distribution (>44.9mg/d) had a relative risk of stroke mortality of 0.5 (95% CI: 0.3-0.8, *P=0.003*) after adjusting for age, gender, diastolic blood pressure and cholesterol concentration. No association between vitamin C intake and death from coronary heart disease (CHD) was found in this study (Gale et al, 1995). The authors suggested "factors that predict premature death from CHD may become less important when measured in a population of elderly survivors" and thus the subjects' age, as well as a narrow range of vitamin C intakes were possible explanations for why no differences were detected between CHD mortality risk and the distributions of vitamin C intake.

Data from participants in the prospective Kuopio Ischemic Heart Disease Risk Factor (KIHD) Study demonstrated an association between low plasma vitamin C and increased risk of acute myocardial infarction and stroke incidence, particularly in hypertensive and overweight men. In a sample of 1,605 middle-aged men from this study, those in the lowest [median intake <11.4μmol/L] category of plasma vitamin C had a 2.6-fold (95% CI: 1.3-5.2, *P=0.0095*) greater risk of myocardial infarction (MI) after

adjusting for age, season, year of examination, and dietary intake of tea, saturated fat and fibre (Nyyssonen et al, 1997). In an another sample of 2,419 men from the same cohort, those in the lowest quartile of plasma vitamin C [median intake <28.0μmol/L] had a 2.1-fold (95% CI: 1.4-4.3, *P=0.002*) greater risk of any stroke compared to men in the highest quartile [>64.96μmol/L] with adjustment for age, examination months, body mass index (BMI), blood pressure, smoking, alcohol, cholesterol, diabetes, and exercise-induced myocardial ischemia (Kurl et al, 2002). This increased to a 2.6-fold (95% CI: 1.52-4.48, *P<0.001*) greater risk in hypertensive and 2.7-fold (95% CI: 1.48-4.90, *P=0.001*) greater risk in overweight men in the lowest category of vitamin C intake (Kurl et al, 2002).

Two studies that do not support an association between vitamin C and cardiovascular conditions are the Iowa Women's Health Study (Kushi et al, 1996) and a cohort of elderly participants from the Rotterdam Study (Klipstein-Grobusch et al, 1999). The former study examined coronary heart disease (CHD) mortality in over 34,486 post-menopausal women who did not have CHD at baseline and found no association for either dietary or supplemental intake of vitamin C: (for vitamin C intake quintile 1 [≤87.3mg/day] vs. quintile 5 [391.3mg/day] CHD risk-factor adjusted RR=1.49 [95% CI: 0.96-2.30], *P=0.02*). In the latter study there was no observed association between dietary energy-adjusted vitamin C intake and MI endpoints in 4,802 men and women from the Netherlands (CHD risk factor adjusted RR comparing highest [>126mg] and lowest [<87mg] quintiles of intake: 1.05, 95% CI: 0.65-1.67, *P=0.86*).

Data from intervention trials investigating the effect of vitamin C on CVD endpoints is lacking. A review of randomized controlled trials for the US Preventive Services Task Force identified only one trial of secondary prevention with supplemental vitamin C and no trials for primary prevention (Morris & Carson, 2003). The review concluded that the current available evidence "failed to demonstrate a consistent or significant effect of any single vitamin or combination of vitamins on incidence of or death from cardiovascular disease" (Morris & Carson, 2003).

1.1.2 β-carotene protection against coronary heart disease

β-carotene is a major carotenoid found abundantly in orange coloured vegetables and fruit such as carrots, pumpkin, apricots and mangos and in dark green leafy vegetables such as spinach and kale. β-carotene is another nutrient that has received much attention in diet and disease research because a number of prospective cohort studies have shown that β-carotene protects against CVD (Rimm et al, 1993; Gaziano et al, 1995; Klipstein-Grobusch et al, 1999). In 1,299 elderly Massachusetts residents, those consuming one or more daily servings of vegetables rich in β-carotene were less likely to die from MI and cardiovascular causes than those who consumed less (Gaziano et al, 1995). The multivariate relative risks (RR) (adjusted for sex, age, smoking, alcohol and cholesterol intake, and functional status) comparing the highest [≥2.05 servings/d of foods high in carotenoid content] to lowest [<0.8 servings/day] quartiles in carotene intake in this study was 0.27 (95% CI: 0.10-0.74; *P=0.005*) for MI and 0.59 (95% CI: 0.37-0.94; *P=0.014*) for cardiovascular mortality. This study did not adjust for other antioxidant nutrients, but a number of studies that have controlled for such dietary confounders have obtained similar results, particularly in high-risk populations (Rimm et al, 1993; Klipstein-Grobusch et al, 1999).

High β-carotene intakes were associated with a significant reduction of risk of MI in a cohort of elderly Dutch men and women (tertile 1 [<1.13mg/d] vs. tertile 3 [>1.57mg/d] = 0.55, 95% CI: 0.34-0.83, *P=0.03*). The association of reduced MI risk with increased β-carotene intake was more pronounced in former smokers (tertile 1 vs. tertile 3 = 0.32, 95% CI: 0.14-0.66, *P=0.002*) and current smokers (tertile 1 vs. tertile 3 = 0.45, 95% CI: 0.17-01.10, P=0.058), though for current smokers this did not reach statistical significance (Klipstein-Grobusch et al, 1999). Similarly, the Health Professionals Follow-up Study (HPFS) showed that the coronary heart disease (CHD) protection associated with β-carotene intake was largely confined to smokers. The RR in this study comparing quintile 1 [<5030IU/d] and quintile 5 [≥14,388IU/d] for current

smokers was 0.30 (95% CI: 0.11-0.82, *P=0.02*) and for former smokers was 0.60 (95% CI: 0.38-0.94, *P=0.04*) while no benefit was seen in non-smokers (RR = 1.09, 95% CI: 0.66-1.79, *P=0.64*) (Rimm et al, 1993).

Conversely, randomized controlled trials using supplemental β-carotene have failed to demonstrate any benefit and in some cases have even suggested that β-carotene may be harmful (Hennekens et al, 1996; Rapola et al, 1997). In a meta-analysis of eight randomized trials of β-carotene alone or combined with other antioxidant vitamins the odds ratio (OR) for all cause mortality 1.07 (95% CI: 1.02-1.11, *P=0.003*) and cardiovascular death 1.1 (95% CI: 1.03-1.17, *P=0.003*) were slightly greater in patients receiving β-carotene compared to those who did not receive it (Vivekananthan et al, 2003).

1.1.3 Adverse effect of supplementation with β-carotene

The Alpha-Tocopherol Beta-Carotene Cancer Prevention Study (ATBC) and the Beta Carotene and Retinol Efficacy Trials (CARET) provide the strongest evidence against β-carotene supplementation. The primary endpoint for these trials was cancer, but cardiovascular endpoints were also investigated. Of 29,133 male smokers who were randomly assigned to receive daily supplementation of 50mg of alpha-tocopherol, 20mg β-carotene, both, or a placebo for a period of 5 to 8 years, those in the β-carotene group showed an increased risk for both CHD and cancer of the lung (ATBC Cancer Prevention Study Group, 1994). Further analyses in men free from CHD at baseline showed a slight supplementation-associated increase in angina pectoris also (Rapola et al, 1996), and in smokers with previous MI an increased risk of fatal CHD (Rapola et al, 1997). The CARET study tested a combined daily treatment of 30mg β-carotene and 25000IU retinyl palmitate (a form of vitamin A) in a high-risk population of current and former smokers and asbestos-exposed workers. After 4 years, the active treatment group had a 28% and 26% higher incidence of lung cancer and cardiovascular mortality, respectively (Omenn et al, 1996).

A number of possible explanations have been suggested for the adverse effect of supplementation with β-carotene in these studies, for example the duration of the studies may have been too short to inhibit cancers that may have resulted from a lifetime of carcinogen exposure (ATBC Cancer Prevention Study Group, 1994). In addition, supplement dosages may not have been optimal, possibly becoming toxic at serum levels well above baseline and resulting in possible pro-oxidant activity (Omenn et al, 1996). Additionally, the apparent protective effect of β-carotene observed in epidemiological research may be the result of other known or unknown confounding factors that have not been considered (Omenn et al, 1996) and thus β-carotene may be only a "marker" of some lifestyle factor that protects against chronic diseases. Based on this evidence, advice now focuses on whole foods such as fruit and vegetables rather than individual or combination micronutrient supplements.

1.1.4 Folate protection against cardiovascular disease

Folate-rich foods include dark green leafy vegetables such as spinach, cabbage and kale, along with some other foods such as oranges, eggs and whole-grain cereals. Folates are involved in the transfer of single carbon units e.g. providing methyl and formyl groups to diverse reactions in vivo, and thus play an essential role in the synthesis and repair of deoxyribonucleic acid (DNA) (Scott, 2000). Folate is involved in the removal of cytotoxic homocysteine (Hcy) by providing methyl groups for the remethylation of tHcy to methionine.

Epidemiological research has indicated that moderately elevated plasma or serum tHcy is independently associated with an increased risk of CVD irrespective of other established CVD risk factors (Boushey et al, 1995; Verhoef et al, 1996, Wald et al, 2002). Folate is inversely associated with homocysteine (Hcy) and is the primary

nutritional predictor of Hcy concentrations (Homocysteine Lowering Trialists' Collaboration, 1998).

Intakes of both supplemental and dietary folate have been shown in randomized control trials to lower plasma tHcy concentrations (Brouwer et al, 1999a; Brouwer et al, 1999b; Ashfield-Watt et al, 2002), and thus may potentially reduce CVD risk. In a four week intervention trial involving 66 healthy men and women (aged 18-45 years) a diet rich in citrus fruit and vegetables (supplying an extra 350μg/d of dietary folate to the basal diet which consisted of ~200μg/d of dietary folate) significantly decreased tHcy levels by a mean 2.0μmol/L (95% CI: 1.0-3.0, $P<0.001$). Subjects in the same study on a low folate diet (~25μg/d of dietary folate in addition to the basal diet) and receiving supplemental folic acid (500μg on alternate days) demonstrated a mean decrease in tHcy concentration by 2.4μmol/L (95% CI: 1.4-3.4, $P<0.001$) (Brouwer et al, 1999b). In another trial of 126 adult subjects who received three dietary interventions for a period of four months each, both a folate-rich diet and a diet supplemented with synthetic folic acid significantly ($P<0.001$) reduced plasma homocysteine from baseline levels. In this trial, the folate-rich diet (subjects advised to consume folate-fortified foods in addition to usual diet in order to attain total folate intake ≥ 400μg/d) and supplement diet (usual diet plus 400μg/d of synthetic folic acid daily) reduced plasma homocysteine from 10.2(± SD: 4.2)μmol/L at baseline to 8.7(± 3.3)μmol/L and 8.6(± 3.1)μmol/L respectively (Ashfield-Watt et al, 2002). Additionally, a meta-analysis of randomised controlled intervention trials using folate and vitamin B12 (a co-factor in the remethylation of homocysteine) found that in typical Western population's supplementation with 0.5-5mg of folic acid and about 0.5mg of vitamin B12 daily may reduce homocysteine concentrations by roughly a third to one quarter (Homocysteine Lowering Trialist's Collaboration, 1998).

As yet, there is no data from clinical trials to confirm that lowering tHcy concentrations prevents death from cardiovascular or coronary causes. Additionally

prospective evidence linking serum or plasma levels of folate and B vitamins to cardiovascular disease incidence are inconsistent and further research from randomized trials are required to test the effectiveness of these vitamins in reducing CVD mortality and morbidity (Ford et al, 1998; Hung et al, 2003).

1.1.5 Dietary patterns and protection against cardiovascular disease

The unique combinations in which all individuals consume food make it difficult to identify any single nutrient as being protective against disease. More recently, investigations into diet and disease relationships have looked at the association of dietary patterns, rather than single nutrients, in relation to chronic disease. Diets rich in fruits and vegetables have consistently been associated with lower rates of many diseases. In a pooled analysis of data from the Nurses Health Study (NHS) and the Health Professionals Follow up Study (HPFS) a 20% (RR for quintile 1 vs. quintile 5 = 0.80, 95% CI: 0.69-0.93) and 31% (RR for quintile 1 vs. quintile 5 = 0.69, 0.52-0.92) lower risk of coronary heart disease and ischemic stroke, respectively, was observed for individuals in the highest compared to the lowest quintiles of fruit and vegetable intake (Joshipura et al, 1999 & 2001). Data from these studies suggests that increasing fruit and vegetable intakes by one serving a day corresponds to a 4% (RR = 0.96, 95% CI: 0.94-0.99; *P=0.01*) and 6% (RR = 0.94, 0.90-0.99; *P=0.01*) reduction in coronary heart disease and stroke respectively. Specific food items that conferred the most protection from the selected diseases included cruciferous and green leafy vegetables, citrus fruit and juices (Joshipura et al, 1999 & 2001).

Data from the first National Health and Nutrition Examination Survey (NHANES I) of the general US population demonstrated that eating fruit and vegetables 3 times/day compared to 1 time/day reduced mortality from stroke (RR: 0.52, 95% CI: 0.33-0.81, *P=0.004*), ischemic heart disease (RR: 0.66, 95% CI: 0.49-0.90, *P=0.007*), CVD (0.63,

95% CI: 0.51-0.79, *P<0.001*) non-CVD (0.80, 95% CI: 0.66-0.96, *P=0.004*) and all causes (RR: 0.72, 95% CI: 0.62-0.84, *P<0.001*) after adjusting for age, race, sex and energy intake (Bazzano et al, 2002). Adjustment for physical activity, diabetes, education level, alcohol intake, smoking, and vitamin use however, weakened the association and only demonstrated a significant association between fruit and vegetables and reduced risk of stroke incidence.

In 2641 middle-aged men from Finland, those in the top quintile of fruit, berries and vegetable intake experienced lower mortality rates from all causes (comparing 5^{th} vs. 1^{st} quintiles of intake: 74 events vs. 145 events, *P<0.001*), from CVD (17 events vs. 39 events, *P<0.001*), and from non-CVD (34 events vs. 72 events, *P<0.001*). The relative risks comparing extreme quintiles of intake for deaths from all-causes was 0.65 (95% CI: 0.49-0.86, *P<0.001*), for CVD was 0.43 (95% CI: 0.24-0.76, *P=0.001*), and non-CVD was 0.56 (95% CI: 0.38-0.83, *P<0.001*) after adjusting for age and examination years. Adjustment for traditional CHD-risk factors and maximal oxygen uptake however diminished the strength of associations between fruit, berries and vegetables and both CVD mortality and non-CVD mortality, resulting in a significant association only for all-cause mortality (RR: 0.74, 95% CI: 0.55-0.98, *P=0.002*) (Rissanen et al, 2003). Therefore, the beneficial effects observed may be associated with other lifestyles factors related to high intakes of fruit, berries and vegetables.

On the other hand, a large cohort of Danish men and women (n = 54506) demonstrated fruit, but not vegetables, to be associated with reduced risk of acute ischemic stroke. The relative risk of acute ischemic stroke comparing extreme quintiles of fruit intake was 0.60 (95% CI: 0.38-0.95, *P=0.02*) (Johnsen et al, 2003).

Few intervention studies have examined whether the consumption of fruit and/or vegetables (as whole foods rather than their individual constituents) can reduce disease morbidity or mortality. Trials that have investigated dietary patterns indicate a traditional

Mediterranean style diet centered on a high intake of fruits and vegetables, breads, cereals, monounsaturated olive oil and fish may be cardio-protective. In the randomized, single blind secondary prevention trial de Longeril and colleagues (1994) tested an alpha-linolenic acid (ALA) rich Mediterranean-style diet compared to a prudent Western-style diet on the recurrence of MI. The trial involved 605 patients who had survived a first heart attack, 302 subjects who followed a Mediterranean diet low in saturated fat with moderate amounts of linoleic and alpha-linolenic fatty acids and rich in fruits and vegetables, and 303 control subjects who were given no dietary advice other than the prudent diet recommendations of their physician. The mean follow up time was 27 months, but this was later extended to a mean of 46 months (de Longeril et al, 1999). Significant risk reductions were observed in cardiac mortality and morbidity between experimental and intervention groups (8 versus 33 events) after the first follow-up that were maintained with prolonged intervention (14 versus 44 events). The reduced risk ratios varied from 0.28 (95% CI: 0.15-0.53, $P<0.05$) for primary endpoints (cardiac mortality and nonfatal myocardial infarction) to 0.53 (0.38-0.74, $P<0.05$) for secondary endpoints (i.e. stroke, heart failure, pulmonary or peripheral embolism, unstable angina) (de Longeril et al, 1999). The main characteristics of a Mediterranean diet for which cardio-protective effects were attributed to were an increased intake of antioxidant vitamins (particularly alpha-tocopherol and ascorbic acid) and the ratios of fatty acids (increased omega-3 and decreased omega-6 fatty acids).

Additional benefits for high fruit and vegetable intakes were observed in a multi-centre randomized controlled feeding trial that tested the effect of dietary patterns on blood pressure in 459 adults (Appel et al, 1997). Individuals consuming a combination diet (high in fruit, vegetables and low fat dairy products and low in saturated fat, total fat and cholesterol) reduced systolic blood pressure (BP) by 5.5mmHg (97.5% CI: 3.7-7.4, $P\leq0.001$) more and diastolic BP by 3.0mmHg (97.5% CI: 1.6-4.3, $P\leq0.001$) more than

the control diet (a typical western diet). Compared to the control group individuals consuming the high fruit and vegetable diet significantly reduced systolic BP by 2.8mmHg (97.5% CI: 0.9-4.7, *P<0.001*). Although diastolic BP reduced by 1.1mmHg (97.5% CI: 0.3-2.4, *P=0.07*) more than the control diet this failed to reach significance.

In summary, although several studies have provided evidence for a protective effect of fruits and vegetables, more understanding is required to determine whether defense against chronic disease is mediated by isolated nutrients or the complex interaction of a number of nutrients and non-nutritive components. It is generally accepted that fruit and vegetables are important for health; therefore, by increasing the intake of a variety of fruits and vegetables the consumption of numerous potentially protective compounds is promoted.

1.2 Cancer

Cancer ranks as the second leading cause of death in New Zealand, accounting for more than a quarter of all deaths in the late 1990's (MOH, 2002). In New Zealand cancers of the lung, colon, reproductive organs (prostate, breast, endometrium) and stomach contribute most to morbidity and mortality (MOH, 2002). What we eat may play an important role in the development of cancers because many foods contain carcinogenic mutagens while others may have anti-carcinogenic properties.

1.2.1 Fruit and vegetable consumption and cancer protection

The relation between fruit and vegetables and cancer has been extensively examined in epidemiological research, and especially in case-control studies various types of fruit and vegetables are consistently reported to protect from various different cancers. In recent meta-analysis of 197 identified studies Riboli and Norat (2003) found that in case-control studies vegetables significantly reduced cancer risk at the breast (RR = 0.86; 95% CI: 0.78-0.94,

P<0.01), oesophagus (RR = 0.89; 0.82-0.97, *P=0.002*), lung (RR = 0.85; 0.77-0.92, *P=0.006*), stomach (RR = 0.78; 0.71-0.86, *P<0.01*) and colorectum (RR = 0.87; 0.80-0.95, *P<0.01*) while fruit significantly reduced cancer risk at the lung (RR = 0.83; 0.74-0.94, *P<0.01*), bladder (RR = 0.82; 0.70-0.94, *P=0.004*), stomach (RR = 0.69; 0.62-0.77, *P<0.01*), colorectum (RR = 0.93; 0.87-0.99, *P=0.003*), mouth and pharynx (RR = 0.53, 0.37-0.76, *P<0.05*), larynx (RR = 0.73; 0.64-0.84, *P<0.05*), and oesophagus (RR = 0.72, 0.62-0.83, *P<0.01*). However, the analysis of cohort studies provided weaker evidence overall finding a significant effect only for increased fruit intake with lung cancer (RR = 0.86; 0.78-0.94, *P<0.01*) (Riboli & Norat, 2003).

The data from the above mentioned meta-analysis is in general agreement with the 1997 World Cancer Research Fund review panel which concluded that there was convincing evidence that a high intake of fruit and vegetable decreased cancer risk at sites of the mouth, pharynx, oesophagus, lung (especially for green vegetables), and stomach (especially for raw and allium vegetables, tomatoes and citrus fruit), as well as the colon and rectum (for vegetables only) (WCRF & AICP, 1997). The panel also concluded that fruit and vegetables probably reduced the risk of larynx, pancreas, breast and bladder cancers (WCRF & AICP, 1997).

There has been little evidence from clinical trials to support the observed epidemiological benefit of fruit and vegetables in cancer prevention. Trials that have been conducted using individual antioxidant or other vitamins have produced disappointing results and for some nutrients may even have harmful consequences. As mentioned in section 2.1.3, male smokers from the ATBC study who were given β-carotene supplements (20mg daily) exhibited an increased incidence of lung cancer (by 18%, *P=0.01*) and overall mortality (by 8%, *P=0.02*) than those who were not (ATBC Cancer Prevention Study group, 1994). Adverse effects of β -carotene supplementation were also reported in subjects from the CARET study who were current and former smokers and asbestos exposed workers (Omenn et al, 1996). Supplementation (50mg β -carotene on

alternate days) in healthy males from the Physicians Health Study however, resulted in no effect on disease or death (Hennekens et al, 1996).

While there are some inconsistencies in epidemiological research and very little support from human intervention trials the available evidence still strongly supports the increased consumption of fruit and vegetables daily for the prevention of a number of different cancers. Fruit and vegetables in addition to being rich in well-known and much tested antioxidants (vitamin C and β -carotene) are also the primary source of other phytochemicals with possible cancer preventing properties. Whether these or other substances work individually or through complex interactions to provide protection against disease is not clearly understood. Therefore, consuming a variety of fruits and vegetables in quantities of at least five servings daily increases the likelihood that potential cancer protective nutrients will also be consumed and thus cancer prevention enhanced.

1.3 Bone health

Nutrition plays an important role in bone health and is a modifiable risk factor for osteoporosis (Smith, 2000). The roles calcium and vitamin D play in bone status and maintenance have been extensively researched, but more recently, the associations between fruits and vegetables and their constituent nutrients (specifically potassium and magnesium) have been explored.

1.3.1 Potassium and magnesium protection for bone health

Potassium is an essential element required in the body for normal nerve impulse conduction and muscle contraction. Potassium-rich foods include bananas, tomatoes, and citrus fruit. Magnesium, predominantly found in bones as a component of mineral crystal structures, is an activator of enzymes involved in phosphorus and mitochondrial oxidative metabolism

Magnesium is widely distributed in many foods including leafy green vegetables, nuts, legumes and whole-grain cereal. Potassium and magnesium are two dietary nutrients that may play an important role in the maintenance of healthy bones.

Foods such as meat and fish are high in sulphur-containing amino acids and their metabolism creates a high acid load that must be neutralized by the body (Barzel et al, 1998). Ordinarily the kidneys regulate plasma acidity levels by excreting excess acid in the urine, but a typical Western diet high in animal protein may overload the renal process (Barzel et al, 1998). It is hypothesized that diet-generated acid that is not excreted by the kidneys may result in the mobilization of bone and calcium, which are used as a buffer, to neutralize acid (Barzel, 1998; Kerstetter et al , 2003a), this maybe particularly important in older people because renal function declines with age (Kerstetter et al, 2003b, Tucker et al, 2002). It has been suggested that an acidic environment, which stimulates the resorption of bone mineral, may over time may weaken bones. Fruits and vegetables or their components (specifically potassium and magnesium) produce acid-neutralizing bases, and diets rich in these foods may counteract the high acid load from a typical Western diet, creating a less acidic environment that may preserve skeletal mineral density and health.

A number of epidemiological studies have highlighted the importance of adequate potassium and magnesium intakes on bone health; for example, low reported intakes of these minerals were associated with decreased bone mineral density in cross-sectional analysis in pre menopausal women from the Aberdeen Prospective Osteoporosis Screening Study. In these subjects (aged 45-55 years), those in the lowest compared to the highest quartile of potassium and magnesium intake had significantly lower lumbar spine and femoral neck bone mineral density (BMD) (New et al, 1997). Subsequent analysis of a random sample of these women showed that intakes of these nutrients were negatively associated with bone resorption measured by urinary excretion of pyridinoline

and deoxypyridinoline (New et al, 2000). Pyridinoline excretion was moderately and negatively associated with dietary potassium (r = -0.31, n=62, *P<0.02*), dietary magnesium (r = -0.37, n=62, *P<0.005*) and dietary phosphorus (r = -0.36, n=62, *P<0.005*). Deoxypyridinoline was also negatively associated with magnesium (r = -0.37, n=62, *P<0.005*) and potassium (r =-0.31, n=62, *P<0.01*), as well as ß-carotene (r = -0.32, n=62, *P<0.01*) and fibre (r = -0.30, n=62, *P<0.01*). Additionally, high reported intake of fruits and vegetables in these women during childhood was associated (*P<0.01*) with greater femoral neck BMD compared to women who reported consuming low or medium amounts.

Similarly, the cross-sectional Framingham Osteoporosis Study investigated the relationship of potassium, magnesium and fruit and vegetable intakes on bone mineral density (BMD) in over 907 surviving participants of the Framingham Heart Study (Tucker et al, 1999). Biennial measurements of BMD at three hip sites (femoral trochanter, femoral neck and femoral Ward's area) and one forearm site (radial shaft), and dietary intake by semi-quantitative FFQ were made. A significant association between potassium and BMD was demonstrated at all four sites in men (cross-sectional difference in BMD per 1000mg of potassium was at the femoral neck: 0.032g/cm^2, the trochanter: 0.030g/cm^2, Ward's area: 0.040g/cm^2 and the radius: 0.022g/cm^2; *P<0.05*). There was also a significant association between magnesium and BMD at three sites in men (cross-sectional difference in BMD per 100mg of magnesium was at the femoral neck: 0.023g/cm^2, trochanter: 0.027g/cm^2, and the radius: 0.023g/cm^2; *P<0.05*). In women, potassium was significantly associated with BMD at three sites (trochanter: 0.034g/cm^2, Ward's area: 0.019g/cm^2, radius: 0.016g/cm^2; *P<0.05*) and magnesium was significantly associated with BMD at one site (trochanter: 0.020g/cm^2; *P<0.05*). A significant change in BMD over a 4-year period was observed for men only, baseline potassium and magnesium intakes being predictive of subsequent bone loss in men at all three hip sites. The reason for the lack of association between these nutrients and change in BMD in women was unclear, though the authors suggested that "hormonal factors or other

unmeasured interactions in the metabolic environment" might have had an effect (Tucker et al, 1999).

High intakes of fruits and vegetables have also been shown to beneficially influence bone size in a cross-sectional study in early pubertal white girls (Tylavsky et al, 2004). In this study of fifty-six white girls aged between eight and 13 years (at Tanner stage 2) those who reported consuming high fruit and vegetable intakes (defined as ≥ 3 servings per day) when compared to low consumers (<3 servings per day) had 6% (*P=0.03*) and 8.3% (*P=0.03*) larger bone area of the whole body and wrist respectively, after adjusting for age, BMI and physical activity. High fruit and vegetable consumers also had lower urinary calcium excretion (*P=0.04*) and lower parathyroid hormone (*P=0.01*) indicating that these foods reduce bone resorption.

The link between foods rich in alkali-forming precursors and BMD was tested in a clinical trial of 18 postmenopausal women who were administered supplemental potassium bicarbonate (60-120mmol/d per 60kg) for 18 days following a control diet (Sebastion et al, 1994). During periods of supplementation calcium and phosphorus balance became significantly more positive (i.e. less calcium [*P=0.009*] and phosphorus [*P=0.007*] were excreted) reducing bone resorption and subsequently increasing serum osteocalcin concentration (a marker of bone formation). This study tends to support other work in this area however; the results should be interpreted with caution because of the small number of subjects involved and short study duration. Further work would be required to determine the relationship between the alkali-forming precursors and BMD.

An association between fruit and vegetables and bone status was also observed in results from the DASH I intervention trial (Dietary Approaches to Stop Hypertension). In this clinical trial, a fruit and vegetable rich diet (providing potassium and magnesium intakes at levels close to the 75th percentile of United States adult consumption) significantly reduced systolic blood pressure by 2.8mm Hg (97.5% CI: -4.7 to -0.9;

P<0.001) and reduced diastolic blood pressure by a non-significant 1.1mm Hg (-2.4 to 0.3, *P<0.07*) compared to the control group. More importantly, such a diet reduced urinary calcium excretion by 47 ± 6mg/d (from 157 ± 7 mg/d at baseline to 110 ± 7mg/d) (Appel et al, 1997).

The available evidence suggests that the production of endogenous acid from a normal diet can be countered to some degree by the neutralizing effect of base-producing constituents of fruit and vegetable foods. Moreover, the benefits of fruits and vegetables on bone health are not limited to adults as children may also benefit from consuming diets rich in these foods. Compliance with the recommendation to consume at least five servings every day children may positively affect bone development and ultimately long-term bone health.

1.4Obesity

Obesity and overweight are associated with a range of diseases that cause multiple health problems and increased mortality. In a large-scale prospective study of 750,000 men and women from the general US population participants were divided into seven weight categories ranging from <80% of average group weight to ≥140% of the average group weight. In this study those who were 30-40% heavier than average (weight category 6: 130-139% of average) had almost 50% higher mortality rates (Lew et al, 1979) than those of average weight. The major disease outcomes associated with increased mortality in overweight or obese individuals from this study were coronary heart disease, diabetes and some cancers (Lew et al, 1979).

Diet and physical activity are modifiable determinants of obesity. Fruits and vegetables may play an important role in prevention and treatment of obesity. These foods, which are generally low in fat and a good source of fibre and many micronutrients, if consumed instead of high-fat energy-dense foods may help to attain a healthy weight status.

1.4.1 Trends in childhood obesity

The prevalence of obesity and overweight in adolescents worldwide has increased in the last three decades and seems to be accelerating. A survey of young people in the United States (aged 5-24 years) indicated that rates of overweight (defined as 85th percentile of weight-for-height) approximately doubled over two decades from 1973-74 until 1994, with yearly increases during the second decade being nearly double those of the first decade (Freedman et al, 1997). Recent cross-sectional surveys of children and adolescents from Britain (Chinn et al, 2001), the Netherlands (Fredriks et al, 2000), Australia (Booth et al, 2003) and USA (Troiano et al, 1998) present similar findings which indicate more than a 2-fold increase of overweight children from these regions in the last thirty years.

A recent study of schoolchildren aged 11-12 years from the Hawkes Bay region of New Zealand has highlighted the problem of childhood obesity in this country (Turnbull et al, 2004). Data on height, weight and ethnicity were collected from 871 schoolchildren in 1989 and 894 children in 2000 as part of asthma prevalence research. The findings show that for all gender and ethnic groups (except for those whose ethnicity was classified as "Other") mean body mass index (BMI) in these children was increased significantly over an eleven-year period from 18.1kg/m^2 (95% CI: 17.9, 18.3) in 1989 to 19.8kg/m^2 (95% CI: 19.6, 20.0) in 2000 ($P<0.001$). In this study, the percentage of overweight and obese children rose from 11.0% to 20.9% and 2.4% to 9.1% respectively from 1989 to 2000. Furthermore, higher percentages of overweight and obesity were reported for Maori (24.7% and 15.3% respectively) and Pacific Island (35.0% and 15.0% respectively) children compared to European children (18.2% and 5.7% respectively). These results are in agreement with the findings from the 2002 National Children's Nutrition Survey (CNS02) in children aged 5-14 years that shows that the prevalence of obesity/overweight in Pacific Islanders is 62%, in Maori 41% and in New Zealand European and Others 24% (MOH, 2003b).

It has been observed that many obese children and adolescents become obese adults (Whitaker et al, 1997, Guo et al, 2002) with a much greater risk of obesity and associated chronic health problems (Must et al, 1992). Recent rapid increases in child and adolescent obesity over the last 20 years (Booth et al, 2003; Chinn et al, 2001) pose a major concern for public health. Preventing obesity in young people through nutritional education and regular physical activity may not only alleviate the burden of adult obesity-related conditions, but may also reduce the likely negative psychosocial consequences an obese child may experience (Dietz, 1998).

1.5 Impact of fruit and vegetables on child/adolescent health

In addition to an increased risk of chronic non-communicable diseases in the long-term, inadequate consumption of various constituents in fruits and vegetables may be associated with respiratory functioning in children. In a recent study in school-aged children, low dietary intake of antioxidant vitamins was associated with shortfalls in lung function and measures of flow (defined by forced vital capacity [FVC], forced expiratory volume in one second [FEV_1], and forced expiratory flow between 25% and 75% of forced vital capacity [FEV_{25-75}]) in both girls and boys (Gilliland et al, 2003). The data for this study was collected during 1997-1998 from 2,566 schoolchildren who were participants of the Children's Health Study, a 10-year study of respiratory health in children from 12 communities in and surrounding Los Angeles, California. Dietary data were collected using a validated Youth/Adolescent food frequency questionnaire and lung function data by spirometric measurements.

Deficits in forced vital capacity were observed in both girls (FVC percentage change -2.7 [95% CI: -5.2, -0.1],) and boys (FVC percentage change -2.6 [95% CI: -5.1, -0.2]) who took supplements but had low vitamin C intakes, and in girls who had low vitamin C intakes and did not take supplements (FVC percentage change -3.1, [95% CI: -5.6, -0.6]), compared

to those children with higher vitamin C intakes (all $P<0.05$). Low intakes (defined as an intake ≤ the gender-specific lowest decile) of vitamin C were also associated with losses in FEV_1 (percentage change -3.3 [95% CI: -6.0, -0.5] in those who took supplements, and -3.5 [95% CI: -6.2, -0.8] in those who did not), and FEV_{25-75} (percentage change -5.5 [(95% CI: -10.5, -0.3] in those who took supplements) in girls but not boys.

The study also demonstrated adverse effects of low vitamin A intakes (in girls only), and low intakes of orange juice and other juices (in boys only) on respiratory function suggesting that inadequate intakes of antioxidant vitamins may play an important role in respiratory health.

1.6 Dietary intake of fruits and vegetables in children

The food and nutrition guidelines for New Zealand school-aged children, as for adults, recommend the consumption of at least three servings of vegetables and two servings of fruit every day (MOH, 1998). Despite these healthy eating guidelines, the actual intake of fruits and vegetables in New Zealand children is markedly below recommendations. Data from the first children's nutrition survey carried out in New Zealand (CNS02) has indicated only 43% of children meet daily recommendations for fruit, while 57% of children meet those for vegetables (MOH, 2003b). These findings are consistent with studies from the United States and Australia where large numbers of children and adolescents routinely consume less than the five or more servings of fruit and vegetables daily (Dennison et al, 1998; Reynolds et al, 1999; Magarey et al, 2001). The findings from the CNS02 will be further discussed in section 7.6.

1.7 Dietary interventions in children

A number of reasons exist for the health benefits of dietary interventions in young people, four of these include (1) immediate health and social benefits for the child, (2) enhanced health in adulthood resulting from improved nutrition at critical periods of child growth and development, (3) potential for reduced rates of chronic disease by modifying childhood risk factors, (4) potential protection from chronic disease by positively modifying dietary behaviours in childhood which persists into adulthood (Baranowski et al, 2000).

Primary schools are important media through which dietary interventions and nutrition education can be delivered. Interventions in school environments have the advantage of providing the opportunity to learn and to practice healthy eating habits for large numbers of children. They are therefore suitable settings from which to implement nutrition education and promote healthy eating (Warren et al, 2003). School based-approaches to nutritional interventions generally include classroom components in which students are educated and motivated to adopt healthier habits following sound theoretical models (Huon et al, 1999). A number of programmes have implemented environmental changes; including alterations to food service (Perry et al, 1998; Sahota et al, 2001) in which certain foods are promoted and made more readily available to children whilst access is reduced to other less healthy options.

Huon and colleagues (1999) investigated the efficacy of a number of major child nutrition interventions in published literature, which varied in terms of study duration and intended purpose. Many of the reviewed interventions targeted a reduction in CVD risk through proposed modifications to specific dietary components and increases in physical activity. Four studies clearly aimed to reduce salt intake and six to reduce fat intake in children, while other studies targeted whole foods, particularly increased fruit and vegetable intakes. Given the differences in programme aims, implementation and duration, comparisons between studies are limited. The authors noted that while many of the studies

claim statistically significant improvements in dietary intake with intervention compared to control groups, no mention of clinical significance has been made, thus the long-term health benefits are unclear. What is clear from this review and a similar, more recent review by Burchett (2003) is that 'environmental' factors (e.g. availability of targeted foods and social norms) and 'individual' factors (e.g. preferences and skills) influence food choice in children suggesting that programmes which aim to beneficially alter both aspects will be more likely to succeed (Huon et al, 1999).

