Nutritional status of older Māori hospitalised due to infection

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Abstract

Background

Life expectancy amongst Māori is increasing and more Māori are expected to live into advanced age (80+ years). Māori have higher rates of morbidity and health disparities compared to non-Māori Māori diets are seen to have high fat intakes and marginal intakes of zinc and selenium. Deficiencies in these minerals may have negative effects on immune status. Nutrition is a modifiable factor that may help to reduce the risk of infection. This study aims to look at the nutrient intake of Māori in advanced age (80+ years) and to investigate differences in energy and nutrient intakes of those hospitalised due to infection and not hospitalised.

Methods

There were 200 Māori participants in this study aged 80-90 years. Detailed nutritional information was collected using the 24 hour multiple-pass recall method on two separate days. FOODfiles was used to analyse nutrient intake. Selected International Classification of Disease (ICD) codes for infections were paired with National Health Index (NHI) numbers to identify participants who had been hospitalised over a two year period. Face to face interviews were conducted in the LiLACs NZ to obtain demographic, social and health information.

Results

Participants had a higher percentage of energy from fat intake (38%) compared to the NHMRC recommendations for adults (25-35%). Participants intakes were below the NHMRC recommendations for adults for calcium (47% vs 50%) and selenium (29% vs 37%) respectively. Only men had intakes below the NHMRC recommendations for zinc (28%) and vitamin E (24%).

A total of 18% of participants were hospitalised due to infection. The main type of infection was infection of the lower respiratory tract.

Participants who had been hospitalised were more likely to have smoked (p=0.013), been diagnosed with diabetes (p =0.05) and have chronic lung disease (p >0.001) and cardiovascular disease (p= 0.003). They also had a higher consumption of total fat (78.3g vs 64g) (p=0.05) and monounsaturated fat (28g vs 21g) (p=0.04). Those who had not been hospitalised versus those hospitalised had a higher percent of energy from protein (17% vs 15%) (p=0.009).

Conclusions

The nutritional intake of the older Māori participants was similar to New Zealanders aged 71 years and over reported in the National Nutrition Survey 2008/9. Participants tended to have inadequate intakes of calcium, selenium and vitamin E. Zinc intakes were inadequate only in men. Participants who had been hospitalised had a lower percentage of energy from protein compared to those not hospitalised. Protein may have a protective effect on the nutritional health of older Māori and this may reduce hospitalisation due to infection in this age group.

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Glossary

Māori Terms

Māori name	Translation
hākari	feast
hāngi	kai cooked in an earth oven
hapū	sub-tribe
haukāinga	people of the marae
Hauora	health care providers
hui	gatherings
ika	fish
iwi	tribe
kai	food
kaimoana	seafood
kaitiaki	protectors/ guardians of the land
kuia	older women
kaumātua	older men
mana	honour/ prestige
manaakitanga	ethical principle donating the importance of caring for others
manuhiri	visitors
marae	traditional meeting place
noa	unrestricted
Pākehā	New Zealand European
piko piko	sow thistle
powhiri	Welcome ceremony
pūhā	New Zealand spinach
Rēwena	Māori bread
Tapu	sacred
Tītī	muttonbird
whānau	family, usually inclusive of extended family

1. Introduction

The population of older people in New Zealand is increasing. The New Zealand Census 2006 showed that people over the age of 65 years accounted for 12.3% of New Zealand's population. It has been projected that by 2051 New Zealand will have a 24% growth in the 85+ years' population increasing from 57,000 (2006) to 322,000 (Statistics New Zealand, 2007).(Figure 1.1)

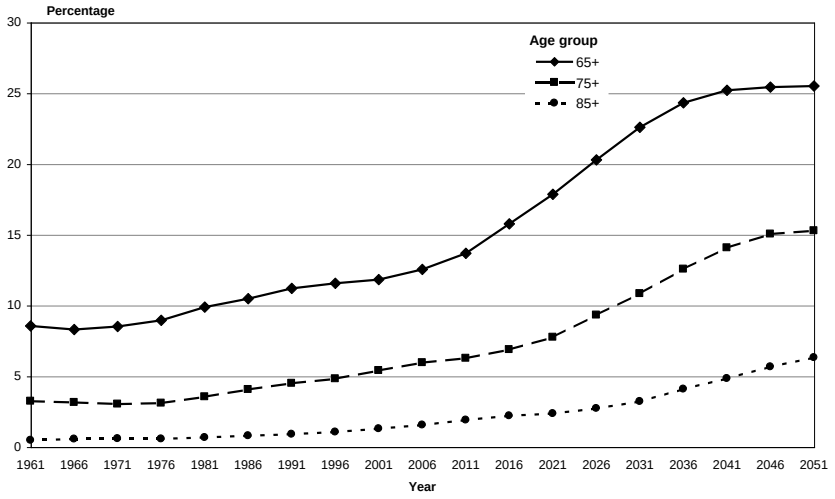


Figure 1.1 New Zealand population aged 65- 85 as a percentage of the total population: 1961 to 2051

Source: Statistics New Zealand, Census of Population and Dwellings 1961–1996 and Population Projections (1999 base)

In 2012 people living in New Zealand who identify as Māori accounted for 15.4% of the total population with 4.1% aged over 65 years (Statistics New Zealand, 2013). Although older Māori are a small percentage of the current older population, over the past two decades the number of Māori living into advanced age 80+ years has more than doubled from1,400 in 1992 to 5,000 in 2012 (Statistics New Zealand, 2013). This trend is projected to continue as the relatively large population of younger Māori advance in years. With the predicted increase in life expectancy, numbers of Māori aged 65 years and older will increase to 7% by 2021.

Maintaining a good health status throughout life is related to successful aging. It is proposed that as life expectancy increases, people will live longer with better health

status (Marmot & Wilkinson, 2009). This may not be the depictive of all Māori entering advanced age.

Māori are over represented in health statistics and they have higher hospitalisation rates and mortality rates compared to non-Māori (Ministry of Health., 2012b), (Robson & Harris, 2007). Poor health, early mortality and lower life expectancy are a direct result of the health disparities Māori experience. Socioeconomic disparities are also experienced by Māori such as: lower incomes, lower levels of education, inadequate housing standards and food insecurities. (Ellison-Loschmann and Pearce, 2006; Hirini et al., 1999). These also may contribute to poor health status. Over the past century there have been improvements in the health status of Māori, however today disparities still exist between Māori and non-Māori (Robson & Harris, 2007; Statisitics New Zealand, 2012).

Older Māori experience high rates of hospitalisation. Between 2009 and 2010 Māori 85 years and older had a higher rate of public hospital admissions compared to Māori of other age groups (Ministry of Health., 2012b). Māori 85 years and older were twice as likely to be hospitalised due to infections as non-Māori (Baker et al.,2010). The infections that Māori were mostly hospitalised for were lower respiratory tract infections, skin infections and gastro enteric infections.

There has been a lot of research done to indicate that there is a relationship between nutritional intake and infection (Pae, Meydani, and Wu, 2012). In 1968 the World Health Organisation (WHO) investigated the relationship between immunological interactions and nutrition (Scrimshaw., Taylor, and Gordon, 1968). This global study looked at different populations and measured immunoglobulin and antibody sensitivity to nutritional status. Since that initial investigation there have been many studies investigating the important role nutrition has on the immune system and how sub-optimal nutrition can increase susceptibility to infections (Forster et al., 2012; Tucker and Buranapin., 2001).

The relationship between nutritional intake and infection in older Māori is unknown. This study aims to investigate whether there is a relationship between nutritional intake and hospitalisation from infections amongst a cohort of advanced age Māori.

2. Literature Review

2.1 Kai (food) perspectives

Food gathering and sharing is an integral part of Māori tradition and life. In past times it was the role of each hapū (sub tribe) and iwi (tribe) to work together to maintain resources such as lakes, rivers, forests and land which provided the food for sharing (Wham, Maxted, Dyall, Teh, & Kerse, 2012). Māori had respect for the places where they gathered kai, and the way kai was gathered was integrated into beliefs, rituals and mythology. These practices ensured that the resources that provided kai weren't exploited. The sharing and cultivation of kai holds a significant role in Māori culture. Roles were given within iwi to be kaitiaki (protectors of the land), for managing and harvesting the food and to gather food for whānau (family), hapū and iwi of the area. (Wolfe, Miller, and Miller., 2008). Manaakitanga (hospitality) and sharing of kai is integrated within Māori culture.

Food is not only considered to be a source of nourishment to sustain life but is also an important part of expressing welcome. Sharing kai with manuhiri (visitors) is significant to upholding the mana (honour/ prestige) of the manuhiri and the haukāinga (people of the marae). For the hosting iwi it is an important cultural practice that occurs during formal occasions such as when manuhiri are received on to the marae after the powhiri (welcome), also before visitors make their journey home (hākari). Prior to the guest's arrival a hāngi (kai cooked in an earth oven) is laid down and the kai significant to that area, such as kaimoana (seafood) is shared with the manuhiri. Manuhiri receive the best of what the hapū have to offer for that area. The powhiri places people in a tapu (sacred) state and kai is used to return to a state of noa (unrestricted). The haukāinga works together to ensure their guests are well fed to maintain manaakitanga. For the guests to refuse receiving a meal or leave before food is shared may be perceived to be offensive by the hosting iwi (Ashcroft, 1985). These practices of preparing and sharing kai for cultural purposes continue within hui (gatherings) today.

2.1.1 Pre–colonial eating practices.

In pre-colonial times Māori were guardians of the land. They cultivated crops, were hunters and gatherers and collected food they required to feed themselves and their

hapū/whanau. Food was gathered from natural resources and Māori only took what they needed at that time. Food sources were looked-after and respected so that the supply would not diminish. Maori lived in balance with their surrounding environment (Murchie, 1984). These practices not only held Māori in good health but also gave a spiritual significance and value to food (Jensen et al., 2006).