In Burchett's review (2003) of five randomized control trials in the USA in which the specific target of intervention was to increase fruit and vegetable intake in primary school children, several elements appeared important for programme effectiveness. Programmes should be:

i. Based on behavioural change theory and have a behaviourally focused design.

ii. Have specific target (e.g. 'increase fruit and vegetable intakes to five or more servings daily).

iii. Incorporate elements aimed at improving environmental and individual factors (e.g. availability, preference, preparation skills).

iv. Use a variety of interactive teaching methods.

v. Provide sufficient training and support for teachers and support staff.

vi. Sustain the duration and intensity of the programme.

vii. Incorporate and maintain family involvement and involve community.

1.8 United States 5-a-day fruit and vegetable campaigns

The *5 A Day for Better Health Program* was instigated by the American National Cancer Institute and the Produce for Better Health Foundation in 1991 on a national level to encourage the consumption of five or more daily servings of fruit and vegetables for all Americans (Havas et al, 1994). The programme involved nine research projects of theoretically based behavioural interventions including four school-based initiatives in Alabama (High-5-Alabama), Georgia (Gimme 5 Fruits and Vegetables for Fun and Health), Minnesota (5-a-day POWER PLUS Program), and Louisiana (Gimme 5: A Fresh Nutrition concept for Students). Other projects included three based in worksites, one based in churches and one based in sites of the Special Supplemental Food Program for Women, Infants and Children (WIC) (Havas et al, 1994). Some of these studies that targeted adult populations are shown in Table 1.

The dietary goal for most of the projects was to increase the daily intake of fruit and vegetables to at least five servings. One exception to this was the Maryland WIC project that aimed to increase daily intake of fruit and vegetables by one-half portion from baseline, as consuming five or more daily servings was considered unrealistic in the low-income population targeted. Various intervention components were implemented at each of the 5-a-day project areas, some of which included provider encouragement, individual strategies (e.g. self-help resources), environmental changes, and family involvement. In both the WIC 5-a-day project and the Massachusetts 5-a-day worksite project measurements of dietary intake were collected by self-administered questionnaires. The Seattle 5-a-day project employed four dietary assessment methods, though the primary outcome measure was by food frequency questionnaire (FFQ).

In the WIC 5-a-day project intervention effectiveness was influenced by attendance at nutrition sessions, i.e. the more sessions attended by individuals the greater the change in fruit and vegetable intake from baseline (Havas et al, 1998). This suggests that the strength

of an intervention may depend on how well an intervention is implemented according to design and how motivated the audience is to receive it. Involving family as well as the worksite in the intervention programme resulted in greater changes to fruit and vegetable intake in the Massachusetts 5-a-day project. The author suggested that by "addressing broader social contexts influencing dietary patterns, beyond those residing at work" such as obstacles that limit fruit and vegetable intake at home might enhance intervention success (Sorenson et al, 1999).

Table 1: 5-a-day for Better Health Worksite and WIC intervention

Intervention	Area	Study duration & type	Participants	Intervention components	Outcome
The Maryland WIC 5-A-Day Promotion Program Havas et al, 1998	16 sites WIC sites in Baltimore city and Maryland counties	4 months (followed up at one year) Randomised crossover trial	3122 women†	Peer educator led nutrition sessions *(three 45 minute sessions and one brief discussion at enrolment)* Printed material and visual reminders *(e.g. cue cards, recipe book, calendar, posters, stickers, journal)* Direct mail *(e.g. personalised letters with tips, Encouragement and progress report)*	Increased F&V intake in INT groups *(mean Δ s/d: CTL= 0.13±0.17 vs. INT= 0.56±0.11 (p=0.002)* Attendance at nutrition sessions associated with intake *(3 sessions: increased F&V intake by 1.25 s/d±0.21; 2 sessions: increased intake by 0.91 s/d±0.25; 1 session: increased intake by 0.68 s/d±0.21; no sessions: increased F&V intake by 0.15 ±0.15, P=0.02)*
The Massachusetts Treatwell 5-A-Day Study Sorenson et al, 1999	22 community health centres from eastern Massachusetts	2 years Randomised trial	1359 men & women (84%) Aged 17-75y	Worksite and Work-site + family interventions: Community organising Discussion series *(ten 30 minute educational sessions)* Environmental changes *(increased F&V available in Vending machines, break rooms, during snack times)* Family newsletters and learn-at-home material	Increased F&V intake in both (WINT and WINT+F) intervention groups *(mean Δ s/d: CTL=0.4% [baseline s/d 2.61, final s/d 2.26]: WINT=7% [2.69, 2.89]; and W+FINT=19% [2.53, 3.02]; controlled for gender, education, occupation, living situation and worksite, P<0.05)*
The Seattle 5-A-Day Worksite Program Beresford et al, 2001	28 paired worksites with food serving cafeterias from the larger metropolitan areas around Seattle	2 years Randomised trial	2828 men & women (51%)	Intervention messages following stages of change model *stage 1: increase awareness about eating F&V* *stage 2: educational opportunities and self evaluation* *stage 3: skill building changes to food services* *stage 4: ways to adapt skills & knowledge to everyday life*	Increased F&V intake in both CTL and INT groups, but more so in INT *(INT effect by FFQ: 0.25 [95% CI: -0.01, 0.50])* *(INT effect by FFB: 0.11 [95% CI: 0.04, 0.17, P<0.01])* *(INT effect by Usual-day checklist: 0.47 [95% CI: 0.04, 0.09, P<0.05]), (INT effect by single question: 0.13 [95% CI: 0.03, 0.22, P<0.01])*

Δ Change from baseline
FFB Fat- and Fibre Questionnaire
CTL Control group
INT Intervention group
WINT Worksite intervention group
FFQ Food Frequency Questionnaire
F&V Fruit and vegetables
† Those served by the Special Supplemental Nutrition Program for Women, Infants and Children
W+FINT Worksite plus family intervention group

1.8.1 The Alabama High-5 Project

The High 5 Project was one of the four 5-a-Day school-based interventions for children. Based on social cognitive theory concepts, the aim was to increase fruit and vegetable intake using classroom, parental, and food service components. The project was conducted in 1,698 families of fourth grade students from 28-paired elementary schools in Birmingham, Alabama (control and intervention matched according to ethnic composition and percentage of children receiving free or reduced price meals) (Reynolds et al, 2000). Classroom components included role modeling, self-monitoring, problem-solving, reinforcement, taste-testing, and other methods in a 14-week curriculum that was taught by outside personnel (i.e., other than the teachers) trained to deliver bi-weekly classroom sessions. Parents received information about the project, were encouraged to support increased fruit and vegetable consumption by their child and completed homework activities with their child. For school-based food service managers and staff, half day training on purchasing, promoting, and preparing fruit and vegetables was given and routine monitoring was made to ensure compliance with intervention principles.

In this study, the intervention group children consumed more fruit, vegetables, and fruit and vegetables combined at both the first (one-year post intervention) and second (two years post intervention) follow-ups (both $P<0.01$) compared to the controls with whom they were matched at baseline. Mean consumption of fruit and vegetables combined at first follow-up was 3.96 (95% CI: 3.51, 4.44) and 2.28 (95% CI: 1.92, 2.66) servings/day for intervention and control groups respectively, and at the second follow-up 3.20 (95%CI: 2.89, 3.52) and 2.21 (95% CI: 1.94, 2.49) servings/day for intervention and control groups respectively.

Additional benefits of the intervention included positive changes to a number of psychosocial variables in children and improved fruit and vegetable consumption in parents, though differences in parental intake between experimental conditions was only

significant for the first follow-up period. Mean combined fruit and vegetables intakes for parents in the intervention compared to the control groups was 4.23 (95% CI: 4.03, 4.43) vs. 3.94 servings/day (95% CI: 3.75, 4.12) at the first follow-up (*P<0.04* for difference between groups*)* and 4.52 (95% CI: 4.28, 4.77) vs. 4.24 servings/day (95% CI: 4.00, 4.48) at the second follow-up (*P<0.09* for difference between groups).

1.8.2 The Minnesota 5-a-day POWER PLUS Program

The Power Plus Program was implemented to increase fruit and vegetable intakes of over 1750 fourth-grade students from 20 elementary schools in St Paul, Minnesota and was based upon social learning theory (Perry et al, 1998). It comprised a four-component intervention that included behavioural interventions, parental education and involvement, changes to food service, and industry involvement and support. Like the High 5 project, the Power Plus intervention classroom activities included problem solving, skill-building, taste-testing and the use of role model to reinforce messages. Parent and food service components were similar also to the corresponding High 5 Project components, while industry supports included supplying produce and information to intervention schools.

Dietary intake of fruit and vegetables was measured using a child 24-hour recall and lunchtime observations by specially trained observers. Intervention effects included small, but significant increases in lunchtime fruit (mean difference in servings between groups = 0.30 [95% CI: 0.13, 0.46], *P<0.05*) and combined fruit and vegetable intakes in all children (mean difference in servings between groups = 0.47 [95% CI: 0.21, 0.72], *P<0.05*) and in vegetable intakes for girls (mean difference in servings = 0.26 [CI: not reported], *P<0.05).* In contrast to the lunchtime assessments, measurements of dietary intake using 24-hr recall showed a significant difference between intervention and control groups for fruit only (mean difference: 0.62 [95% CI: 0.10, 1.14], *P=0.02).* Differences between conditions for vegetable servings (mean difference: -0.02 [95% CI: -0.43, 0.48], *P=0.92*) and fruit and

vegetable servings (mean difference: 0.58 [95% CI: -0.15, 1.13], *P=0.14*) were not significant (Perry et al, 1998). The effect of intervention on parental dietary intake in this study was not reported.

1.9 British 5-a-day fruit and vegetable pilot projects

The United States 5-a-day intervention programmes discussed above have been intense 1-2 year programmes involving multiple components and targeting specific population groups (i.e. schoolchildren, worksite employees, mothers in the WIC program). Recently, 5-a-day fruit and vegetable pilot initiatives with similar designs were commissioned by the British Department of Health (DOH) and undertaken in five underprivileged urban and rural regions of England. The pilot programmes included community-based activities and development of partnerships, and targeted various audiences at each site. They were conducted to determine the feasibility of developing strategies to improve access to fruit and vegetables, to increase awareness of the health benefits associated with fruit and vegetables and to increase people's daily consumption (DOH, 2002).

The pilot projects were evaluated nationally in 1560 people from all five regions and 400 control subjects from Norfolk (an area not involved in the projects) (DOH, 2003). Post-intervention there was no significant increase in overall fruit and vegetable intakes in intervention groups, however those who consumed less than five servings a day of fruit and vegetables at baseline increased intake by about one portion per day (DOH, 2002). The projects were also evaluated individually at each site, some of which included information on changes to fruit and vegetable intakes. A summary of the school activities for each pilot project is shown in Table 2. Because of the variability in each region's approach to the 5-a-day programme, and in data measurement and evaluation, comparison between sites is limited. However, the table shows two of the three projects that reported

changes to fruit and vegetable intake in schoolchildren demonstrated a positive intervention effect (Durkin et al, 2002; Coady et al, 2002).

1.10 The Sustain, Grab 5! Fruit and vegetable project

The Sustain Grab 5! Fruit and vegetable project, in contrast to the mentioned 5-a-day initiatives in the United States and pilot projects in Britain, was a less concentrated attempt to increase fruit and vegetable intakes specifically in schoolchildren using educational resource packs and supporting material (e.g. a Model school food policy, stickers, banners, posters, pens, bags, an electric blender for taste testing sessions). Training courses were made available for school staff, cooks and management and the schools were allowed the opportunity to identify their own work scheme and range of activities to undertake.

The project was implemented to test the practicality and effectiveness of a fruit and vegetable promotion programme that could be delivered nationally to all schools, and was tested in 26 primary schools from three, typically low-income regions, from Lambeth, Leeds and Plymouth. Nine primary schools were selected for in-depth evaluation using a Day in the Life Questionnaire (DILQ) before and after one year of programme completion (Edmunds et al, 2003) Overall, average fruit and vegetable consumption significantly increased ($P<0.01$) from 1.73 pieces (± standard deviation 1.55) in 2001 to 2.21 pieces (± 1.71) in 2002. Significant increases ($P<0.05$) were also evident for overall fruit (from 0.94 pieces ± 1.15 – 1.31 pieces ± 1.15) and overall vegetable intakes (from 0.80 ± 0.99 – 0.91± 1.03) during this time. However, changes in fruit and vegetable intake patterns varied between schools. Four schools reported significant increases in fruit and vegetables (ranging from 0.68 – 0.90 pieces/day), three reported small but not significant increases (ranging from 0.08 – 0.31 pieces/day), and two reported small decreases in fruit and vegetables (ranging from -0.15 to -0.22) pieces/day).

The cause of disparity between schools for fruit and vegetable intakes is likely to be associated with the complex interaction of activities chosen by the individual schools. While there was no clear indication of a specific activity or number of activities that effectively increased intakes, a number of key features were suggested to improve the likelihood of success. These included choosing activities that were appropriate for the school, not over ambitious, sensitive to teacher workload and provided fun and exciting experiences for both teachers and children. It was also suggested in focus groups that excessive focus on fruit and vegetables might possibly result in children becoming 'fatigued' by hearing the message too often.

Table 2: School components of the 5-a-day pilot projects in five areas of England

Intervention and area	Evaluation tool	Frame work for intervention	School intervention activities	Intervention outcome	Comments
"Five-a-day" Airedale & Craven *Durkin et al, 2002*	In-depth interviews	Theoretical models of behaviour change	F&V tasting, parent involvement, art & drama based F&V projects, fruit tuck shops, educational resources Assemblies, breakfast clubs	↑ awareness of need for F&V (*Δ awareness: 45%, † baseline 35%, final 80%†*). Increased intake of F&V (3-month mean ↑ *0.67p/d*). ↑ *preference for vegetables (Δ preference: 11%* [baseline73%, final 84%]	More positive changes made in schools that: 1) took part in art & drama project, 2) ↑ availability of F&V, 3) had class teachers with a positive/neutral Attitude toward F&V
"Five-a-day Community project" County Durham & Darlington *Coady et al, 2002*	Health Attitude Survey administered by street interviews, Focus group discussion	Four 3-month phases for each target Stages of Change	Established fruit bars and breakfast clubs, worked with caterers to ↑ availability and affordability of F&V, educational resource packs.	Schools benefited from intervention *(Sales of F&V ↑ by 12% in Dales, & 1000% in Darlington) (40% of schools indicated 5-a-day activities encouraged them to undertake extra ways to provide F&V in their School)*	Intervention strategy not recommended - resource requirements very high (especially administration support)
"Give me 5" Sandwell *Rex et al, 2002*	None reported	Theoretical models Of behaviour change	Fruit tuck shops (9 schools), football Coaching scheme (2178 children given fruit after each coaching session)	Outcome success measured in terms of partnerships made and dialogue and was deemed to be successful 9 schools set up fruit tuck shops, 6 maintained after INT	Intervention strategy required dedicated project manager
"5-a-day keeps the doctor away" Somerset *Chant et al, 2002*	Self-administered postal questionnaire	Theoretical models of behaviour change	Competition to develop project to ↑ F&V intake. Initiatives included fruit tuck shop, curriculum-based activities, food growing projects	↑ awareness of F&V recommendations† (*Δ awareness: 14% [baseline 51%, final 63%†]*) ↑ intake of F&V (Δ intake: 7% *[baseline 62%, final 69%†]*†	Training course developed *(e.g. courses for staff in nursing homes, community gardens, cooking skills)* for 5-a-day programme have been integrated into future training programmes
"Making F&V the easy choice" *Caraher et al, 2002*	Measurement of F& V in schools by 5-a-day food diary	Development of 2 F&V co-ops. Theoretical models of behaviour change	Co-ops provided schools with F&V & promoted 5-a-day message. 5-a-day posters & postcards. Helped set up Fruit tuck shops	No change in self-reported intake of F&V *(assessed by Food diary)* from baseline	Dietary assessment method may have lacked the sensitivity to detect significant differences in intakes Small number of children (30-40)

Δ Change from baseline
† Results for whole population group
INT Intervention
F&V fruit and vegetables
p/d portions/day
↑ Increased

1.11 New Zealand United Fresh 5+ A Day Fruit and Vegetable Campaign

The concept of a 5+ A Day campaign to promote the consumption of fruits and vegetables was first developed in 1991 in the USA by the National Cancer Institute and the Produce for Better Health Foundation. Similar programmes have since been conducted in numerous countries worldwide, New Zealand's own campaign being initiated in 1994 by United Fresh – an industry group including growers, merchants and retailers (United fresh, 2003). Children are the target audience for the nationwide campaign that is delivered through various media including advertisement and promotion in supermarkets, on product packaging, in magazines, on buses, television and radio as well as direct education in early childhood centres and primary schools. Educational resources provided for schools include nutrition activities, posters, stickers, compact discs, "Fun zone", and "Educator" sections of the 5+ A Day website.

School and community programmes have the potential to help children and adolescents develop lifelong healthy nutritional and physical activity patterns. Given that nutritional knowledge may be an important determinant of healthy eating patterns most school-based dietary interventions contain some component of nutrition education that attempts to motivate dietary change by increasing health and food awareness in the children. Few school-based interventions however involve educating and improving parental knowledge, a component that is identified to increase the likelihood of successful intervention (Burchett, 2003). It would be of interest to investigate the effect of intervention in children to influence parental knowledge and behaviour.

There is no published research on the effect of 5+ A Day school educational resources on actual fruit and vegetables intakes in New Zealand children. A central aim of this thesis is therefore to examine what effect the 5+ A Day educational resources for primary schools have on fruit and vegetable intakes of children in schools which receive specific 5+ A Day resources (exposed schools) and those who do not (non-exposed

schools). The major aim of the 5+ A Day school-based campaign is to provide education for children about the benefits of healthy eating therefore, this study will also investigate nutrition knowledge and attitudes to healthy eating in these children. Additionally, because parents are important influential factors in the determination of a child's dietary intake parental nutrition knowledge, attitudes and shopping habits will be examined between exposed and non-exposed schools.

2. AIMS AND OBJECTIVES

2.1 Aims

i. To determine the daily intake of fruit and vegetables in a sample of 10 year old children from primary schools in the Whangarei area. This area was chosen because little previous research in children of this area exists.

ii. To compare nutritional knowledge and 5+ A Day awareness of children in schools exposed to 5+ A Day educational resources vs. non-exposed schools.

iii. To compare fruit and vegetable intakes of children in schools exposed to 5+ A Day educational resources vs. non-exposed schools.

iv. To compare dietary intakes from children in these Whangarei schools with data from the 2002 National Children's Nutrition Survey.

v. To determine how body mass index, gender and physical activity levels affect fruit and vegetables intakes.

vi. To investigate parental nutritional knowledge and factors that influence family food purchases.

2.2 Objectives

i. To collect data on usual dietary intake in 10-year-old children using a FFQ designed for use in New Zealand children.

ii. To use a group administered questionnaire to:

a. Collect data on the children's knowledge on general nutrition, health and food relationships, perceived importance of various food groups, sources of nutrition information and some eating habits.

b. Collect data on exercise and leisure time activities of the children

iii. To determine the body mass index of children using measurements of height and weight.

iv. To collect data on parental knowledge using a questionnaire similar to that designed for child participants including additional questions to examine factors that influence fruit and vegetable intake and general food purchases as well as demographic characteristics.

3. METHODOLOGY

3.1 Selection of schools

A complete listing of all Whangarei schools was obtained from the Ministry of Education that included 37 primary schools. Of these, 17 rural schools were excluded due to small school roll numbers and difficulties with matching the schools by location and deciles. The focus of this study was therefore urban schools in Whangarei. The 5+ A Day manager provided a list of schools that had in the previous two years enrolled to receive United Fresh 5+ A Day campaign educational resources and schools that had not enrolled or participated in the last two years.

A target number of 50 participants each from a control and an intervention school were set for this pilot study to fit in with time and financial restrictions. Six schools were excluded from the 20 urban schools based on school roll size. These schools were listed as having less than 200 pupils and it is likely that there would have been insufficient numbers of 10-year-old students attending from which to collect data. Another school that was not enrolled and received no educational resources, but did partake in 5+ A Day competitions and promotional activities in the previous year (which may have introduced biased to the study) was also excluded. Additional exclusions included any identifiable special schools, as they were deemed not representative of the general population.

The remaining 12 schools were categorized into exposed (intervention) and non-exposed (control) schools and a pair of schools was selected (one from exposed school list and one from non-exposed school list) which were the most closely matched in terms of size, location and decile rating to reduce the likely impact of confounding associated with these factors. These two schools were located to the north of the city.

Refined list of 12 primary school (decile ratings in brackets)

Intervention schools	*Control schools*
Kamo Primary (5)	*Hurupaki Primary (6)*
Manaia View Primary	*Morningside Primary (1)*
Maunu Primary (10)	*Onerahi Primary (4)*
Otangarei Primary (1)	*Totara Grove Primary (1)*
Raumanga Primary	*Whau Valley Primary (3)*
St Francis Xavier (5)	
Tikipunga Primary (3)	

3.2 Recruitment of schools

Initial contact with selected schools was made by telephone. Visits were then arranged to meet key staff to discuss the purpose and procedures of the study. An information sheet, consent form (see appendix 1 and 2) and copies of the questionnaires were presented and time was taken to answer any relevant questions. Both of the selected schools agreed immediately to participate. A letter was then sent on to the Board of Trustees explaining the study and requesting permission to undertake the study in those schools (see appendix 3).

It became apparent after all consent forms were collected that an inadequate number of children had agreed to participate in the study, once this was known other pairs of schools were identified in order to obtain the required numbers of children (see section 4.3). This resulted in the study being undertaken in a total of five primary schools, three intervention schools and two control schools. Hurupaki, Onerahi and Whau Valley primary schools made up the intervention group while the control group consisted of Kamo Primary and St Francis Xavier Primary.

3.3 Recruitment of subjects

Participants in the study were children aged 10 years of age on the first day of July 2003 from five urban Whangarei primary schools, and their usual guardians. Ethical permission was obtained from the Massey University Human Ethical Committee. Consent was also obtained from the principal and Board of Trustees at each school. All eligible participants received an information sheet explaining the study and their possible involvement in it. In addition, a consent form requiring permission from the guardian for their child to take part and for themselves, as well as the child's consent to participate was also sent home. All children and guardians who returned written consent forms were included in the study.

3.4 Problems encountered with recruitment processes

Unfortunately, despite the large school roll numbers of the original pair of schools selected, the number of children who returned signed consent forms was low. As discussed above, in order to achieve the target number of subjects another three schools were subsequently approached to participate. Difficulties in recruiting subjects became more prevalent and numbers available diminished with each new school approached. This may have been due to curricular activities, which meant that time for the study was limited. Attempts to increase recruitment were made by the placing 'reminders' in weekly newsletters and daily notices at all schools.

4. DATA COLLECTION

4.1 Anthropometrical measurements

Height and weight were measured using a stadiometer following a standard technique (see appendix 4). Standing height of each subject was measured to the nearest 0.1 cm without shoes. Body mass was measured to the nearest 0.01 kg, in participants lightly clothed, using digital scale (Wedderburn, Tanita: Model 1609N) with a weighing capacity of 150 kg. The scale used during the study was first calibrated with a standard 5-kg weight and checked prior to use at each assessment. Body mass index (BMI) was determined by dividing the child's weight in kilograms by their height in metres squared. The resulting BMI value was categorized into non-overweight/obese or overweight/obese using age and gender-specific standard cutoff points for children (Cole et al, 2000).

4.2 Administration of Questionnaires

The questionnaires were administered in a class setting so that the environment would be familiar to the children. Group numbers ranged from seven to 15 children at a time. The researcher administered the questionnaire one question at a time so that all children could seek clarification without 'falling behind' the other children. Care was taken to stress the confidentiality and anonymity of their answers and that complete honesty was required. Subjects were also asked not to shout out or discuss their answers with other members of the group. To minimize seasonal variation in intakes the questionnaires were administered at each school within the same season.

4.3 Food Frequency Questionnaire

A qualitative food frequency questionnaire (FFQ) piloted by Massey University for the 2002

National Children's Nutrition Survey was used to gather data on usual dietary intake over the past month. The FFQ was developed from 24-h diet records collected in over 400 children and consisted of 117 edible items (food and beverage) with an additional section for supplement use (Metcalfe et al, 2003). Seven categories were used to classify the frequency of consumption of these foods. These ranged from 'never or less than once per month' to '2 or more times per day'. The questionnaire did not include any portion size estimates.

Food groups included fruit (10 items); vegetables (21 items); mixed dishes; eggs, meat, poultry and fish; pies, fast foods and sausages; breads and cereals; spreads and sauces; convenience meals/snacks; dairy foods; biscuits or cakes; snacks and sweets; milks; and other drinks. Subjects were required to state how often they consumed the foods pictorially described in the questionnaire. Each image represented a portion/serving of that food.

4.4 Child Nutritional Knowledge Questionnaire

Each child completed a nutritional knowledge questionnaire comprised of multiple-choice questions with listed answer options and a section on exercise and leisure time activities. A more extensive questionnaire that also examined shopping habits and demographic characteristics was sent home with each child for their guardian to complete. The questionnaire survey instrument for child participants consisted of four sections:

1. Nutritional knowledge about dietary recommendations
2. Health and diet relationships
3. Attitudes to nutrition
4. Physical activity and leisure time

Section 1 of the questionnaire examined general nutrition knowledge; questions one to three and five to seven were adapted from a similar nutrition survey (Thakur & D'Amico, 1999) based on food guide pyramid principles. Question 4 directly related to 5+ A Day information and asked about the serving size of a portion of fruit or vegetables. The remaining questions in this section (questions 8-10) were adapted from another questionnaire (Green & Boyle, 2001) and related to the child's awareness of public health messages and sources of nutrition information. Adaptations to questions taken form other survey involved some rewording of questions to ensure children would comprehend what was being asked of them. In this section, each child was given a score out of 18. One point was gained for each correct answer to questions one to four and eight. For questions five, six and seven three points each were available for correct answers and for question nine, one point was gained for each correct answer to the four sections.

Section 2 investigated the child's concept of health and diet relationships and included (questions 11-15) original questions. Health constructs queried were whether general health, cancer, heart disease, overweight/obesity and bone health are affected by diet. Section three (questions 16-18) involved a Likert scale response ranging from "very important" to "not important at all", and dealt with the perceived importance of consuming various food groups and learning about nutrition. Questions 20-23 of this section explored eating behaviours such as snacking and skipping meals. The final section estimated the amount of extra physical activity the child is involved in, outside of school, as well as their sedentary behaviours (i.e. television watching, computer and video games). Time spent watching television was obtained as the average time per weekday and at the weekends. Assessment of physical activity included the type and average time in minutes per week of activity.

4.5 Parent/guardian Nutritional Knowledge Questionnaire

The more extensive parent/guardian nutritional knowledge questionnaire (PNKQ) consisted of six sections. The first three sections of the child nutritional knowledge questionnaire (CNKQ) were repeated in the parental/guardian questionnaire, which also had additional sections on shopping habits, influential factors for food purchases, and demographic questions. Section four examined how often and where the family's food purchases were made. Section five required participants to rank the importance of various factors that determine food purchases and indicated what factors limited fruit and vegetable intake for their family (adapted from the National Nutrition Survey, Quigley et al, 1997). Demographic questions were included in the last section.

4.6 Pilot testing of the CNKQ

A preliminary version of the CNKQ was reviewed for clarity and interpretation by two primary school teachers who teach pupils of the targeted age level. The questionnaire was then administered in a group of 10-yr old volunteers from one of the excluded rural Whangarei primary schools. Simplicity of questions was considered vital and a small number of changes were made (questions that resulted in ambiguous answers on pilot testing were reworded to enhance clarity). It was important that the questions be easily understood and presented in a format that allowed completion in a short time period. In order to ascertain whether questions fell within the children's comprehension and reading abilities the final CNKQ was again reviewed by a primary school teacher.

5. DATA ANALYSIS

5.1 Data handling

Food intake was reported as the number of items consumed per day, per week, per month or never. All intake frequencies were processed to give the number of times per day that a food item was consumed. An appropriate conversion factor was applied to each of the seven frequencies used in the questionnaire (the number of days per month set at 30.5 days: monthly frequency = 1/30.5 potions per day). If the frequency of consumption was reported as 'never or less than once per month' a value of zero was recorded.

The average daily intake of specified food groups were computed by summing the relevant individual foods. For the analysis of 'total fruits' the frequencies all nine fruit categories were summed. For total vegetable consumption, frequencies of all raw, cooked fresh or frozen vegetables were summed. Data were examined for missing values and errors. Because recorded intakes for the three dietary variables (total fruit, total vegetables and total combined fruit and vegetables) were somewhat high, analyses between intervention group and by gender were repeated excluding children with reported intakes above the 90th percentile for each group. After exclusions, there were minor reductions in intake and no change in difference observed between groups or by gender. Therefore, all further analyses were performed using data from all subjects.

Major food items, other than fruits and vegetables, were grouped into six categories:

i. Meat, eggs, poultry and fish (MEPF) *(including all eggs, roast meats, steak, lamb/mutton/pork chops, boiled and tinned corned beef/silverside, mince, liver, bacon/ham, chicken, fish, fish pie/cake/fingers, tinned fish, shellfish and other similar items).*

ii. Breads, rice, cereal and pasta (BREADS) *(including all breads, buns, rice, breakfast cereals, pasta and other similar items).*

iii. Dairy foods (DAIRY) *(including ice cream, cream, milk, cheese, yoghurt and other similar items).*

iv. Convenience foods (CONVENIENCE) *(including tinned spaghetti, pizza, soup, instant noodles, and other similar items).*

v. Savoury snacks (SNACKS) *(including potato chips/corn snacks/crisps, popcorn, and crackers*

vi. Sweets, biscuits and cakes (SWEETS) *(including chocolate, candy coated chocolate and other sweets, chocolate coated/cream filled biscuits, other biscuits, muesli bars, crackers/crisp breads, cake, doughnuts/croissants, scones/muffins/sweet buns, pancakes/pikelets, fruit pie/crumble/tart, pudding, custard/custard pudding, fizzy drinks and other similar items).*

5.2 Presentation of data

For the most commonly consumed fruits, individual fruits were analysed and then grouped into 6 fruit categories and presented in pie chart form on the basis of median intakes (see section 7.5, figure 4). The categories included:

i. Apples or pears,

ii. Bananas,

iii. Oranges or mandarins,

iv. Kiwifruit and all berry fruits *(e.g. raspberries, strawberries, blueberries)*,

v. Stone fruit *(nectarines, peaches, and plums)*, and

vi. Other fruits *(e.g. pineapple, grapes, and watermelon).*

Individual vegetable items were similarly grouped into 5 vegetable categories and presented in pie chart form to illustrate the most commonly consumed vegetables in the sample of children (see section 7.5, figure 5). Vegetables groups included:

i. Salad vegetables *(tomatoes, avocado, celery, lettuce or salad greens, and cucumber),*

ii. Dark green leafy vegetables *(broccoli, cauliflower or cabbage, silver beet, spinach, puha or watercress),*

iii. Starchy vegetables *(fried potatoes, other potatoes, kumara, and taro).*

iv. Mixed vegetables *(peas, corn, carrots, and mixed vegetables)*, and

v. Other vegetables *(pumpkin, beans, and other vegetables).*

Physical activity was classified as light or moderate-to-intense. Light activities were those that involved standing, walking or non-weight bearing exercise such as riding a bicycle, delivering pamphlets, housework, and playing cricket or games outdoors with friends. Moderate-to-intense activities included were those that involved more vigorous exercise such as team sports (e.g. netball, rugby, soccer, and touch rugby), tennis, dancing and running.

5.3 Statistical analysis

Statistical analyses were conducted using SPSS version 11.0 for Windows (SPSS, Inc., Chicago, IL, USA). Initially descriptive statistics and frequency distributions were used to examine for skewness. Data were analysed using non-parametric statistical tests. Between group comparisons of dietary intakes were made using Mann Whitney tests. Data are presented as median (Q1, Q4) unless otherwise stated in the text. For categorical

variables, associations were investigated using cross-tabulation and Chi-square statistics. Comparisons between dietary intake in Whangarei children and dietary data from the CNS02 were made using Chi-square tests performed on absolute values. Associations between variables were also determined using the Spearman rank correlation co-efficient (rs). Significance levels were two-sided and $P=0.05$ was used as the cut off for assessing statistical significance.

6. RESULTS

6.1 Characteristics of sample

Ninety-four children volunteered and completed assessments: forty-one control subjects from two schools (Kamo primary $n = 33$ and St Francis Xavier $n = 8$) and 53 intervention subjects from three schools (Hurupaki $n = 24$, Whau Valley $n = 11$ and Onerahi $n = 18$). One intervention subject was excluded from the analysis of the FFQ measurements due to extreme and improbable recorded intakes of all foods. Therefore, statistical analyses are based on 93 subjects.

The children were mostly New Zealand European (72%). Other ethnic groups represented by the children were Māori (16%), Pacific Islander (3%), and Asian and others (9%). Within the whole group, forty-four percent of children were from households earning more than $50,000 annually, while twelve percent were from households earning $20, 000 or less. Thirty-six percent of families spent more than $200 on the weekly food bill, and eight percent spent $100 or less. Annual income was positively correlated with the amount of money spent on food on a weekly basis (r_s: 0.48, n=59, $P<0.01$). Seventy-three percent of parents who completed the questionnaire had gained higher than secondary school education or qualifications, while 67% of their partners had also gained higher than secondary school education/qualifications. There were no significant differences in parental income or education between intervention groups. Demographic characteristics as reported by those parents or guardians who completed questionnaires are shown in Table 3.

Overall, there were similar numbers of boys (49%) and girls (51%) in the whole sample, and an even number of boys in intervention (50%) and control groups (50%), but non-significantly more girls in the intervention (62%) than the control group (38%) ($P=0.26$). Boys were on average two centimeters taller (mean height ± SD for boys: 1.45 ± 0.06 cm, and for girls: 1.43 ± 0.06 cm; $P=0.23$) and about one kilogram lighter than girls

though the differences were not significant (mean weight ± SD for boys 37.78 ± 6.96 kg, and for girls: 38.77 ± 9.26 kg; *P=0.56*). A higher percentage of girls than boys (21% vs. 9%, *P=0.16*) were overweight or obese and fewer girls than boys (68% vs. 80%, *P=0.26*) exercised or played sport regularly outside of school activities. The differences in weight status and physical activity between genders were not statistically significant.

Eighty-five percent of the children sampled were found to be in a healthy weight range for their age according to BMI standards (Cole et al, 2000). The average BMI for the whole group of children was 18.3m²/kg (± 2.85) (Table 4). Seventy-four percent of children reported being physically active or participating in sport outside of school activities. In comparison to children in the control group, five percent more children in the intervention group were overweight or obese and 11% fewer children in this group were regularly active or played sport outside of school activities, though there were no significant differences between groups. Table 4 shows the characteristics of the sample in terms of anthropometric measurements.

Table 3: Parent demographics

	Total (n=59)	*Control (n=26)*	*Intervention (n=33)*	*P values*
Average children in household (n)[1]	2.72 ± 0.90	2.85 ± 1.05	2.58 ± 0.75	(0.25)
Education of 1st parent (%) [2]	73	69	78	(0.58)
Education of 2nd parent (%) [2]	67	50	53	(0.86)
Family income per year (%)				
≤$10,000	3	0	6	
$10,001-$30,000	20	27	15	
$30,001-$50,000	27	23	30	
> $50,000	44	46	42	(0.63)
Weekly food bill (%)				
≤$100	8	4	12	
$101-$200	56	54	58	
>$200	36	42	30	(0.61)

[1] Mean values ± SD

[2] Percentage of parents who gained higher than secondary school education/qualifications

Between group comparisons by Chi-square and independent t-tests

Table 4: Sample characteristics

	Total	*Control*	*Intervention*	*P values*
Number of children (n)	93	41	52	(0.25)
Boys (n)	46	23	23	(n/a)
Girls (n)	47	18	29	(0.26)
Height (m)[1]	1.44 ± 0.62	1.45 ± 0.06	1.44 ± 0.06	(0.82)
Weight (kg)[1]	38.28 ± 8.17	38.06 ± 7.70	38.46 ± 8.59	(0.50)
BMI (kg/m^2)[1]	18.30 ± 2.85	18.08 ± 2.67	18.47 ± 3.01	(0.51)
Overweight (%)	15	12	17	(0.70)
Exercisers (%)	74	80	69	(0.32)

[1] Mean values ± SD

Between group comparisons determined by Chi-squared and independent t-tests

6.2. Fruit and vegetable intakes in all children

The reported median daily intakes of fruit and vegetables for the sampled children were fruit: 2.77 (1.63, 4.25) times/day (t/d), vegetables: 5.91 (2.86, 7.91) t/d, and combined fruit and vegetables (FV): 8.25 (5.46, 11.12) t/d.

6.2.1 Effect of physical activity on fruit and vegetable intakes in the whole sample

In the whole cohort there were no significant differences in fruit (*P=0.62*), vegetable (*P=0.56*), and combined fruit and vegetable (*P=0.59*) intakes between children who exercised regularly (EX) and those who did not (NEX). Median intakes were: fruit NEX=3.24 (1.58, 5.66), EX= 2.71 (1.63, 4.03) t/d; vegetables NEX=7.20 (4.50, 9.50), EX= 5.55 (2.78, 7.62) t/d; and combined fruit and vegetables NEX=9.70 (5.62, 14.79) EX=7.76 (5.38, 10.82) t/d.

6.2.2 Effect of weight status on fruit and vegetable intakes in the whole sample

Reported intakes of fruit (*P=0.77*), vegetables (*P=0.15*), and combined fruit and vegetables (*P=0.21*) did not differ significantly between children who were overweight or obese (OO) and those who were not (NW). The median intakes were: fruit NW=2.77 (1.63, 4.41), OO=2.60 (1.50, 3.84) t/d; vegetables NW=5.99 (2.97, 8.05), OO=4.73 (2.47, 6.48) t/d; and combined fruit and vegetables NW=8.76 (5.48, 11.53), OO=6.81 (5.08, 9.33) t/d.

6.3 Fruit and vegetable intakes in control and intervention groups

The average daily fruit and vegetable intakes for both control and intervention groups were above recommended daily intakes and were not significantly different between groups (fruit *P=0.28*, vegetables *P=0.54*, and combined fruit and vegetables *P=0.67*) (see Table 5). Figures 1, 2, and 3 show the intake frequencies for fruits, vegetables, and combined fruits and vegetables respectively, comparing children in each study group. The figures illustrate intake patterns for both intervention and control group children across the range of daily intakes.

Analysis of fruit and vegetable intakes between control and intervention groups, after stratifying each group by gender, also revealed no significant intake differences for either boys or girls (Table 5).

Table 5: Fruit and vegetable intakes for the whole sample and according to gender in control and intervention groups

	Fruit intake			***Vegetable intake***			***Fruit and vegetables***		
	25th	***Median***	***75th***	***25th***	***Median***	***75th***	***25th***	***Median***	***75th***
Group									
Control *(n=41)*	1.63	2.84	4.03	3.12	5.92	7.80	5.46	8.18	10.98
Intervention *(n=52)*	1.23	2.74	4.47	2.63	5.86	8.02	5.19	8.37	11.45
(P value)		(0.78)			(0.54)			(0.67)	
Females									
Control (n=18)	1.63	2.28	3.50	3.23	5.80	7.60	5.62	7.93	10.49
Intervention (n=29)	0.99	2.71	4.20	2.46	6.11	8.06	5.36	7.49	11.87
(P value)		(0.88)			(0.95)			(0.96)	
Males									
Control (n=23)	2.06	3.07	5.00	2.81	6.12	8.05	5.40	8.76	12.48
Intervention (n=23)	1.76	2.77	4.71	2.70	4.35	7.92	4.88	9.32	11.20
(P value)		(0.95)			(0.46)			(0.64)	

Between group comparisons by Mann-Whitney tests

Figure 1: Frequency of fruit intake by children in control and intervention groups

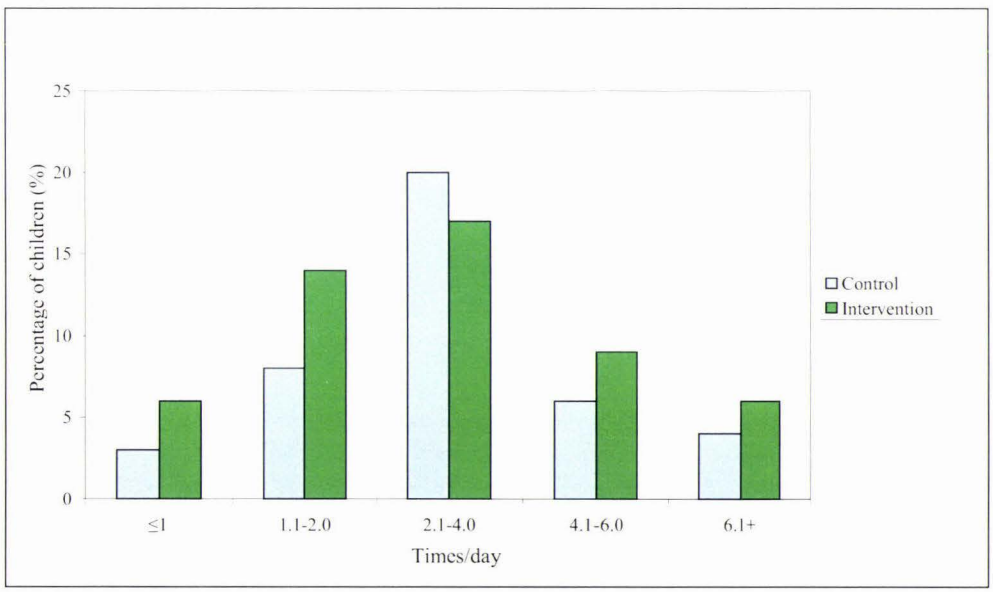


Figure 2: Frequency of vegetable intake by children in control and intervention groups

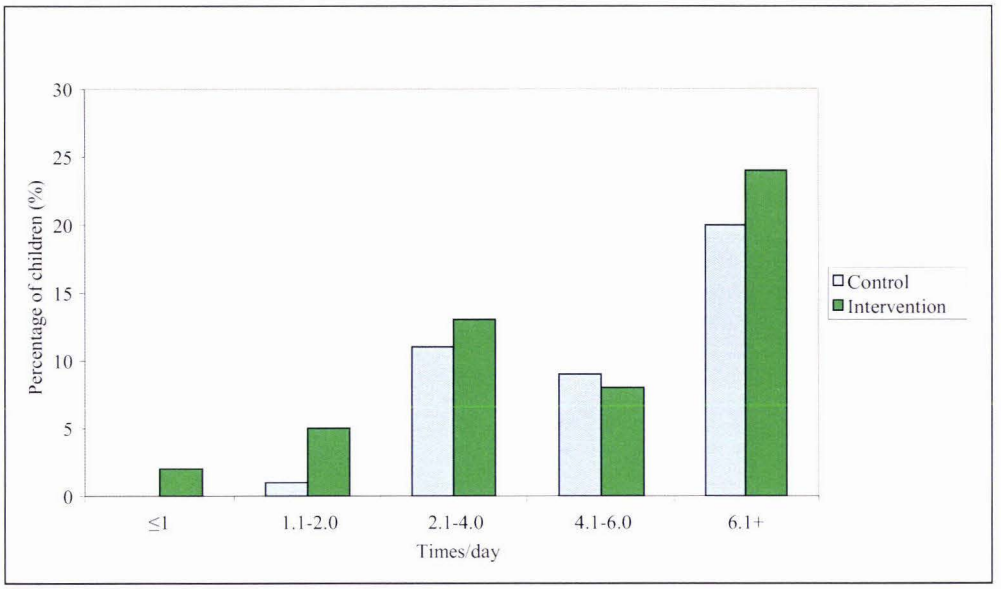
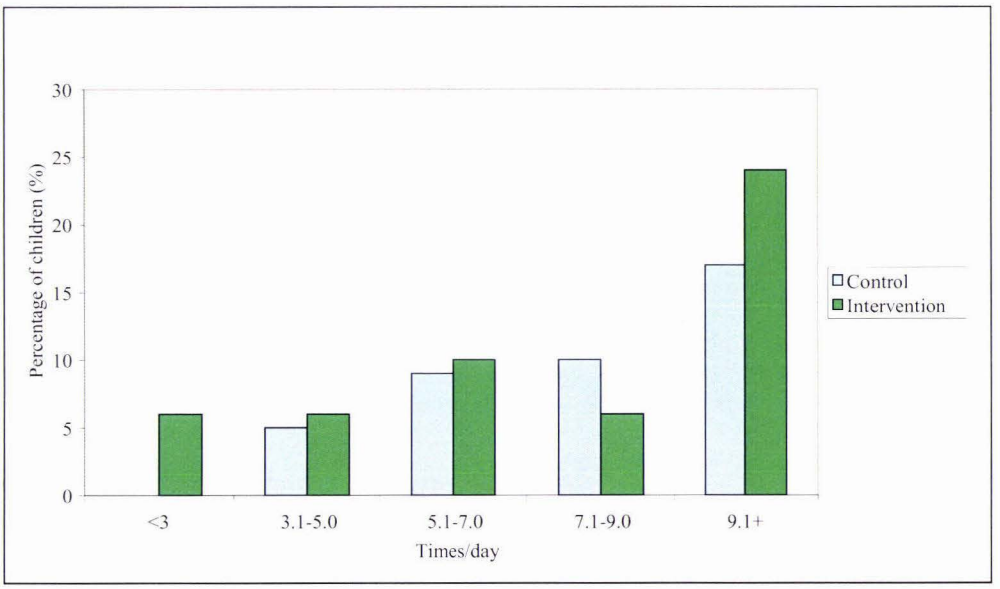


Figure 3: Frequency of combined fruit and vegetable intake of children in control and intervention groups



6.3.1 Effect of physical activity on fruit and vegetable intakes in each study group

Table 6 shows the reported intake of fruits and vegetables in control and intervention children grouped by physical activity levels. In those children who took part in exercise outside of school (EX), there were no significant intake differences between control and intervention groups. However, in children who were not regularly active outside of school (NEX), those from the intervention group reported consuming fruit *($P \leq 0.05$)* significantly more frequently than those in the control group (Table 6).

There were no significant between group differences in fruit and vegetable intakes of children who exercised regularly at a light intensity level, though intervention group children reported consuming all three dietary variables more frequently than did control group children. The number of children in this activity category was small and thus reliability of such tests is limited. There was, however, a significant difference between groups for fruit *($P=0.04$)*, vegetable *($P=0.03$)* and combined fruit and vegetable *($P=0.02$)* intakes in children who exercised regularly at a moderate-intense effort level, whereby control group children consumed more of each dietary variable (Table 6).

Table 6: Fruit and vegetable intakes in control and intervention groups, according to level of physical activity

Exercise status	*Fruit intake*			*Vegetable intake*			*Fruit and vegetables*		
	25th	*Median*	*75th*	*25th*	*Median*	*75th*	*25th*	*Median*	*75th*
Extra activity[1]									
Control group (n=33)	2.10	2.98	4.25	2.81	6.07	7.87	5.56	8.18	11.29
Intervention group (n=36)	1.14	2.45	3.71	2.63	4.34	6.63	4.92	7.03	9.76
(P value)		(0.10)			(0.15)			(0.13)	
Light activity[2]									
Control group (n=6)	1.81	2.07	4.01	2.77	3.76	7.71	5.16	5.97	11.01
Intervention group (n=5)	3.07	3.49	5.43	2.86	5.59	8.37	7.13	10.09	11.59
(P value)		(0.17)			(0.73)			(0.31)	
Mod-intense activity[3]									
Control group (n=27)	2.06	2.85	4.21	3.97	6.13	8.05	7.49	8.76	12.48
Intervention group (n=31)	1.09	1.92	3.63	2.30	4.34	6.27	4.45	6.76	9.45
(P value)		(0.04)*			(0.03)*			(0.02)*	
No activity†									
Control group (n=8)	1.08	1.88	3.09	4.50	5.8	7.47	5.42	7.90	9.38
Intervention group (n=16)	1.87	3.88	6.54	3.61	7.91	12.59	6.67	11.66	19.46
(P value)		(0.05)*			(0.22)			(0.11)	

[1] Subjects who take part in physical activity/exercise in addition to what is performed at school (i.e., extra activity).

[2] Extra activity of light intensity (e.g., walking, riding a bicycle, housework, playing outside with friends)

[3] Extra activity of moderate-to-intense level (e.g. netball, soccer, rugby, running, dancing)

† Subjects who do not take part in physical activity/exercise in addition to what is performed at school.

* $P \leq 0.05$, between group comparisons determined by Mann-Whitney test

Comparing fruit and vegetable intakes according to exercise status (NEX vs. EX) within the control group, showed no significant intake differences (fruit *P=0.08*, vegetables *P=0.97*, and combined fruit and vegetables *P=0.66*). In contrast, in the intervention group NEX children reported consuming fruit (P=0.05), vegetables *(P=0.02)* and combined fruit and vegetables *(P=0.01)* more frequently than did the more active EX children. The differences in fruit and vegetable intakes in NEX intervention children were

not accompanied by a greater overall intake of 'other' food categories described in section 6.1.

6.3.2 Effect of weight status on fruit and vegetable intakes in each study group

Reported dietary intake of fruits and vegetables in control and intervention children grouped according to weight status are shown in Table 7. In both the normal weight (NW), and the overweight or obese (OO) categories, there were no statistically significant differences in intake between control and intervention groups (*P* values for fruit = *0.86*, vegetables = *0.50*, and combined fruit and vegetables = *0.69*). However, these results may not be reliable due to the small number of subjects in each weight category.

Table 7: Fruit and vegetable intakes in control and intervention groups, according to weight status

	Fruit intake			*Vegetable intake*			*Fruit and vegetable intake*		
Weight status	*25th*	*Median*	*75th*	*25th*	*Median*	*75th*	*25th*	*Median*	*75th*
Non-overweight									
Control (n=36)	1.63	2.74	4.17	3.62	6.09	8.02	5.53	8.21	11.41
Intervention (n=43)	1.35	2.77	4.49	2.70	5.76	8.07	4.88	9.27	11.53
(P value)		(0.86)			(0.50)			(0.69)	
Overweight/obese[1]									
Control (n=5)	1.99	2.85	3.96	2.53	3.96	6.49	4.52	8.18	9.66
Intervention (n=9)	1.02	2.21	4.46	2.26	5.96	6.56	5.36	6.76	10.13
(P value)		(0.74)			(0.84)			(0.95)	

[1] Subjects categorized as overweight or obese according to BMI standards for 2-18yrs (Cole et al, 2000)

Difference between groups determined by Mann-Whitney test

6.4 Fruit and vegetable intakes in boys and girls

Table 8 shows the reported dietary intake of fruit and vegetables stratified by gender in the whole sample, and with control and intervention groups separately. Overall, boys had slightly higher fruit and combined fruit and vegetable intakes than girls did, but not significantly so (*P=0.11* and *P=0.48* respectively).

In the control group boys reported higher intakes of all three dietary variables than the girls, however, the differences were not significant (*P=0.27* for fruit, *P=0.73* for vegetables and *P=0.55* for combined fruit and vegetables). The boys in the intervention group also reported consuming fruit and combined fruit and vegetables slightly more frequently than the girls, but these did not achieve statistical significance (*P=0.24* for fruit, *P=0.96* for vegetables and *P=0.75* for combined fruit and vegetables) (Table 8).

Table 8: Fruits and vegetable intakes in boys and girls

	Fruits			***Vegetables***			***Fruits and vegetables***		
	25th	***Median***	***75th***	***25th***	***Median***	***75th***	***25th***	***Median***	***75th***
All subjects									
Females (n=47)	1.35	2.42	3.79	2.90	5.99	7.91	5.67	7.67	10.92
Males (n=46)	1.87	2.92	4.78	2.80	5.52	7.96	5.39	9.13	11.53
(P value)		(0.11)			(0.88)			(0.48)	
Control									
Females (n=19)	1.63	2.28	3.50	3.23	5.80	7.60	5.62	7.93	10.49
Males (n=23)	2.06	3.07	5.00	2.81	6.12	8.05	5.40	8.76	12.48
(P value)		(0.27)			(0.73)			(0.55)	
Intervention									
Females (n=29)	0.99	2.71	4.20	2.46	6.11	8.06	5.36	7.49	11.87
Males (n=23)	1.76	2.77	4.71	2.70	4.35	7.92	4.88	9.32	11.20
(P value)		(0.24)			(0.96)			(0.75)	

Difference between genders determined by the Mann-Whitney test

6.4.1 Effect of physical activity on fruit and vegetable intakes in boys and girls

Boys who were not active outside of school reported consuming more fruit, vegetables, and combined fruit and vegetables than girls who had similar activity, though the differences were not significant (see Table 9). Additionally, no significant differences were observed in fruit and vegetable intakes between boys and girls who were active.

Analysis of fruit and vegetable intakes between NEX and EX girls in the whole sample revealed no significant differences (P values for fruit = 0.38, vegetables = 0.28, and combined fruit and vegetables = 0.24). Similarly the intakes of fruits (*P=0.53*), vegetables (*P=0.06*) and combined fruits and vegetables (*P=0.16*) did not differ significantly between NEX and EX boys.

Table 9: Fruit and vegetable intakes in girls and boys, according to exercise

	Fruits			*Vegetables*			*Fruits and vegetables*		
Exercise status	*25th*	*Median*	*75th*	*25th*	*Median*	*75th*	*25th*	*Median*	*75th*
Non-exercisers									
Girls (n=13)	1.57	3.07	3.98	3.33	6.85	8.19	6.09	9.10	12.75
Boys (n=11)	1.28	4.49	7.71	4.51	7.92	12.18	5.39	12.4	20.53
(P value)		(0.44)			(0.27)			(0.36)	
Exercisers									
Girls (n=34)	1.23	2.32	3.76	2.84	5.86	7.30	5.41	7.32	10.89
Boys (n=35)	1.91	2.84	4.32	2.73	5.05	7.76	5.28	8.76	10.82
(P value)		(0.13)			(0.92)			(0.49)	

Difference between genders determined by the Mann-Whitney test

6.4.2 Effect of weight status on fruit and vegetable intakes in boys and girls

Normal weight boys had slightly higher intakes of fruit (*P=0.12*) and combined fruit and vegetables (*P=0.62*) than normal weight girls, but the differences were not significantly different (Table 10).

Table 10: Fruit and vegetable intakes in girls and boys, according to weight status

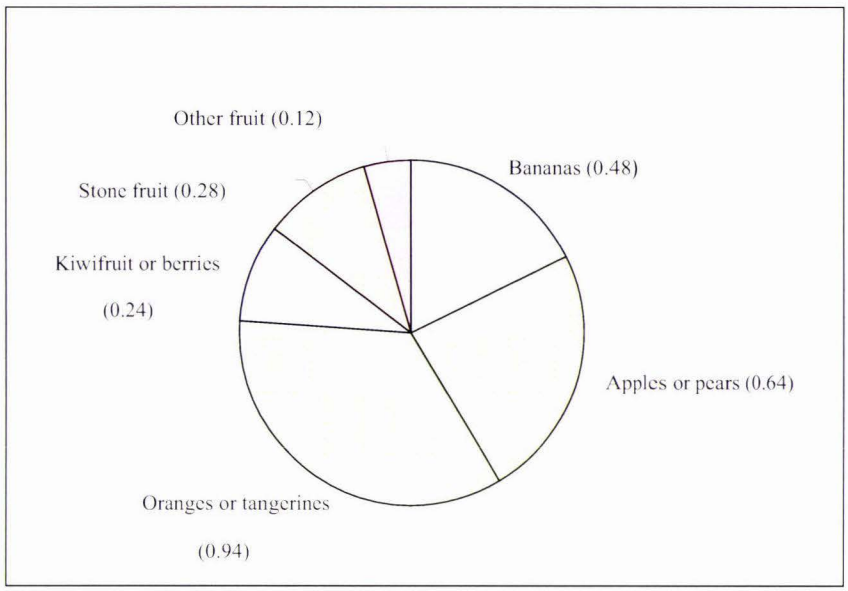
	Fruits			*Vegetables*			*Fruits and vegetables*	
Weight status	***25th***	***Median***	***75th***	***25th***	***Median***	***75th***	***25th***	***Median***	***75th***
Non-overweight									
Girls (n=37)	1.27	2.42	3.88	3.12	6.07	8.07	5.58	8.25	11.44
Boys (n=42)	1.87	2.92	4.78	2.93	5.64	7.96	5.44	9.30	11.53
(P value)		(0.12)			(0.89)			(0.62)	
Overweight/obese									
Girls (n=10)	1.45	2.53	3.84	2.47	4.96	6.48	5.53	6.81	8.84
Boys (n=4)	1.43	2.93	5.59	1.91	4.12	8.65	3.34	7.05	14.24
(P value)		(0.67)			(0.78)			(1.00)	

Difference between genders determined by the Mann-Whitney test

6.5 Dietary patterns for the whole cohort – the most commonly consumed fruits and vegetables

There were no statistically significant differences in the most commonly consumed fruit and vegetables between control and intervention groups or between boys and girls. Figures 4 and 5 present the most commonly consumed fruit and vegetables for the whole sample, determined by the highest median frequency of intake. Fruit items consumed most often were oranges or tangerines, apples or pears, and bananas. The most frequently consumed vegetable items were mixed vegetables, dark green leafy vegetables, and starchy vegetables (refer to section 6.2 for the vegetable items included in each category).

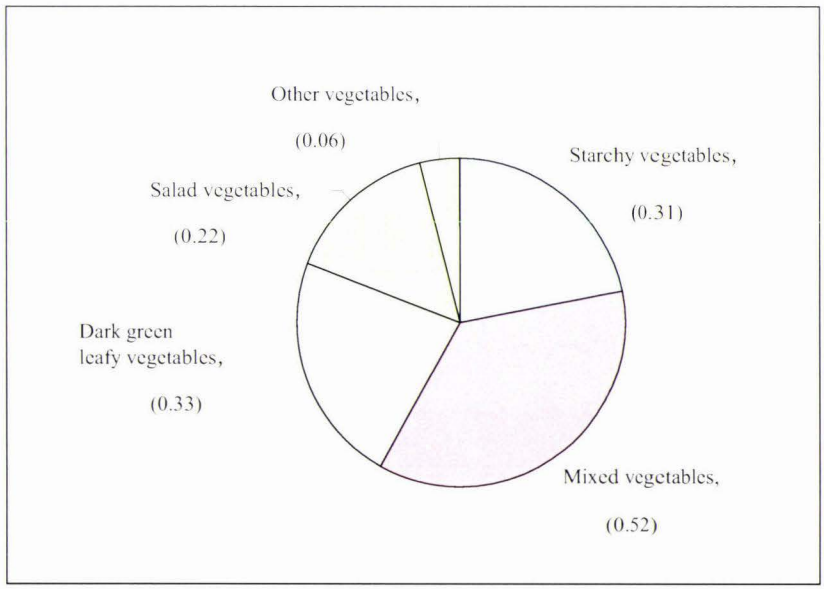
Figure 4: The most commonly consumed fruit by all children



† Numbers in brackets indicate median frequency (times/d) of the summed intake of individual or grouped fruit intakes by all children.

‡ Stone fruit include nectarines, peaches, plums and/or apricots.

Figure 5: The most commonly consumed vegetables by all children



† Numbers in brackets indicate median frequency (times/d) of the summed intake of grouped vegetable intakes by all children.

6.5.1 Intakes of food items other than fruit and vegetables in the whole cohort

The median intake frequencies of 'other' food categories for all children are shown in Table 11. In the whole sample, there were no significant intake differences between control and intervention groups for the six 'other' food categories (MEFP *P=0.19*, BREADS *P=0.25*, DAIRY *P=0.89*, CONVENIENCE *P=0.31*, SNACKS *P=0.48*, and SWEETS *P=0.18*) (Table 11).

Overall, the reported intakes of 'other' food categories did not differ significantly between boys and girls (Table 12). In addition, further analysis of the six individual food categories between groups for both boys and girls did not reveal any significant intake differences.

Table 11: Intakes of 'other' food categories in the whole cohort

	Whole sample (n=93)			*Control group (n=41)*			*Intervention group (n=52)*			
Food category	*25th*	*Median*	*75th*	*25th*	*Median*	*75th*	*25th*	*Median*	*75th*	*(P values)*
MEFP	1.39	2.41	4.06	1.79	2.69	4.09	1.08	2.23	3.99	(0.19)
BREADS	1.25	2.28	3	1.07	1.5	2.11	1.21	1.75	2.5	(0.25)
DAIRY	1.26	2.69	4.03	1.28	2.78	4.06	1.15	2.63	3.96	(0.89)
CONVEN	0.41	0.64	1.2	0.44	0.76	1.14	0.27	0.5	1.2	(0.31)
SNACKS	0.35	1	1.21	0.31	0.92	1.14	0.37	1	1.26	(0.48)
SWEETS	1.99	3.01	4.82	1.9	3.33	5.3	2.03	2.71	4.72	(0.18)

Between group comparisons determined by the Mann-Whitney test

Refer to section 6.1 for the food items included in each category

Table 12: Intake of 'other' food categories, according to gender

	Boys (n=46)			*Girls (n=47)*			
Food category	*25th*	*Median*	*75th*	*25th*	*Median*	*75th*	*(P value)*
MEFP	1.37	2.21	3.77	1.39	2.69	4.12	(0.49)
BREADS	1.21	1.71	2.52	1.07	1.5	2.29	(0.31)
DAIRY	1.28	2.66	4.08	1.21	2.78	3.99	(0.76)
CONVENIENCE	0.21	0.7	1.01	0.41	0.64	1.21	(0.36)
SNACKS	0.71	1.27	2.3	0.56	1.06	2.41	(0.71)
SWEETS	1.12	1.97	3.69	1.21	2.24	3.61	(0.76)

Between gender comparisons determined by the Mann-Whitney tests

Refer to section 6.1 for the food items included in each category

6.5.2 Effect of physical activity on the intake of other food categories

In the whole sample, exercise status did not affect the intake of other food groups. There were no differences in the intake of 'other' food categories between children who exercised regularly (outside of school activities), and those who did not (Table 13). Additionally, for those children who were active, the intake of 'other' food groups did not differ in respect to the type of activity performed (Table 14).

Table 13: Intake of 'other' food categories according, to exercise status

Food category	*No exercise (n=24)*			*Regular exercise (69)*			
	25th	*Median*	*75th*	*25th*	*Median*	*75th*	*P value*
MEFP	1.44	2.37	4.00	1.39	2.38	3.92	(0.86)
BREADS	1.28	1.68	2.95	1.07	1.63	2.25	(0.25)
DAIRY	1.23	2.28	4.23	1.17	1.86	2.38	(0.49)
CONVENIENCE	0.23	0.42	0.78	0.25	0.50	0.92	(0.25)
SNACKS	0.50	1.07	1.50	0.35	1.00	1.28	(0.44)
SWEETS	2.14	3.40	5.89	2.03	3.10	4.61	(0.95)

Between group comparisons determined by the Mann-Whitney tests

Refer to section 6.1 for the food items included in each category

Table 14: Intake of 'other' food categories according to exercise intensity

Food category	*Light exercise (n=12)*			*Moderate-intense (n=57)*			*(P value)*
	25th	*Median*	*75th*	*25th*	*Median*	*75th*	
MEFP	1.37	2.16	3.53	1.33	2.49	4.16	(0.55)
BREADS	1.07	1.46	2.45	1.10	1.67	2.19	(0.99)
DAIRY	0.91	2.1	3.99	1.48	2.78	3.64	(0.44)
CONVENIENCE	0.3	0.53	1.19	0.48	0.77	1.21	(0.69)
SNACKS	0.30	0.78	1.05	0.50	1.03	1.28	(0.19)
SWEETS	0.95	2.64	3.64	2.07	3.17	4.78	(0.09)

Between group comparisons determined by Mann-Whitney tests

Refer to section 6.1 for the food items included in each category

6.5.3 Effect of weight status on the intake of other food categories

Reported intakes of the other major food categories did not differ between children who were overweight or obese and those who were not. The median intake frequencies for each weight group are shown in Table 15.

Table 15: Intake of 'other' food categories according to weight status

	Non-overweight (n=79)			*Overweight or obese (n=14)*			
	25th	*Median*	*75th*	*25th*	*Median*	*75th*	*(P value)*
MEFP	1.39	2.49	4.26	1.33	1.87	3.42	(0.14)
BREADS	1.21	1.71	2.5	0.97	1.57	2.00	(0.25)
DAIRY	1.26	2.63	3.99	1.02	3.02	4.22	(0.65)
CONVENIENCE	0.41	0.70	1.20	0.28	0.49	1.04	(0.48)
SNACKS	0.35	1.00	1.21	0.33	0.82	1.17	(0.86)
SWEETS	2.01	3.01	4.83	1.61	2.94	4.88	(0.66)

Between weight group comparisons determined by the Mann-Whitney test

6.6 Dietary intakes in Whangarei schoolchildren & comparisons with the National Survey

Significantly more children from the present study consumed the Ministry of Health's recommended fruit and vegetable intakes (at least two servings of fruit and at least three servings of vegetables) (MOH, 1998) compared to the CNS02 (67% vs. 43% for fruit, 72% vs. 57% for vegetables, both $P \leq 0.01$). The percentage of children consuming less than one portion of fruit daily in this study was almost half that reported in the national survey (12% versus 23%) ($P \leq 0.01$). Tables 16, 17 and 18 (a and b) present the percentage of children who consumed fruits (Table 16), vegetables (Table 17), and other food items (Tables 18 a and b) one or more times per week and the equivalent data from the CNS02.

Fruits and vegetables that were consumed significantly more frequently in the sampled Whangarei children than in the National survey were: oranges or mandarins, stone fruits, berry fruits, and dried fruits (all $P \leq 0.01$), green beans, mixed vegetables, peas, kumara, lettuce or green salad (all $P \leq 0.01$), broccoli ($P = 0.03$), capsicum and avocado (both $P = 0.02$). The Whangarei children's reported intakes of other food items were more similar to those from the CNS02 (Tables 18a and 18b); however, there were a number of significant differences observed in the consumption of high fat energy dense foods. In this study, children reported consuming sausages, bacon or ham, burgers, pizza, chocolate and energy drinks (all $P \leq 0.01$) more frequently than did the National Survey participants. Additionally, Whangarei children also consumed reduced fat and extra calcium milks more frequently (both $P \leq 0.01$), and full-fat milk, chicken and bread (all $P \leq 0.01$) less frequently than children in the CNS02.

Food and beverage items consumed more frequently by Whangarei girls included stone fruit, berries, mixed vegetables, avocado, pizza and low fat milk (all $P \leq 0.01$), kumara, green beans, cauliflower, energy drinks and extra calcium milk (all $P \leq 0.05$); while full fat milk and chicken (both $P \leq 0.01$) were consumed less frequently than those in the CNS02. In Whangarei boys, individual food and beverage items that were consumed more frequently included oranges or mandarins, stone fruit, dried fruit and berries, kumara and mixed

vegetables, burgers, bacon or ham, pizza, chocolate and energy drinks (*all $P \leq 0.01$*), bananas, fried potatoes, corn, peas, green beans, meat pies, sausages and luncheon (all *$P \leq 0.05$*). Whangarei boys were also more likely to consume the recommended fruit and vegetable intakes (both $P \leq 0.01$) than boys in the CNS02.

Table 16: Intakes of individual fruits items[a] – comparisons with CNS02†

	WHG children 10 yrs	*CNS02 children 5-14yrs*	*(P value)*	*WHG Boys 10yrs*	*CNS02 Boys 7-11yrs*	*(P value)*	*WHG Girls 10yrs*	*CNS02 Girls 7-11yrs*	*(P value)*
Food Type	%	%		%	%		%	%	
Fruit servings[1] < 1/day	12	23	(≤0.05)*	7	23	(≤0.05)*	17	20	(0.77)
Fruit servings[2] 2+/day	67	43	(≤0.01)**	73	42	(≤0.01)**	60	47	(0.13)
Banana, raw	72	63	(0.09)	85	67	(≤0.05)*	60	64	(0.65)
Apple or pears	86	83	(0.53)	91	85	(0.34)	81	88	(0.23)
Oranges or mandarins	81	67	(≤0.01)**	85	65	(≤0.01)**	77	69	(0.35)
Kiwifruit	29	24	(0.32)	35	22	(0.07)	23	24	(1.00)
Nectarines, peaches, plums or apricots	50	22	(≤0.01)**	50	20	(≤0.01)**	49	24	(≤0.01)**
Strawberries or other berries	46	18	(≤0.01)**	46	17	(≤0.01)**	47	22	(≤0.01)**
Canned or cooked fruit	57	39	(≤0.01)**	50	39	(0.19)	43	39	(0.74)
Dried fruit	40	24	(≤0.01)**	50	23	(≤0.01)**	30	26	(0.69)
Other fruit	20	14	(0.11)	15	12	(0.67)	26	15	(0.09)

CNS02 Data from the 2002 National Children's Nutrition Survey (MOH, 2003)

WHG Data from Whangarei schoolchildren

[a] Food frequency questionnaire questions 1-10.

[1] Percent of children consuming less than one serving daily of fruit.

[2] Percent of children consuming more than two servings daily of fruit.

* P≤0.05, ** P≤0.01; difference between groups determined by Chi-square test performed on absolute values

† Data shown are percentages of children consuming relevant food items at least once per week, unless otherwise stated

Table 17: Intakes of individual vegetables items[a] – comparisons with CNS02 data†

Food Type	*WHG children 10 yrs* %	*CNS02 children 5-14yrs* %	*(P value)*	*WHG Boys 10yrs* %	*CNS02 Boys 7-11yrs* %	*P value*	*WHG Girls 10yrs* %	*CNS02 Girls 7-11yrs* %	*(P value)*
All vegetable servings[1] 3+/day	72	57	(≤0.01)**	73	53	(≤0.01)**	71	56	(0.08)
All vegetable servings[2] <3+/day	28	43	(≤0.01)**	26	47	(≤0.01)**	29	44	(0.08)
Fried potatoes	73	65	(0.13)	80	65	(0.05)*	70	62	(0.33)
Other potatoes	90	87	(0.43)	91	86	(0.43)	87	87	(1.00)
Kumara	36	18	(≤0.01)**	46	18	(≤0.01)**	28	14	(0.02)*
Carrots, raw	75	79	(0.46)	73	79	(0.53)	79	86	(0.25)
Pumpkin	37	29	(0.14)	37	27	(0.20)	36	28	(0.30)
Mixed vegetables	79	58	(≤0.01)**	78	56	(≤0.01)**	79	57	(≤0.01)**
Corn	58	48	(0.07)	67	50	(0.03)*	49	47	(0.92)
Peas	74	60	(≤0.01)**	76	60	(0.04)*	72	58	(0.08)
Silverbeet, spinach, puha, or watercress	33	29	(0.43)	39	29	(0.20)	28	30	(0.86)
Green beans	44	27	(≤0.01)**	43	27	(0.03)*	45	30	(0.05)*
Broccoli	68	56	(0.03)*	63	56	(0.43)	72	61	(0.17)
Cauliflower	66	55	(0.06)	59	55	(0.73)	72	56	(0.04)*
Lettuce or green salad	65	51	(≤0.01)**	65	51	(0.09)	64	58	(0.53)
Tomatoes, raw or cooked	55	49	(0.32)	52	49	(0.80)	57	53	(0.66)
Capsicum	25	15	(0.02)*	26	15	(0.07)	23	21	(0.84)
Avocado	19	11	(0.02)*	15	11	(0.52)	23	9	(≤0.01)**
Other vegetables	17	17	(1.00)	13	17	(0.63)	21	20	(0.97)

[a] Food frequency questionnaire questions 11-20.