The diet of early Māori mainly consisted of shoots and leaves such as piko piko (sow thistle) andpūhā, (New Zealand spinach) which were gathered, and kumara and ureniki (types of potatoes) which were cultivated. They ate berries from the karaka tree and seeds from the flax plant and miro were collected (Cambie & Ferguson, 2003). Meats such as titi (muttonbird) were sourced from the land and forests. Kaimoana (seafood) such as kina, pipi, koura (crayfish), ngaeti (periwinkles) and ika (fish) tuna (eels) were gathered from the sea rivers and lakes (Cambie and Ferguson, 2003; Jensen et al., 2006). Reports in journals of early explorers to New Zealand describe the Māori diet as having little variety and mainly consisting of, "fern roots, dogs, rats, fish and wild fowl" (Murchie, 1984).

Māori diet pre-colonisation would have been high in protein and fibre and low in fat (Rush, 2010). These foods provided good sources of micronutrients and macronutrients enabling Māori to consume a healthy, nourishing diet. This traditional diet was very much in-line with the dietary guidelines set today (Jensen et al., 2006).

2.1.2 Post- Colonial eating practices

With the arrival of European settlers came the introduction of new foods such as potato, sweet potato, pumpkin, cabbage, and maize. They also introduced animals which became staple food sources like pigs, chicken, sheep, and beef cattle. Māori integrated these foods into their diet along with traditional foods (Whiu, (n.d)). Prior (1964) looked at the diet of Māori that lived in the remote region of the Urewera mountain ranges. The diets of Māori in this region were described as "simple diets". Staple foods consisted of bread, potatoes, sugar, butter, meat, and green vegetables. Meat was part of every meal and usually consisted of mutton or corned brisket. The manner in which the foods were generally consumed was that one main meal was cooked and the other two meals of the day used the leftovers from the main meal (Prior et al., 1964).

2.1.3 Contemporary eating practises

Hāngi is still commonly consumed amongst Māori at gatherings today. This style of food generally consists of meats (mutton, pork, lamb or chicken) and root vegetables (kumara, potato). Once prepared the kai is then wrapped and cooked under- ground with hot stones to retain the flavour and juices. The preparation of a hāngi is labour intensive and is generally reserved for special occasions and hui (Rush. et al, 2010).

Foods such as kaimoana, meat, vegetables and rewena (Māori bread) are still offered as part of cultural traditions, at hui's and celebrations. Today there are also other foods such as desserts, salads, fruit and drinks included in the celebrations; an indication that culture and tradition evolve as resources and food processes change. (Rush. et al., 2010).

"Boil up" is another preferred way to prepare foods where by various cheaper cuts of meat and bones or tuna are boiled first before adding vegetables such as pumpkin, potatoes, kumara, puha, watercress, cabbage and carrots. The dish is simmered over a few hours then served (Ashcroft, 1985).

Whilst Māori still have traditional foods in their diet everyday food choices are similar to that of non-Māori. The Hillary Commission for Recreation and Sport conducted the "Life in New Zealand" (1991) survey that reported Māori were high consumers of cereals, breads, biscuits, organ meats and boiled meats. The types of meats chosen for main meals were generally fattier cuts. Māori women were higher consumers of snack foods such as pies, twisties, crisps, ice-blocks and hamburgers (Horwarth., 1991). While today many Māori still consider traditional kai such as tuna, tītī and kaimoana to be important foods, there are now more challenges to accessing it and older Māori find that barriers such as gathering and access to traditional kai can greatly limit how much they consume (Wham et al., 2012).

2.1.4 Nutrient intakes of Māori from National Nutrition Surveys

The New Zealand National Nutrition Survey (NNS) is undertaken about every 10 years to produce a snapshot of New Zealanders dietary intakes. The NNS uses the 24 -hour

multiple pass recall method, a qualitative food -frequency questionnaire and a questionnaire to identify key food habits to obtain information on the dietary habits of people living in New Zealand (Quigley & Watts, 1997). Information that is collected is then analysed to give details of macronutrient and micronutrient intake and the contribution from energy for each participant. This information can be used to investigate nutrient intakes amongst a population and enable researchers to make comparisons with recommended intakes set by National Health and Medical Research Council (NHMRC., 2006). Reference ranges that were used to report dietary data in the NNS were; acceptable macronutrient distribution range (AMDR) which is the estimated range required for each macronutrient (expressed as a % contribution to energy) and the recommended daily intakes for micronutrients. The NHMRC recommendations contributions to total energy for adults are 15-25% from protein, 45-65% from carbohydrates and 20-35% from fats (no more than 10% from saturated fats). These reference ranges and figures have been calculated to meet the intakes that allow for an adequate intake of all other nutrients, whilst maximising the general health for a healthy person (NHMRC., 2006).

The first reported survey on dietary intake of New Zealanders was conducted by the National Heart Foundation in 1977 (Birkbeck., 1979). This survey reported nutritional information on Pākeha/ NZ European and Māori, of which 40 participants identified as Māori and only 13 of those represented the oldest age group (50-63 years). Due to the small sample size only energy and macronutrient intakes were reported. Māori had similar intakes to Pākeha but were reported as having high intakes of fat and with animal fat being the main fat contributor.

The Ministry of Health conducted the following National Nutrition Survey (NNS) in 1996/7 surveying 4,636 people living throughout New Zealand. This report was able to give greater detail regarding the nutrient and dietary intakes of the Māori population. As the sample size for the older population was small, older Māori were classified as 45+ years. The NNS 1997 included information on micronutrient and macronutrient intakes and percentage of energy from carbohydrates, protein and fat. (Russell, Parnell, and Wilson., 1999).

Results from the NNS 1997 showed Māori aged 45+ years, were higher than the NHMRC recommendations for adults for total fat (men 36%, women 37%) and saturated fat (men 15%, women 16%). The percentage of energy from protein (men 18%, women 17%) was within the recommended range but carbohydrates were lower for men (40%). Findings showed inadequate mean intakes of calcium (men and women), selenium, vitamin B6 (women) and higher mean intakes for vitamin C, vitamin E and iron (men and women) compared to the recommended micronutrient intakes (Russell et al., 1999). The NNS 1997 also investigated average fruit and vegetable intakes of Māori adults. Findings from the NNS 1997 reported Māori adults had low intakes of fruit and vegetables were not meeting the recommended intakes of 2 serves of fruit and 3 serves of vegetables per day (Ministry of Health., 2002).

The most recent NNS was conducted in 2008/9. This survey recruited 1,021 Māori respondents, 247 were 51 years and older. (University of Otago and Ministry of Health, 2011). Māori aged 51+ years had above the NHMRC range for total fat (men 37%, women 36%) with saturated fat being the main source of fat (14% for men and women). The percentage of energy from protein was within the recommended range (17% for men and women) and percentage of energy from carbohydrates was only marginally lower (43% men 44 women) then the recommendations (Ministry of Health, 2012a). Calcium intakes for both Māori men and women and zinc intakes for Māori men were below the recommendations.

National nutrition surveys indicate that for Māori in the older age groups the percentage of energy from fat and saturated fat were above the NHMRC recommendations.

2.1.5 Regional studies on nutrient intakes of older Māori

While national surveys provide a snapshot of the nation's nutritional intakes, a number of smaller regional studies have also explored the dietary intakes of older population groups including Māori. These studies provide an insight of diet and lifestyle influences amongst the older Māori population.

Metcalf's (2008) study looked at the dietary habits of Māori, Pacific Islanders and Asian people aged 40-65 years living in the Auckland region. Food group servings between the different ethnic groups were compared the findings to the NNS 1997 study. Findings were similar to the NNS 1997 with diets of Māori being high in fat, mainly saturated fat. Māori participants ate larger portions of chicken and red meat than the other ethnic groups which could also contribute to the higher intakes of fats and saturated fats.

McElnay et al., (2012) investigated nutritional risk in community living people aged 65+ years in the Hawkes Bay region which included 40 participants who identified as Māori. A validated screening tool (SCREEN II) was used to assess participants at risk of malnutrition. Self-reported dietary intake from the questionnaire gave information regarding the participant's food group intakes. The findings revealed Māori participants had low intakes of fruit and vegetables (71%), meat protein (68%), and milk products (68%). Sixty percent of Māori participants frequently skipped meals. A total of 62% were at high risk of malnutrition and were more than five times more likely to be at nutritional risk compared to non-Māori (McElnay et al., 2012).

Wham et al., (2012) conducted a sub-study of the LiLACS feasibility study in the Northland and Bay of Plenty regions on community living Māori aged between 75-79 years using SCREEN II. This study reported Māori had low intakes of fruit and vegetables (59%), meat and meat alternatives (60%) and milk products (75%) and regularly skipped meals (52%). These findings were similar to McElany (2012). These findings highlight the lower then recommended intakes of certain food groups and may explain why older Māori tend to have inadequate intakes of some micronutrients.

2.1.6 Food Security and Māori

The definition of food security is the assured access to sufficient food that is nutritious, of good quality, safe, meets cultural needs and has been acquired in socially acceptable ways (Russell et al., 1999). Food insecurity has been associated with poorer health and an increase in chronic health conditions, nutrient deficiencies, and poor self-related mental and physical health (Carter et al., 2010). Food security influences the types and amounts of food people have access to and impacts on the ability to maintain a healthy nourishing diet.

Food security reported in the NNS 1997 indicated that 47% of Maori household's lack of money affected the variety of foods eaten, and 31% reported they sometimes ran out of food. These figures are more than double that of non-Māori (Russell et al., 1999). Being able to afford food is an element of food security. The NNS 1997 questioned participants if they "can afford to eat properly". One third of Māori reported food runs out "often or sometimes", and this was mainly due to lack of money (Russell et al., 1999). Māori families on lower incomes are reported to eat less fruit and vegetables, milk and meats and are more likely to skip meals than those who have higher food security (Ministry of Health., 2010).