[1] Percent of children eating three or more servings daily of vegetables

[2] Percent of children eating less than three servings daily of vegetables

† Data shown are percentages of children consuming relevant food items at least once per week, unless otherwise stated

CNS02 Data from the National Children's Nutrition Survey 2002 (MOH, 2003)

WHG Data from Whangarei schoolchildren

* P≤0.05, ** P≤0.01 determined by Chi-square test performed on absolute values

Table 18 (a): Intakes of 'other' food items – comparisons with CNS02 data

Food Type	*WHG children 10 yrs* %	*CNS02 children 5-14yrs* %	*(P value)*	*WHG Boys 10yrs* %	*CNS02 Boys 7-11yrs* %	*(P value)*	*WHG Girls 10yrs* %	*CNS02 Girls 7-11yrs* %	*(P value)*
Breads and cereals									
Bread <daily	57	29	(≤0.01)**	59	24	(≤0.01)**	55	29	(≤0.01)**
Bread - daily	43	28	(≤0.01)**	41	?	(n/a)	45	?	(n/a)
Breakfast cereal < weekly	14	15	(0.90)	13	9	(0.52)	15	12	(0.73)
Breakfast cereal - daily	44	40	(0.50)	41	52	(0.21)	47	32	(0.05)
Meat, eggs, fish, poultry									
<1/day	12	9	(0.45)	7	7	(1.00)	17	11	(0.31)
2+/day	60	51	(0.10)	63	51	(0.15)	57	44	(0.10)
Eggs	53	62	(0.09)	54	60	(0.55)	51	61	(0.23)
Chicken	71	83	(≤0.01)**	83	87	(0.52)	60	86	(≤0.01)**
Fish	34	37	(0.69)	41	33	(0.32)	28	38	(0.21)
Meat pie	39	36	(0.67)	52	35	(0.03)*	26	30	(0.63)
Burgers	35	20	(≤0.01)**	48	20	(≤0.01)**	23	16	(0.27)
Sausages	61	45	(≤0.01)**	70	50	(0.02)*	53	43	(0.23)
Bacon or ham	61	43	(≤0.01)**	71	43	(≤0.01)**	51	42	(0.29)
Luncheon, ham or chicken	51	48	(0.71)	67	48	(0.02)*	34	43	(0.30)

WHG Data from Whangarei schoolchildren

CNS02 Data from the National Children's Nutrition Survey 2002 (MOH, 2003)

* P≤0.05, ** P≤0.01; determined by Chi-square test performed on absolute values

† Data shown are percentages of children consuming relevant food items at least once per week, unless otherwise stated

Table 18 (b): Intakes of 'other' food items – comparisons with CNS02 data

Food Type	*WHG children 10 yrs* %	*CNS02 children 5-14yrs* %	*(P value)*	*WHG Boys 10yrs* %	*CNS02 Boys 7-11yrs* %	*P value*	*WHG Girls 10yrs* %	*CNS02 Girls 7-11yrs* %	*(P value)*
Milk and dairy									
Standard milk (full-fat)	56	74	(≤0.01)**	64	80	(≤0.01)**	49	76	(≤0.01)**
Lite blue milk (low fat)	23	13	(≤0.01)**	16	11	(0.52)	29	12	(≤0.01)**
Extra calcium	11	4	(≤0.01)**	11	4	(0.07)	11	3	(0.02)*
Butter	23	25	(0.68)	22	26	(0.64)	23	25	(0.94)
Ice cream	69	64	(0.40)	72	64	(0.37)	66	63	(0.81)
Snacks, sweets, drinks									
Chocolate	55	40	(≤0.01)**	59	36	(≤0.01)**	51	39	(0.14)
Other sweets	52	48	(0.56)	54	47	(0.42)	49	45	(0.71)
Potato crisps, corn chips	76	83	(0.12)	78	85	(0.31)	74	84	(0.14)
Pizza	34	18	(≤0.01)**	41	15	(≤0.01)**	28	13	(≤0.01)**
Soft drinks	46	45	(0.90)	52	39	(0.11)	40	46	(0.55)
Energy-type drinks	19	6	(≤0.01)**	26	3	(≤0.01)**	13	4	(0.02)*

WHG Data from Whangarei schoolchildren

CNS02 Data from the National Children's Nutrition Survey 2002 (MOH, 2003)

* P≤0.05, ** P≤0.01 determined by Chi-square test performed on absolute values

† Data shown are percentages of children consuming relevant food items at least once per week, unless otherwise stated

6.7. Child nutrition knowledge and awareness

In the whole cohort, 79% of children were able to identify how many daily servings of fruit and vegetables they are recommended to eat, and 71% knew how to quantify one serving of fruit and vegetables. Ninety-two percent of all children were aware of the 5+ A Day message, and 83% the Push Play message. Less well recognised campaigns were the MOH Food and nutrition guidelines (30%) and the National Heart Foundation's 'Pick the Tick' (40%). Ninety-five percent of children associated diet with bone health, 84% associated diet with general health, 79% associated diet with overweight and 67% associated diet with heart disease, but only 44% associated diet with cancer.

6.7.1 Effect of study group on nutrition knowledge and awareness

General knowledge scores relating to nutrition and health did not differ between the control and intervention groups (mean score ± SD), CTL = 11.07 ± 2.50 and INT = 10.98 ± 3.15 (*P=0.88*). Table 19 presents the main findings from the CNKQ for each group. Eighteen percent more children in the intervention group identified the recommended serving size of fruits or vegetables, but there were no statistically significant differences between groups for any of the general knowledge questions. A greater number of children in the control group (17% more) were able to correctly identify the message promoted by the Push Play exercise campaign than in the intervention group, a difference which approached statistical significance (*P=0.06*). Awareness of the other health campaigns, however, did not differ between groups.

Table 19: Child knowledge and awareness of the relationship between health and diet - main findings from the CNKQ

	Total (n=93) (%)	*Control (n=41) (%)*	*Intervention (n=52) (%)*	*(P value)*
Nutrition Knowledge Questions[1]				
Foods you should eat the most	24	21	29	(0.64)
Foods you should eat the least	93	98	90	(0.16)
Number of fruit and vegetable servings/day	79	73	82	(0.33)
Serving size of fruits/vegetables	71	61	79	(0.13)
Awareness of health campaigns[2]				
Push Play message	83	93	76	(0.06)
Pick the Tick message	40	37	43	(0.80)
Food and Nutrition message	30	29	30	(0.90)
5+ A Day message	92	90	93	(0.95)

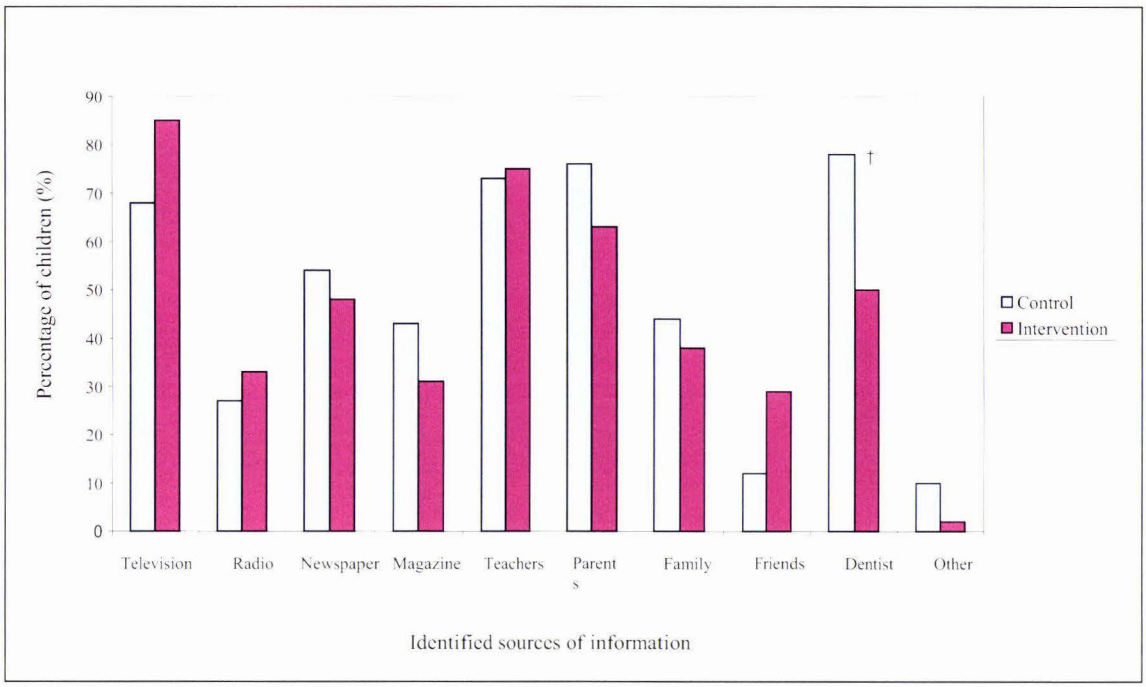
[1] Percentage of children who correctly answered the selected general nutrition knowledge questions

[2] Percentage of children who correctly identified the health messages for specific campaigns

Between group comparison determined by the Chi-squared test

Figure 6 presents the sources of nutrition information identified by children, in the control and intervention groups. Significantly more children from the control group indicated receiving information from the dentist or dental nurse than in the intervention group (*P=0.008*). For all other identified sources of information there were no statistically significant differences between control and intervention groups. The most commonly indicated sources of nutrition information for all children were television (77% of all children) teachers (74% of all children) and parents (69% of all children).

Figure 6: Where do you get nutrition information?

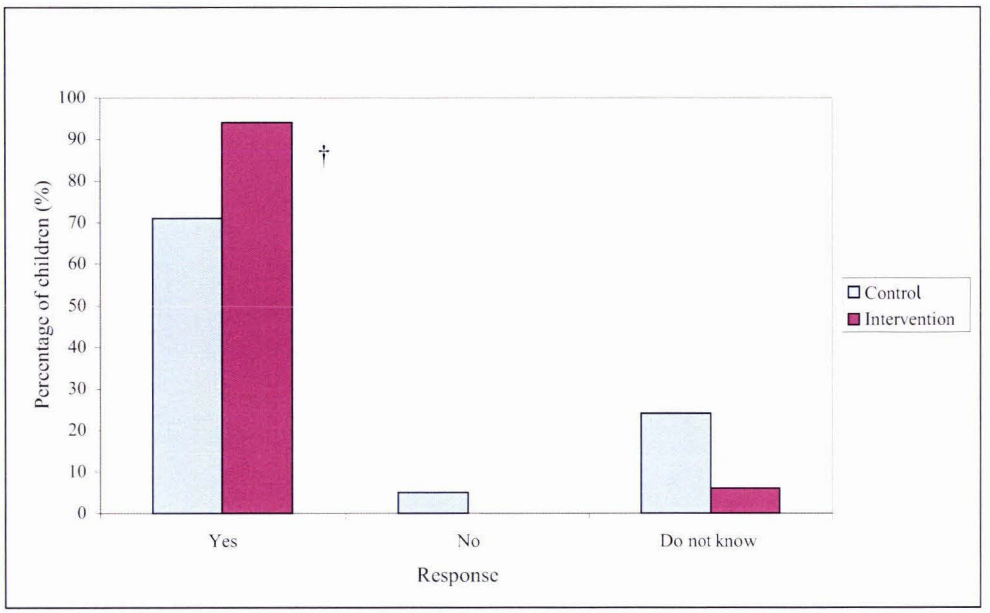


† *P≤0.01*

† Between group comparisons determined by the Chi-Squared test

Significant differences were evident between control and intervention groups in the perception of whether diet was likely to play a role in certain health conditions, as shown in figures 7a – 7e. The intervention group was more aware of the relation between diet and disease than the control group. More intervention than control group children perceived that diet 'can make you healthy' (difference=23%, *P=0.007*), that diet 'can stop you getting cancer' (difference=25%, *P=0.045*), and that diet 'can stop you getting heart disease' (difference=20%, *P=0.004*). Perceptions of whether diet has an effect on overweight and bone health did not differ significantly between groups.

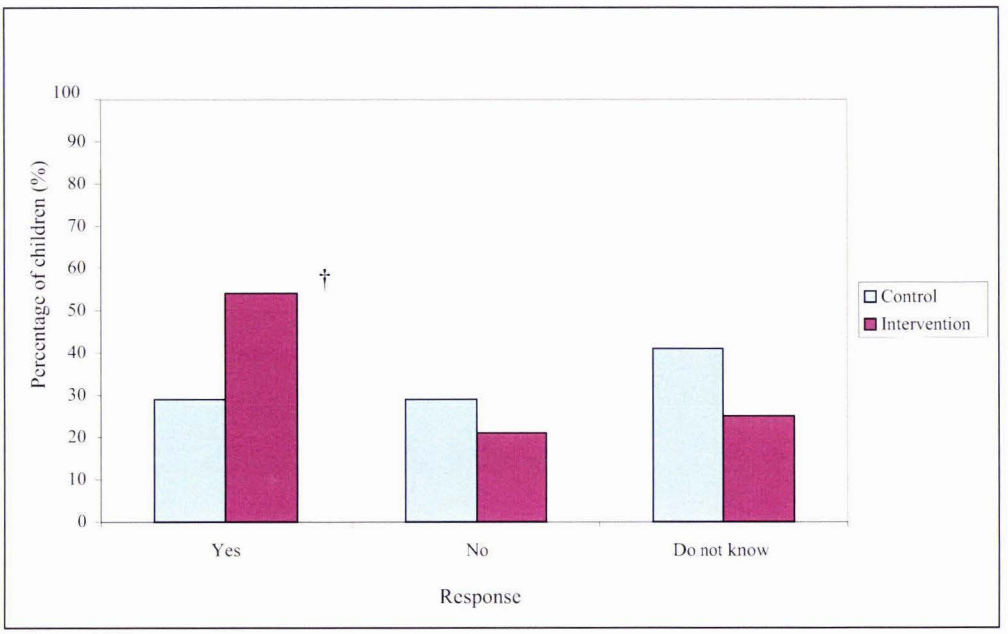
Figure 7(a): Children's responses to the question 'Can diet make you healthy?'



† *P≤0.01*

† Between group comparisons determined by Chi-Squared test

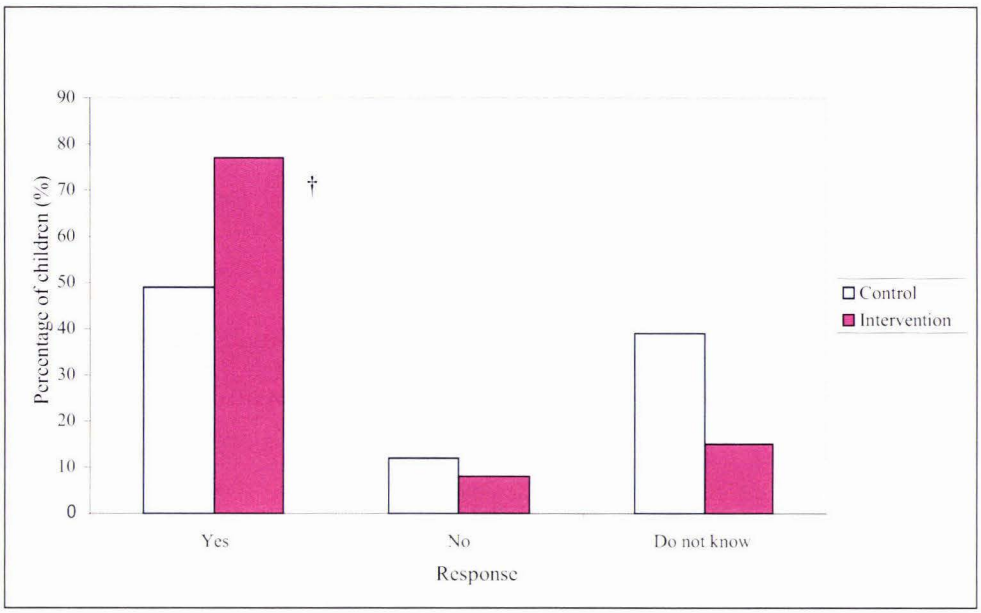
Figure 7(b): Children's responses to the question 'Can diet stop you getting cancer?'



† *P≤0.01*

† Between group comparisons determined by Chi-Squared test

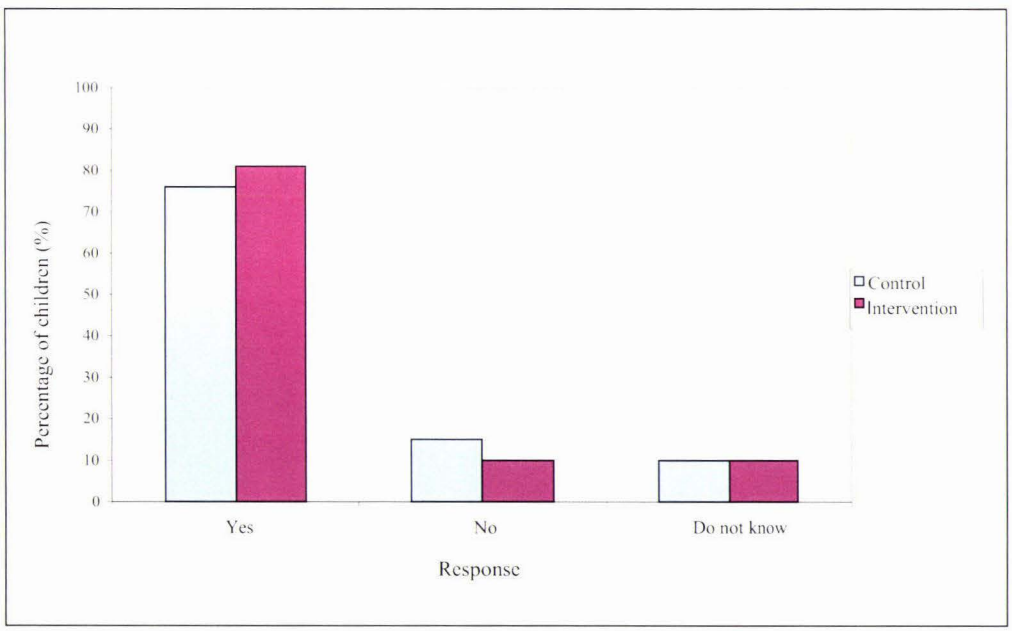
Figure 7(c): Children's responses to the question 'Can diet stop you getting heart disease?'



† *P≤0.05*

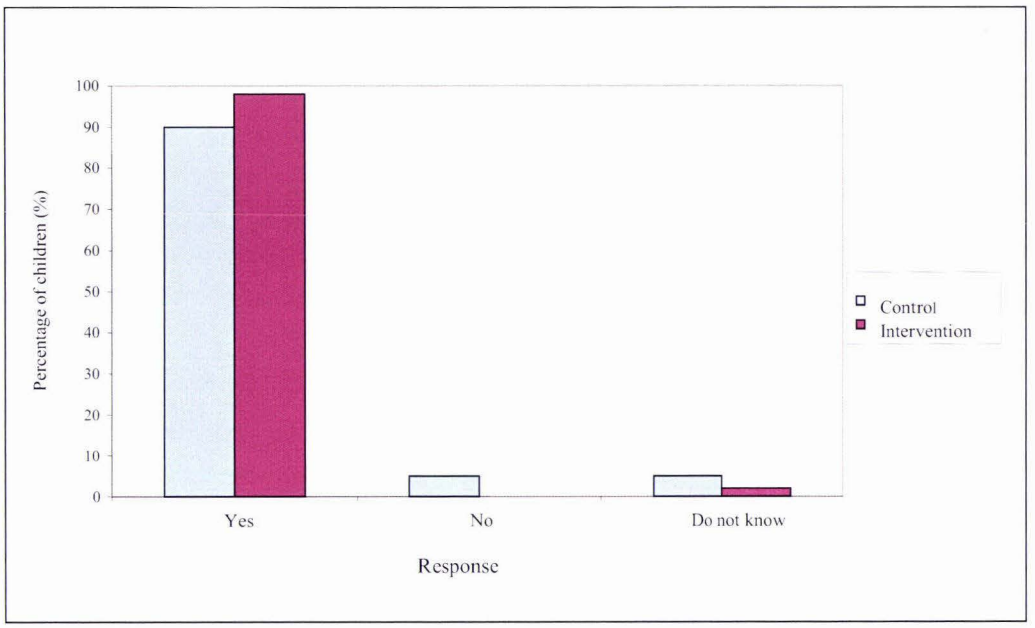
† Between group comparisons determined by Chi-Squared test

Figure 7(d): Children's responses to the question 'Can diet stop you from becoming overweight?'



No statistically significant differences between groups

Figure 7(e): Children's responses to the question 'Can diet make your teeth and bones healthy and strong?'



No statistically significant differences between groups

6.7.2 Effect of nutrition knowledge and awareness on fruit and vegetable intakes

General nutrition knowledge was not associated with fruit, vegetable or combined fruit and vegetable intakes in the whole sample. Table 20 shows the combined fruit and vegetable intakes for children who answered the general knowledge questions correctly and those who answered incorrectly. For those children that answered the general nutrition knowledge questions correctly, there were no significant differences in fruit, vegetable or combined fruit and vegetable intakes comparing control and intervention groups. Some comparisons within each study group were invalid due to small group numbers e.g. for the question "which foods should you eat the least?"

Table 20: Intake of (combined) fruits and vegetables comparing responses to general nutrition knowledge questions of the CNKQ

	Correct				*Incorrect*			
	(N)	***25th***	***Median***	***75th***	***(N)***	***25th***	***Median***	***75th***
How many servings of fruit and vegetables should we eat every day?								
Control	*(30)*	5.39	8.00	10.73	*(10)*	6.11	8.68	14.64
Intervention	*(42)*	5.53	8.71	11.61	*(9)*	5.27	9.63	13.42
Total	*(72)*	5.38	8.00	10.9	*(19)*	6.26	8.39	11.53
Which foods should you eat the most?								
Control	*(8)*	5.41	7.93	12.36	*(31)*	5.48	8.18	10.71
Intervention	*(15)*	3.74	9.04	12.69	*(37)*	5.36	8.35	11.06
Total	*(22)*	5.40	7.45	12.64	*(71)*	5.53	8.58	10.83
Which foods should you eat the least?								
Control	*(39)*	5.45	8.18	11.04	*(1)*	10.63	10.63	10.63
Intervention	*(46)*	5.53	9.30	11.61	*(5)*	6.97	8.35	10.72
Total	*(85)*	5.58	8.25	11.28	*(6)*	5.13	8.00	11.16

(N) Number of children in each group

No significant differences in total fruit and vegetable intake between study groups

In the whole cohort and within each intervention group, children who agreed with the statement that diet was associated with cancer reported higher combined fruit and vegetable intakes than did children who disagreed, though the differences were not significant (Table 21). A non-significant trend was also observed for greater vegetable *(P=0.06)* and combined fruit and vegetable (*P=0.07*) intakes in children who recognized an association between diet and overweight compared to those who did not. The median intakes for children who did and did not associate overweight with diet, respectively, were: vegetables = 6.11 (3.33, 8.05) t/d and 4.02 (2.36. 6.34) t/d, and combined intake of fruits and vegetables = 9.04 (5.91, 11.53) t/d, and 7.00 (4.05, 10.12) t/d.

When subjects were stratified according to their responses to the diet and health questions there were no significant differences in the intake of fruits, vegetables or

combined fruits and vegetables between or within each study group. Table 21 shows the intakes of combined fruits and vegetables for each group according to these responses.

Table 21: Intake of (combined) fruits and vegetables comparing responses to diet and health questions of the CNKQ

	Yes[1]				*No*[2]			
	(N)	*25th*	*Median*	*75th*	*(N)*	*25th*	*Median*	*75th*
Can diet make you healthy?								
Control	*(29)*	5.44	8.18	11.29	*(11)*	5.50	7.90	10.34
Intervention	*(50)*	5.36	8.35	11.36	*(3)*	4.88	9.27	20.62
Total	*(79)*	5.39	8.29	11.28	*(14)*	5.67	8.25	10.63
Can diet cause cancer?								
Control	*(12)*	7.86	9.91	12.12	*(29)*	5.41	7.67	10.71
Intervention	*(29)*	4.61	8.69	12.73	*(23)*	5.86	7.92	10.90
Total	*(41)*	5.39	8.18	10.98	*(52)*	5.67	7.55	12.40
Can diet cause heart disease?								
Control	*(20)*	5.42	8.93	11.01	*(21)*	5.56	7.76	11.63
Intervention	*(42)*	5.53	7.92	10.89	*(10)*	3.83	10.88	14.09
Total	*(62)*	5.39	8.90	11.08	*(31)*	5.68	8.30	11.54
Can diet cause overweight?								
Control	*(43)*	5.44	8.21	11.16	*(10)*	5.20	7.75	11.86
Intervention	*(30)*	5.70	8.35	11.20	*(10)*	4.39	8.83	12.43
Total	*(73)*	5.57	8.25	11.12	*(20)*	5.03	8.11	11.63
Can diet make your teeth and bones healthy and strong?								
Control	*(36)*	5.41	8.18	11.41	*(4)*	7.53	7.96	8.63
Intervention	*(51)*	5.01	8.35	11.20	*(1)*	11.83	11.83	11.83
Total	*(88)*	5.41	8.26	11.16	*(5)*	7.59	8.25	14.69

(N) Number of children in each group

[1] Those children who recognised an association between the health conditions and diet

[2] Those children who did not recognize an association between the health conditions and diet

6.7.3 Effect of nutrition knowledge and awareness on the intakes of other food items

In the whole group of children, awareness of relationships between diet and general health, cancer, heart disease, overweight, and bone health were not associated with intakes of the 'other' food categories.

6.8 Parent nutrition knowledge and awareness

The nutrition knowledge score for all parents was (mean ± SD) 10.22 ± 1.54 points out of a possible 13 points. The majority of parents identified which food group should be consumed the least frequently (98%), the recommended daily fruit and vegetable servings (98%), and what constitutes a serving of fruits and vegetables (73%). Less well known was the food group that should be consumed the most (14%). Nearly all the parents were aware of an association between diet and general health (100%), cancer (81%), heart disease (100%), overweight (100%), and bone health (95%).

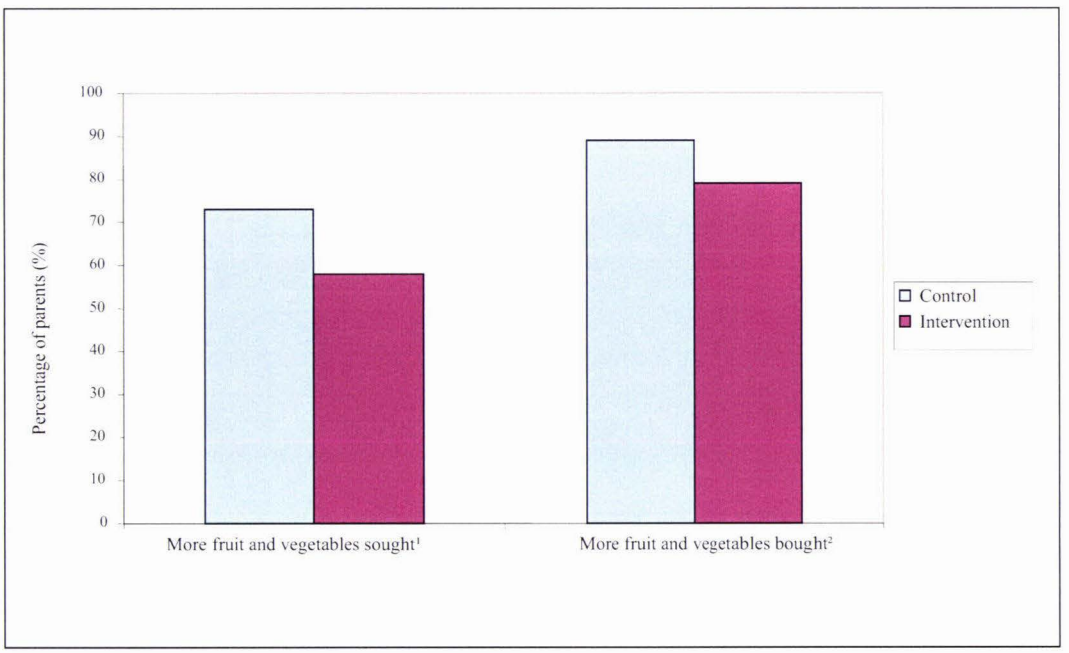
The 5+ A Day campaign was the most recognized health initiative, the majority of parents being able to recognize the 5+ A Day message (98%). Sixty-nine percent were able to identify the 'Push Play' campaign message, whereas fewer of the parents recognised the 'Pick the Tick' message (42%) and the MOH Food and Nutrition guidelines (47%).

6.8.1 Effect of study group on parent nutrition knowledge and awareness

Table 22 presents the main findings from PNKQ for parents of control (PC) and intervention (PI) children. A greater number of PC were able to correctly identify which foods should be eaten the most compared to PI (23% vs. 6%, $P=0.08$), though this did not reach statistical significance. Additionally, there were no significant differences for any of the general knowledge questions, awareness of health campaigns or perceptions of diet and health relationships between parent groups.

Similar proportions of parents in both control and intervention groups indicated that their child had brought home information about the 5+ a day campaign (81% of PC and 82% of PI). A greater proportion of PC reported that their child had asked for more fruit and vegetables in their diet (73% compared to 58%, *P=0.34*). Of the parents who indicated their child had asked for more fruit and vegetables, those from the control group were more likely to buy extra fruit and vegetables because of this request (89% compared to 79%, *P=0.20*) compared to those from the intervention group (Figure 8), however the differences in response to both questions did not reach statistical significance.

Figure 8: Fruit and vegetables requested by children and parental response to the request[a]



[a] Questions 22 and 23 of PNKQ

[1] Percentage of parents in each group who indicated child sought extra fruit and vegetables (intervention n=19, control n=19)

[2] Percentage of parents who indicated more fruit and vegetables were bought as requested (intervention n=15, control n=17)

Table 22: Parent nutrition knowledge and awareness of diet and health – main findings of the PNKQ

	Total (n=58) (%)	*Control (n=26) (%)*	*Intervention (n=32) (%)*	*(P value)*
Nutrition Knowledge Questions[1]				
Foods you should eat the most	14	23	6	(0.08)
Foods you should eat the least	98	96	100	(0.90)
Number of fruit and vegetable servings/day	98	100	97	(1.00)
Serving size of fruits/vegetables	73	77	70	(0.75)
Awareness of health campaigns[2]				
Push Play campaign	69	73	67	(0.81)
Pick the Tick campaign	42	27	55	(0.06)
Food and Nutrition guidelines	47	58	39	(0.26)
5+ A Day campaign	98	96	100	(0.90)
Health and diet relationships[3]				
Can diet make you healthy?	100	100	100	(n/a)
Can diet cause cancer?	81	73	88	(0.12)
Can diet cause heart disease?	100	100	100	(n/a)
Can diet cause overweight?	100	100	100	(n/a)
Can diet effect bone health?	95	100	91	(0.29)
5+ a day fruit and vegetable campaign				
Effectiveness in school[a]	92	88	94	(0.37)
Effectiveness in the community[a]	100	100	100	(1.00)
Has your child brought home any information about the 5+ a Day campaign? (yes)	81	81	82	(0.99)
Has your child asked for more fruit/vegetables? (yes)	64	73	58	(0.34)
Have more fruit/vegetables been bought as requested? (yes)	84	89	79	(0.20)

[1] Percentage of parents who answered the selected general knowledge questions correctly

[2] Percentage of parents who had previously heard of the selected health campaigns

[3] Percentage of parents who answered 'yes' for the questions relating diet to health

[a] Percentage of parents who strongly agree/agree that the campaign is an effective way to increase fruit and vegetable intake in children

Between group comparisons determined by Chi-squared tests

6.8.2 Effect of parent education on children's fruit and vegetable intakes

In the whole sample, dietary intakes of fruits and vegetables did not differ significantly between children whose parents had attained higher than secondary school qualifications and those whose parents had not (Table 23).

Table 23: Fruit and vegetable intakes (times/d) in all children according to parent education

	Fruits			*Vegetables*			*Fruits and vegetables*		
	25th	*Median*	*75th*	*25th*	*Median*	*75th*	*25th*	*Median*	*75th*
Extra education† (n=41)	1.84	2.84	4.25	3.15	6.13	8.07	5.57	9.04	11.69
No extra education‡ n=14)	1.28	3.41	4.47	2.61	5.90	9.16	5.24	7.11	13.73
(P value)		(0.95)			(0.85)			(0.80)	

Difference between groups determined by Mann-Whitney test

† Those parents who received further education or gained qualifications after leaving high school

‡ Those parents who did not receive any further education or qualifications after leaving high school

6.8.3 Parental perception of the family diet

In the whole group of parents who completed questionnaires, 44% and 39% thought their family consumed too much fatty food and too much sugary foods, respectively. Forty-two percent of parents thought the family should eat more fruit and 27% thought they should eat more vegetables. There were no between group differences in parents' perceptions of the family's intake of fatty food (*P=0.98*), sugary food (*P=0.69*), fruit (*P=1.00*) and vegetables (*P=0.79*).

6.8.4 Parental perception of diet and reported intakes of fruits and vegetables in children

Parents perceptions of family intake were reflected by children's reported intakes of certain food groups (Table 24). Children of parents who thought the family should eat

more fruit ate significantly less fruit than children whose parents thought the family ate enough (*P=0.03*). Similarly, children of parents who said they ate enough vegetables reported consuming significantly more fruit (*P=0.03*) and combined fruit and vegetables (*P=0.05*) than did children whose parents thought the family should eat more. Children of parents who thought the family should eat less 'fatty food' reported eating significantly less fruit than children whose parents who thought the family ate enough 'fatty food' (P = 0.04). A similar trend was also observed for sugary foods whereby children whose parents thought they ate too much sugary food reported eating less fruit and vegetables, though the differences in intake were not statistically significant (Table 24).

Table 24: Fruit and vegetable intakes in all children according to parental perception of the family's current diet

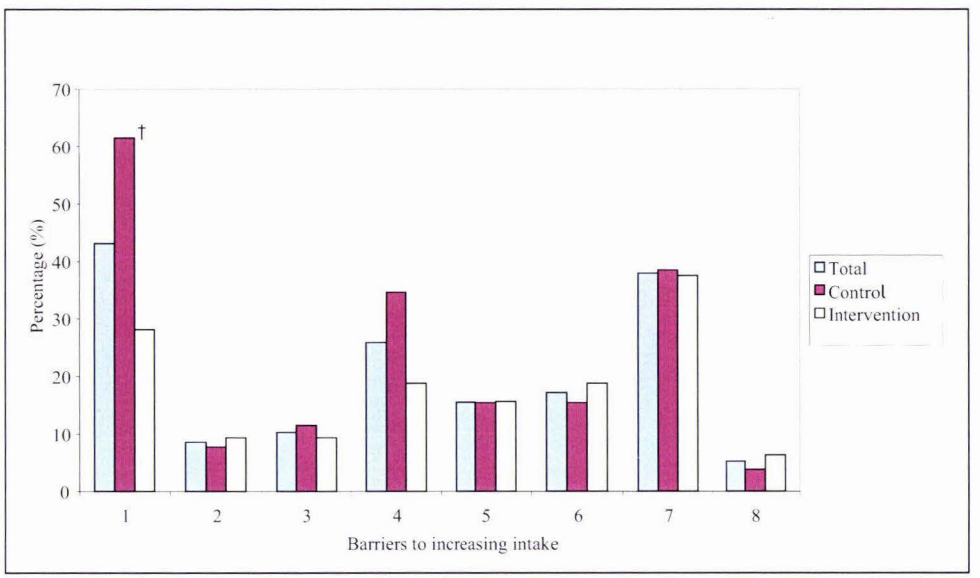
	Fruits			*Vegetables*			*Fruits and vegetables*		
	25th	*Median*	*75th*	*25th*	*Median*	*75th*	*25th*	*Median*	*75th*
Fatty foods									
We should eat less (n=26)	0.99	2.14	3.96	3.21	6.11	7.98	5.55	8.18	11.35
We eat enough (n=33)	2.13	3.41	4.67	2.61	5.71	7.99	5.56	9.04	11.53
(P value)		(0.04)*			(0.77)			(0.49)	
Fruits									
We eat enough (n=34)	2.31	3.41	4.41	2.90	6.53	8.06	5.70	9.91	12.42
We should eat more (n=25)	0.84	1.91	4.21	2.61	5.51	6.63	5.41	7.18	9.70
(P value)		(0.03)*			(0.30)			(0.16)	
Vegetables									
We eat enough (n=43)	1.99	3.41	4.44	2.96	6.09	8.06	5.99	9.37	12.52
We should eat more (n=16)	0.86	1.74	3.52	2.52	4.23	6.41	4.74	7.66	9.23
(P value)		(0.03)*			(0.11)			(0.05)*	
Sugary foods									
We should eat less (n=33)	1.11	2.78	4.21	2.59	5.37	7.91	5.62	7.66	10.56
We eat enough (n=25)	2.08	3.19	4.58	2.95	6.13	8.05	5.36	10.09	12.34
(P value)		(0.24)			(0.65)			(0.30)	

* P≤0.05, between group comparisons determined by Mann-Whiney test

6.8.5 Reported barriers to increasing fruit and vegetable intakes

Figures 9 and 10 present the factors indicated by parents that limit their family's ability to increase fruit and vegetable intake. The most common barriers to increasing both fruit and vegetables for all participants were (1) the cost and (2) the quality of produce; however, a considerable number of parents indicated that increasing both fruit and vegetable intakes would not be a problem (38% of all parents for fruit and 41% of all parents for vegetables). Significant associations were observed between level of household income and perception of 'cost' as a barrier to increasing the family's intake of fruit (P=0.014) and of vegetables (P=*0.001*). Subjects in the lower income brackets were more likely to perceive the expense of fruit and vegetables as a reason not to increase daily intake.

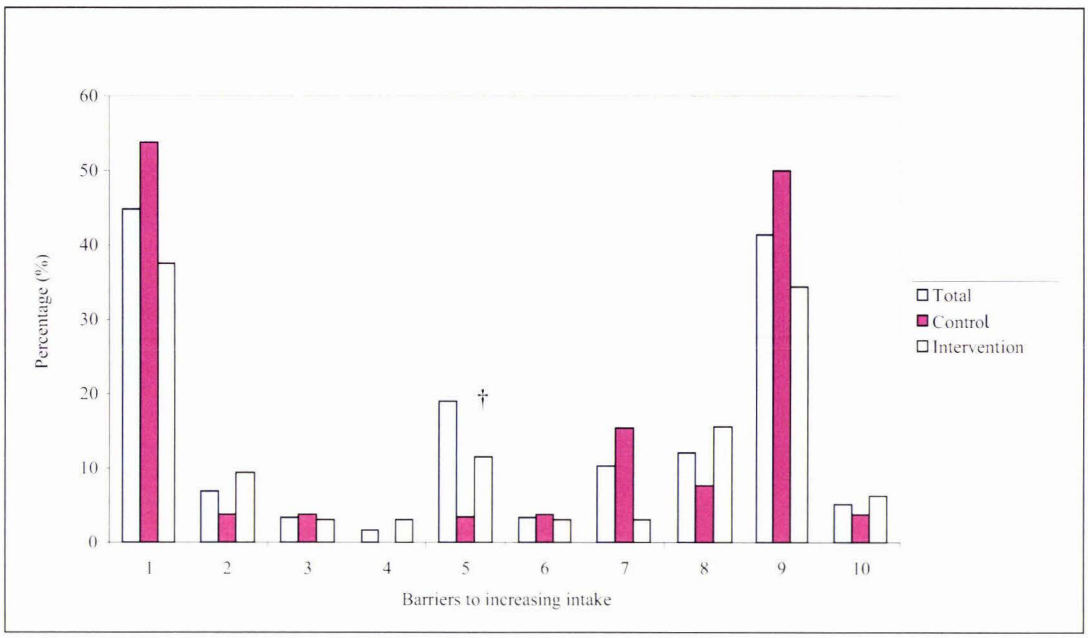
Figure 9: Factors that limit the family's ability to increase fruit intake



† P<0.05 for between group comparison determined by Chi-Squared test

1- Fruit costs too much
2- I/my family don't like fruit
3- Can't store fruit for long
4- Fruit often poor in quality
5- Do not always have fruit at home
6- Pesticides/chemicals on fruit
7- Increasing fruit intake would be no problem
8- Other reasons limit fruit intake

Figure 10: Factors that limit the family's ability to increase vegetable intake



† P<0.05 for between group comparisons determined by Chi-Squared test

1- Vegetables cost too much
2- I/my family don't like vegetables
3- Can't store vegetables for long
4- It is a hassle to eat more
5- Vegetables are often poor in quality
6- Vegetables take too long to prepare
7- Don't always have vegetables at home
8- Pesticides/chemical on vegetables
9- Increasing vegetable intake would be no problem
10- Other reasons limit vegetable intake

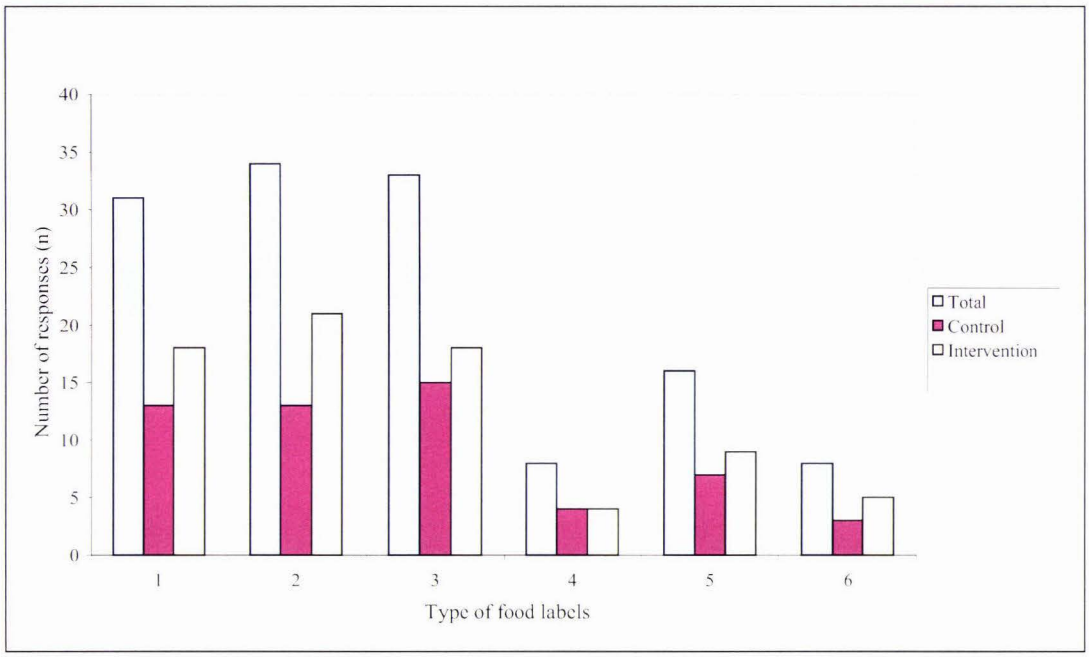
6.8.6 Effect of study group on reported barriers to increasing fruit and vegetable intake

In general, PC were more likely to report barriers to increasing fruit and vegetable intakes in the family than were PI. Significantly more PC indicated cost as a reason not to increase fruit (62% versus 28%, p = 0.02) (Figure 9) and quality as a reason not to increase vegetable intake (35% versus 9%, p = 0.04) (Figure 10).

6.8.7 Shopping processes

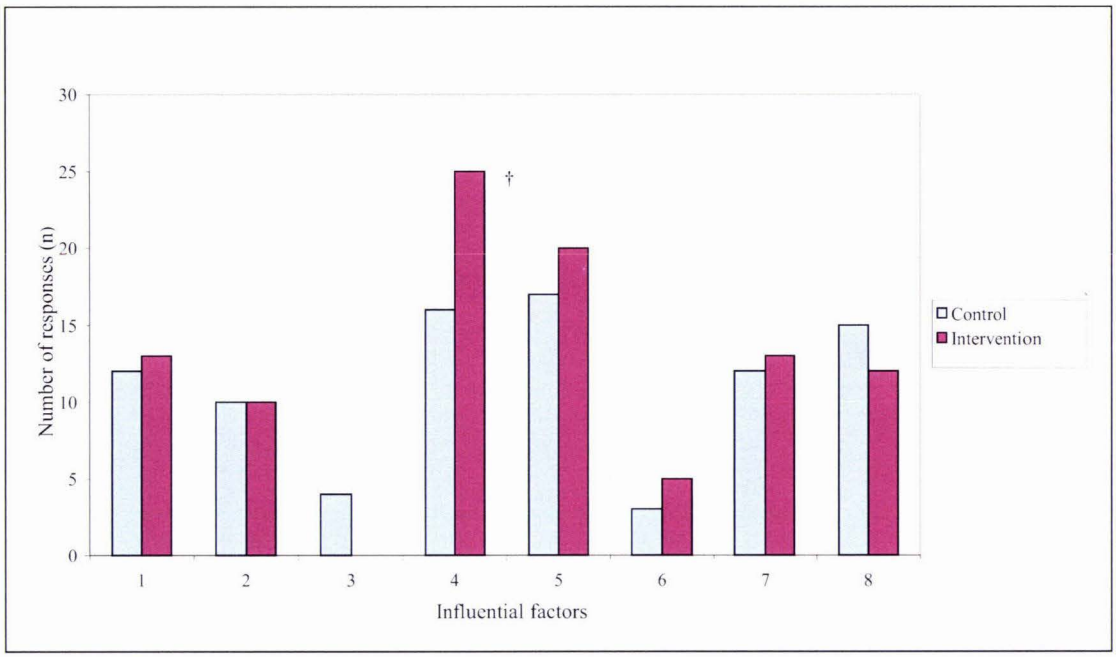
There was no difference between groups in terms of the reported shopping processes. Figure 11 shows which of the labels on food packaging parents read when making food purchases for control and intervention groups. Over half of all parents reported reading the nutritional panel (62%), nutritional phrases such as *'low fat'* or *'light'* (64%) and the list of ingredients (58%), while only 15% of parents indicated not reading any food labels. There were no statistically significant differences in the types of labels read between groups. Figure 12 shows factors, which were ranked from a list of eight, that were rated by parents as the top three most influential when making food purchases. The notable difference between groups in the overall ranking of all factors was that significantly more PI than PC (52% vs. 13%, *P=0.03*) reported the nutritional value of food as the most important factor.

Figure 11: Parent's responses to the question 'Which of the labels on food packaging do you read?'



1- List of ingredients
2- Nutritional phrases (e.g. "low fat" or "good source of fibre")
3- Nutritional panel
4- Information about serving size
5- Health benefit statements (e.g. "good for your heart")
6- Don't read labels

Figure 12: Factors rated in the top three most influential considerations when making food purchases



1- Taste/preference
2- Special deals (e.g. reduced prices)
3- How easy it is to prepare
4- Nutritional value of the food
5- Quality or appearance of the food
6- Storage life
7- Whether or no the family will eat it
8- Price

† P≤0.05, determined by Chi-square test

7. DISCUSSION

7.1 Dietary intake of fruits and vegetables

This research aimed to determine the usual daily intake of fruits and vegetables in 10-year-old children from Whangarei primary schools. The findings of this study indicate that 67% and 72% of all children from this region consume the recommended daily servings of fruit and vegetables, respectively. These intakes are considerably higher than those recorded in the CNS02 (MOH, 2003b), where recommended daily intakes were consumed by only 43% of children for fruit and 57% for vegetables. Additionally, the sampled Whangarei children also indicated consuming various individual fruits (oranges or mandarins, stone fruits, berries, cooked or canned fruits and dried fruits), vegetables (kumara, mixed vegetables, broccoli, peas, avocado, capsicum and green beans), and less healthy food items (pizza, sausages, bacon or ham, burgers, chocolate and energy drinks) more frequently than did those from the national survey.

These findings would suggest that Whangarei children are consuming more fruit and vegetables than the national average as reported in the CNS02. There are, however, some important considerations to take into account when comparing data from the present study and the CNS02. In the CNS02, dietary data was collected from 3275 children by individual interviews (usually) at the child's home and in the presence of a parent/guardian using both 24-hour recall and food frequency questionnaire. Parents were able to help children to recall their usual dietary intake. In contrast, although the present study used the same food frequency questionnaire, due to time constraints the questionnaire was administered in a group situation within a school setting. To ensure accurate completion of the questionnaire the researcher monitored the progress of each child, making certain that all relevant questions were understood and completed. Even so, differences in the data collection methods between the two studies may have resulted in some variation in dietary intake estimates.

Additionally, some degree of disparity in fruit and vegetable intakes between the sampled Whangarei and CNS02 children may in part be due to seasonal variations in dietary intake. Seasonal changes in the consumption of certain nutrients and food items have previously been demonstrated. In a small study of male industrial employees (*n=94*) from Israel, Shahar et al (2001) collected dietary data using an administered semi-quantitative FFQ on two separate occasions: once in the summer and once in the winter. Significant increases in intakes were reported for the nutrients: total fat, cholesterol, sodium, vitamins B1, E and D, calcium and zinc (all $P<0.01$) and for the intake of total meat and hard-boiled eggs (both $P=0.03$) in the winter FFQ as compared to the summer. This study was limited by the highly specific population represented by the study group (i.e. middle-aged industrial working Israeli men), though epidemiological research in other ethnic and gender groups have also suggested dietary intake of fruits and vegetables in particular, is affected by seasonal change associated with food availability and eating customs (Fahey et al, 2003, Shu et al, 2004). In a dietary calibration study, FFQ validity and reliability were tested in older women (n=200, mean age 55.4 ± 9.0) from Shanghai, China, using repeated 24-hr recalls. Nutrient and food intake assessed by both methods were mostly well correlated except for fruits and vegetables, which were substantially overestimated. Possible explanations for error in dietary measurement of fruits and vegetables were the desire for "social approval" and "seasonal variation of supply of these foods" (Shu et al, 2004).

Seasonal influences may therefore apply to the differences in intakes between the present study and the national survey of dietary intake in New Zealand children. Collection of dietary data for the CNS02 spanned almost an entire year, beginning the last week of February and ending the second week of December 2002, while data collection for the present study took place in the final third of 2003 (from August to November). This means that the effect of seasonal changes on dietary patterns in the CNS02 is equally

distributed throughout the year, while in the smaller study of Whangarei children dietary data represents the intakes of these children over a four-month period from the end of winter and including spring. Stone fruits, berries, avocados and green beans are foods that are not available all year round and thus are subject to seasonal variation, which may explain the significant differences in intake between the two studies. The greater consumption of take away foods (pizza, burgers, sausages) in the Whangarei children may also be a reflection of seasonal variation because these are foods served hot and possibly more frequently during winter months. Because the present study was conducted over a four-month period (during winter-spring months) using a questionnaire that assessed intake over a period of one month prior to assessment, foods that are habitually eaten during certain times of the year are likely to be over- or under-estimated.

Dietary variation may be due to dissimilarities in demographic factors, such as socioeconomic status, of the participants represented by each of these studies. Research from eleven studies from seven countries has shown in a systematic review that higher socioeconomic status (determined by education level) is associated with greater fruit and vegetable intake (De Irala-Esteves et al, 2000). The 1995 Australian National Nutrition Survey also supports an association between fruit and vegetable intake and socio-economic status (determined by occupation level). The survey demonstrated that adults in the lowest income group consumed about half as much fruit and 25% fewer vegetables than did persons in the most affluent households (Giskes et al, 2002). In order to control for confounding the control and intervention groups in the current study were matched closely by decile, thus the decile ratings of all the schools involved were between four and six. The national survey of dietary intake in children includes data from a greater range of income, geographical areas and socioeconomic status. Therefore, differences in the intake of various foods between the two studies may be a reflection of a more diverse spread of children represented in the national survey.

Self-reported fruit and vegetable intakes of these Whangarei schoolchildren may have been overestimated and, to some degree, this overestimation may have resulted from social desirability. Social desirability results in a tendency to over- or underreport a behaviour that is considered desirable or undesirable. In a study of 95 African American girls (aged 8-10 years) subjects with higher levels of social desirability, measured by a psychosocial questionnaire relating to diet, reported lower ratings of preference for sweetened beverages than would have been expected given their reported intake levels ($P = 0.018$); and significantly overestimated self-reported physical activity levels compared to actual physical activity ($P = 0.02$) determined by CSA (Computer Science Application) accelerometer (Klesges et al, 2004). It was suggested by these authors that "bias may reflect recognition of foods with socially negative connotations such as sweets and sugary" foods. In contrast, for this study it may be the recognition of foods with positive connotations such as fruits and vegetables that influenced very high self-reported intakes. Nonetheless, only small statistically non-significant differences were observed for the majority of other food groups, between Whangarei children and the national survey.

There is also the possibility that the qualitative nature of the food frequency questionnaire has led to overestimation of fruit and vegetable intakes. The images of foods presented in the food frequency questionnaires illustrated a whole portion of that food. Children may have indicated that a whole portion of food was consumed when in fact less than a whole portion was actually eaten. A quantitative assessment of dietary intake would be required to overcome this issue.

The other main goals of this study were to compare dietary fruit and vegetable intakes and nutritional knowledge and awareness of children attending schools that received 5+ a Day educational resources and those attending schools that did not register for 5+ a Day resources. The findings indicate that for children from selected urban Whangarei primary schools, there are no appreciable differences in fruit and vegetable

consumption or in general nutrition knowledge between the intervention and control groups. These results contrast with a number of randomized controlled trials of school-based dietary interventions that showed significant intervention associated effects on fruit and vegetable consumption in primary school children (Burchett, 2003).

In the 5-a-day Power Plus programme lunchtime observation of combined fruit and vegetable intake, increased by about half a serving more in intervention schools than in reference schools ($P<0.01$) after one year (Perry et al, 1998). Greater increases were also evident in both lunchtime observation (+0.34 servings/day, $P<0.01$) and 24-hour recall (+0.62 servings/day, $P=0.02$) of fruit intake for intervention schools. In the Alabama High 5 Project, intakes of fruit (+0.73 servings/day, $P=0.0001$), vegetables (+ 0.34 servings/d, $P=0.0001$) and combined fruit and vegetables (+1.58 servings/day, $P=0.0001$) increased significantly for intervention schools compared to controls at one year follow up, and the intervention was successful regardless of gender, ethnicity and household education (Reynolds et al, 2000).

Several reasons may account for the lack of observed intervention effect in the present study including the design of the 5+ a Day strategy and its implementation in the participating schools. The USA 5-a-day studies mentioned above were intense, multi-component, school-based interventions that addressed both environmental and individual determinants of food choice. Trained research staff (Reynolds et al, 2000) or teachers who received intervention training (Perry et al, 1998) implemented classroom curricula and alterations were made to school food service, whereby less healthy foods were substituted for healthier fruit and vegetable options.

In contrast to these interventions, the New Zealand 5+ a Day campaign is a widespread, but less intense strategy aimed to increase fruit and vegetable intake, particularly in children, by improving awareness of fruit and vegetables and their health benefits. The campaign is delivered on a national basis through mass media communications

and supplies participating schools with educational resources. The use of these resources to supplement lessons with a nutrition/health focus is at the discretion of the teachers.

In follow-up to the current study, the researcher approached teachers from participating schools to gain an insight into their opinion about the effectiveness of the nutrition resource material they used. A self-completed questionnaire (see appendix 5) was designed with eighteen questions relating to the 5+ a day material (for intervention schools only) and another section concerning other sources of nutrition information (for all schools). The questionnaire was distributed to the teachers from four schools and was returned by those who consented to provide information. The fifth school agreed to a group discussion and this was conducted using the questions in the questionnaire. It was indicated from this follow-up that nutritional resources, including 5+ a Day material, were used as part of an annual health module. Healthy eating messages such as the need to increase fruit and vegetables were reinforced often throughout the year, but concentrated health modules were only delivered on one to two weeks of the school year. Delivery of health modules varied between teachers and both within and between schools. Other school-based intervention studies that have reported increases in fruit and vegetable intakes have often lasted from six weeks to more than a year (Burchett, 2003, DOH, 2002). It is possible that the lack of difference in fruit and vegetable intake and nutrition knowledge comparing children who were exposed to 5+ a Day resources and those who were not, relates to the quantity or "dose" of education and exposure to such material. Therefore, more intensive, sustained delivery of campaigns such as '5+ a Day', which promote dietary change, would be likely have a greater influence on children's fruit and vegetable consumption.

It is also possible that the educational sources from which control schools obtained teaching resources relating to nutrition and heath may have introduced some confounding. Schemes such as the Heart Foundation's School Food Programme or the

Health Promoting Schools initiative, which have modules relating to fruit and vegetables, may have influenced both children's knowledge and intake of these foods. One intervention school indicated actively participating in the above-mentioned schemes, while staff from control schools identified other sources, particularly health organizations and food company websites.

Additionally, components that enhance the success of school-based dietary intervention such as increasing the availability of fruit and vegetables and including a parent-home component (French & Stables, 2003) were not employed. None of the participating schools had made changes to the school canteen/tuck shop or food policies to increase fruit and vegetable intake, though two intervention schools indicated that they had imposed healthy-eating rules e.g. banning 'fizzy' drinks at school. Other successful intervention studies have included fruit tuck shops (Durkin et al, 2003; Rex et al, 2003; Caraher et al, 2003) and healthy breakfast clubs (Coady et al, 2002), parent-child activities, and incorporated community projects and support (Reynolds et al, 2000; Perry et al, 1998).

On the other hand, the lack of difference between intervention and control schoolchildren may be due to the nature of the 5+ a Day campaign. The widespread community base of the 5+ a Day campaign may have produced some degree of contamination within the control group, such that fruit and vegetable intakes of children in both control and intervention groups have been influenced. The 5+ a Day campaign was well recognised by most children and all parents, and it is possible that widespread promotion (e.g. on television, radio, in supermarkets and on food packaging,) of this message over the last ten years has reached those children (or at least their parents) in the control schools that are not receiving lessons involving 5+ a Day resource material. If this awareness has in fact influenced dietary behaviour, then children of both control and intervention schools may be expected to have made similar changes in fruit and vegetable intake.

7.2. Nutritional Knowledge

Knowledge of food recommendations and other aspects of nutrition did not differ between intervention and control groups in this study. It is likely that control schools taught health and nutrition modules that covered similar topics using resources from other organizations. Teachers from both study groups reported in the follow-up questionnaire/group discussion that they had used resources from a variety of organizations. This was usually printed material from the National Heart Foundation, the Department of Education, food companies and other information from their websites.

Nutritional knowledge of these children from selected Whangarei schools did not correlate with fruit and vegetable intake as may have been expected. Other studies that have examined eating behaviours and knowledge have found similar or mixed results. Gibson et al (1998) investigated the effects of psychosocial and parental influences (using knowledge and behaviour questionnaires and 3-day food diaries) on children's fruit and vegetable intakes in 92 mothers and their children (aged 9-11 years) who were recruited from five primary care practices in south London. In this study, children's knowledge of the nutrient content of common foods was not related to their intakes of any macronutrients nor with intakes of fruit (r_s = 0.06, n=92, *P>0.05*), fruit juice (r_s =-0.17, n=92, *P>0.05*), or vegetables (r_s = 0.03, n=92, *P>0.05*). In another study of 532 students from a randomly selected school in Lima, Ohio, the eating patterns of sixth grade (aged 10-11 years), seventh grade (11-12 years), and eighth grade (ages 12-13 years) students were investigated in relation to nutrition knowledge using a Comprehensive Assessment of Nutrition Knowledge, Attitude, and Practices (CANKAP) questionnaire (Pirouznia, 2001). No correlation between knowledge and eating habits was found in both sixth grade girls (r=0.02, n=532, *P=0.85*) or boys (r=0.02, n=532, *P=0.29*), nor in 7th and 8th grade boys (r=0.12, n=532, *P=0.13*). On the other hand, knowledge was correlated with food choices in girls of the 7th and 8th grades (r=0.20, n=532, *P=0.006*). Nutrition scores were

significantly higher in these girls (mean score = 29.53) compared to boys of the same grades (mean score = 26.66) ($P<0.05$) and it was suggested by the authors that girls may have been more concerned with body image and weight and in this age group were more likely to seek out nutrition information and make changes to their diets.

An interesting finding in the current study was that children from the intervention schools were more aware of the relationship between diet and general health as well as some diseases. Greater awareness in these children may stem from exposure to 5+ a Day material containing information that reinforces a connection between fruit and vegetables and the risk of cancer, in particular. Furthermore, when all children are considered, those who acknowledged associations between both diet and cancer and diet and overweight tended to consume more fruits and vegetables than children who were not aware. These findings vary from those in the above-mentioned study by Gibson et al (1998). In that study, awareness was not associated with a greater intake of fruit and vegetables in children who thought health was important when making food choices. Awareness was, however, negatively associated with the consumption of confectionary (summed from intakes of sweets, chocolate, chocolate snacks and sweet biscuits) (r_s = -0.24, n=92, $P<0.05$). The authors found the more convinced children were that vegetables were healthy the lower their reported intake was (rs =-0.27, n=92, $P<0.025$) (Gibson et al, 1998).

Even if children are aware of a relationship between diet and disease, this may not be enough motivation for them to adopt relevant behaviours (i.e. eating more fruit and vegetables) for better health, possibly because children do not perceive themselves to be at great risk from these diseases. In a study of 326 children (aged 9-10yrs) and young persons (aged 15-16yrs) from six inner city, suburban and rural schools in England with considerable knowledge about the causes and prevention of cancer, only a small percentage (12%) considered cancer to be fatal, while 75% thought it could be cured (Oakley et al, 1995). The study also indicated that health was not considered an important life goal; rather,

unemployment was the most important concern for the future (Oakley et al, 1995). The fact that in Whangarei children, health awareness might influence fruit and vegetable intake may indicate that greater importance is being placed on the benefits of food in relation to long-term health.

7.3 Television viewing

The fact that television was rated as the most common source of nutrition information for all children in the present study has both negative and positive implications. Intense marketing of food products aimed at children through television advertising has the potential to influence nutritional views, desire for, and consumption of unhealthy foods. Many of the nutritional messages delivered through this medium can be misleading and often promote foods, particularly snacks and breakfast cereals, high in salt, fat and sugar (Birch & Fisher, 1998), while less focus is given to healthy foods such as fruits and vegetables. Repeated exposure to such information may negatively influence dietary patterns by fostering a child's desire to consume nutritionally poor foods (Birch and Fisher, 1998) in the place of fruits and vegetables.

Fruit and vegetable intake was negatively associated with time spent watching television in a prospective study of 548 ethnically diverse public school students (average age 11.7 ± 0.8 years) from Boston, Massachusetts. Baseline hours of television viewing was associated with reduced fruit and vegetable intake (0.16 servings/day 95% CI: -0.22, -0.10, *P=0.008*) and during the 19 month study period for every one hour increase in television viewing fruit and vegetable intake decreased further by 0.14 servings/day (95% CI: -0.22, -0.07, *P=0.025*) after adjusting for anthropometric, demographic, dietary and physical activity variables (Boynton-Jarrett et al, 2003). More time spent watching television has also been associated with larger year-to-year increases in BMI in a study of

over 10,000 children from the United States (0.0372 ± 0.0106 kg/m²/hr/day for girls and 0.0384 ± 0.0101 kg/m²/hr/day for boys) (Berkey et al, 2000).

On the other hand, as television is the most common source of nutrition information in the current study, there is potential to use this medium to model and reinforce positive health messages such as increasing daily fruit and vegetable intake. This point has particular relevance to the present study because a new 5+ a Day television advertisement to encourage fruit and vegetable consumption, aimed at children and screened at peak viewing time, began shortly before the first questionnaires were administered. The researcher had not been made aware of this when planning the current study. Given that 77% of all children indicated getting nutritional information from television, it is possible that children from both control and intervention schools viewed the commercial and that it influenced their nutritional awareness and reported eating patterns. This potential source of contamination may explain, in part, why there were no differences between the control and intervention groups in respect of both fruit and vegetable intake and knowledge about the 5+ a day campaign.

The effects of television advertising on children was investigated by Gorn and Goldberg (1982) in a controlled experiment involving 288 children aged 5-8 years who attended a summer camp in Quebec, Canada. Groups of children were exposed to nine 30-second food messages throughout a daily 30-minute session of watching cartoons. The different experimental conditions were candy commercials (messages for sweets and other highly sugared foods), no commercials (only the control programmes), fruit commercials (messages about fruits and fruit juices), and Public Service announcements (PSA-messages about healthy eating). The children were then given the opportunity to choose from a variety of snack foods and beverages while their options were recorded inconspicuously by an assistant present in the room. Differences in food and beverage choices that were influenced by the experimental conditions were observed in this study. Children who viewed fruit commercials selected more orange juice (45%) than did children who viewed candy

commercials (25%) during afternoon snack sessions *(P<0.05)*. Children who viewed candy commercials also picked less fruit (25%) than did children in any of the other conditions (fruit consumption according to commercial: no messages = 33%, fruit messages = 36%, PSA messages = 35%) *(P<0.05)*.

The Quebec study also demonstrated, in young children, an understanding of which food they should eat regardless of their exposure to television advertising. In all conditions, children indicated knowing that the camp doctor wanted them to eat fruit rather than candy (Gorn and Goldberg, 1982). Even with this knowledge, food choice was swayed by exposure to candy commercials. Therefore, it would seem that there are other important considerations in the determination of food selection. This may also apply to knowledge of diet and disease associations. The fact that a child is aware of a relationship between diet and certain health conditions may not necessarily mean their dietary intake is any different from a child who is not aware. As was demonstrated in the present study, more children from the intervention group indicated diet to be related to general health, cancer, and heart disease, than did those in the control group, however, differences in reported dietary intakes of fruit, vegetables and other food groups, between the groups did not reach statistical significance.

7.4 Body mass index

In this study, there were no appreciable differences in fruit and vegetable intakes between weight categories in the children, regardless of gender or study group. Somewhat similar findings were reported in a small USA study of children (n=54) from an elementary school in Bridges County, Kentucky (Crooks, 2000). The study differed methodologically from the current study in both the dietary assessment tool (four non-consecutive 24-hr recalls) and determination of weight status (overweight defined as BMI $\geq 90^{th}$ percentile of the first and second National Nutrition and Health Examination Survey (NHANES I

and II). There were no statistically significant differences between overweight and non-overweight children in the consumption of the six Food Guide Pyramid food groups (i.e. fats and sugars, dairy products, meats or meat substitutes, vegetables, fruit, breads and cereals). Overweight children did, however, appear to tend to eat more foods from the fats and sugar group (28.29 servings ± 13.43 vs. 22.17 servings ± 9.33, *P=0.07*) and less fruits (0.60 servings ± 0.61 vs. 1.02 servings ± 0.60, *P=0.19*) but the differences were not significant. The study sample was small and represented only European Americans.

7.5 Physical activity

Unexpectedly, in children who were regularly involved in exercise of a moderate-to-intense level e.g. running, team sports, dancing, or tennis, those from the control group consumed more fruits and vegetables than did intervention group children. One possible reason for these differences may relate to the 'Push Play' campaign, which was better recognised and used in control schools, but not intervention schools. Similar to the 5+ a Day programme the 'Push Play' campaign uses various channels of communication, including providing schools with education resources, to encourage all New Zealanders to undertake 30 minutes of moderate physical activity on most days of the week. Children from control schools who were actively involved in the campaign may have also been more motivated to make complimentary dietary changes such as increasing fruit and vegetable intakes.

The classification of children into light and moderate-to-intense activity groups was defined by their self-reported after-school activities. The two categories did not however take into account the duration of reported activity. It is possible that children from the control schools, though they were performing similar activities to intervention children, were active for longer periods of time and, therefore, their energy requirement may have been higher resulting in a higher intake of fruits and vegetables.

7.6 Parents

When asked about barriers that limit the family's ability to increase fruit and vegetable intakes, cost and quality were most commonly reported. It is plausible that during the winter-spring period in which data collection for this study was carried out, less fresh produce was available than throughout the rest of the year. That which is available would therefore induce greater expense and consequently may influence people's willingness to increase their intake. This reasoning, however, does not explain why parents of the control group report these barriers more frequently, and for this, the researcher is uncertain as to the explanation. This study revealed that persons with lower income were more likely to perceive cost as a barrier to increasing both fruit and vegetable intakes, therefore, demographic differences such as level of income between the groups may account for the discrepancy in potential barriers. In this study, however, there were no significant differences in demographic variables. A more complete understanding of these aspects warrants further investigation.

In a survey of 8,163 respondents from 14, 000 randomly selected New Zealand households, perceived barriers to eating fruit and vegetables differed according to current intakes and willingness to improve intakes of fruits and vegetables (Sullivan et al, 2004). Subjects from this survey who did not meet the MOH targets for fruit and vegetable intakes but intended to in the future ("Don't But Might" group) were more likely to perceive cost as a barrier to increasing fruit (34% vs. 25%) and vegetable intakes (30% vs. 23%) compared to subjects who met MOH targets for these foods ("Do Now" group). Other highly rated barriers for the "Don't But Might" group included that both fruit (28%) and vegetables (24%) spoil too quickly, preference for other snacks (25%), and difficulty eating vegetables on the run (24%). Perception of barriers to improving fruit and vegetable intakes may, therefore, be a reflection of a person's current intake and their confidence in the own ability to change this for the better (Sullivan et al, 2004).

7.7 Limitations of the study

A number of limitations should be considered when interpreting the results of this study. Firstly, the present study is only able to compare current dietary intakes, nutritional knowledge and campaign awareness between the selected control and intervention group schools. As there is no previous research regarding the use of 5+ a Day resource material from the region from which to compare this study's data, an estimate of dietary change or change in knowledge and awareness before and after its implementation cannot be made.

Secondly, limitations associated with respondent bias apply to this study. The subjects recruited for assessment were those children and their guardians from the selected schools who volunteered to participate, and thus, they may differ from those who were not willing to take part. It is likely that the willing participants were more motivated or were interested in the nature of the study and may represent a population group with dissimilar lifestyle patterns to non-responders. In addition, the small number of subjects involved in the study may have increased the chance that the findings observed, particularly when analyzing subgroups of the sample, may be due to a type II error (the null hypothesis is not rejected i.e. it is accepted that there is no difference between groups), when in fact a difference does exist. In this case, the small number of subjects may have limited the ability to detect a real difference between control and intervention groups. However, because there is a lack of data on dietary intakes in schoolchildren in this area, this study contributed useful information on the dietary intakes of Whangarei children, but should be interpreted with some caution. This pilot study suggests that it would be useful to collect further data on fruit and vegetable intakes in Whangarei schoolchildren in order to make a more definitive judgement on the quality of their diets.

Thirdly, limitations associated with the assessment tool used to collect dietary intake information should be considered. Children tend to have highly variable diets from one day to the next, therefore, a FFQ was used to estimate usual intake over a period of one month.

Compared to other methods, the FFQ is relatively inexpensive with lower respondent burden (Thompson et al, 1994), however, a disadvantage of this method is that it depends on respondent memory which can lead to errors in the estimation of how much and how often food is eaten, particularly in children (Biro et al, 2002). Validation studies with doubly labeled water, multiple food records, 24-hr recall, and serum micronutrients have demonstrated that food frequency questionnaires used in children significantly overestimate the intake of certain nutrients, particularly total fat, polyunsaturated fatty acids, fibre and calcium, while studies of reliability suggest the method tends to overestimate energy and nutrient intakes at first administration in comparison to subsequent administrations (McPherson et al, 2000).

Evaluation of the FFQ used in this study was assessed in 130 children during pilot testing of methods for the CNS02 and was found to have similar or better repeatability in New Zealand children compared to child or adolescent food frequency questionnaires from other countries (Metcalf et al, 2003). Nonetheless, the FFQ still resulted in slightly higher intakes of most food groups at second administration (13 days after the first FFQ administration), which was significant for vegetables (P=0.006) and snack & sweets (P=0.019). This finding, however, only relates to precision of the dietary assessment tool, i.e. whether or not it will give similar results when used again in the same situation. Although, there are no published data on the validity of the FFQ used in this study, one possible reason for the high fruit and vegetable intakes observed in this study is that intakes of these foods are overestimated by this questionnaire.

Nonetheless, this questionnaire was used in the CNS02, albeit with a slightly different methodology and population, and therefore the results of the present study can be compared to the data from the national survey. In addition, the control and intervention groups in this study of Whangarei schoolchildren completed the same questionnaires under similar conditions; therefore, it is appropriate for between group comparisons to

determine differences in dietary intake. In this study, children's intakes of fruit and vegetables tend to reflect the parent's perception of the family's intake, and this strengthens the reliability of responses from the food frequency questionnaire. Children who ate less fruit tended to be those whose parents thought that overall, their family ate "too much" as opposed to "enough" fatty food. This may indicate that families who were eating too much fatty food were consequently eating less fruit. Similarly, those families who were eating too much sugary foods were possibly eating too little fruit, which is what the children in this present study have reported. Consumption of too many fatty or sugary foods is likely to be associated with overall less 'healthy' diets. This finding is in agreement with that from a study in 4th grade Norwegian children where the intake of fruit decreased with increased intake of added sugar (Øverby et al, 2003). It could be suggested that more successful public health promotion strategies to increase fruit and vegetables should involve the entire family unit, necessitates the modification of the eating environment, and may require that attention be given to other aspects of the diet e.g. demotion of fatty and sugary foods.

7.8 Implications of this research

This study shows that children from Whangarei primary schools are achieving the Ministry of Health recommendations for fruit and vegetable intakes, and that intakes are above the national average. If these results indeed reflect true intakes, and assuming these are habits that will maintain into adult life, children from this area may potentially reduce their risk of chronic diseases associated with low fruit and vegetable intakes. In this pilot study, quantification of dietary intake was not undertaken. A more detailed dietary methodology would be required to investigate whether or not fruit and vegetable consumption really is higher in Whangarei children. Such a project should also recruit subjects from a more representative range of schools from all deciles, include a larger sample of children and perhaps investigate the effect of age on fruit and vegetable intakes.

The objective of the 5+ a Day programme is to encourage the consumption of at least five servings of fresh fruits and vegetables every day to all New Zealanders. Are the educational resources used in school effective in bringing about such dietary patterns? What is clear from this study is the lack of disparity in fruit and vegetable intakes between children who are exposed and those who are not exposed to specific 5+ a Day resources. There is no evidence from the current study to suggest that the resources have increased fruit and vegetable intakes, nor is there any evidence to suggest that they have not. What is more relevant here is the fact that awareness of the 5+ a Day campaign from television advertising may have led to a similar effect on awareness and possibly intake in schools regardless of the use of educational resources.

The 5+ a Day message was well recognised by almost all children and parents implying that the campaign effectively enhances awareness about daily fruit and vegetables consumption. Furthermore, the message to eat five or more servings of fruit and vegetables daily was also understood by both children (92%) and parents (98%), regardless of intervention or control grouping. This may be because other resources used by those schools not registered for 5+ a Day resources may overlap sufficiently with the 5+ a Day resources to be able to promote 5+ a Day awareness e.g. the Heart Foundation resources. Another possibility is that the other media through which the message is being delivered e.g. television advertisement and food labeling, may be more effective or considerably reinforce the school resources in promoting this awareness.

It is possible that this multifaceted campaign effectively increases awareness of the need to eat more fruit and vegetables. However, the effect of individual strands of this campaign on fruit and vegetable intakes are difficult to evaluate. A more accurate prediction of the effectiveness of the 5+ a Day campaign may be better measured by prospective research or a randomized controlled trial that investigates the effect of the campaign as a whole.