A high proportion of Māori live in areas of high deprivation (Ministry of Health, 2011; Robson and Harris., 2007). Areas of high deprivation have more fast food outlets, lower quality supermarkets that supply a greater range of foods high in fat and sugar, and families living in these areas have less access to affordable and healthy nutritious foods (Te Hotu Manawa Maori., nd). It is not known to what extent food security impacts on access to healthy foods for older Māori.

2.2 Māori and Health

2.2.1 Life Expectancy

Life expectancy for Māori is around eight years less than it is for non-Māori (Statistics New Zealand, 2013). Data obtained from the New Zealand Census 2006 indicates that life expectancy for Māori at 50 years of age was 25 years for men and 28 years for women (Ministry of Health, 2011). The participants of this study have lived beyond their predicted life expectancy. As the population of Māori is projected to increase, the life expectancy of Māori will also increase (Ministry of Health., 2002).

Although life expectancy is increasing it may not mean that is being lived in good health. A report on Health Loss in New Zealand indicates that as life expectancy increases, only 60% of it will be spent in good health, the remaining 40% will be in poorer health with people requiring some form of health service assistance (Ministry of Health., 2013a). Currently if a Māori male lives to 73 years he will spend 62.6 years in good health or functioning independently and the remaining 9 years will be spent

requiring input from health services. To reduce health costs is important to improve the health of older Māori and reduce the burden of disease. Good health status throughout life is a key factor in successful aging (Marmot & Wilkinson, 2009).

2.2.2. Lifestyle and successful aging

The term "successful aging" is now used to change the way people perceive aging and to move away from the concept that old age is about inevitable sickness and decline (Marmot and Wilkinson., 2009). Rowe and Kahn (1997) defined successful aging as having a low probability of disease or disability, maintaining cognitive and physical function and actively engaging in life. Camacho et al., (1993) reported people in their 60's that had good self-rated health ,better health habits and more social contacts had better health outcomes in their 70's compared to those with low self-rated health. Maintaining good support networks such as visiting family members indicates that older people are more likely to have better access to amenities, such as doctors and community services. These networks assist in maintaining good health status and cognitive function (Marmot and Wilkinson., 2009).

For older Māori being actively involved with whanau, marae and community is an important aspect of Māori culture. A feasibility study for LiLAC NZ investigated Māori aged 75-79 years and reported the majority of the 33 participants were actively involved in community and marae activities (Dyall et al., 2011). Oranga Kaumātua, a study that investigated the health of older Māori over the age of 65 years reported 68% of kaumātuas were involved in marae activities, 73% had weekly contact with their whanau (Waldon., 2004). Another study, Living Standards of Older Māori, interviewed 542 Māori aged 65-69 years old. This report showed 90% of older Māori had contact with whanau at least once a week, not just socially but also assisting with household chores. (Cunningham et al., 2002). Involvement with whanau is important for social and cognitive function and is also is seen as an important aspect of Māori culture which may assist older Māori with healthy aging.

Physiological changes associated with aging and can influence nutritional and dietary intakes, these changes can sometimes have a negative effect on nutritional intake (Brownie., 2006). Changes in cognition and mental wellbeing such as dementia can impact on appetite and oral intake (Rush., 1997). .

2.2.3 Māori and Body Mass Index classifications

Body Mass Index (BMI) was implemented to enable a global measure for the nutritional status of adults (World Health Organization., 2006) and it is commonly used to measure the health status of a population (Rush et al., 2007). Currently the sole use of BMI measures are being challenged as studies are now finding that BMI alone is not a good indicator of health issues and waist circumference needs to be considered (Staiano., 2012).

The NNS 2008/9 survey included BMI as part of the anthropometric measures for Māori and non-Māori adults. The NNS 2008/9 reported Māori men and women had mean BMI's of 30kg/m2 and 31kg/m2 respectively (Ministry of Health, 2012a) indicating that the average Māori adult is classified as obese. Obesity rates are higher amongst the adult Māori population then non-Māori the New Zealand National Health Survey 2006 reported that Māori adults were 1.5 times more likely to be obese compared to non-Māori (Ministry of Health., 2008).

It has been proposed that BMI should be adjusted for ethnicity and investigations have been carried out on across different ethnic groups including Māori. Māori have a higher percentage of fat-free mass and bone mass compared to non-Māori and the recommendation should be to increase the threshold for the Māori population (Rush. et al., 2007). The World Health Organisation (WHO) set international cut off points for underweight, overweight and obese are <18.5kg/m^2, 25 kg/m^2 and 30kg/m^2 respectively (World Health Organization., 2006). The NNS 1997 and the 2002/03 New Zealand Health Survey, used higher BMI cut-off points to assess BMI in the Māori population (over weight 26kg/m^2 and obese 32kg/m^2) (Ministry of Health., 2004; Russell et al., 1999).

There has been little research performed regarding the relationship between older Māori and BMI, however the relationship between aging and BMI cut-offs are currently being investigated. Older people with low BMI (underweight) has been associated with having increased health risks, frailness and increased risk of mortality (Janssen & Mark, 2007). However, high BMI (overweight/obese) is often associated with increased mortality yet this is not proving the case with older people. Current research is showing that within the

population over 70 years, a higher BMI may not be associated to increased mortality and the current recommendations may not be suitable for the older population and higher thresholds should be considered (Corrada et al ., 2006; Heiat, Vaccarino, and Krumholz., 2001).

2.2.4 Health conditions affecting Māori

The Māori population is over represented in health statistics over all ages. (Baker et al., 2012; Hefford, Crampton, and Foley., 2005; Ministry of Health., 2012b). Long term health conditions such as heart disease, stroke, diabetes, and high blood pressure are more prevalent amongst Māori adults (Ministry of Health., 2010). Māori have higher rates of hospitalisation and mortality from cardiovascular disease (CVD), chronic obstructive pulmonary disease (COPD), pneumonia, and diabetes compared to non-Māori (Ministry of Health, 2011; Robson and Harris., 2007). Over representation of Māori in chronic health conditions is associated with health disparities such as the unmet need for health care and poor access to primary health care services (Ellison-Loschmann, and Pearce., 2006; Hirini et al., 1999).

2.2.5 Health disparities amongst Māori

Disparities are unnecessary, avoidable and are also considered unfair and unjust (Robson & Harris, 2007). Health disparities are common amongst indigenous populations that are part of wealthy populations such as New Zealand, Australia and Canada (Bramley, Hebert, Jackson, & Chassin, 2004). Indigenous populations of wealthy countries commonly suffer from poorer health, early mortality, and lower life expectancy when compared with non- indigenous populations (Bramley et al., 2004). Indigenous cultures have lower levels of education, lower socioeconomic status and higher levels of poverty and social stressors that can lead to poorer health outcomes (Hirini., 1999). Socioeconomic status, lifestyle patterns and access to healthcare are amongst some of the factors that are associated with the health differences between Māori and non-Māori (Ellison-Loschmann and Pearce, 2006).

Areas of deprivation in New Zealand is measured by area mesh-blocks, that use information from the NZ census 2006 to rank the socioeconomic deprivation of groups

of people in small residential areas (Salmond and Crampton., 2012) The rank is reported in deciles ranging from 1- 10 with a higher score indicating a more deprived neighbourhood and lower score least deprived (Salmond, Crampton, & Atkinson, 2007). Over 50% of Māori people live in areas of high deprivation areas (decile 8-10).Socioeconomic factors such as, income, education, occupation, housing impact on health status. Māori living in areas of high deprivation are more likely to have increased health concerns and higher rates of mortality (Ellison-Loschmann and Pearce., 2006; Ministry of Health, 2011; Robson and Harris., 2007).

Older Māori are at risk of depressed living standards due to economic disparities. A report on the Living Standards of Older Māori states that one in five older Māori will face material hardships (Jensen et al., 2006). The Oranga Kaumatua report showed that 76% of older Māori relied solely on superannuation for income in retirement with 68% of older Māori earning less than $20,000 per year and few (3%) had extra savings. Half of Māori participants that were home owner reported being mortgage free (Waldon., 2003).

Māori also have significantly higher rates of unmet need for health care compared with non- Māori (Ellison-Loschmann and Pearce, 2006). The Health of New Zealand Report 2011/12 found that 39% of Māori were not accessing health care when required were predominately due to barriers relating to cost and transport (Ministry of Health., 2012a). Hirini et al., (1999) interviewed kuia (older women) and kaumatua (older men) in New Zealand about utilisation of health services, health status and activity limitations. These kuia and kaumātua presented with multiple chronic health conditions but these conditions didn't limit their daily activities. Despite the presence of major health conditions they only occasionally visited their general practitioner and very few (7%) consulted a medical specialist (Hirini et al., 1999).

Māori health inequity is not a new issue yet it is an area that is of growing concern. As the Māori population grows so will the issues related to health status if they are left untreated. Māori need greater support in all sectors of life to ensure they can age with good health, and remain living independently with good quality of life for as long as possible (McElnay et al., 2012).

2.2.6 Māori models of health.

Māori have a holistic view of health. Te Whare Tapa Wha, Te Pae Mahutonga and Te Wheke reflect the spiritual, physical, emotional / intellectual and social aspects of health (Rochford, 2004). All areas of these models need to be acknowledged in unison to achieve wellbeing (Durie., 1999). Māori models of health have been established to assist health promotion services in New Zealand. These models assist agencies to gain an understanding of health issues from a Māori perspective and to align programmes to make them relevant for Māori communities (Ministry Of Health., 2010). Māori Hauoras (health care providers) have been established with the intention of creating primary health care services that can support Māori with self–sufficiency and give Māori control over health initiatives whilst employing Māori staff to access Māori communities (Ellison-Loschmann and Pearce, 2006). The introduction of Maori health providers will hopefully increase the numbers of Māori with access to primary health care.