The combination of widespread promotion of the programme through media and other channels as well as its incorporation into child learning centres through educational resources maximize its exposure and is important to enhance awareness of the 5+ a Day message. Schools, however, have the potential to be used for more intense strategies to implement an increase in fruit and vegetable intakes. Effectiveness of the 5+ a Day programme in schools could be strengthened by the simultaneous use of behavioural strategies to motivate dietary change, and modification of the eating environment in school e.g. implementation of fruit tuck shops, to make these foods more readily available. A recent pilot study that provided free fruit to low decile primary schools in the Auckland area has demonstrated a significant increase in fruit intakes over a single academic term (data presented at the International 5+ a Day Symposium, 2004).

More importantly, to be more effective the programme requires a certain level of support from teaching staff and the wider community. As mentioned before, the delivery of health education for children within the school setting is at the discretion of the teachers and they can determine the emphasis placed on educating children about the benefits of fruit and vegetables at school. An ideal strategy to improve fruit and vegetable intakes of children also requires the involvement of parents, as they are responsible for the types of foods made available to children at home, and thus ultimately determine a large proportion of their dietary intake.

8. CONCLUSION

Whangarei primary school children reported consuming above MOH recommendations for fruit and vegetable intakes. Consumption of fruits and vegetables and knowledge of nutrition did not differ significantly between children in schools receiving 5+ a Day specific educational resources and those in school not registered to receive the 5+ a Day resources. Children from schools that did receive resources, however, were more aware of a connection between food and certain health conditions, i.e. general health, heart disease, and cancer. The 5+ a Day message is well recognised by both children and parents regardless of whether or not they are registered to receive resources from the 5+ a Day organization. It would seem that widespread promotion of the programme via many channels of communication has effectively enhanced awareness of the 5+ a Day message in Whangarei schoolchildren and their families.

8.1 Future research

Some areas for future research include:

i. To extend this pilot study of the dietary intakes of Whangarei schoolchildren by recruiting more subjects from a wider range of schools (from all deciles) in order to determine whether the dietary intakes of these children really do differ from the national average.

ii. To determine the relative effectiveness of individual components of the 5+ a Day programme, as well as the effect of the programme as a whole, on the dietary intakes of fruits, vegetables and other food groups across different age groups.

iii. Investigate whether there are any differences in dietary intakes of fruits and vegetables between schools exposed and non-exposed to the 5+ a Day material using a more detailed dietary methodology, which also controls for seasonal variation in intake.

iv. Investigate prospectively the effect of exposure to new 5+ a Day strategies and educational materials used in schools on fruit and vegetable intakes in the long-term.

v. Review the content of educational resources available to teachers from the different schools to gain further insight into the types of health education material delivered to children and why there were no significant differences in intakes and knowledge between control and intervention groups in this study.

vi. To further investigate what influence the 5+ a Day campaign has on parents, particularly in lower socioeconomic groups or those who perceive barriers to increasing fruit and vegetable intakes and how they could be overcome.

REFERENCES

Appel, L. J., Moore, T.J., Obarzanek, E., Vollmer, W. M., Svetkey, L. P., Sacks, F. M., Bray, G. A., Vogt, T. M., Cutler, J. A., Windhauser, M. M., Lin, P-H., Karanja, N. For the DASH Collaborative Research Group (1997). A clinical trial of the effects of dietary patterns on blood pressure. *New England Journal of Medicine, 336* (16), 1117-1124.

Ashfield-Watt, P. A. L. (2004). *An evaluation of a free fruit to schools programme in low decile primary schools in Auckland.* Presentation at the International 5-A-Day Symposium, 2004. Christchurch, New Zealand.

Ashfield-Watt, P. A., Pullin, C. H., Whiting, J. M., Clark, Z. E., Moat, S. J., Newcombe, R. G., Burr, M. L., Lewis, M. J., Powers, H. J., McDowell, I. F. (2002). Methylenetetrahydrofolate reductase 677C-->T genotype modulates homocysteine responses to a folate-rich diet or a low-dose folic acid supplement: a randomized controlled trial. *American Journal of Clinical Nutrition, 76* (1), 180-186.

Baranowski, T., Mendlein, J., Resnicow, K., Frank, E., Cullen, K. W., Baranowski, L. D. (2000). Physcial activity and nutrition in children and youth: An overview of obesity prevention. *Preventive Medicine, 32* (supplement), S1-S10.

Barzel, U. S., Massey, L. K. (1998). Excess dietary protein can adversely affect bone. *Journal of Nutrition, 128* (6), 1051-1053.

Bazzano, L. A., He, J., Ogden, L. G., Loria, C. M., Vupputuri, S., Myers, L., Whelton, P. K. (2002). Fruit and vegetable intake and risk of cardiovascular disease in US adults: the first National Health and Nutrition Examination Survey Epidemiologic Follow-up Study. *American Journal of Clinical Nutrition, 76* (1), 93-99.

Beresford, S. A., Thompson, B., Feng, Z., Christianson, A., McLerran, D., Patrick, D. L. (2001). Seattle 5 a Day worksite program to increase fruit and vegetable consumption. *Preventive Medicine, 32* (3), 230-238.

Berkey, C. S., Rockett, H. R., Field, A. E., Gillman, M. W., Frazier, L., Camargo, C. A., Colditz, G. A. (2000, April). Activity, dietary intake, and weight changes in a longitudinal study of preadolescent and adolescent boys and girls. [45] Pediatrics [online serial], 105(4). URL: *http://www.pediatrics.org/cgi/content/full/105/4/e56*

Birch, L. L., Fisher, J. O. (1998). Development of eating behaviors among children and adolescents. *Pediatrics, 101* (3), 539-549.

Biro, G. Hulshof, K. F., Ovesen, L., Amorim-Cruz, J.A. (2002). Selection of methodology to assess food intake. *European Journal of Clinical Nutrition, 56* (supplement 2), 25S-32S.

Booth, M. L., Chey, T., Wake, M., Norton, K., Hesketh, K., Dollman, J., Robertson, I. (2003). Change in the prevalence of overweight and obesity among young Australians, 1969-1997. *American Journal of Clinical Nutrition, 77*(1), 29-36.

Boushey, C. J., Beresford, S. A., Omenn, G. S., Motulsky, A. G. (1995). A quantitative assessment of plasma homocysteine as a risk factor vascular disease: Probable benefits of increasing folic acid intakes. *Journal of the American Medical Association, 274,* 1049-1057.

Boynton-Jarrett, R., Thomas, T. N., Peterson, K. E., Wiecha, J., Sobol, A. M., Gortmaker, S. J. (2003). Impact of television viewing patterns on fruit and vegetable consumption among adolescents. *Pediatrics, 112* (6), 1321-1326.

Brouwer, I. A., van Dusswldorp, M., Thomas, C. M., Duran, M., Hautvast, J. G., Eskes, T. K., Steegers-Theunissen, R. P. (1999a). Low-dose folic acid supplementation decreases plasma homocysteine concentrations: a randomized trial. *American Journal of Clinical Nutrition, 69* (1), 99-104.

Brouwer, I. A., van Dusseldorp, M., West, C. E., Meyboom, S., Thomas, C. M. G., Duran, van het Hof, K. H., Eskes, T. K. A. B., Hautvast, J. G. A. J., Steegers-Theunissen, R. P. M. (1999b). Dietary folate from vegetables and citrus fruit decreases plasma homocysteine concentrations in humans in a dietary controlled trial. *Journal of Nutrition, 129* (6), 1135-1139.

Burchett, H. (2003). Increasing fruit and vegetable consumption among British primary school children: a review. *Health Education, 103*(2), 99-109.

Caraher, M., Dixon, P., Felton, M., South, L., Tull, A. (2002, August). Making fruit and vegetables the easy choice: Report of a five-a-day pilot project in Hastings and St Leonards. September 2000 – August 2001 [Online article], United Kingdom, Department of Health.URL: *http://www.doh.gov.uk/fiveaday*

Chinn, S., Rona, R. J. (2001). Prevalence and trends in overweight and obesity in 3 cross-sectional studies of British children, 1974-1994. *British Medical Journal, 322* (7277), 24-26.

Chant, S., Grant, T., Andrews, F. (2002, August). Five-a-day keeps the doctor away: report of a five-a-day pilot project in Somerset. August 2000 – August 2001 [Online article], United Kingdom, Department of Health. URL: *http://www.doh.gov.uk/fiveaday*

Coady, J. & O'Hara, E. (2002, August). Five-a-day community project, County Durham and Darlington: Report of a five-a-day pilot project. September 2000 – August 2001 [Online article], United Kingdom, Department of Health. URL: *http://www.doh.gov.uk/fiveaday*

Cole, T. J., Bellizzi, M. C., Flegal, K. M., Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal, 320* (7244), 1240-1243.

Crooks, D. L. (2000). Food consumption, activity, and overweight among elementary schoolchildren in an Appalachian Kentucky community. *American Journal of Physical Anthropology, 112* (2), 159-170.

De Irala-Estévez, Groth, M., Johansson, L., Oltersdorf, U., Prättälä, R., Martínez-González, M. A. (2000). A systematic review of socio-economic differences in food habits in Europe: consumption of fruit and vegetables. *European Journal of Clinical Nutrition, 54* (9), 706-714.

De Lorgeril, M., Renaud, S., Mamelle, N., Salen, P., Martin, J. L., Monjaud, I., Guidollet, J., Touboul, P., Delaye, J. (1994). Mediterranean alpha-linolenic acid-rich diet in secondary prevention of coronary heart disease. *Lancet, 343*(8911), 1454-1459.

De Lorgeril, M., Salen, P., Martin, J. L., Monjaud, I., Delaye, J., Mamelle, N. (1999). Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. *Circulation, 99*(6), 779-785.

Dennison, B. A., Rockwell, H. L., Baker, S. L. (1998). Fruit and vegetable intake in young children. *Journal of the American College of Nutrition, 17*(4), 371-378.

Dietz, W. H. (1998). Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics, 101* (3), 518-525.

DOH. (2002, November). Five-a-day pilot initiatives: Executive summary of the pilot initiatives evaluation study [Online article], United Kingdom, Department of Health. URL: *http://www.doh.gov.uk/fiveaday*

DOH. (2003). A local 5-A-Day initiative: Increasing fruit and vegetable consumption, improving health: Booklet 1 [Online article], United Kingdom, Department of Health. URL: *http://www.doh.gov.uk/fiveaday*

Durkin, M., Hobbiss, A., Robinson, J. (2002, August). Five-a-day in Airedale and Craven: Report of a five-a-day pilot project. September 2000 - August 2001 [Online article], United Kingdom, Department of Health. URL: *http://www.doh.gov.uk/fiveaday*

Edmunds, L., Jones, C (2003, May). Evaluation of the Sustain Grab 5! School fruit and vegetable project. Report for the British Heart Foundation Healthy Promotion Research group by Sustain: the alliance for better food and farming [Online article]. URL: *http://www.grab5.com*

Eston, R. & Reilly, T. (2001). *Kinanthropometry and exercise physiology laboratory manual: tests, procedures and data* (2nd ed.). Volume 1: Anthropometry. London: Routledge.

Fahey, M. T., Kobayashi, M., Akabane, M., Tsugane, S. (2003). Seasonal misclassification error and magnitude of true between-person variation in dietary nutrient intake: a random coefficients analysis and implications for the Japan Public Health Centre (JPHC) Cohort Study. *Public Health Nutrition, 6* (4), 385-391.

Ford, E. S., Byers, T. E., & Giles, W. H. (1998). Serum folate and chronic disease risk: findings from a cohort of United States adults. *International Journal of Epidemiology, 27* (4), 592–598.

Fredriks, A. M., van Buuren, S., Wit J. M., Verloove-Vanhorick, S. P. (2000). Body index measurements in 1996-1997 compared with 1980. *Archives of Diseases & Children, 82* (2), 107-112.

Freedman, D. S., Srinivasan, S. R., Valdez, R. A., Williamson, D. F., Bevenson, G. S. (1997). Secular increases in relative weight and adiposity among children over 2 decades: The Bogalusa Heart Study. *Pediatrics 99* (3): 420-426.

Gale, C. R., Martyn, C. N., Winter, P. D., Cooper, C. (1995). Vitamin C and risk of death from stroke and coronary heart disease in cohort of elderly people. *British Medical Journal, 310* (6994), 1563-1566.

Gaziano, J. M., Manson, J. E., Branch, L. G., Colditz, G. A., Willet, W. C., Buring, J. E. (1995). A prospective study of consumption of carotenoids in fruits and vegetables and decreased cardiovascular mortality in the elderly. *Annals of Epidemiology, 5* (4), 255-260.

Gibson, E. L., Wardle, J., Watts, C. J. (1998). Fruit and vegetable consumption, nutritional knowledge and beliefs in mothers and children. *Appetite, 31* (2), 205-228.

Gilliland, F. D., Berhane, K., T., L, Y-F., Gauderman, J., McConnell, R., Peters, J. (2003). Children's lung function and antioxidant vitamin, fruit, juice, and vegetable intake. *American Journal of Epidemiology, 158*(6), 576-584.

Giskes, K., Turrell, G., Patterson, C., Newman, B. (2002). Socioeconomic differences among Australian adults in consumption of fruit and vegetables and intakes of vitamins A, C and folate. *Journal of Human Nutrition and Dietetics, 15* (5), 375-385.

Gorn, G. J., Goldberg, M. E. (1982). Behavioural evidence of the effects of televised food messages on children. *Journal of Consumer Research, 9,* 200-205.

Green, J. H., and Boyle, F. E. (2001). Lack of awareness of public health promotion messages among a group of adult New Zealanders who meet national guidelines for food intake and physical activity. *Asia Pacific Journal of Clinical Nutrition, 10* (1), 17-20.

Guo, S. S., Wu, W., Chumlea. W. C., Roche, A. F. (2002). Predicting overweight and obesity in adulthood from body mass index values in childhood and adolescence. *American Journal of Clinical Nutrition, 76* (3), 653-658.

Havas, S., Heimendinger, J., Reynolds, K., Baranowski, T., Nicklas, T. A., Bishop, D., Buller, D., Sorenson, G., Beresford, S. A., Cowan, A., Damron, D. (1994). 5 a day for better health: a new research initiative. *Journal of the American Medical Association, 94* (1), 32-37.

Havas, S., Anliker, J., Damron, D., Langenberg, P., Ballesteros, Feldman, R. (1998). Final results of the Maryland WIC 5-A-Day Promotion Program. *American Journal of Public Health, 88* (8), 1161-1167.

Hennekens, C. H., Buring, J. E., Manson, J. E., Stampfer, M., Rosner, B., Cook, N. R., Belanger, C., LaMotte, F., Gaziano, J. M., Ridker, P. M., Willet, W., Peto, R. (1996). Lack of effect of long-term supplementation with beta-carotene on the incidence of malignant neoplasms and cardiovascular disease. *New England Journal of Medicine, 334* (18), 1145-1149.

Homocyteine Lowering Trialists' Colaboration. (1998). Lowering blood homocysteine with folic acid based supplements: a meta-analysis of randomized trials. *British Medical Journal, 316* (7135), 894-898.

Hung, J., Beilby, J. P., Knuiman, M. W., Divitini, M. (2003). Folate and vitamin B-12 and risk of fatal cardiovascular disease: cohort study from Busselton, Western Australia. *British Medical Journal, 326* (7381), 131-137.

Huon, G. F., Wardle, J., Szabo, M. (1999). Improving children's eating patterns: intervention programs and underlying principles. *Australian Journal of Nutrition and Dietetics, 56* (3), 156-165.

Johnsen, S. P., Overvad, K., Stripp, C., Tjønneland, A., Husted, S. E., Sørensen, H. T. (2003). Intake of fruit and vegetables and the risk of ischemic stroke in a cohort of Danish men and women. *American Journal of Clinical Nutrition, 78* (1), 57-64.

Joshipura, K. J., Ascherio, A., Manson, J. E., Stampfer, M. J., Rimm, E. B., Speizer, F. E., Hennekens, C. H., Spiegelman, D., Willet, W. C. (1999). Fruit and vegetable intake in relation t risk of ischemic stroke. *Journal of the American Medical Association, 282* (13), 1233-1239.

Joshipura, K. J., Manson, J. E., Stampfer, M. J., Rimm, E. B., Speizer, F. E., Colditz, G. A., Ascherio, A., Rosner, B., Spiegelman, D., Willet, W. C. (2001). The effect of fruit and vegetable intake on risk for coronary heart disease. *Annals of Internal Medicine, 134* (12), 1106-1114.

Kerstetter, J. E., O'Brien, K. O., Insogna, K. L. (2003a). Low protein intake: the impact of calcium and bone homoestasis in humans. *Journal of Nutrition, 133* (supplement), 855S-861S.

Kerstetter, J. E., O'Brien, K. O., Insogna, K. L. (2003b). Dietary protein, calcium metabolism, and skeletal homeostasis. *American Journal of Clinical Nutrition,* 78 (3), 584S-592S.

Klesges, L. M., Baranowski, T., Beech, B., Cullen, K., Murray, D. M., Rochon, J., Pratt, C. (2004). Social desirability bias in self-reported dietary, physical activity and weight concerns measures in 8- to 10-year-old African-American girls: results from the Girls health Enrichment Multisite Studies (GEMS). *Preventive Medicine, 38,* S78-S87.

Klipstein-Grobusch, K., Geleijnse, J., den Breeijen, J. H., Boeing, H., Hofman, A., Grobbee, D.E., Witteman, J. C. (1999). Dietary antioxidants and risk of myocardial infarction in the elderly: the Rotterdam Study. *American Journal of Clinical Nutrition, 69* (2), 261-266.

Kurl, S., Tuomainen, T. P., Laukkanen, J. A., Nyyssonen, K., Lakka, T., Sivenius, J., Salonen, J. T. (2002). Plasma vitamin C modifies the association between hypertension and risk of stroke. *Stroke, 33* (6), 1568-1573.

Kushi, L. H., Folsom, A. R., Prinaes, R. J., Mink, P. J., Ying, W., Bostick, R. M. (1996). Dietary antioxidant vitamins and death from coronary heart disease in postmenopausal women. *New England Journal of Medicine, 334* (18), 1156-1162.

Lew, E. A., Garfinkel, L. (1979). Variations in mortality by weight among 750,000 men and women. *Journal of Chronic Diseases,* 32 (8), 563-576.

McPherson, R. S., Hoelscher, D. M., Alexander, M., Scanlon, K. S., Serdula, M. K. (2000). Dietary assessment methods among school-aged children: validity and reliability. *Preventive Medicine, 31*(supplement), 11S-33S.

Magarey, A., Daniels, L.A., Smith, A. (2001). Fruit and vegetable intakes of Australians aged 2-18 years: an evaluation of the 1995 National Nutrition Survey data. *Australian New Zealand Journal of Public Health 25* (2), 155-161.

Mathers, C. D., Vos, E. T., Stevenson, C. E., Begg, S. (2001). The burden of disease and injury in Australia. *Bulletin of the World Health Organization, 79* (11), 1076-1081.

Metcalfe, P. A., Scragg, R. K. R., Sharpe, S., Fitzgerald, E. D. H., Schaaf, D., Watts, C. (2003). Short-term repeatability of a food frequency questionnaire in New Zealand children aged 1-14y. *European Journal of Clinical Nutrition, 57* (11), 1498-1503.

MOH. (1998). Food and nutrition guidelines for healthy children aged 2-12 years: A background paper [Online article], Wellington, Ministry of Health. URL: *http://www.moh.govt.nz*

MOH. (1999). NZ Food, NZ People: Key results of the 1997 National Nutrition Survey [Online article], Wellington, Ministry of Health. URL: *http://www.moh.govt.nz*

MOH. (2002). Cancer in New Zealand: Trends and projections [Online article], Wellington, Ministry of Health. URL: *http://www.moh.govt.nz*

MOH. (2003a). Food and Nutrition Guidelines for Healthy Adults: A background paper [Online article], Wellington, Ministry of Health. URL: *http://www.moh.govt.nz*

MOH. (2003b). NZ Food, NZ Children: Key results of the 2002 National Children's Nutrition Survey [Online article], Wellington, Ministry of Health. URL: *http://www.moh.govt.nz/phi*

Morris, C. D., & Carson, S. (2003). Routine vitamin supplementation to prevent cardiovascular disease: a summary of evidence for the US Preventive Services Task Force. *Annals of Internal Medicine, 139* (1), 56-71.

Must, A., Jacques, P. F., Dallal, G. E., Bajena, C. J., Dietz, W. H. (1992). Long-term morbidity and mortality of overweight adolescents: a follow up of the Harvard Growth Study of 1922 to 1935. *New England Journal of Medicine,* 327 (19), 1350-1355.

New, S. A., Bolton-Smith, C., Grubb, D. A., Reid, D. M. (1997). Nutritional influences on bone mineral density: a cross-sectional study in premenopausal women. *American Journal of Clinical Nutrition, 65* (6), 1831-1839.

New, S. A., Robins, S. P., Campbell, M. K., Martin ,J. C., Garton, M. J., Bolton-Smith, C., Grubb, D .A., Lee, S. J., Reid, D. M. (2000). Dietary influences on bone mass and bone metabolism: further evidence of a positive link between fruit and vegetable consumption and bone health. *American Journal of Clinical Nutrition, 71* (1), 142-151.

Nyyssonen, K., Parviainen, M. T., Salonen, R., Tuomilehto, J., Salonen, J. T. (1997). Vitamin deficiency and risk of myocardial infarction: prospective population study of men from eastern Finland. *British Medical Journal, 314* (7081), 634-638.

Omenn, G. S., Goodman, G. E., Thornquist, M. D., Balmes, J., Cullen, M. R., Glass, A., Keogh, J. P., Meyskens, F. L., Valanis, B., Williams, J. H., Barnhart, S., Hammer, S. (1996). Effects of a combination of beta carotene and vitamin A on lung cancer and cardiovascular disease. *New England Journal of Medicine, 334* (18): 1150-1155.

Øverby, N. C., Lillegaard, I. T. L., Johansson, L., Anderson, L.F. (2003). High intake of added sugar among Norwegian children and adolescents. *Public Health Nutrition, 7* (2), 285-293.

Perry, C.L., Bishop, D.B., Taylor, G., Murray, D.M., Mays, R.W., Dudovitz, B.S., Smyth, M., Story, M. (1998). Changing fruit and vegetable consumption among children: The 5-a-Day Power Plus Program in St. Paul, Minnesota. *American Journal of Public Health, 88* (4), 603-609.

Pirouznia, M. (2001). The association between nutrition knowledge and eating behaviour in male and female adolescents in the US. *International Journal of Food Science and Nutrition, 52* (2), 127-132.

Oakley, A., Bendelow, G., Barnes, J., Buchanan, M., Husain, O. A. N. (1995). Health and cancer prevention: knowledge and beliefs of children and young people. *British Medical Journal, 310* (6989), 1029-1033.

Quigley, R., and Watt, C. (1997). Food comes first: methodologies for the National Nutrition Survey of New Zealand [Online article], Wellington, Ministry of Health. URL: *http://www.moh.govt.nz*

Rapola, J. M., Virtamo, J., Ripatti, S., Huttunen, J. K., Albanes, D., Taylor, P. R., Heinonen, O.P. (1997). Randomised trial of alpha-tocopherol and beta-carotene supplements on incidence of major coronary events in men with previous myocardial infarction. *Lancet, 349* (9067), 1715-1720.

Rapola, J. M., Virtamo, J., Haukka, J. K., Heinonen, O. P., Albanes, D., Taylor, P. R., Huttunen, J. K. (1996). Effect of vitamin E and beta carotene on the incidence of angina pectoris. A randomized, double-blind, controlled trial. *Journal of the American Medical Association, 275* (9), 693-698.

Reynolds, K. D., Baranowski, T., Bishop, D. B., Farris, R. P., Binkley, D., Nicklas, T. A., Elmer, P. J. (1999). Patterns in child and adolescent consumption of fruit and vegetables: effects of gender and ethnicity across four sites. *Journal of the American College of Nutrition, 18* (3), 248-254.

Reynolds, K. D., Franklin, F. A., Binkley, D., Raczynski, J. M., Harrington, K. F., Kirk, K. A., Person, S. (2000). Increasing the fruit and vegetable consumption of fourth-graders: results from the High 5 Project. *Preventive Medicine, 30,* 309-319.

Rex, D. (2002, August). Give me 5: Report of a five-a-day pilot project in Sandwell. August 2000 – July 2001 [Online article], United Kingdom, Department of Health. URL: *http://www.doh.govt.uk/fiveaday*

Riboli, E., Norat, T. (2003). Epidemiological evidence of the protective effect of fruit and vegetables on cancer risk. *American Journal of Clinical Nutrition, 78* (supplement), 559S-569S.

Rimm, E. B., Stampfer, M. J., Ascherio, A. Giovannucci, E., Colditz, G. A., Willet, W. C. (1993). Vitamin E consumption and the risk of coronary heart disease in men. *New England Journal of Medicine, 328* (20), 1450-1456.

Rissanen, T. H., Voutilainen, S., Virtanen, J. K., Venho, B., Vanharanta, M., Mursu, J., Salonen, J. T. (2003). Low intake of fruits, berries and vegetables is associated with excess mortality in men: the Kuopio Ischemic Heart Disease Risk Factor (KIHD) Study. *Journal of Nutrition, 133* (1), 199-204.

Sahota, P., Rudolf, M. C. J., Dixey, R., Hill, A. J., Barth, J. H., Cade, J. (2001). Randomised controlled trial of primary school based intervention to reduce risk factors for obesity. *British Medical Journal, 323* (7303), 1-5.

Scott, J. (2000). Folate (Folic acid) and vitamin B12. In Garow, J. S., James, W. P., Ralph, A. (Eds.). *Human Nutrition and Dietetics* (10th ed.) (pp. 271-280). London: Churchill Livingstone.

Sebastian, A., Harris, S. T., Ottaway, J. H., Todd, K. M., Morris, R. C., Jr. (1994). Improved mineral balance and skeletal metabolism in postmenopausal women treated with potassium bicarbonate. *New England Journal of Medicine, 330* (25), 1776-1781.

Shahar, D. R., Yerushalmi, N., Lubin, F., Fromm, P., Shahar, S., Kristal-Boneh, E. (2001). Seasonal variation in dietary intake affect the consistency of dietary assessment. *European Journal of Epidemiology, 17* (2), 129-133.

Shu, X. O., Yang, G., Liu, D., Kushi, L., Wen, W., Gao, Y-T., Zheng, W. (2004). Validity and reproducibility of the food frequency questionnaire used in the Shanghai Women's Health Study. *European Journal of Clinical Nutrition, 58* (1), 17-23.

Smith, R. (2000). Bone mineral. In Garrow, J. S., James, W. P., Ralph, A (Eds.). *Human Nutrition and Dietetics*. (10th ed.) (pp. 165-175). London: Churchill Livingstone.

Sorenson, G., Stoddard, A., Peterson, K., Cohen, N., Hunt, M. K., Stein, E., Palombo, R., Lederman, R. (1999). Increasing fruit and vegetable consumption through worksites and families in the Treatwell 5-a-Day study. *American Journal of Public Health, 89* (1), 54-60.

Sullivan, C., Oakden, J., Young, J., Lau, M., Lawson, R. (2004). *Pulp Fiction – The facts harvested: a study of New Zealanders' physical activity and nutrition.* Prelimary report for the Cancer Society of New Zealand, Ref no. 1401720. URL: *http://www.cancernz.org/INFO/PDF/media/finalreport.pdf*

Thakur, N., and D'Aminco, F. (1999). Relationship of nutrition knowledge and obesity in adolescence. *Family Medicine, 31* (2), 122-127.

The Alpha-Tocopherol, Beta-Carotene Cancer Prevention Study Group. (1994). The effect of vitamin E and beta carotene on the incidence of lung cancer and other cancers in male smokers. *New England Journal of Medicine, 330* (15), 1029-1035.

The American Cancer Society Advisory Committee on Diet, Nutrition and Cancer Prevention. (1996). Guidelines on diet, nutrition and cancer prevention: reducing the

risk of cancer with healthy food choices and physical activity. *CA A Cancer Journal for Clinicians 46* (6), 325-341.

Thompson, F. E., Byers, T., Kolmeier, L. (1994). Dietary assessment resource manual. *Journal of Nutrition, 124* (supplement 11), 2245S-2261S.

Thurnham, D. I. (2000). Vitamin C and B vitamins, thiamin, riboflavin and niacin. In Garrow, J. S., James, W. P. T., Ralph, A. (Eds.) *Human Nutrition and Dietetics* (10th ed.) (pp. 249-268). London: Churchill Livingston.

Troiano, R. P., Flegal, K. M. (1998). Overweight children and adolescents: description, epidemiology and demographics. *Pediatrics, 101* (3), 497-504.

Tucker, K. L., Hannan, M. T., Chen, H., Cupples, A., Wilson, P. W. F., Kiel, D. P. (1999). Potassium, magnesium, and fruit and vegetable intakes are associated with greater bone mineral density in elderly men and women. *American Journal of Clinical Nutrition, 69* (4), 727-736.

Tucker, K. L., Chen, H., Hannan, M .T., Cupples, A., Wilson, P. W. F., Felson, D., Kiel, D. P. (2002). Bone mineral density and dietary patterns in older adults: the Framingham Osteoporosis Study. *American Journal of Clinical Nutrition,* 76 (1), 245-252.

Turnbull, A., Barry, D., Wickens, K., Crane, J. (2004). Changes in body mass index in 11-12 year-old children in Hawkes Bay, New Zealand (1989-2000). *Journal of Paediatrics and Child Health, 40* (1-2), 33-37.

Tylavsky, F. A., Holliday, K., Danish, R., Womack, C., Norwood, J., Carbone, L. (2004). Fruit and vegetable intakes are an independent predictor of bone size in early pubertal children. *American Journal of Clinical Nutrition, 79* (2), 311-317.

Verhoef, P., Stampfer, M. J., Buring, J. E., Gaziano, J. M., Allen, R. H., Stabler, S. P., Reynolds, R. D., Kok, F. J., Hennekens, C. H., Willet, W. C. (1996). Homocysteine metabolism and risk of myocardial infarction: relation with vitamins B6, B12, and folate. *American Journal of Epidemiology, 143* (9), 845-859.

United Fresh. (2003). The 5+ a Day campaign [Online article]. URL: *http://www.5aday.co.nz*

Vivekananthan, D. P., Penn, M. S., Sapp, S. K., Hsu, A., Topol, E. J. (2003). Use of antioxidant vitamins for the prevention of cardiovascular disease: meta-analysis of randomized trials. *Lancet, 361*, 2017-2023.

Wald, D. S., Law, M., Morris, J. K. (2002). Homocysteine and cardiovascular disease: evidence on causality from a meta-analysis. *British Medical Journal, 325* (7374), 1202-1206.

Warren, J. M., Henry, C. J., Lightowler, H. J., Bradshaw, S. M., Perwaiz, S. (2003). Evaluation of a pilot school programme aimed at the prevention of obesity in children. *Health Promotion International, 18* (4), 287-296.

Whitaker, R. C., Wright, J. A., Pepe, M. S., Seidel, K. D., Dietz, W. H. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *New England Journal of Medicine 337* (13), 869-873.

WHO, FAO. (2003). *Diet, Nutrition and the Prevention of Chronic diseases.* Report of a joint WHO Expert Consultation. Geneva. World Health Organization.

WHO. (2002). The World Health Report 2002: Reducing risks, promoting healthy life. Geneva. World Health Organization.

World Cancer Research Fund and American Institute for Cancer Prevention. (1997). Food, Nutrition and the prevention of cancer: A global perspective. Washington, DC: World Cancer Research Fund and American Institute for Cancer Prevention.

Appendix 1: Consent form

Massey University
COLLEGE OF SCIENCES
Institute for Food, Nutrition and Human Health - Albany Campus

A study of nutritional knowledge and dietary intakes in Whangarei school children

Consent form

This consent form will be held for a period of five (5) years

I have read the information sheet and understand the nature of the study and my part in it. I have had the opportunity to ask questions and I am satisfied with the answers I have been given.

I understand that taking part in the study is voluntary and that I may withdraw from the study up until completion of data collection or refuse to answer any particular question.

I understand that my participation in this study is confidential and that no material, which could identify me, will be used in any reports on this study.

I have had time to consider whether to take part. I understand that I may ask further questions about the study at any time, and know whom to contact if I wish to do so.

Child consent

I _____ (full name) hereby consent to take part

Child's signature _____

I _____ (full name) hereby consent to my child (or

child under my guardianship) _____ to take part

Parent / guardian's signature _____

Parent/Guardian consent

I _____ (full name) hereby consent to take part

Parent / guardian's signature _____

Researcher's signature _____

Date _____

Appendix 2: Information sheet

Massey University
COLLEGE OF SCIENCES

Institute for Food, Nutrition and Human Health - Albany Campus

A study of nutritional knowledge and dietary intakes in Whangarei schoolchildren

Information sheet

Background

Eating patterns play an influential role in long-term health. Research has shown that an unhealthy diet and lack of physical activity are among the primary factors, which cause various diet-related diseases including cardiovascular disease, coronary heart disease, obesity and cancer.

Eating habits and food preferences developed during childhood are thought to persist into adult life, affecting food selection in later years and patterns of adult disease. For this reason, guidelines that encourage a lifestyle of healthy eating and regular exercise are just as important for children as they are for adults.

A number of organizations, including the National Heart Foundation of New Zealand and the Cancer Society of New Zealand have developed nutritional programmes and messages to promote health to the public. The focus of several strategies has been to improve dietary knowledge and eating patterns in school age children.

My name is Keri Linklater and I am a Masters student at Massey University. I am conducting a study that aims to find out what children eat, what information they gain from nutrition campaigns and how this information affects the wider family.

Participant recruitment

All children who are 10 years of age, attending one of two schools selected from the Whangarei region, are invited to participate in the study. It is estimated that 50 students will be selected from each school (depending on school rolls) and asked to participate.

Project procedures

The information collected will be used in a thesis to fulfill the requirements of a Masters Degree of Nutritional Science. All information collected will be treated confidentially and no individual will be personally identified in any reports. The hard copy of data will be kept in a locked data storage room, in a building fitted with a burglar alarm. University policy requires the data to be retained for a period of five years. After this time a responsible nominee will destroy the data.

After completion of the study each subject will receive a summary of his or her nutrient intake and body measurements. A summary of the project findings will be sent to the participating schools.

Children

We would like you to:

- ✓ Answer some simple questions about food and health
- ✓ Tell us about the food you usually eat (we'll show you some pictures of food and drinks and you can tell us how often you eat them)
- ✓ Tell us about the amount of exercise you usually take
- ✓ We would also like to take your height and body weight measurements

This information will be gathered during school with the help of the researcher. The collection of this data is estimated to take one hour per child.

Parents

We would like you to:

- ✓ Answer some simple question about food and health
- ✓ Answer some simple questions about the factors that influence your shopping habits
- ✓ Answer some simple questions on your demographic characteristics

This information will be collected by a questionnaire that will be sent home with your child. The questionnaire will take around 20-30 minutes to complete. Even if you do not have time to complete the questionnaire we would be grateful for your consent to allow your child to participate.

Why do I need your help?

Considerable effort has gone into researching diet health relationships in schools from the Auckland region, however little is known about the children of Whangarei. The information provided by you will represent that of the school children and parents in your region of Whangarei.

Do I have to take part?

It is your choice whether to participate.

You have the right to:

- Decline to participate;
- Decline to answer any question;
- Withdraw from the study up until the time when all of the data on you/ your child has been collected;
- Ask any questions about the study at any time during participation;
- Provide information on the understanding that your name will not be used in any reports of the study;
- Be given access to the summary of the project findings when it is concluded

Contact details

If you have any further questions please feel free to contact:

Keri Linklater
telephone: (09) 4335 767
e-mail: keri.link@mail.com

or Dr Pauline Ashfield-Watt
telephone: (09) 443 9700 x9874
e-mail: P.Ashfield-Watt@massey.ac.nz

Committee Approval Statement

This project has been reviewed and approved by the Massey University Human Ethics Committee, ALB Protocol NO/NO (03/028). If you have any concerns about the conduct of this research, please contact Associate Professor Kerry P Chamberlain, Chair, Massey University Campus Human Ethics Committee: Albany, telephone 09 443 9700 x9078, email K.Chamberlain@massey.ac.nz.

Appendix 3: Letter to Board of Trustees

(original letters on Massey University Letterhead)

Date

Name
Address

Dear Mr. / Mrs.

A study of nutritional knowledge and dietary intakes in Whangarei schoolchildren

My name is Keri Linklater and I am a post-graduate student undertaking this research project for a Masters Degree in Science, my supervisor is Dr Pauline Ashfield-Watt, Institute of Food Nutrition and Human Health, Massey University, Albany Campus.

I am investigating nutritional knowledge, attitudes to health and dietary intake in children, and how nutrition education in school affects the wider family. By participating in this study children will help to determine the impact of nutritional campaigns on children from the Whangarei region.