2.3 Hospitalisations

The frequency of hospital admissions increases with age. Older people may have higher rates of hospital admissions than younger people are because their immune systems are more susceptible to infections and disease (Yoshikawa and High., 2000). This is a result of decreased cell-mediated immunity and decreased immunity related to other pre-existing chronic health conditions (Yoshikawa and High., 2000).

The advanced age (85+ years) population had higher rates of public hospital admissions compared to other age groups between the period of 2009/10 (Ministry of Health., 2012b). Māori are over- represented in hospital admissions compared to other ethnicities in New Zealand. However there is little data available on Māori in advanced age due to low representation of this age group.

2.3.1 Hospitalisation from infection in New Zealand

Chronic health conditions may be accompanied by symptoms like fever, delirium, falls, and malnutrition that can mask signs of infections. Comorbidities and masking symptoms can make diagnosing of infections harder, thus increasing the length of time to receiving treatment (Gavazzi and Krause, 2002).

The population in New Zealand that are most at risk of hospitalisation from infections are people of Māori ethnicity aged 65 years and older (Robson and Harris., 2007). Māori are twice as likely to be hospitalised due to infectious diseases compared to non-Māori and this is more common amongst children and older adults (Barker., 2012). In some cases if treatment of infections was accessed earlier it may eliminate the need for hospitalisation.

The relationship between hospitalisation and respiratory infections, in children under 14 years of age was investigated by Grant et al (2012). Poor living conditions increased the risk of children being hospitalised with respiratory infections and future investigations into nutrition status was recommended. Amongst older Māori (60+years) respiratory infections, stomach ulcers, and urinary tract infections were higher amongst Māori of this age than non-Māori.

Māori 80+ years were reported having 703 admissions due to infection between 2010 to2011. This accounted for 22% of all hospital admissions form Māori aged 80+ years. (Ministry of Health.,2013). The most common types of infections reported were predominantly respiratory related, infection of the skin and gastric ulcers see Table 2.1 (Baker et al., 2012; Petri et al., 2008). These figures represent a large proportion of hospital admissions for a relatively small percentage of the population.

For Māori aged between 80 years and older the most common type of infection reported for hospital discharges was from chronic lower respiratory disease followed by chronic obstructive pulmonary disease, pneumonia and acute lower respiratory infection (Table 2.1).

Table 2.1: Number of hospital admissions from infections in Māori 80+ years

ICD-10 *	Infection type	Total discharges
A08	Viral and other specified intestinal infections	4
C16	Malignant neoplasm of stomach	10
R11	Nausea and vomiting	17
K25	Gastric ulcer	23
K26	Duodenal ulcer	3
J06	Acute upper respiratory infections of multiple and unspecified sites	2
J18	Pneumonia, organism unspecified	129
J22	Unspecified acute lower respiratory infection	63
J44	Other chronic obstructive pulmonary disease	169
J40–J47	Chronic lower respiratory diseases	192
L00–L08	Infections of the skin and subcutaneous tissue	52
B86	Scabies	1
A41	Other sepsis	36
A49	Bacterial infection of unspecified site	2
	Total admissions from infections	703

*ICD-10 –International classification of disease 10th revision.

There has been no investigation into the relationship between infection and nutrition or between diet, nutrition and hospitalisation due to infection in advanced- aged Māori.

2.4 Types of infections

Hospitalisation due to infectious diseases such as respiratory infections, influenza and bacterial skin infections has increased in New Zealand over the past 20 years (Baker et al., 2010).

2.4.1 Respiratory infections

Research has established that there is a relationship associated increased risk to respiratory infections with living conditions such as damp housing, heating, over-crowding and lack of access to health care (Grant et al., 2012). In particular insufficient heating in homes has been associated as a problem amongst older people in relation to increase risk of respiratory infections (Howden-Chapmanet et al.,1999).

Māori are over represented in hospital admissions related to respiratory infections (Grant et al., 2001; O'sullivan, Baker, and Zhang, 2011). Respiratory infections in accounted for

79% of hospital discharges from Māori aged 80+ years old in 2010-2011 (Ministry of Health., 2013). The older Māori population have higher rates of hospital admissions from respiratory infections compared to any other type of infection.

Pneumonia, a type of respiratory infection, is a common cause of hospital admissions for adults. It is associated with high mortality rates and has a high prevalence amongst indigenous cultures (Chambers et al., 2006). It has been found that the risk of Māori developing community-acquired pneumonia is higher than in non-Māori (Chambers et al., 2006). Hospitalisation due to pneumonia in Māori men and women 65+ years were 3.5 and 3 times higher respectively compared to non –Māori and mortality rate in men resulting from pneumonia was 6 times higher in older Māori men compared to non – Māori (Ministry of Health., 2011). Most of the studies found in this literature review investigated hospitalisation in Māori children in relation to pneumonia (Clark et al, 2007; Grant et al., 1998).

Chronic obstructive pulmonary disease (COPD), another respiratory related infection and has also been termed an avoidable disease (Baker et al., 2010). It is the fourth leading cause of death for Māori aged 65+ years and Māori are 3.5 more likely to have hospital admissions from COPD compared to non- Māori (Ministry of Health., 2011).

2.4.2 Skin infections and cellulitis

Cellulitis is a bacterial infection that affects the lower dermis and subcutaneous soft tissue. The infection is caused by bacteria entering broken skin tissue from cuts, abrasions or ulcers. As skin tissue thins with age these types of breakages to the skin are common. Severity of skin infections can be caused by decreased awareness, close contact living conditions, delayed treatment, cognition and poly-pharmacy (Laube, 2004). Most research in association with skin infections and Māori has been on children and key findings are related to overcrowding, poor housing conditions and delays in treatment (Ete-Rasch and Nelson, 2013; Lines, 1977; O'sullivan et al., 2011).

2.4.2 Enteric infections

Enteric infections are viruses, parasites or bacterial pathogens that enter the body usually via the mouth. These infections can result in chronic bouts of diarrhoea leading to other major health complications of dehydration, electrolyte imbalances and malabsorption of nutrients (Paradise, Bendinelli, and Friedman, 1996; Saunier and Doré, 2002). Reduced intestinal immunity and increased enteric bacteria can predispose to gastrointestinal infections like clostridium difficile, shigella, helicobacter pylori (Saunier and Doré, 2002; Whiu, (n.d)).

Baker (2010) investigated the burden of close contact diseases in Māori over a period of five years. It was observed that Māori had significantly higher rates of hospitalisation for enteric infections compared to non- Māori over a five year period (Baker et al., 2010).

Foodborne infections such as salmonella, campylobacter and staphylococcus aureus can be more severe amongst the older population. These infections may be related to physiological changes to the gut but also to changes in smell and vision. This may alter a person's ability to make accurate judgment whether or not food is safe to consume (Smith., 1998). Illness from foodborne infections can adversely affect the nutritional status of a person especially if the person has an already impaired immune system.

2.5 Nutrients and relationship to infections

The term infection is described by the World Health Organisation (1976) as an invasion of a living host by an organism; its development or multiplication, and the reaction of tissues to its presence or to toxins it generates (Scrimshaw and Suskind., 1976). In 1968 a publication from the WHO monograph "Nutrition and Infections" provided extensive evidence of the relationship between under nutrition on morbidity, mortality, and infection (Scrimshaw., 2003). Clinical trials have been carried out to investigate the effects of nutrient deficiencies and immune response. Animal studies identified essential amino acids which affect the immune response (Scrimshaw and San-Giovanni., 1997).

2.5.1 Total energy and infections

As people age there is a decreased requirement for energy intake. Appetite also declines, which coincides with decreased energy expenditure and physical activity (Wakimoto and

Block., 2001). The decline in energy intake raises concerns about older people achieving an adequate intake of nutrients. Deficiencies in some nutrients such as vitamin B_{12}, calcium and protein are more common amongst the older population (Gavazzi, Herrmann, and Krause, 2004; Pae et al., 2012). Other determinants for low immunity such as disability, disease, impaired health status and poor socio-economic status also need to be considered (Pae et al., 2012).

Energy intake in older adults aged 79-89 years was investigated to determine if increasing energy intake would result in a decrease in infections (Odlund Olin et al., 2003). Over 15 weeks an intervention groups were provided a diets of either standard energy of 1600 kcal/ day (control group) or increased energy of 2100 kcal/day (experimental group). The most common infection types amongst both groups were respiratory infections, urinary infections and skin infections. The group with the higher energy intake were found to have incurred fewer episodes of infection then the lower energy group (Odlund Olin et al., 2003).

Insufficient intake of key nutrients such as protein, vitamin E, vitamin A, vitamin C, iron, zinc and selenium may enhance immunodeficiency and can also lead to infections (Calder and Kew., 2002; Gavazzi and Krause, 2002). Malnutrition and obesity may contribute to increasing susceptibility to infections (Falagas and Kompoti., 2006; Solomons., 2007). Pneumonia, skin infections, urinary tract infections and post-surgery infections may be higher amongst obese people (BMI >30kg/m^2) (Falagas & Kompoti, 2006).

2.6 Macronutrient relationship to infection

Macronutrients consist of carbohydrates, proteins, and fats. They are the main contributors of energy the body uses for fuel.

2.6.1 Protein

Protein is as an essential nutrient to maintaining functional status during the aging process (Tucker and Buranapin., 2001). Optimal protein intake means the body is more adapt at fighting infections (Tucker and Buranapin., 2001). A reduction in protein stores may cause changes to red and white blood cells, antibodies, antigens, enzymes, skins-elasticity and immunity (Wolfe et al., 2008). These functional changes can affect the

skin's integrity, delay wound and fracture healing and impair the ability to fight infections (Chernoff., 2004).

As a result of physiological changes that occur with aging, older adults have 25% higher protein requirements for maintenance compared to younger adults (NHMRC., 2006). Protein metabolism changes with age and there is an imbalance in regulation and of protein degradation to protein synthesis (Koopman and Van Loon., 2009). These regulatory changes can result in a decrease to lean muscle mass leading loss of strength and can affect mobility (Tucker and Buranapin., 2001).

The type of protein consumed (high biological value or low biological value) can impact on total protein intake. Older people may consume less high biological value protein such as animal protein (Gaffney-Stomberg et al., 2009). Age associated factors such as difficulty chewing, fear of increasing cholesterol, perceived intolerances and affordability may be reasons for a decrease in consumption of animal protein sources (Houston et al., 2008). Having adequate protein is part of maintaining a healthy functional status and decreases risk of prolonged infections that may lead to hospitalisation (Volpi et al., 2013).

The frequency of protein intake may affect how protein is metabolised and utilised. Intakes of small portions of protein, (20g-30g) spread throughout the day enhance skeletal muscle synthetic response in older people and may counteract sarcopenia (Tieland et al., 2012). The body can only metabolise a limited amount of protein at each intake. To maximise total protein intake, researchers are suggesting protein should be spread throughout the day (Gaffne-Stomberg et al., 2009; Volpi et al., 2013). Older adults are reported as generally consuming the majority of their intake protein in one meal, usually the main meal of the day hence not achieving the maximum value from protein intakes (Jordan et al., 2010). Following the current EAR of 46g/day for women and 56g/day for men this would mean having 15-20g of protein for breakfast, lunch and dinner to get optimise protein utilisation.

Amongst the population of 70 years and older, the recommendations for protein to meet daily functional needs of healthy adults has been established with an EAR of 0.75g/kg/day for women and 0.86g/kg/day for men (NHMRC., 2006). However this is

being challenged, that the EAR is set too low to meet the needs of older adults to compensate for the loss of lean body mass (Tieland et al., 2012). Further research in this area is required to ascertain revised optimal protein levels to meet the functional needs of the older population and improve health outcomes.

2.6.2 Fats

Fats are the most concentrated source of energy in the diet and there are three main types in the diet; saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA) (University of Otago and Ministry of Health, 2011).

Diets that have a moderate polyunsaturated fat intake particularly omega 3 and omega 6 have been reported to suppress natural killer (NK) cell activity, production of inflammatory markers and interleukin production which all of these provide immunosuppressive functions that help the body fight to infections (Calder and Kew., 2002; Field, Johnson, and Schley., 2002; Pae et al., 2012). Manufactured fish oil tablets are high in PUFA's which contain anti- inflammatory properties. Calder (2006) reviewed studies that investigated the effect of PUFA's on inflammatory disease. High doses of fish oils were administered to see if the anti-inflammatory effect would prevent or reduce the incidence of respiratory and enteric infections. The findings showed a weak association between fish oil and respiratory or enteric infections but future research was required to give conclusive evidence (Calder., 2006).

Yaqoob (2002) reported that MUFAs such as olive oil have properties similar to fish oils which may assist in the suppression of NK cell activity. More trials are necessary to understand the mechanisms and its role in immune regulation and reducing risk of infections (Yaqoob., 2002).

2.7 Micronutrients and infection

Micronutrients are generally found in small quantities of food and are just as important to optimal health status and immunity to fight infections (Calder and Kew., 2002; Solomons, 2007).

Micronutrients are an intricate part of food. Having a sub-optimal food intake can also result in sub-optimal micronutrient intake (Field et al., 2002; Pae et al., 2012). Forster et

al., (2012) investigated diet and infection in an elderly community living population aged 65-85 years. The aim was to see if there was a difference between improving diet quality and taking a supplement to meet the micronutrient recommendations in order to reduce the incidence or duration of infections. Improving the nutritional status in the diet group reduced the severity and duration of infections although there was no significant difference seen in the frequency of episodes of infection between the diet and supplement groups (Forster et al., 2012).

Paw et al., (2000) conducted a 12-week intervention trial on adults over 70 years of age This objective was to find if exercise and enrichment of foods with vitamins and minerals 25-50% above the Dutch recommended daily intake (RDI) would reduce susceptibility to infection. The results showed no difference in infection status of the groups possibly due to the short duration (Paw et al., 2000).

2.7.1 Vitamin E

Vitamin E may enhance T-cell mediated immune function through influencing membrane integrity and signal transduction and by reducing the production of suppressive factors, prostaglandin E2 (PGE_2) (Pae et al., 2012). In mice supplemented with high levels of vitamin E (500mg/kg) it was found high levels of vitamin E suppressed PGE_2 synthesis and enhanced immune response (Meydani et al., 1986). Another animal study performed on elderly mice (22 months) investigated the relationship between vitamin E, influenza and respiratory infections (Han et al., 2000; Hayek et al., 1997). There was a significant reduction in the amount of PGE_2 and an increase in cytokines which help defend against influenza infections. In elderly men and supplemented with vitamin E (200mg per day) over 6 weeks found an increased neutrophil lymphocyte count and enhanced T-cell mediated immunity (De la Fuente et al., 2008).

Other types of trials have been performed using plasma markers to investigate if vitamin E reduces the risk of infections. Graat, Schouten and Kok (2002) investigated investigate if taking a supplement containing multivitamin and minerals would reduce the rate of respiratory or viral infection adults 60+ years. The multivitamin was calculated to account for 25-50% of the participants of the Dutch RDA with one group receiving a multivitamin with an extra 200mg of Vitamin E over 15 months. The participants with

the additional vitamin E supplement showed an increase in the severity of the infection (Graat, Schouten, and Kok, 2002). Chavance et al (1993) looked supplementation of Vitamin E over two months in healthy adults 60+ years. There was no significant difference in reducing the incidence of viral infection compared to those in the placebo group.

2.7.2 Vitamin C

Vitamin C has been documented for its role in the immune system. As early as the 1930's Vitamin C has been investigated for its role in the preventing the common cold and its role in respiratory infections (Hemilä, Chalker, and Douglas., 2007). In 1942 a trial using vitamin C supplements in school students with adequate diets, found high doses had no effect on the severity of upper respiratory infections (Cowan, Diehl and Baker, 1942). High doses (5000mg) of vitamin C decreased the duration of colds in by up to five days in the group that received the supplements compared to a control group (Gorton and Jarvis, 1999). A Cochrane review (Hemilä and Louhiala, 2007) found that vitamin C supplementation was beneficial in both preventing and treating pneumonia in an unwell adult population that had extremely low vitamin C levels (Hemilä and Louhiala 2007).

2.7.3 Vitamin A

Vitamin A is responsible for maintaining normal antibody response and suppresses production of certain lymphocytes to prevent infection (Maggini, Wintergerst, Beveridge, & Hornig, 2007). Low vitamin A levels are linked to increased risk of developing respiratory infections and chronic ear infections (Katona and Katona-Apte, 2008; Maggini et al., 2007). Sommer, Katz and Tarwotjo., (1984) noted that children who had mild vitamin A deficiency were at increased risk of diarrhoea and respiratory diseases (Sommer, Katz, and Tarwotjo., 1984). Hospitalised children showed that there was a reduction in the duration of intestinal infections, and diarrhoea was significantly reduced by an average of 36 hours when supplemented with vitamin A. (Villamor and Fawzi., 2000).

2.7.4 Zinc

Zinc plays a role in T-cell activation and NK cell and beta cell production (Ngom et al., 2011). Zinc deficiency may reduce immunity response by decreasing NK cell and b-cell function. These actions are seen to be associated with infections such as tuberculosis, pneumonia, pulmonary infections, wound healing and HIV infections (Katona & Katona-Apte, 2008; Shankar and Prasad, 1998).

Trials in older people have observed zinc supplementation assists with wound healing time and resistance to infections (Meydani et al., 2007). In the older population normal zinc levels (>70ug/dL) have been found to be associated with a decrease in incidence and duration of pneumonia (Meydani et al., 2007). Prasad et al., (2007) carried out a controlled randomized trial in the older population and reported a significant decrease in incidence of pneumonia in the group with optimal zinc levels (104ug/dL ± 16.69) compared to those receiving a placebo with lower zinc levels (88 ug/dL ± 9.6) (Prasad et al., 2007).

In school children zinc supplements were used to see if there was a reduction in the incidence of and lower respiratory infection. A randomized control trial supplemented children with 10mg of zinc per day for 120 days. This trial found a 45% decrease in lower respiratory tract infection episodes compared to those who did not receive supplements (Sazawal et al., 1998).

There is a worldwide prevalence of sub-optimal intake and deficiency of zinc amongst children and older people and these are the populations who are prone to infections (Pepersack et al., 2001; Prasad et al., 2007; Tuerk and Fazel, 2009). New Zealand men aged 71+ years have low levels of zinc, well below the EAR recommendations (Ministry of Health., 2010) and this may increase the risk of infection.

2.7.5 Selenium

Selenium has a role in antibody production by up regulating the expression of T-cell response which is a key to providing beta cells for antibody synthesis (Field et al., 2002). Increasing dietary selenium intake could assist in rejuvenating the aging immune system

and treating inflammatory conditions (McKenzie, Rafferty, and Beckett., 1998). However interventions addressing these are not available.