I have had preliminary discussion with your school's principal about recruiting children for this survey at (name of the school), and would like the Board of Trustees' approval to do this. The students would be year 6 pupils aged 10 years. Information on children's' knowledge and beliefs about diet and health will be collected using a simple questionnaire. Dietary assessment will involve a food frequency method developed at Massey University for the Children's Nutrition Survey and height and weight will be measured by myself using calibrated equipment. A parent/guardian of the participating child will also be asked to complete a simple questionnaire, which will be sent home with the child.

Enclosed is an information sheet explaining in more detail what the study involves and requirements of the children and their parent/guardian. Should you require any further information then please feel free to contact either myself on (09) 433 5767 or Dr Ashfield-Watt on (09) 443 9700 extension 9874.

Yours sincerely,

Keri Linklater

Appendix 4: Weight and height measurements

Protocol for BMI measurement was taken from "Kinanthropometry and exercise physiology laboratory manual: Tests, procedures and data" (Eston & Reilly, 2001).

(a) Weight

- body mass measurements taken without shoes and lightly clothed.
- Measurement recorded to nearest 0.1 kg.

(b) Height

- All measurements taken with subject barefoot.
- Subject stands erect, feet together against a wall on a flat surface.
- Heels, buttocks, upper back and cranium all touching the wall (where possible).
- Subject head in Frankfurt plane: position of head when the line joining the orbital lower margin of the eye socket) to the tragion (notch above tragus of the ear) is horizontal.
- Subject instructed to inhale and stretch up.
- Measurement recorded to the nearest 0.1 cm using a tape measure (Lufkin: Execute thinline) and right angle triangle (wooden block). The subject while standing upright had placed on their head the right angle triangle and then stepped away from the wall. A mark was made at the base of the triangle and this was measured from the floor to the point marked using the tape measure.

Appendix 6: Child Nutrition Knowledge Survey

Massey University
COLLEGE OF SCIENCES

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A study of nutritional knowledge and dietary intakes in Whangarei schoolchildren

Child questionnaire **Date** ☐☐☐☐☐☐

Height: **Weight:** **Gender: F/M**

ID ☐☐☐

Nutrition Knowledge about dietary recommendations

Office use

1. Which groups of food should you eat the **least** of? (Tick one only). ☐

- o Meat, fish, chicken
- o Milk, yoghurt, cheese
- o Fats, oils, sweets
- o Vegetables and fruit
- o Bread, cereal, rice, pasta
- o Don't know

2. Which groups of food should you eat the **most** of? (Tick one only). ☐

- o Meat, fish, chicken
- o Milk, yoghurt, cheese
- o Fats, oils, sweets
- o Vegetables and fruit
- o Bread, cereal, rice, pasta
- o Don't know

3. How many **servings** of fruit and vegetables should we eat every day? (Tick one only). ☐

- o 1
- o 2
- o 3
- o 4
- o 5
- o 6
- o Don't know

4. What **size** is a serving of fruit and vegetables? (Tick one box only).

Office use

- o About one full plate
- o About one full cup
- o About one handful
- o About one tablespoonful
- o Don't know

5. Please tick all the foods you think are high in **fat**.

- o Fried chicken
- o White bread
- o Bananas
- o Peanut butter
- o Marshmallows
- o Hot chips

6. Please tick all the foods you think are high in **fibre**.

- o Bran flakes
- o Carrots
- o Hamburger
- o Doughnuts
- o Lettuce
- o Cocoa pops

7. Please tick all the foods you think are high in **vitamin C**.

- o Broccoli
- o Macaroni cheese
- o Carrot cake
- o Kiwifruit
- o Olives
- o Orange juice

8. Please tick any of these healthy living messages you have heard of before.

- o "Push Play"
- o "Pick the Tick"
- o "Food and nutrition guidelines"
- o "5+ a day"
- o Haven't heard of any of these messages

0=unticked
1=ticked

9. For the following messages pick the correct piece of advice

Office use

(a) "Push Play" what does this message want you to do?

- o Eat 5 or more servings of fruit and vegetables a day
- o Eat 5 servings of milk, cheese and meat every day
- o Exercise for 30 minutes every day
- o Eat a variety of certain foods that are good for your health
- o Eat foods that have a red "Heart Foundation" tick on the packet
- o Don't know

(b) "Pick the Tick" what does this message want you to do?

- o Eat 5 or more servings of fruit and vegetables a day
- o Eat 5 servings of milk, cheese and meat every day
- o Exercise for 30 minutes every day
- o Eat a variety of certain foods that are good for your health
- o Eat foods that have a red "Heart Foundation" tick on the packet
- o Don't know

(c) "Food and nutrition guidelines" what does this message want you to do?

- o Eat 5 or more servings of fruit and vegetables a day
- o Eat 5 servings of milk, cheese and meat every day
- o Exercise for 30 minutes every day
- o Eat a variety of certain foods that are good for your health
- o Eat foods that have a red "Heart Foundation" tick on the packet
- o Don't know

(d) "5+ a day" what does this message want you to do?

- o Eat 5 or more servings of fruit and vegetables a day
- o Eat 5 servings of milk, cheese and meat every day
- o Exercise for 30 minutes every day
- o Eat a variety of certain foods that are good for your health
- o Eat foods that have a red "Heart Foundation" tick on the packet
- o Don't know

1=correct
2=incorrect
9=don't know

Office use

10. Where do you learn about food and nutrition? (Tick as many as you need). ☐

- o Newspaper ☐
- o Television ☐
- o Radio ☐
- o Magazines ☐
- o Teachers or classes at school ☐
- o Parents ☐
- o Other family members ☐
- o Friends ☐
- o Other sources (Please explain) ☐

0=unticked
1=ticked

Health and diet

11. Do you think what you eat can make you healthy? ☐

- o Yes 01
- o No 02
- o Don't know 09

12. Do you think what you eat can stop you getting cancer? ☐

- o Yes 01
- o No 02
- o Don't know 09

13. Do you think what you eat can stop you getting heart disease? ☐

- o Yes 01
- o No 02
- o Don't know 09

14. Do you think what you eat can stop you becoming overweight? ☐

- o Yes 01
- o No 02
- o Don't know 09

15. Do you think what you eat can make your teeth and bones healthy and strong?

Office use

o	Yes	01
o	No	02
o	Don't know	09

Attitudes to nutrition and food

For the following questions, please circle your answer on the scale of 1 to 5, 1 being very important and 5 being not important.

16. How important to you is it to eat lots of **fruit and vegetables**?

Very important				Not important
1	2	3	4	5

17. How important to you is it to eat lots of **cereals, bread and pasta?**

Very important				Not important
1	2	3	4	5

18. How important to you is it to eat or drink foods such as **milk, yoghurt and cheese?**

Very important				Not important
1	2	3	4	5

19. How important to you is it to **learn** about food and health?

Very important				Not important
1	2	3	4	5

Office use

20. Why should you eat fruit and vegetables everyday?
(You may tick more than one answer)

- o To give you energy and help you run faster ☐
- o To grow strong teeth and bones ☐
- o For healthy skin and hair ☐
- o For good eyesight and to help you see better at night ☐
- o Because your parents tell you to eat them ☐
- o Because I have learned that they are good for me at school ☐
- o Don't know ☐

21. What meals if any do you skip more than 2 times per week? ☐

- o Breakfast
- o Lunch
- o Dinner
- o Don't skip meals

22. Do you eat snacks between meals? ☐

- o Yes 01
- o No 02

If yes, what kinds of foods do you **usually** eat?

- o Chips or flavoured crackers ☐
- o Rice crackers or plain crackers ☐
- o Chocolates, lollies or candy bars ☐
- o Fresh or dried fruits ☐
- o Nuts or seeds ☐
- o Bread and spreads ☐
- o Biscuits or cake ☐
- o Raw or cooked vegetables (NOT hot chips) ☐
- o Other (Please write down what it is that you eat) ☐

_____

23. Do you think the foods you usually eat are healthy? ☐

- o Yes 01
- o No 02
- o Sometimes 03
- o Don't know 04

Physical activity and leisure time

Office use

1. In the last 4 weeks how much time did you usually spend watching television/videos?

a) During **school days**

o	0-1 hour each day	01
o	1-2 hours each day	02
o	2-3 hours each day	03
o	3-4 hours each day	04

b). During the **weekends**

o	0-1 hour each day	01
o	1-2 hours each day	02
o	2-3 hours each day	03
o	3-4 hours each day	04
o	4 or more hours each day	05

2. In the last 4 weeks, how much time did you usually spend playing computer or video games?

a). During **school days**

o	0-1 hour each day	01
o	1-2 hours each day	02
o	2-3 hours each day	03
o	3-4 hours each day	04
o	4 or more hours each day	05

b). During the **weekends**

o	0-1 hour each day	01
o	1-2 hours each day	02
o	2-3 hours each day	03
o	3-4 hours each day	04
o	4 or more hours each day	05

3. In the last 4 weeks how much time did you usually spend outdoors during the day?

Office use

a). During **school days**

- o 0-1 hour each day 01
- o 1-2 hours each day 02
- o 2-3 hours each day ☐ 03
- o 3-4 hours each day 04
- o 4 or more hours each day 05

b). During the **weekends**

- o 0-1 hour each day 01
- o 1-2 hours each day ☐ 02
- o 2-3 hours each day 03
- o 3-4 hours each day 04
- o 4 or more hours each day 05

4. How long does it usually take to travel from your home **to school**?

- o Less than 5 minutes 01
- o 5-15 minutes 02
- o 15-30 minutes ☐ 03
- o 30 minutes to 1 hour 04
- o More than 1 hour 05

5. In the last 4 weeks, how did you usually travel from your home **to school**? (You may choose more than one answer).

- o On foot ☐
- o Bicycle ☐
- o Bus ☐
- o Car ☐
- o Train ☐
- o Taxi ☐
- o Horse ☐
- o Motorcycle ☐
- o Skateboard/rollerblades ☐
- o Other (please explain) ☐

0=unticked,
1=ticked

Office use

6. In the last 4 weeks, how did you usually travel from school **to home**? (You may choose more than one answer).

- o On foot ☐
- o Bicycle ☐
- o Bus ☐
- o Car ☐
- o Train ☐
- o Taxi ☐
- o Horse ☐
- o Motorcycle ☐
- o Skateboard/rollerblades ☐
- o Other (please explain) ☐

_____

0=unticked,
1=ticked

In the last 4 weeks have you taken part in any sports or physical activities **before or after school** during the week, or at the weekend?

(DO NOT INCLUDE SCHOOL TIME ACTIVITES).

- o Yes ☐ 01
- o No 02

If yes,

a) Please write down the name(s) of the sports/activities ☐

_____ ☐

b) The days per week you took part in the sports/activities ☐☐☐

_____days

c) Average time per day you spent involved in the sports/activities

_____minutes

Thank you very much for filling in this questionnaire

Appendix 7: Parent Nutrition Knowledge Questionnaire

Massey University

COLLEGE OF SCIENCES

Institute for Food, Nutrition and Human Health - Albany Campus

A study of nutritional knowledge and dietary intakes in Whangarei schoolchildren

Parent/Guardian questionnaire

Date

Nutrition knowledge about dietary recommendations

Office use

1. Which groups of food should you eat the least of? (Tick one box only)

- o Meat, fish, poultry
- o Milk, yoghurt, cheese
- o Fats, oils, sweets
- o Vegetables and fruit
- o Bread, cereal, rice, pasta
- o Don't know

2. Which groups of food should you eat the most of? (Tick one box only)

- o Meat, fish, poultry
- o Milk, yoghurt, cheese
- o Fats, oils, sweets
- o Vegetables and fruit
- o Bread, cereal, rice, pasta
- o Don't know

3. How many servings of fruit and vegetables are we recommended to eat every day? (Tick one box only)

- o 1
- o 2
- o 3
- o 4
- o 5
- o 6
- o Don't know

0=unticked
1=ticked
9=don't know

Office use

4. What size is a serving of fruit and vegetables? (Tick one box only)

- o About one full plate
- o About one full cup
- o About one handful
- o About one tablespoonful
- o Don't know

☐

5. Please tick all the foods you think are high in fat.

- o Fried chicken
- o White bread
- o Bananas
- o Peanut butter
- o Marshmallows
- o Hot chips

☐☐☐☐☐☐☐

6. Please tick all the foods you think are high in fibre.

- o Bran flakes
- o Carrots
- o Hamburger
- o Doughnuts
- o Lettuce
- o Cocoa pops

☐☐☐☐☐☐☐

7. Please tick all the foods you think are high in vitamin C.

- o Broccoli
- o Macaroni cheese
- o Carrot cake
- o Kiwifruit
- o Olives
- o Orange juice

☐☐☐☐☐☐☐

8. Have you ever heard of the following messages that promote 'healthy living' to the public? (Tick the ones that you have heard of)

- o "Push Play"
- o "Pick the Tick"
- o "Food and nutrition guidelines"
- o "5+ a day"
- o Haven't heard of any of these messages

☐☐☐☐☐

0=unticked
1=ticked

Office use

9. Where have you heard about nutrition? (Select as many as apply to you)

- o Television ☐
- o Newspaper ☐
- o Radio ☐
- o Magazines ☐
- o Friends ☐
- o Child/children ☐
- o Other sources (Please explain) ☐

Health and diet

10. Do you think what you eat can make you healthy?

- o Yes 01
- o No ☐ 02
- o Don't know 09

11. Do you think what you eat can affect your own chance of getting cancer?

- o Yes 01
- o No ☐ 02
- o Don't know 09

12. Do you think what you eat can affect your own chance of getting heart disease?

- o Yes 01
- o No ☐ 02
- o Don't know 03

13. Do you think what you eat can affect your own chance of becoming overweight?

- o Yes ☐ 01
- o No 02
- o Don't know 09

14. Do you think what you can affect your own chances of developing Osteoporosis later in life?

- o Yes ☐ 01
- o No 02
- o Don't know 09

Attitudes to nutrition and food

Office use

For the following questions please circle your answer on the scale of 1 to 5, 1 being very important and 5 being not important.

15. How important is it to you to eat a diet low in fat?

Very important Not important

1 2 3 4 5

16. How important is it to you to eat a diet high in fruit and vegetables?

Very important Not important

1 2 3 4 5

17. How important to you is it to eat a diet high in cereals, bread and pasta?

Very important Not important

1 2 3 4 5

18. How important to you is it to eat or drink foods such as milk, yoghurt and cheese?

Very important Not important

1 2 3 4 5

19. How important to you is it to learn about food and health?

Very important Not important

1 2 3 4 5

For the following two questions please circle your answer on the scale of 1 to 6, being 'strongly agree' and 5 being 'strongly disagree' and 6 being 'don't know'

Office use

20. 5+ A DAY is promoted in both schools and the community. To what extent do you agree that promoting in schools is an effective way of encouraging people to increase their intake of fresh fruit and vegetables?

Strongly Agree		Neither agree or disagree		Strongly disagree	Don't know
1	2	3	4	5	6

☐

21. In the community the 5+ A DAY programme is an effective way of communicating this message to people?

Strongly Agree		Neither agree or disagree		Strongly disagree	Don't know
1	2	3	4	5	6

☐

22. Has your child brought home anything from school about the programme?

- o Yes 01
- o No 02
- o Don't know 09

☐

23. Has your child ever mentioned anything about eating more fruit and vegetables?

- o Yes 01
- o No 02
- o Don't know 09

☐

24. If yes, have you purchased more fruit and vegetables as a result of this request from your child?

- o Yes 01
- o No 02

☐

Shopping habits | **Office use**

25. Are you the person most responsible for planning/preparing the meals for your family?

o Yes 01
o No 02

26. How often are food purchases made for your household?

o More than once per week 01
o Once per week 02
o Fortnightly 03
o Once per month 04
o Less than once per month 05
o Don't know 09

27. Where do you buy most of your food?

o Supermarket
o Local dairy
o Produce warehouse
o Markets
o Other (please explain)

28. Are fruit and vegetables bought separately from your other food groceries?

o Yes 01
o No 02
o Don't know 09

If yes, please indicate where your fruit and vegetables are purchased?

_____

Factors that influence shopping habits

29. Rank the following factors in descending order of importance to you when you shop for the family food. Please put the appropriate number from 1-8 in the box beside each statement, 1 being the most important factor and 8 being the least important factor.

The nutritional value of the food

The quality or appearance of the food

		Office use
☐	The price of the food	☐
☐	How well the food keeps	☐
☐	How easy it is to prepare	☐
☐	Special deals (e.g. reduced prices or two for one price)	☐
☐	Taste (whether you perceive it to taste good)	☐
☐	Whether or not your family will eat it	☐

30. Do you study the labels on food?

o	Yes	01
o	No	☐ 02

31. If yes, which of the following do you consider when buying food? (Select any that are relevant to you)

o	The list of ingredients	☐
o	Short nutritional phrases on the package e.g. "low fat" or "light"	☐
o	or "good source of fibre"	☐
o	The nutrition panel that lists the amount of calories, protein, fat and such in a serving of the food	☐
o	The information about the size of a serving	☐
o	Statements on the label that describe health benefits of nutrients in foods e.g. "good for your heart"	☐
o	Don't read any labels when buying foods	☐
o	Other	

32. Which if any of the following factors limits your family's ability to increase vegetable intake? (Tick any that apply to you)

o	Cost too much	☐
o	You or your family don't like vegetables	☐
o	Can't store them for long	☐
o	It's a hassle to try and eat more	☐
o	Often of poor quality	☐
o	They cause stomach upsets or indigestion	☐
o	Vegetables are hard to chew	☐

Office use

- o Take too long to prepare ☐
- o Don't always have them at home ☐
- o They are difficult to prepare ☐
- o I have nowhere to cook vegetables ☐
- o They are not good for me or my family ☐
- o Pesticides or chemicals on vegetables ☐
- o I would need will power to eat more ☐
- o Increasing intake would not be a problem ☐
- o Other ☐

33. Which if any of the following factors limits your family's ability to increase fruit intake? (Tick any that apply to you)

- o Cost too much ☐
- o You or your family don't like fruit ☐
- o Can't store fruit for long ☐
- o It's a hassle to try and eat more ☐
- o Often of poor quality ☐
- o Fruit cause stomach upsets or indigestion ☐
- o Fruit are hard to chew ☐
- o Causes allergy or other bad reactions ☐
- o Not enough time ☐
- o Don't always have them at home ☐
- o Contains too much sugar ☐
- o Fruit is not good for me or my family ☐
- o Pesticides or chemicals on fruit ☐
- o I would need will power to eat more ☐
- o Increasing intake would not be a problem ☐
- o Other ☐

34. As a family which statement correctly describes your intake of the following (circle the answers that apply to your family)

Fatty foods	we should eat more	we eat enough	we should eat less	☐
Fruits	we should eat more	we eat enough	we should eat less	☐
Vegetables	we should eat more	we eat enough	we should eat less	☐
Sugary foods	we should eat more	we eat enough	we should eat less	☐

Demographic questions | **Office use**

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

o	House/townhouse	01
o	Flat/unit	02
o	Hostel	03
o	Garage	04
o	Caravan	05
o	Sleep-out	06
o	Other (specify)	07

2. Where you live is...

o	Rented privately	01
o	Rented (housing NZ/Council)	02
o	Owned	03
o	Owned/rented by relatives	04
o	Other (specify)	05

---

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

o	Loss	01
o	$0 - $5,000	02
o	$5,001 - $10,000	03
o	$10,001 - $20,000	04
o	$20,001 - $30,000	05
o	$30,001 - $40,000	06
o	$40,001 - $50,000	07
o	$50,001 or more	08
o	Don't know	09

4. How much money in total does your household usually spend each week on food and groceries (i.e. at supermarket, dairy, takeaway)?

o	$1 - $50	01
o	$51 - $100	02
o	$101 - $150	03
o	$151 - $200	04
o	$201 or more	05
o	Don't know	06

Office use

5. Who usually prepares your child's food?

- o The child ☐ 01
- o Parent 02
- o Brother/sister 03
- o Other (specify) 04

_____

6. Which ethnic group(s) does he/she belong to?

- o Asian ☐ 01
- o European ☐ 02
- o New Zealand European ☐ 03
- o New Zealand Maori ☐ 04
- o Polynesian ☐ 05
- o Other (specify) 06

7. What is your marital status?

- o Married/couple 01
- o Single ☐ 02
- o Divorced/separated 03
- o Other 04

8. How many children live in your household? _____ ☐

9. How many years of school did you complete? _____ ☐

10. After you left school, did you get any further education?

- o Yes ☐ 01
- o No 02

11. Did you get any qualifications after you left school?

- o Yes ☐ 01
- o No 02

12. What type(s) of qualifications?

- o Certificate 01
- o Diploma ☐ 02
- o Degree 03
- o Other (specify) 04

		Office use
13.	Which of the following best describes your present situation?	
o	Homemaker without pay	01
o	Paid employee	02
o	Self-employed and not employing anyone else	03
o	An employer of another person	04
o	Working in a family business	05
o	Domestic purposes benefit	06
o	Unemployment benefit	07
o	Sickness benefit	08
o	Other (specify)	09
	_____	
14.	Is there another main provider for your child?	
o	Yes	01
o	No	02
15.	Does this person live in your household?	
o	Yes	01
o	No	02
16.	How many years of school did he/she complete? ____	
17.	After s/he left school, did s/he get any further education?	
o	Yes	01
o	No	02
18.	Did s/he get any qualifications after s/he left school?	
o	Yes	01
o	No	02
19.	What type(s) of qualification?	
o	Certificate	01
o	Diploma	02
o	Degree	03
o	Other (specify)	04
	_____	

Thank you very much for completing this questionnaire

Appendix 5: Teachers survey – Exposed schools

Massey University

COLLEGE OF SCIENCES

Institute or Food, Nutrition and Human Health - Albany Campus

The following short survey has been designed to examine your opinion as a teacher on the efficacy of the 5+ a Day fresh fruit and vegetable education resources, and to identify what other sources of nutritional or health information resources you use.

5+ a Day educational resources

Please indicate your answers to the following questions in the table by placing a tick in the appropriate column.

	Yes	No	Don't know	Office use
1. Do you have a copy of the 5+ A DAY educational resource pack?				
2. If no, do you have access to a copy?				
3. Do you use the resource?				
4. Do you use activities suggested in the resource pack..?				
(i) as part of a lesson				
(ii) as a stand alone lesson				
(iii) as illustrations				
(iv) as homework activities				
(v) other purposes (please specify)				
5. Do you use the resource to teach about healthy eating?				
6. Do you use the resource to teach about other subjects? (If yes, please explain)				

	Yes	No	Don't know	Office Use
7. Do you find the 5+ A DAY resource easy to use?				
8. Do the children enjoy doing the activities suggested by the resource?				
10. Do you use the 5+ A DAY/United Fresh website? If yes, do you find it useful from a teaching perspective?				
11. Which component of 5+ a day campaign do you think is the most effective in terms of delivering the intended message to the children?				
(ii) 5+ a Day educational resource pack				
(iii) 5+ a Day interactive "fun zone" website				
(iv) 5+ a Day advertisement on television				
(v) 5+ a Day in supermarkets & on food packaging labels				
(vi) 5+ a Day school competitions				
(vii) other (please explain)				
12. Do you include anything about the 5+ a Day programme in school newsletters? 13. Are parents involved in the 5+ A DAY programme at your school? (If yes, please explain)				
14. Have any changes made to school canteens/tuck shops to encourage healthy eating at your school?				
15. Have any changes been made to school canteens / tuck shops to increase fruit and vegetable intake?				
16. Do you think the children have increased their intake of fruit and vegetable intake during the period that you have been using the 5+ A DAY resource?				

17. How much class time is spent during the year using the 5+a Day resources or doing activities related to the 5+a Day programme?

_____

18. What would you consider an ideal resource for teaching children about healthy eating?

_____

Other educational nutrition or health resources

In the two tables on the next page are listed various possible sources of nutrition education resource material.

For table one:

1. Please indicate from which, if any, of the following sources you obtain information or resources for teaching about healthy eating or healthy living. Do this by placing a tick on relevant row in column A.

2. For the resources you receive, please indicate which of the statements in columns B-F are true. Place a tick in the relevant column.

3. Please indicate, on average, how much class time is spent using each resource/source of information (e.g. number of lessons) in the last column of this table (column G).

For table two:

4. Please indicate which, if any, of the listed components were included in the resource kit or were provided by the information source you used by placing a tick in the appropriate column(s) from H-O.

5. Please indicate for each resource you used which component was the most effective at delivering the intended message (e.g. for the push play campaign what component works best to increase exercise). Do this by placing a **circle around the tick** in the appropriate column.

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE

TABLE 1: Other healthy living educational resources used

Columns	A *Yes I use this resource*	B *Useful for teaching about healthy eating*	C *Easy to use (e.g. incorporate into lessons)*	D *Comprehensive and appropriate for cognitive stage of children*	E *Useful for teaching about other topics*	F *Children enjoy activities related to resources*	G *Class time spent using the resource per year*
INTERNET SOURCES ***Food company websites*** *(e.g. Sanitarium, Anchor milk)* ***Health organisation websites*** *(e.g. Cancer Society, National heart Foundation)* ***Other*** *(please specify)*							
HEALTH ORGANISATIONS ***Ministry of Health*** ***(e.g. healthy eating guidelines)*** ***Cancer Society*** ***(e.g. Healthy lifestyles-Nutrition)*** ***National Heart Foundation*** *(e.g. School Food Programme)* ***Sport and Recreation NZ*** ***(e.g. Push Play campaign)*** ***Other*** *(please specify)*							
EDUCATIONAL ORGANISATIONS ***Department or Ministry of Education*** ***Other*** *(please specify)* ***United Fresh*** *(5+ a Day resources)*							
MEDIA ***Television*** *(e.g. food or nutrition documentaries)* ***Newspaper*** ***(e.g. articles on food or nutrition)***							
OTHER SOURCES							

TABLE 2: Components of healthy living educational resources

Columns	**H** *Guidelines for school food policy*	**I** *Changes to food sold in school canteens*	**J** *Visual media (e.g. posters, videos)*	**K** *Interactive websites or computer programmes*	**L** *Nutrition info (e.g. educator's notes)*	**M** *Classroom activities*	**N** *Homework activities*	**O** *Parental involvement*
INTERNET SOURCES								
Food company websites								
Health organisation websites								
Other *(please specify)*								
HEALTH ORGANISATIONS								
Ministry of Health								
Cancer Society								
National Heart Foundation								
Sport and Recreation NZ								
Other *(please specify)*								
EDUCATIONAL ORGANISATIONS								
Department/Ministry of Education								
Other *(please specify)*								
United fresh *(5+ a Day resources)*								
MEDIA								
Television								
Newspaper								
OTHER SOURCES								

Office use only

Study number: ☐☐☐☐☐☐☐

Date completed: ☐☐ ☐☐ ☐☐☐☐ (day month year)

Name: _____

Date of birth: ☐☐ ☐☐ ☐☐☐☐ (day month year)

Food Questionnaire

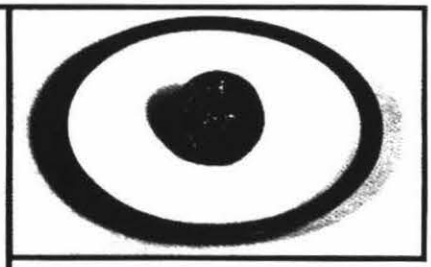
Different eating patterns may affect people's health. To help us understand these eating patterns, we would like you to **think back over the past 4 weeks** and answer the following questions about the foods you usually eat.

Put a tick in the box which best tells **HOW OFTEN** you usually eat the foods.

Example

If you eat apples on 3 or 4 days each week, put a tick in the '3-4 times a week' box.

2. Apples or pears



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☑	☐	☐	☐

If you never or rarely eat a food, tick in the box 'never or less than once a month' and go to the next question.

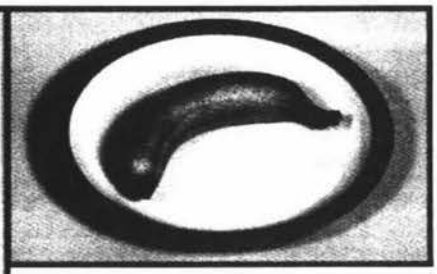
It may be helpful to ask the person who does the cooking and shopping in your household to help you fill in the questions.

PLEASE DO NOT SKIP ANY FOODS

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

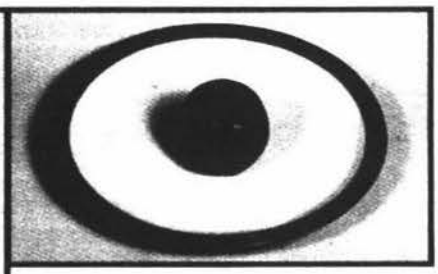
Fruit

1. Banana, raw



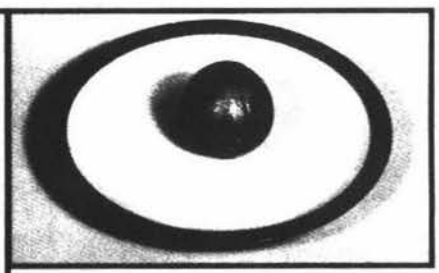
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

2. Apples or pears



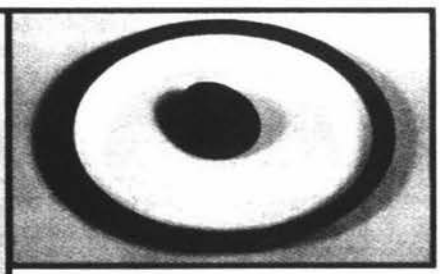
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

3. Oranges or mandarins



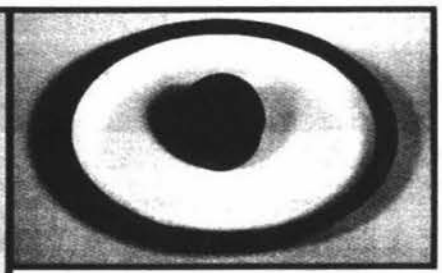
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

4. Kiwifruit



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

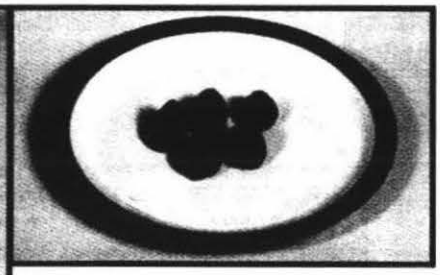
5. Nectarines, peaches, plums or apricots



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

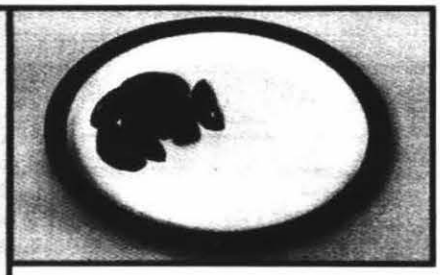
Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

6. Strawberries or other berries



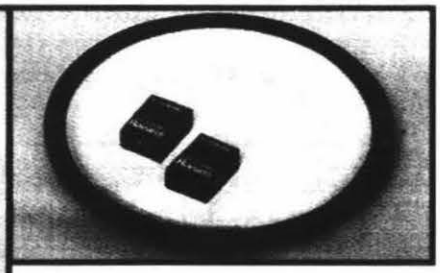
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

7. Tinned or cooked fruit, eg. tinned peaches



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

8. Dried fruit, eg. raisins



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

9. Other Fruit (1) If you often have another fruit, not listed - give the name and tick a box to show how often you eat it _____

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

10. Other Fruit (2) If you often have another fruit, not listed - give the name and tick a box to show how often you eat it _____

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

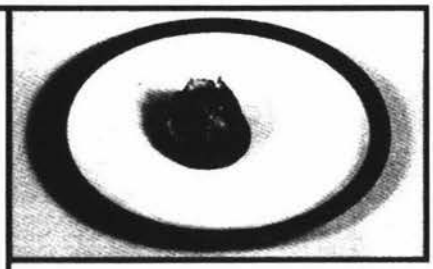
Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

Vegetables

11. Fried potatoes, eg. hot potato chips, kumara chips, french fries, wedges or hash browns

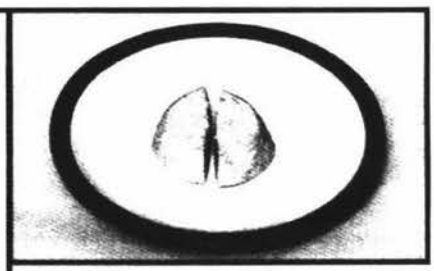
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

12. Other potatoes, eg. boiled, mashed, baked or roasted



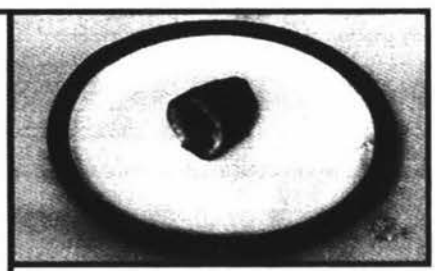
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

13. Taro



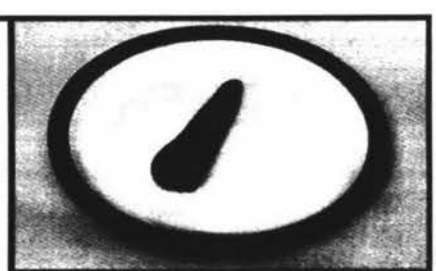
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

14. Kumara



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

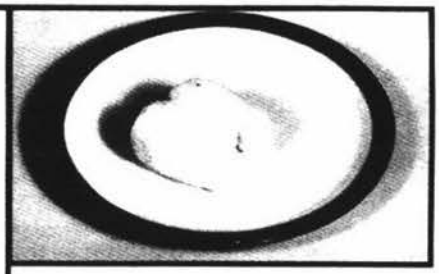
15. Carrots (raw or cooked)



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

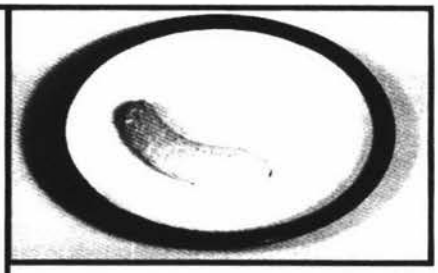
Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

16. Cassava



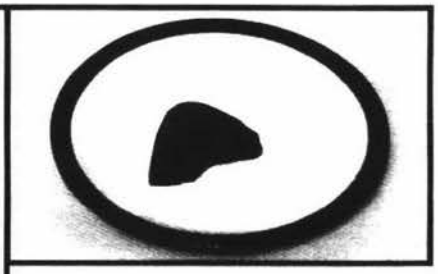
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

17. Cooked green banana



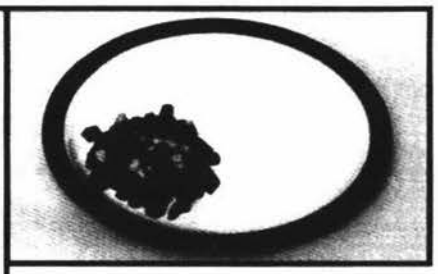
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

18. Pumpkin



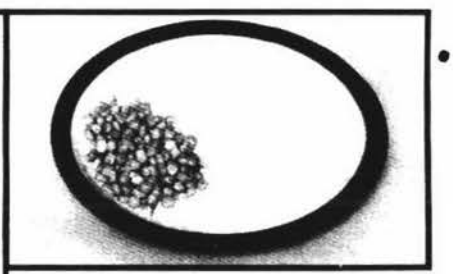
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

19. Mixed vegetables



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

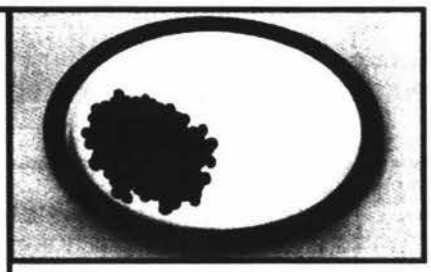
20. Corn



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

21. Peas



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

22. Silverbeet, spinach, puha or watercress

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

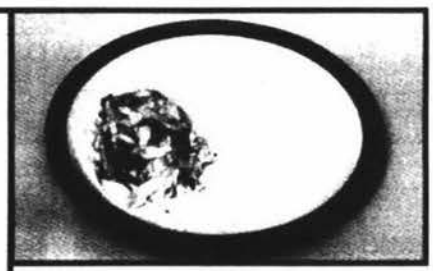
23. Green beans

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

24. Broccoli

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

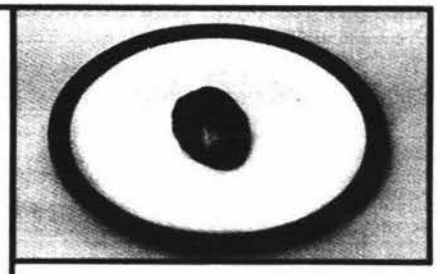
25. Cauliflower or cabbage



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

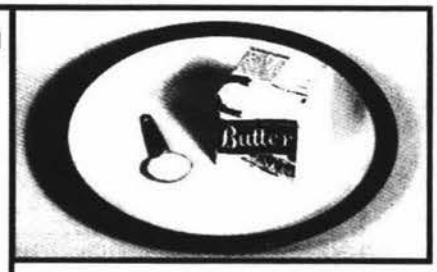
Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

26a. Thinking about **cooked vegetables,** how often would you have **roast vegetables?**



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

26b. Thinking about **cooked vegetables** again, how often would you have **butter or margarine** on them?