Selenium deficiency is not a global issue and this may explain why there are limited studies investigating the relationship between selenium and immunity (Dhur, Galan, and Hercberg, 1990). There have been some trials which have investigated selenium's relationship to infections (Beck, 1997; Ravaglia et al., 2000). Animal studies in mice with lung infections fed a selenium deficient diet had increased inflammation to their lungs and the severity of the infections was prolonged compared to mice fed a selenium sufficient diet (Beck, 1997).

Ravaglia et al., (2000) carried out a randomised control trial on relatively healthy community living people aged over 90 years who were deficient in both zinc and selenium. They reported deficiencies in zinc and selenium were related to decreased NK marker activity, associated with decrease immunity (Ravaglia et al., 2000). When the immune system is not fully functioning the risk to infections is increased. There is insufficient data, particularly in human subjects, to be able to establish an estimate of optimal selenium dietary intake or an optimal plasma selenium concentration for protection against viral infection (Beck and Levander, 2000; Field et al., 2002).

Selenium is predominantly found in soils and foods that are grown in selenium-rich soils containing high amounts of selenium. For most countries selenium deficiency is not an issue however in New Zealand, soils are lacking in selenium resulting in the population having inadequate intakes. The NNS208/9 reports that the older population over 71 years are reported as having of selenium intakes below the recommended EAR (Ministry of Health., 2010). The consequences of low intakes are unknown.

2.7.6 Iron

It is well documented that iron deficiency is association with reduced immunity and increased susceptibility to infections (Field et al., 2002). Iron has a role in innate immunity to assist with cell proliferation and regulating T-lymphocytes, macrophages and natural killer cells (Field et al., 2002; Scrimshaw and San-Giovanni., 1997).

An investigation of immunity indicators; T cell proliferation, lymphocyte subsets and phagocytosis of women over 60 years, compared women with iron deficiency to participants with sufficient iron (Ahluwalia et al., 2004). There was no difference in lymphocytes noted between the groups but T cell proliferation and phagocytosis were significantly lower in the iron deficient women which puts them at risk of impaired immunity and at greater risk of bacterial infections (Ahluwalia et al., 2004).

The studies indicate that an inadequate intake of vitamins and minerals may result in decreased immunity which predisposes to infections (Maggini et al., 2007). Therefore older adults with low intakes of energy, protein, vitamin A, vitamin C, vitamin E, zinc, iron and selenium may be predisposed to higher risk of infection.

2.8 Summary

The older Māori population is growing at a faster rate than non-Māori and in the near future there will be an increase in Māori living into their advanced years (75+). Given the reports on the health status of Māori those years may not be spent in good health.

Māori have higher rates of chronic diseases, experience higher health loss, have greater health inequity and poor access to health care compared to non-Māori. Māori are more likely to be socioeconomically deprived and reside in areas of low rates of employment and levels of education. All of these factors contribute to poorer health outcomes.

Kai is a significant aspect of cultural practises. The gathering, preparation and sharing of food is an integral part of who Māori are and where Māori have come from. The pre-European settler diet would have met current recommendations but contemporary lifestyles and diets are adversely influenced by social and environmental factors. These have resulted in some diets being high in total energy, fats- predominantly saturated fats, and inadequate in some essential vitamins and minerals.

Historically food was plentiful and Māori gathered from the land and waterways to keep them in good health. Today food security is a national issue amongst Māori and one of the contributing factors to poor health conditions. The connection between diet and infection is a key area to consider. A greater understanding may lead to strategies to reduce the incidence of infections and assist in lowering the rates of hospitalisations due

to infections. Māori have high rates of hospitalisation compared to non-Māori. People in advanced age have high rates of hospitalisation due respiratory, gastro-enteric and skin-related infections.

There is a wealth of research that has been done to investigate how specific nutrients are related immunity mechanisms and the effect that sub-optimal intakes may have on the body's defence mechanisms to infections. Therefore this study will aim to investigate the nutritional intake of older Māori and examine the differences in those who have been hospitalised from infection compared to those who have not. This may help to identify any dietary related inadequacies and develop food related strategies that are culturally appropriate for older Māori may be able to address ant dietary related patterns and help reduce hospitalisations due to infections.

3. Aims and objectives

Aim

Investigate the energy and nutrients that may influence hospitalisation from infection for Māori aged 80-90 years in New Zealand

Objectives

- To examine the energy intake, macronutrients (protein, carbohydrate and fats) and micronutrient intake, (vitamin A, vitamin C, vitamin E, iron, zinc, calcium and selenium) in the diets of Māori aged 80-90 years.
- To investigate the differences in energy intake, macronutrient (protein, carbohydrate and fat) and micronutrient intake between Māori who have been hospitalised from infection versus those who have not been hospitalised from infection.

4. Methods

4.1 Te Puāwaitanga o Nga Tapuwae Kia Ora -LiLACS NZ

Te Puāwaitanga o Nga Tapuwae Kia Ora Tonu also referred to as Life and Living in Advanced Age (LiLACS NZ) study is a longitudinal cohort study of the advanced age population. The LiLACS study was established by the University of Auckland, New Zealand, to look at predictors of successful advanced aging among Māori and non-Māori in New Zealand. This study took place in the Bay of Plenty and Lakes district, involving a relatively large advanced age population. The LiLACs study investigated two cohorts, non- Māori aged 85+ and the Māori cohort aged 80-90 years at study inception.

Recruitment and enrolment was carried out by three Primary Health Organisations and four Māori rūnaga (gathering). Eligibility of participants was verified by the; New Zealand general roll and Māori electoral roll, primary health care databases from public health organisations (PHOs) and general practice databases (Haymen., 2012).

Data was collected on dietary intake and hospital admissions. This study will use the data collected to investigate the nutrient intakes of the Māori participants and look into any differences between those that had been hospitalised due to infections with those who had not been hospitalised due to infection.

Ethical approval for the Te Puāwaitanga o Nga Tapuwae Kia Ora Tonu, LiLACs NZ study was approved by the Northern X Regional Ethics Committee of New Zealand in December 2009 (Hayman et al., 2012).

This thesis is a sub- section of the LiLACS study which aims to identify nutrient factors which influence hospitalisations due to infection in the Māori cohort aged 80-90 years. The data used in this study was collected over a two year period from 2010-2012. This study will aim to examine total energy intake, macronutrient and, micronutrient intake in diets of Māori 80 to 90 years old. It will also examine if there is any difference in nutrient intake between participants that have been hospitalised to those who have not been hospitalised from infection.

4.2 Participants and recruitment

Participants are from the Māori cohort of the LiLAC NZ study. From this cohort 421 participants identified as Māori. Ethnicity was ascertained by self–identification. To meet age eligibility the participant's date of birth was required to be between 1 January 1920 and 31 December 1930. Of the 421 Māori participants 200 gave consent for medical information regarding hospital admissions to be used in this study.

4.3 Collection process of data

Information was collected at two stages over a two year period. The first collection was gathered from 2010-2011 (Wave 1) and the second over 2011-2012 (Wave 2).

Wave 1

Interviews were conducted by trained interviewers at the participant's home or at a site chosen by the participant. The data collected in Wave 1 is the baseline data. The following information was gathered from each participant-

- General information- gender, date of birth
- Occupation
- Education
- Medical history- past history of diabetes, chronic lung disease, cardiovascular disease, asthma, smoker
- Living situation (who do you live with)
- General health, health- related quality of life (SF-12)
- Dentures
- NZ deprivation index
- Weight, Body mass index
- Hospital admissions from infections

Wave 2

A second set of data was collected as a 12- month follow-up. The following information was gathered from each participant –

- Support needs- cleaning, shopping, meals, personal care
- Financial- cost of living, food security
- Physical health (SF-12)
- Mental health (SF-12)
- Weight , body mass index
- Hospitalisation from infections
- Nutrition assessment - Two 24-hour multiple pass recall (MPR)

Some of the questionnaires were incomplete therefore rates of participation vary for certain questions through results' section. A brief questionnaire (which included age, gender, living arrangement, functional status and main cause of disability) is offered to participant who finds the main questionnaire too burdensome.

4.3.1 Categories selected from LiLAC NZ questionnaire

Participants of the LiLAC study were interviewed face to face using a standardised questionnaire in paper from in wave one (2010). From the questionnaire the information obtained for this study and the justifications are reported in Table 4.1. Not all of the question items were completed by the participants and for this reason there are differing participant numbers to certain question items.

Table 4.1. Questionnaire categories selected from LiLAC NZ.

Section of questionnaire	Question	Justification for question choice
AA3	Who do you live with most of the time	Social interaction with meals and dietary intake
AA3a	If not living alone how many people are you living with	Social interaction with meals and dietary intake
AG5	What was your main lifetime occupation	Occupation can influence health status
BA1	In general how would you say your health is	Perception of one's health can influence medical treatment
CA4	Do you currently take any nutritional supplements	Influence their micronutrient results separate to diet intake
CA5	Do you take any natural or herbal products or traditional medicines	As above
CA6	Do you take any rongoa Maori medicines	As above
CC1	Do you smoke or have you ever smoked cigarettes	Smoking is associated to lower immunity and increased health risks
CC2	Have you ever smoked pipe or cigars regularly	As above
DA1	Do you wear dentures	May have difficulties with maceration of foods
IB2	Generally how satisfied are you with the warmth of your house in winter	Cold/ damp housing has been proven to increase risk of infections
KA6	Thinking of your money situation right now what would you say	Financial concerns can limit food options and medical assistance
KB1	In the past 12 months have you gone without fresh fruit and vegetables to help keep costs down	Restricting these foods affects micro and macro nutrient intake
KB5	In the past 12 months have you postponed or put off visits to the doctor to keep cost down	Delay in medical attention of infections can increase the severity of the infection
KB6	In the past 12 months have you not picked up a prescription to help keep costs down	Delay in medical treatment can exacerbate the severity of the infection

4.3.2 Demographic Information

Demographic included information regarding age, gender, ethnicity and current marital status. Education was based on highest achievement level using an adapted version of 2006 New Zealand Census questions. New Zealand deprivation (NZDep) Index is a scale of socioeconomic deprivation areas. The scale ranges from 1-10 with 1 indicating living in a least deprived area and 10 being in a most deprived area (Salmond et al., 2007).

Occupations were reported based on nine different job classifications then assigned to one of three categories:

1. Professionals: Legislators, administrators, managers, professionals, agriculture and fishery workers.
2. Tech and Trades: Technicians, trade workers and associated professionals.
3. Clerks, Sales, Factory and Other: Clerks, service and sales workers, plant and machine operators and assemblers, elementary occupations.

Occupation was the main lifetime occupation of the participant or their spouse, whichever was in the highest category.

4.3.3 Health Measures

Questions pertaining to diabetes, asthma, chronic lung disease and smoking were self - reported from a list of standard diagnoses. Cardiovascular disease was coded using items from the Cardiovascular Health Study.

Self- rated physical and mental health related quality of life (QOL) was self-reported then assessed using the Medical Outcomes Short Study Form Health Survey (SF-12). This form asked questions relating to physical function, body pain, general health, vitality and social function, emotional and mental health. Score range from 0-100 with a higher score indicating better physical and mental function (Jenkinson et al., 1997).

Functional status was assessed using the Nottingham Extended Activates of Daily Living (NEADL) scale. This assessment measured the participant's ability to complete kitchen, domestic, and leisure activities. The final score is scaled from 1-22 with 22 being the highest score (Lincoln and Gladman, 1992).

4.3.4 Anthropometric measures

Weight and height measurements were taken according to the protocol advised by the National Nutrition Survey of New Zealand 1997 (Quigley and Watts, 1997).

4.4 Hospital data

Hospitalisation data was attained from medical records using participants' individual National Health Index (NHI) number. The NHI numbers were put into the New Zealand Health Information Services database to match hospital admissions from infection and hospital admission frequency. A total of 36 participants were identified as being hospitalised due to infections.

4.4.1 Hospital admissions

Admission dates for hospitalisation due to infections started from the date the participants were first interviewed at wave 1 (baseline) and the cut-off date was 12 months after wave 2 information was recorded. This gave information on types of infections and frequency of admissions to hospital over a two year period.

Sample size was too small (22 participants) to investigate the participants that had been hospitalised after collection of the 24 hour MPR. Logically, it would have been more appropriate to examine dietary intake and participants that were admitted to hospital from infections after the 24hour MPR. However, future or subsequent hospitalisation is dependent on previous hospitalisation. With a larger sample size and longer follow-up, this relationship could have been controlled using a regression model. Since this thesis is limited with 12- month follow-up, it has combined hospitalisation from baseline and post 24 hour MPR. Dietary intake of older adults is relatively stable when living arrangements are stable (Satia-About et al., 2002). In LiLACS NZ, less than 1% of the participants were residing in rest homes or private hospitals at baseline and only a few were in transition from community living to a rest home or private hospital at 12 months follow-up. Thus, we can assume that dietary intakes of the participants in this study are relatively stable 12 months before and after the 24 hour MPR.

4.4.2 Classifications of infections on hospital admission

Infections investigated were chosen due to their high prevalence amongst the Māori population and were infections that had been identified in the discharge statistics collected from the Ministry of Health (Baker et al., 2010; Ministry of Health, 2013). The classification of infections used an established international classification of diseases (ICD) index.

Infections identified were;

- Pertussis
- Meningitis
- Invasive streptococcal and staphylococcal infections
- Eye infections
- Ear infections
- Rheumatic fever
- Acute glomerulonephritis
- Upper and lower respiratory tract infections
- Skin infections
- Infections of bone, joint and connective tissue
- Late effects of these infections

4.5. Infection codes

The World Health Organisation use ICD codes as a diagnostic classification standard for all clinical and research purposes and they are used by more than 100 countries worldwide (World Health Organisation., 2013). Hospital admissions from infections were matched to the International Classification of diseases and related health problems 10^{th} revision codes (ICD-10 codes). Each category was then grouped according to type of infection and a number was allocated so it could be transferred into the statistical analysis program SPSS 20. Table 4.2 gives the infection type as identified by its matching ICD-10 code and the corresponding code obtained from each of the participants medical information obtained from the LILAC NZ study. Not all of the infections that were initially investigated had hospital admissions from the participants.

Table 4.2: Participants infection types paired to ICD-10 codes.

Infection type	ICD-10 codes for infection	Participant infections codes
1. Gastroenteric		
Rotavirus enteritis, viral enteritis	A080, A083	A080, A083
Viral intestinal infection, unspecified	A084	A084
Nausea and vomiting	R11	R11
2. Other Enteric Infections		None identified in this category
3. Late effects of enteric infections		
Malignant neoplasm of stomach	C16, D002	C162,C165
Peptic ulcer	K25-K28	K250,K255, K259, K269
4. Close contact infection with respiratory transmission		None identified in this category
5. Bacterial meningitis and septicemia		None identified in this category
6. Respiratory viruses		None identified in this category
7. Upper respiratory tract infection		
Acute pharyngitis	J028, J029	J029
Acute laryngitis and tracheitis	J04	J040
Acute upper respiratory infections of multiple and unspecified sites	J06	J069
8. Lower respiratory tract infection		
Influenza	J10, J11	J111
Pneumonia organism, unspecified	J18	J189
Unspecified acute lower respiratory infection	J22	J22
Infective exacerbation of COPD	J440	J440
Abscess of lung and mediastinum, pyothorax	J85, J86	J869
9. Post-streptococcal diseases		None identified in this category
10. Late effects of respiratory infections		
Chronic rheumatic heart disease	I05-I09	I080
Bronchiectasis	J47	J47
Close-contact skin infections		
11. Bacterial skin infections		
Cutaneous abscess, furuncle and carbuncle	L02	L024
Cellulitis	L03	L0301,L0310, -11, L39, L308-9
Scabies	B86	B86
Open wound with infection	T8902	T8902
12. Invasive staphylococcal infections		
Staphylococcal septicaemia	A411- 412	A411
Staphylococcal infection, unspecified	A490	A490
13. Other skin infections		None identified in this category
14. Other bacterial infections		
	A491	A491
15. Other viral infections		None identified in this category
16. Other and mixed infections from human contact		
Conjunctivitis	H100-105, H108, H110	H109
17. Late effects of other close-contact infectious diseases		None identified in this category

4.6. Dietary Assessment - Two 24 hour Multi pass dietary recall

Māori participants completed two 24 hour multiple pass recalls (MPR) on two separate days to obtain detailed dietary information. The 24 hour MPR protocol is suitable for use

in the general and oldest old population and was the tool that was used and validated as part of the Newcastle 85+ study (Adamson et al., 2009). This protocol uses a number of 'passes' through the previous day's food intake:

Pass 1: Quick list of foods eaten. The participant is asked to recall the previous day and what they had done and all the food and drinks they had consumed. After an initial prompt is given for common items omitted from the recall, the recalled intake is recorded without interruption from the interviewer.

Pass 2. Detailed description of foods. More details and the time and occasion for the food and drinks are recorded. Participants are encouraged to recall events during the day that might trigger memories of consumption. Any further intakes recalled are recorded. Portion sizes for each item consumed are assessed with the aid of a photographic food atlas. Prompts about additions prior to consumption, cooking method, fats used in preparation are used and recipes are recorded.

Pass 3: Review. To ensure the participant is confident that all items have been recorded the information is reviewed and a final check is made. Recipes were coded and analysed by a dietitian.

Nutrient intakes were calculated matching the food and beverage to the New Zealand composition database (FOODfiles). The content of FOODfiles has been added into an adapted database based on the Newcastle dietary data entry system. Foods have been added to the photographic atlas to include foods that are common to New Zealand such as pipi, mutton bird, rhubarb, kumara.

4.6.1 Nutrients investigated

Nutrients were selected based chosen macronutrients and micronutrients relationship to either causing or preventing infections investigated in this study. This information was presented in the literature review of this paper. Nutrient information on each participant was extracted from the LiLACS database with regards to the following nutrients.

Energy and macronutrients

- Energy- total (kcal) per day
- Protein- total; calculated from total nitrogen (kcal) per day
- Protein- calculated from total nitrogen % of Energy, total
- Carbohydrate- available (kcal) per day
- Carbohydrate, available % of Energy, total metabolisable
- Fat- total % of Energy, total metabolisable
- Monounsaturated fatty acids total- g/day
- Polyunsaturated fatty acids total- g/day
- Saturated fatty acids total- g/day
- Fibre- dietary fibre, (Prosky) g/day

Micronutrients and Minerals

- Vitamin A- total Vitamin A, equivalents ug/day
- Vitamin B12 mg/day
- Vitamin B6 mg/day
- Vitamin C mg/day
- Vitamin E, alpha-tocopherol equivalents mg/day
- Iron mg/day
- Magnesium mg/day
- Selenium ug/day
- Calcium mg/day
- Zinc mg/day

The Australia New Zealand Reference Values were used to compare the median intakes of protein g/kg, vitamins and minerals from the nutrients listed above. The estimated average requirement (EAR) for adults 70years and over gives a standardised measure of daily nutrient intake that is estimated to meet the requirements of half the healthy individuals 70 years and older by gender. Vitamin E is the only nutrient that used adequate intake (AI) for adults 70 years and over as there no established EAR for vitamin E (Ministry of Health., 2006). Protein was reported as g/kg and g/day. Contribution to energy from carbohydrate, protein and fat was measured using the same AMDR as the Ministry of health used in the 1997 National Nutrition Survey.

Reference ranges for body mass index (BMI) were taken from the Ministry of Health guidelines in accordance with the World Health Organisation (Ministry of Health., 2010). The classification for each cut-off is shown in Table 4.3.