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

26c. Which of these do you usually have on vegetables? *(tick one box)*

☐ butter

☐ low-fat spread

☐ margarine

☐ blend (margarine and butter)

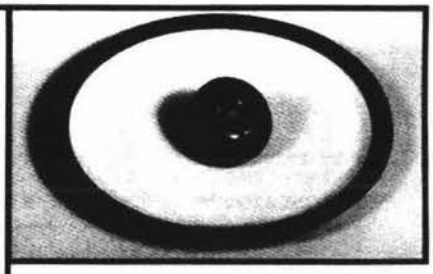
☐ Don't have either

Name of margarine or blend _____

27. Lettuce or green salad

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

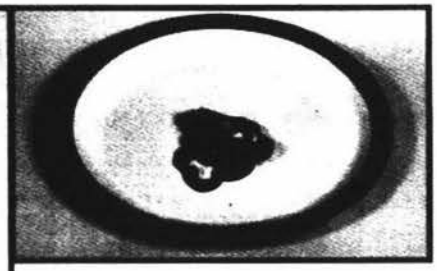
28. Tomatoes (raw or cooked)



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

29. Capsicum (green, red or yellow peppers)



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

30. Avocado

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

31. Other Vegetable (1) If you often have another vegetable, not listed - give the name and tick a box to show how often you eat it

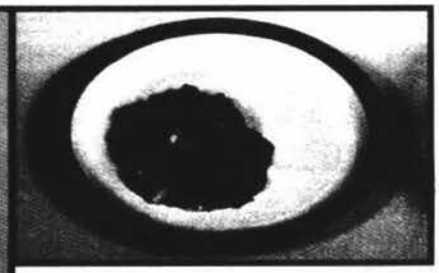
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

32. Other Vegetable (2) If you often have another vegetable, not listed - give the name and tick a box to show how often you eat it

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Mixed dishes

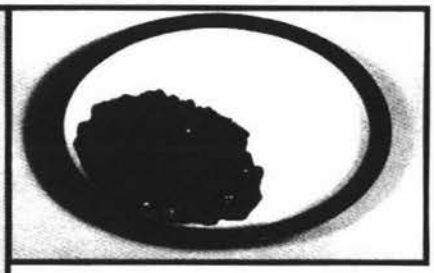
33. Meat and vegetable 'boil-up', eg. puha, povi masima, brisket, mutton flaps, pork bones



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

34. Meat stew or casserole with vegetables



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

35. Pasta with meat and tomato sauce, eg. lasagne, spaghetti bolognaise

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

36. Pasta with cream, white sauce or cheese sauce

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

37. Chinese type dishes, stir-fry meat or chicken and vegetables

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

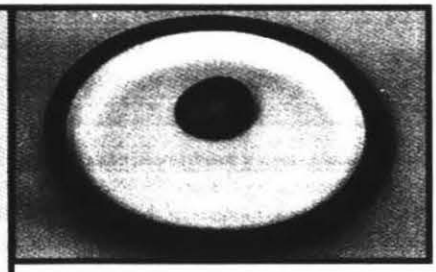
38. Other Mixed Dish If you often have another mixed dish, not listed - give the name and tick a box to show how often you eat it

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

Eggs, meat, poultry and fish

39. Eggs, boiled, poached, fried or scrambled, etc



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

40. Roast beef, lamb or pork

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

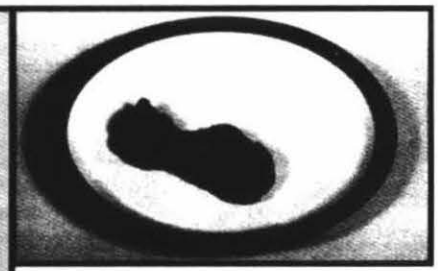
41. Steak

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

42. Lamb or mutton chops

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

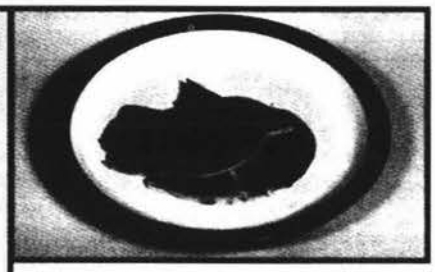
43. Pork chop (or other pork small cuts)



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

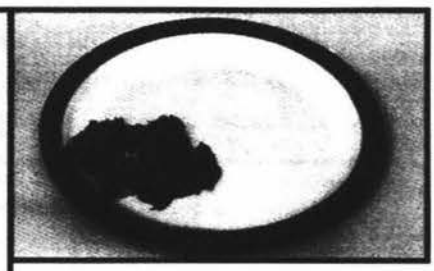
Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

44. Boiled corned beef/silverside



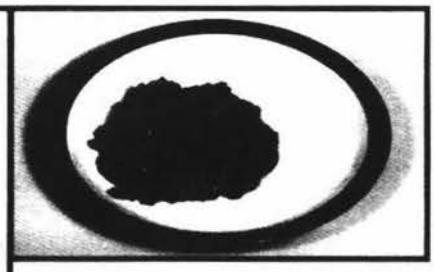
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

45. Tinned corned beef



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

46. Mince, including rissoles, patties, Shepherd's Pie, etc

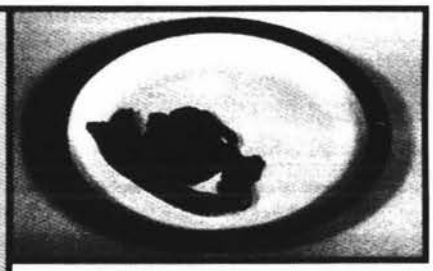


Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

47. Liver or liver paté

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

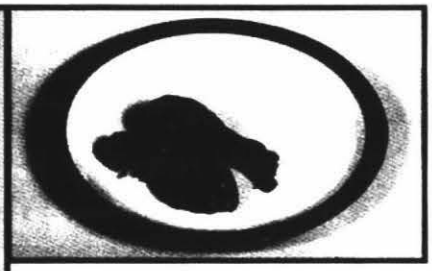
48. Bacon or ham



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

49. Chicken



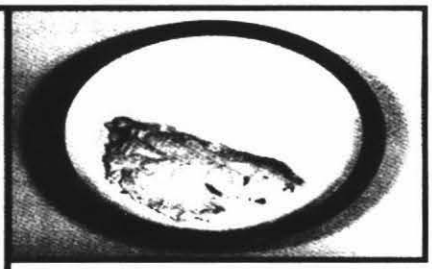
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

49a. How often was the **chicken** you ate **fried chicken or chicken nuggets?**

(tick one box)

- ☐ almost never or never
- ☐ ¼ of the time
- ☐ ½ of the time
- ☐ ¾ of the time
- ☐ almost always or always

50. Fish

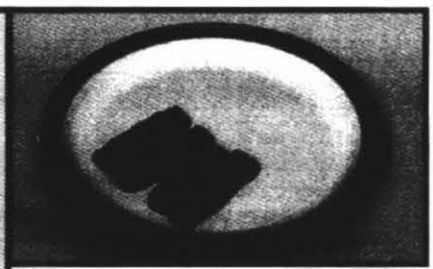


Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

50a. How often was the **fish** you ate **fried fish or takeaway fish?** *(tick one box)*

- ☐ almost never or never
- ☐ ¼ of the time
- ☐ ½ of the time
- ☐ ¾ of the time
- ☐ almost always or always

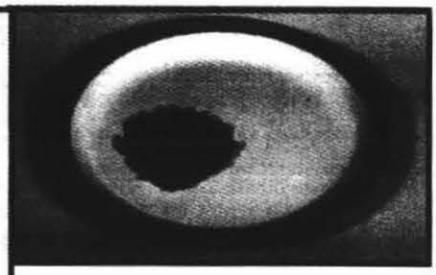
51. Fish cake, fish fingers or fish pie



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

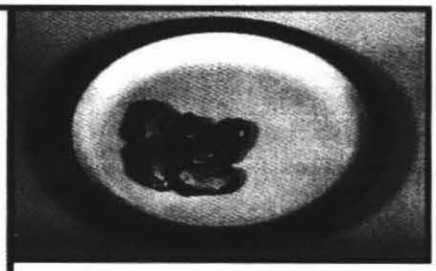
Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

52. Tinned fish, eg. tuna or salmon



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

53. Shell fish, eg. mussel, paua or crabmeat



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

54. Other item of the 'Eggs, meat, poultry and fish' group If you often have another item from this group, not listed - give the name and tick a box to show how often you eat it ☐

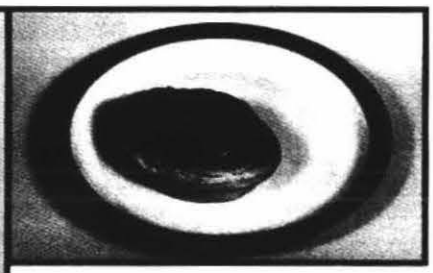
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

55. Which of the following **fats** were regularly used to cook your **meat, poultry or fish?** *(mark all that are used)*

- ☐ Don't know
- ☐ Margarine
- ☐ Butter
- ☐ Lard, dripping
- ☐ Kremelta type fat
- ☐ Canola oil
- ☐ Corn oil
- ☐ Olive oil
- ☐ Safflower oil
- ☐ Sunflower oil
- ☐ Other vegetable oil

Pies, fastfoods, sausages

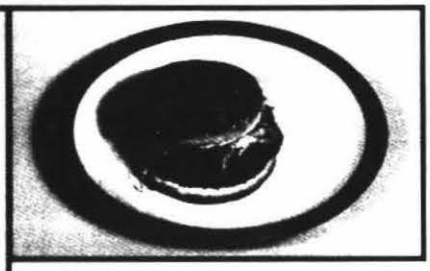
56. Meat pie



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

57. Burgers

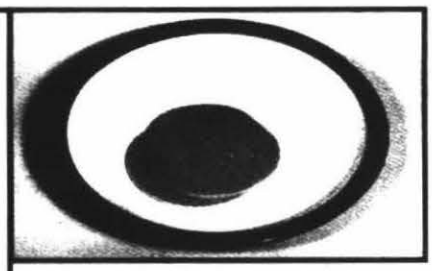


Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

58. Sausages (all types)

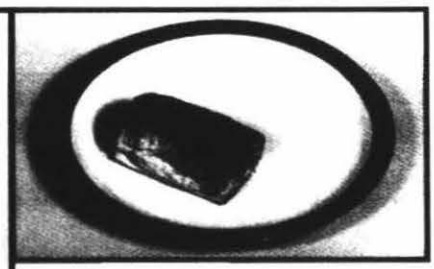
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

59. Luncheon, ham and chicken



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

60. Sausage rolls



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

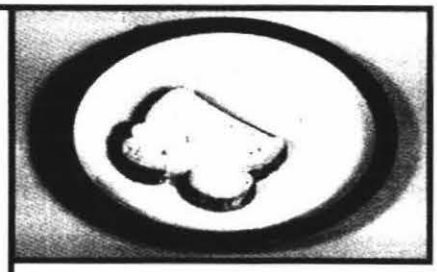
61. Other item of the 'Pies, fast foods, sausages' group If you often have another item from this group, not listed - give the name and tick a box to show how often you eat it _____

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

Bread and Cereals

62. Bread, including toast and bread rolls

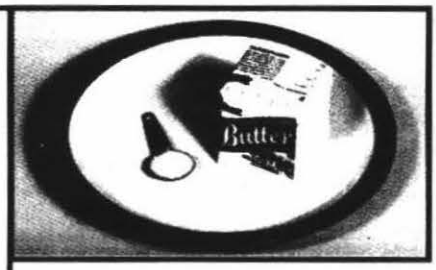


Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

62a. What **type of bread** do you **usually** eat? (tick one box)

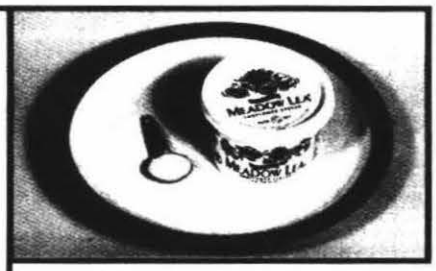
- ☐ white
- ☐ wholemeal
- ☐ mixed grain

62b. How often do you have **butter** on your bread?



- ☐ rarely or never
- ☐ ¼ of the time
- ☐ ½ of the time
- ☐ most of the time

62c. How often do you have **margarine or margarine blend** on your bread?



- ☐ rarely or never
- ☐ ¼ of the time
- ☐ ½ of the time
- ☐ most of the time

62d. Which type of **margarines** do you **usually** have?

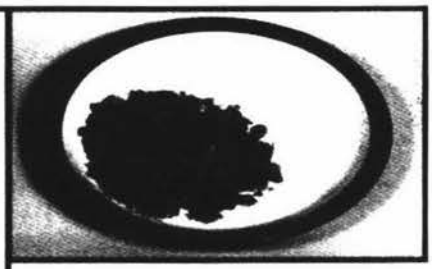
- ☐ Polyunsaturated margarine, eg. Miracle, Meadowlea, Flora, Sunrise
- ☐ Canola margarine, eg. Gold'n Canola, Vraise Canola, Canola Harvest, Country Crock
- ☐ Olive oil, margarine, eg. Olivio, Olivani, Oliveta
- ☐ Blend of butter and margarine, eg. Countrysoft, Dairysmooth
- ☐ Don't know

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

62e. Is the **margarine** you usually have **reduced fat** or **lite**?

- ☐ Yes
- ☐ No
- ☐ Don't know

63. Breakfast cereal



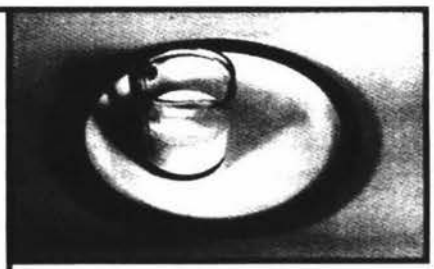
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

63a. What type of cereal do you usually have? *(tick one box)*

- ☐ Weetbix type
- ☐ Cornflakes type
- ☐ Rice bubbles
- ☐ Cocopops
- ☐ Muesli
- ☐ Multi-grain typ
- ☐ Porridge
- ☐ Other (Please give name) _____

63b. Was **milk** added to your **cereal**?

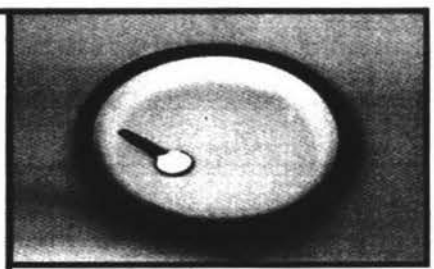
☐ Yes ☐ No



What **kind** of **milk** was usually added?

- ☐ Standard milk/dark blue
- ☐ Light blue
- ☐ Trim (green)
- ☐ Extra calcium
- ☐ Soy milk

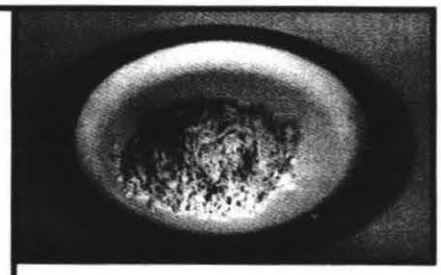
63c. Was **sugar, honey or syrup** added to your cereal?



☐ Yes ☐ No

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

64. Rice



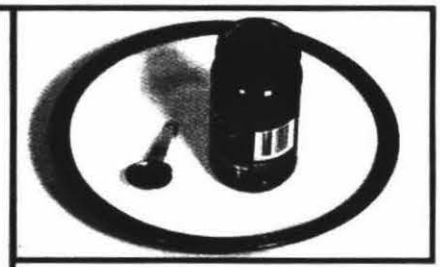
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

65. Other Bread and Cereals If you often have another item from this group, not listed - give the name and tick a box to show how often you eat it

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Spreads, sauces

66. Jam or honey

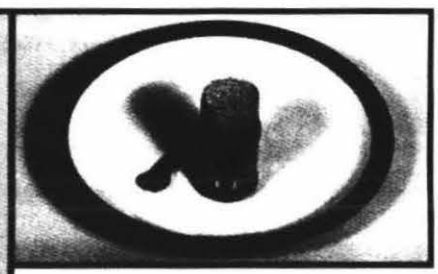


Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

67. Nutella

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

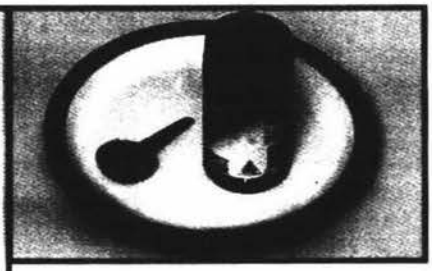
68. Marmite or Vegemite



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

69. Peanut butter

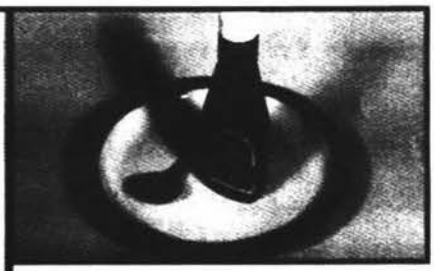


Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

70. Mayonnaise or salad dressing

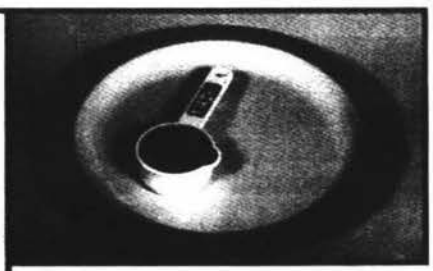
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

71. Tomato sauce or ketchup



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

72. Gravy



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

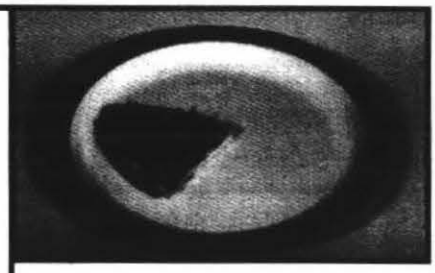
73. Other item of the 'Spreads, sauces' group If you often have another item from this group, not listed - give the name and tick a box to show how often you eat it

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

Convenience meals/snacks

74. Pizza



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

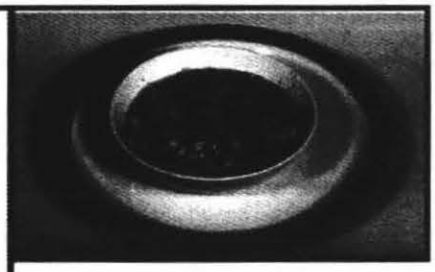
75. Soup

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

75a. What **type of soup** do you usually have? *(tick one box)*

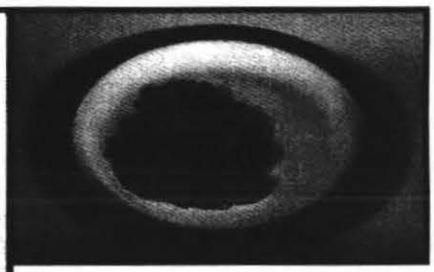
- ☐ Tomato soup
- ☐ Vegetable soup
- ☐ Cream soup
- ☐ Ham and pea soup
- ☐ Other soup

76. Noodles



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

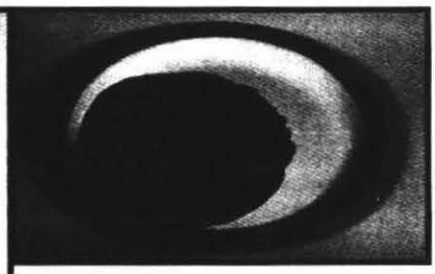
77. Tinned spaghetti with tomato sauce



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

78. Baked beans



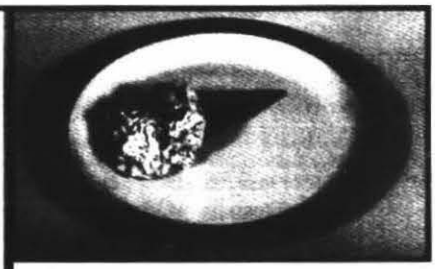
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

79. Other item of the 'Convenience meals/snacks' group If you often have another item from this group, not listed - give the name and tick a box to show how often you eat it ☐

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

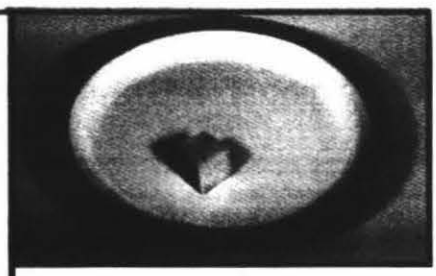
Dairy

80. Ice cream



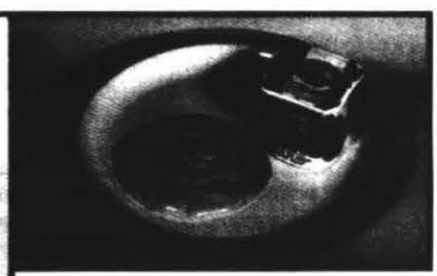
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

81. Cheese, eg. cheddar, colby, etc.



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

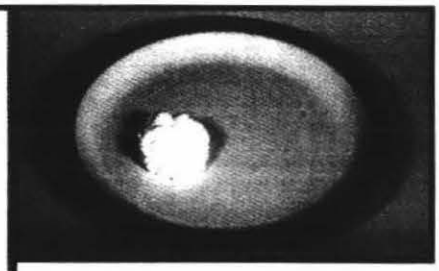
82. Yoghurt or Dairy food (all types)



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

83. Cream



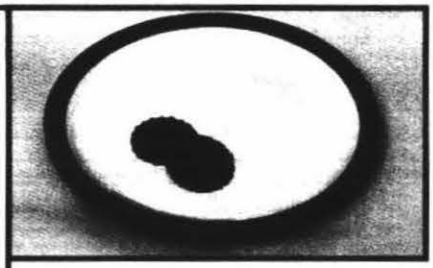
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

84. Other item of the 'Dairy' group (not milk drinks) If you often have another item from this group, not listed - give the name and tick a box to show how often you eat it ☐

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

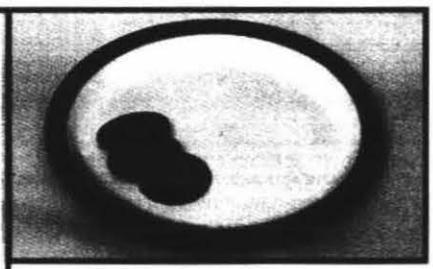
Biscuits/cakes

85. Chocolate coated or cream filled biscuits



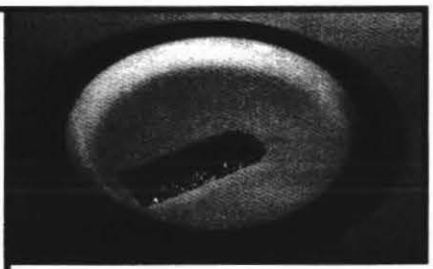
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

86. Biscuits, eg. plain, chocolate chip, semi-sweet, ginger nut, shortbread



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

87. Muesli bars



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

88. Crackers or crispbreads

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

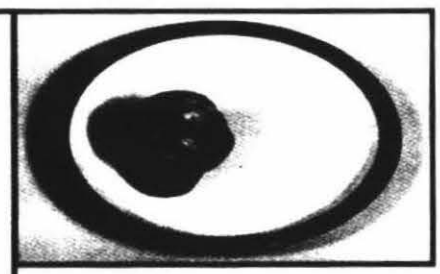
89. Cake

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

90. Doughnuts or croissants

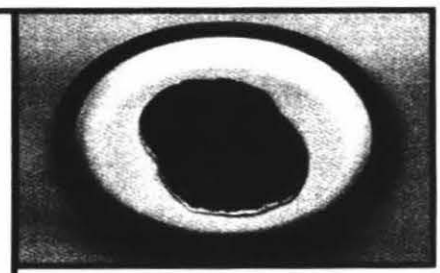
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

91. Scones, muffins or sweet buns



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

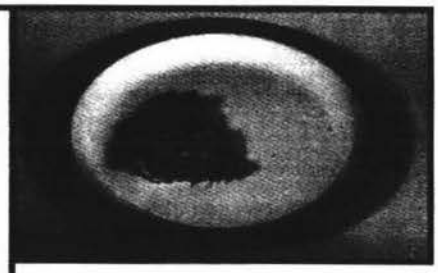
92. Pancake or pikelets



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

93. Fruit pie, fruit crumble or tart

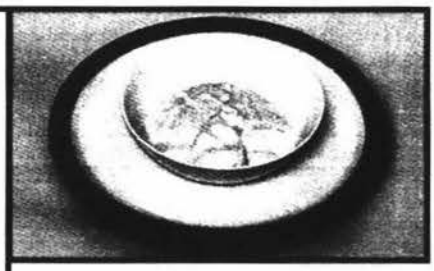


Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

94. Pudding, eg. sponge pudding or steamed pudding

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

95. Custard or custard puddings



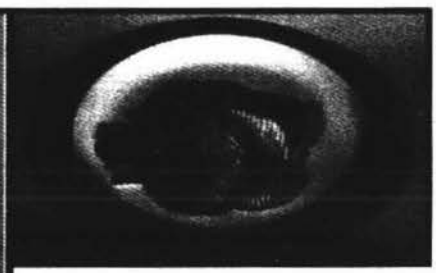
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

96. Other item of the 'Biscuits/cake' group If you often have another item from this group, not listed - give the name and tick a box to show how often you eat it ☐

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Snacks and sweets

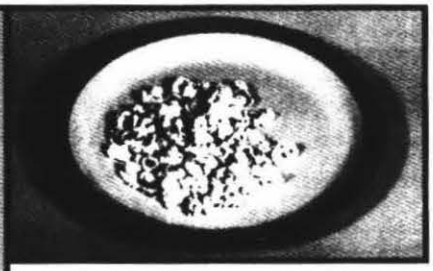
97. Potato crisps, corn snacks or chips, eg. burger rings, rashuns, etc



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

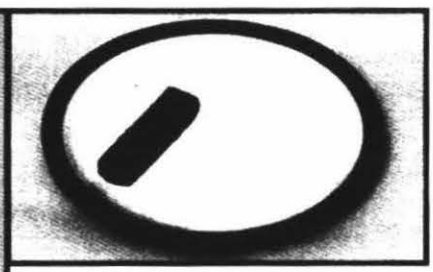
Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

98. Popcorn



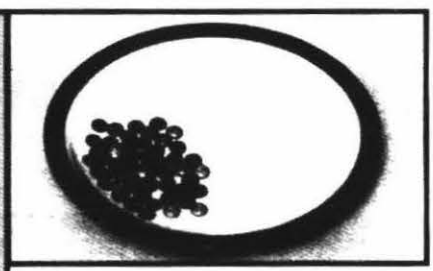
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

99. Chocolate, eg. Moro bar



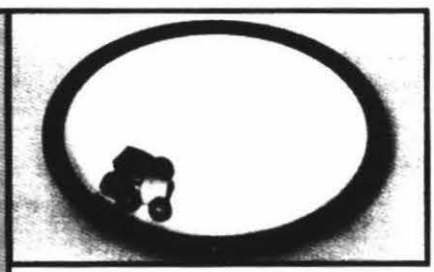
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

100. Candy coated chocolate, eg. pebbles



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

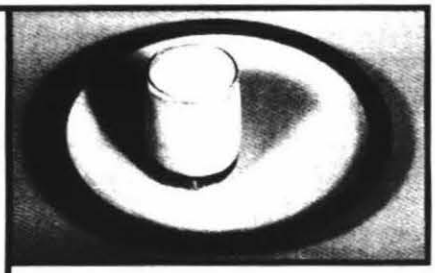
101. Other sweets



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Milks

102. Milk (not flavoured)



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

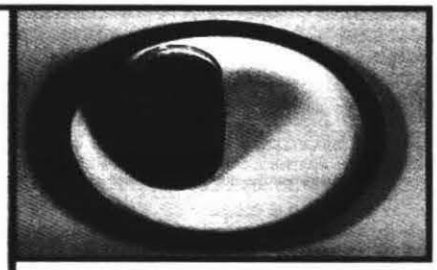
Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

102a. What **kind of milk** do you usually drink?

☐ Standard milk (dark blue) ☐ Trim (green) ☐ Soy milk

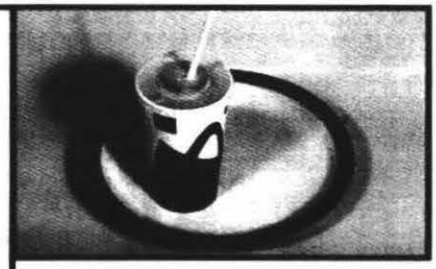
☐ Low fat (light blue) ☐ Extra calcium

103. Flavoured milk



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

104. Milk shake



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

105. Milo powder, Quik or Drinking chocolate

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

105a. With this drink did you use?

☐ All milk

☐ 1/2 milk

☐ 1/4 or less milk

Was **sugar** added?

☐ Yes ☐ No

Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

Infant milks

106. Was your child fed **breast milk** daily in the last 4 weeks?

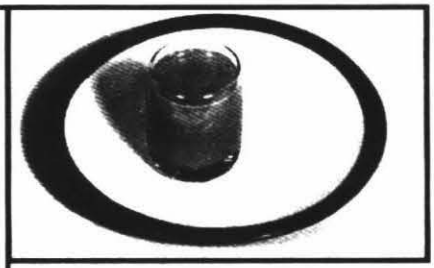
☐ Yes ☐ No

107. Was your child fed **Infant formula** daily in the last 4 weeks?

☐ Yes ☐ No

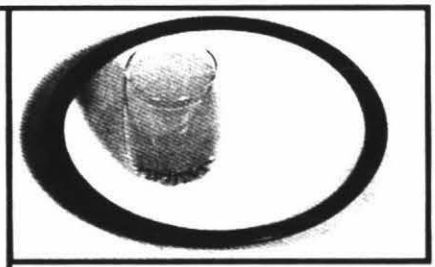
Other drinks

108. **Juice,** eg. fresh orange juice, Just Juice, Freshup, Pams, Ribena diluted



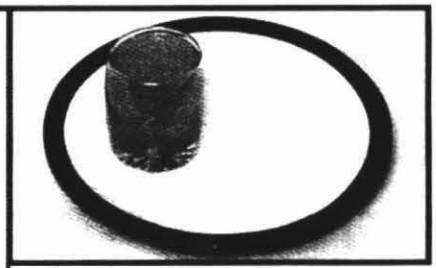
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

109. **Powdered fruit drink,** eg. Refresh, Raro



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

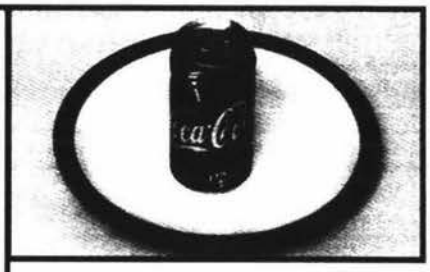
110. **Fruit drink concentrate, cordial**



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

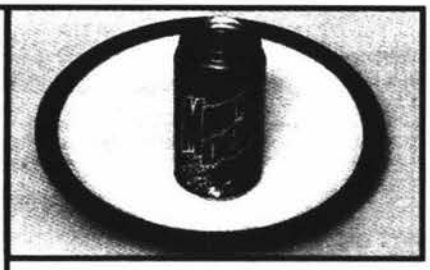
Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

111. Coca cola or other cola drinks



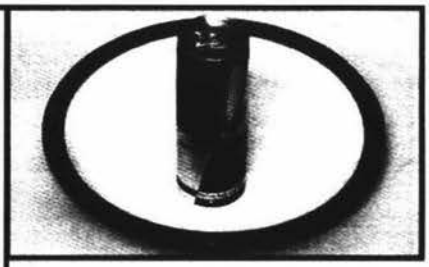
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

112. Mountain Dew



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

113. 'Energy' drinks, eg. V, E_2, Red Bull

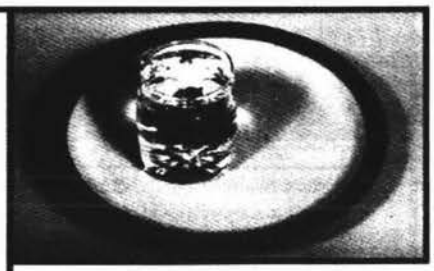


Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

113a. If you have 'energy' drinks, which type do you usually have? (tick one box)

☐ V
☐ E2
☐ Lift
☐ Red Bull
☐ Liquid B
☐ Ikon
☐ Bullrush
☐ Other (Please name) _____

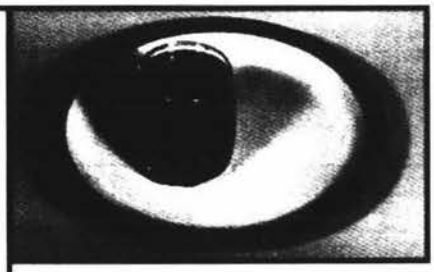
114. Soft drinks, eg. lemonade, orange



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

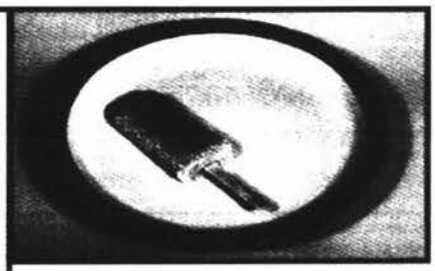
Put a tick ☑ in the box which best tells HOW OFTEN you eat the food.

115. Sports drinks, eg. Gatorade, Powerade



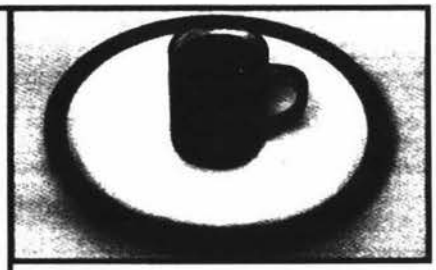
Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

116. Ice blocks



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

117. Tea



Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

117a. Was milk added to your tea?

☐ Yes ☐ No

Was **sugar** added?

☐ Yes ☐ No

118. Other item of the 'Other drinks' group If you often have another item from this group, not listed - give the name and tick a box to show how often you eat it

Never or less than once a month	1-3 times a month	1-2 times a week	3-4 times a week	5-6 times a week	Once a day	2 or more times a day
☐	☐	☐	☐	☐	☐	☐

Dietary supplements

1. During the past month have you taken any vitamins or minerals?
   ☐ Yes ☐ No

2. If **YES**, what do you take fairly regularly? (Choose from the list of dietary supplement types below).

	Number of tablets							
Supplement type	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Multivitamin mineral	☐	☐	☐	☐	☐	☐	☐	☐
Supplement name:								

	Number of tablets							
Supplement type	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Vitamin C	☐	☐	☐	☐	☐	☐	☐	☐
Supplement name:								

	Number of tablets							
Supplement type	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Haliborange	☐	☐	☐	☐	☐	☐	☐	☐
Supplement name:								

	Number of tablets							
Supplement type	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Vitamin A	☐	☐	☐	☐	☐	☐	☐	☐
Supplement name:								

Supplement type	Number of tablets							
	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Iron	☐	☐	☐	☐	☐	☐	☐	☐
Supplement name:								

Supplement type	Number of tablets							
	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Zinc	☐	☐	☐	☐	☐	☐	☐	☐
Supplement name:								

Supplement type	Number of tablets							
	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Calcium	☐	☐	☐	☐	☐	☐	☐	☐
Supplement name:								

Supplement type	Number of tablets							
	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Omega 3 fatty acids	☐	☐	☐	☐	☐	☐	☐	☐
Supplement name:								

Supplement type	Number of tablets							
	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Herbal/Homeopathic	☐	☐	☐	☐	☐	☐	☐	☐
Supplement name:								

Supplement type	Number of tablets							
	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Other (1)	☐	☐	☐	☐	☐	☐	☐	☐
Name:								

Supplement type	Number of tablets							
	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Other (2)	☐	☐	☐	☐	☐	☐	☐	☐
Name:								

Supplement type	Number of tablets							
	None	1-3 per week	4-6 per week	1 per day	2 per day	3 per day	4 per day	5+ per day
Other (3)	☐	☐	☐	☐	☐	☐	☐	☐
Name:								

Thank you very much for filling out this questionnaire.

Please take a moment to fill in any questions you have skipped.