Table 4.3: World Health BMI classifications for Adults 18+.

Classification	BMI (kg/m^2)
Underweight	<18.5
Normal Range	18.5-24.99
Overweight	25-29.99
Obese	>30

4.7 Statistical analysis

The statistical programme SPSS 20 was used to analyse data retrieved from the LiLAC data base. FOODfiles was used to analyse macronutrient and micronutrients intakes. Specific nutrients were then transferred into an excel file.

Descriptive analyses were completed for study variables;

- Demographics- participants, gender,
- Lifestyle characteristics- marital status, living situation, education, occupation,
- Health conditions- smoker, diabetes, asthma, chronic lung disease, CVD, self-rated health
- Daily activities- quality of life
- Dentures
- Support services- meals, shopping, home help cleaning, personal care
- Deprivation index
- Financial security
- Infection types
- BMI classifications

Chi square was used to obtain frequency and percentage and percentages were calculated by columns to enable information to be compared between groups (men and women / hospitalised and not hospitalised).

Continuous data was tested for normal distribution using Kolmogrov- Smirnov test and histograms. Normally distributed data was reported as mean and standard deviation (SD). Non- normally distributed data was reported as median and interquartile range (IQR). Mann-Whitney test or Levenes parametric T-Tests were performed to ascertain differences between groups (men and women / hospitalised and not hospitalised) of continuous data. Fishers exact test was used on data that was categorical. To interpret if there was difference between groups *p*-value of <0.05 was considered as significant.

Variables associated with hospital admission (dependent variable) at p<0.20 at univariate analyses were included in the multiple logistic regression model controlling for age, gender, NZ Deprivation index, diabetes and CVD. A *p* value of <0.05 was considered as statistically significant.

In constructing the logistic regression model, a decision was made to combine hospital admissions from baseline and 12 months post 24-hour MPR. It was acknowledged that dietary intake influence future hospitalisation (Forster et al., 2012) and in older adults, future or subsequent hospitalisation is dependent on previous hospitalisation.

5. Results

In this study there was 200 participants, of which 36 (18%) had been hospitalised due to infection. Of those hospitalised due to infections 23% were men and 14% were women.

5.1 Demographic, lifestyle and health characteristics

5.1.1 Demographics

Age and gender of the participants are shown in Table 5.1of total participants 42% were men with a mean age of 83 years and 58% were women with a mean age of 83 years.

Table 5.1: Participant's age and gender

	Total, n (column %)	**Hospital admission related to infection, (column %)**	
	n=200	**Yes (n=36)**	**No (n=164)**
Participants			
Men	85 (42)	20 (56)	65 (40)
Women	115 (58)	16 (44)	99 (60)
Age mean ± SD			
Men	83 ± 2.7	83 ± 2.9	83 ± 2.7
Woman	83 ± 2.6	83 ± 2.3	84 ± 2.4

5.1.2 Lifestyle characteristics

The lifestyle characteristics of the participants are shown in Table 5.2. Over half (60 %) of the participants lived with partners / family or others. There was a significant difference the between hospitalised and not hospitalised participants in regards to living with other people (p=0.04). The socio-demographics of the participants show that 96% of the participants obtained up to or below a secondary school education. Less than 10% obtained a tertiary qualification. There was no significant difference in education between participants that had been hospitalised and not hospitalised (p= 0.84).

Over 50% of the occupations were clerks, service and sale workers, and plant and machinery operators or elementary occupations. The minority of the participants had occupations of technicians and associate professionals or trade workers.

Table 5.2: Lifestyle status of participants

	Total, n (column %)	**Hospital admission related to infection, n (column %)**		***p*- value**
		Yes	**No**	
Marital status n(%)	**n=198**	**n=36**	**n=162**	**0.45**
Never married	4 (2)	0	4 (2)	
Married/ partnered	69 (35)	9 (25))	60 (37)	
Widow/er	115 (58)	25 (69)	90 (56)	
Separated/ divorced	10 (5)	2 (5)	8 (5)	
Living situation n(%)	**n=172**	**n=33**	**n=139**	**0.04**
Alone	69 (40)	13 (40)	56 (40)	
With partner/spouse/child	67 (39)	9 (27)	58 (42)	
With child/ others	36 (21)	11 (33)	25 (18)	
Education n(%)	**n=200**	**n= 36**	**n= 164**	**0.84**
Primary /none	60 (38)	11 (30)	49 (31)	
Secondary/ no qualification	115 (58)	22 (61)	93 (58)	
Trade/occupation	7 (4)	1 (3)	6 (4)	
Tertiary	16 (8)	2 (6)	14 (7)	
Occupation n(%)	**n=200**	**n=36**	**n=164**	**0.06**
Professionals [1]	51 (26)	13 (36)	38 (23)	
Techs and trades	25 (12)	4 (11)	21 (13)	
Clerks, factory and other	124 (62)	19 (53)	105 (64)	

[1]Professionals: Legislators, administrators, mangers, professionals, agriculture and fisheries workers.
[2] Techs and trades: Technicians, associate professionals, trade workers.
[3] Clerks, sales factory and other: Clerks, service and sales workers, plant and machine operators and assemblers, elementary occupations.

5.2 Health characteristics

The health conditions of the participants are shown in Table 5. 3. A greater proportion of those who had been admitted to hospital were past smokers compared to those who had not been hospitalised. However those who had not been admitted to hospital had a higher percent of current smokers to those who had been hospitalised (12% vs 8%). Many of those hospitalised suffered from health issues. There was a statistical significance in smoking status (p= 0.013), diabetes (p= 0.05) chronic lung disease (p>0.001) and CVD (p= 0.003) in participants that had been hospitalised compared to participants that had not been hospitalised.

There was a significant difference in how the hospitalised participants rated their health. A higher percentage (42%) of participants who had been hospitalised rated their health as excellent / very good compared to participants that had not been hospitalised (16%) (p= 0.04).

Table 5.3: Health conditions of participants hospitalised / not hospitalised

	Total, n (column %)	**Hospital admission related to infection n (column %)**		**p-value**
		Yes	**No**	
Smoker	**n=198**	**n=36**	**n=162**	**0.01**
Never	87 (44)	9 (25)	78 (48)	
Current	22 (11)	3 (8)	19 (12)	
Past	89 (45)	24 (67)	65 (40)	
Diabetes	**n=181**	**n= 33**	**n=148**	**0.05**
Yes	43 (23)	13 (39)	30 (20)	
No	137 (76)	20 (61)	117 (79)	
Don't know	1 (1)	0	1 (1)	
Asthma	**n=181**	**n=32**	**n=149**	**0.09**
Yes	33 (18)	10 (31)	23 (15)	
No	146 (81)	22 (69)	124 (83)	
Don't know	2 (1)	0	2 (1)	
Chronic lung disease	**n=181**	**n= 32**	**n= 149**	**>0.001**
Yes	45 (25)	17 (53)	28 (19)	
No	136 (75)	15 (47)	121 (81)	
CVD[1]	**n=200**	**n=36**	**n=164**	**0.003**
Yes	137 (69)	32 (89)	105 (64)	
No	63 (31)	4 (11)	59 (36)	
Self-rated health	**n=198**	**n= 36**	**n= 162**	**0.02**
Excellent / Very good	42 (21)	15 (42)	27 (16)	
Good	74 (37)	11 (31)	63 (39)	
Fair / Poor	82 (41)	10 (27)	72 (45)	

[1]CVD – Cardiovascular disease

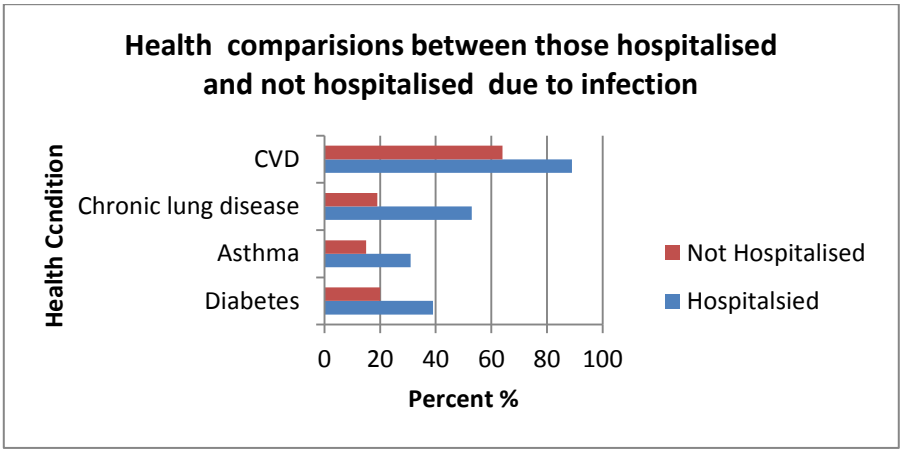


Figure 5.1 - Health conditions of participants hospitalised versus not hospitalised

Participants who had been hospitalised for infections had a higher percentage of CVD 89% vs 64%) chronic lung disease (53% vs 19%), asthma (31% vs 15%) and diabetes (39% vs 20%) to participants that had not been hospitalised (p >0.05) shown in Figure 5.1.

5.3 Function and quality of Life

Self-reported daily activities and quality of life status are shown in Table 5.4. Results indicate most participants are satisfied (50%) or very satisfied (44%) with their lives. Very few participants were dissatisfied (2%) with their life.

There was a significant difference between participants that had been hospitalised compared to those that had not been hospitalised for physical function (activities of daily living). The NEADL score was higher in the group that was not hospitalised to those who had been hospitalised (p= 0.02). Physical health related quality of life was also higher in those who had not been hospitalised to those who have been hospitalised (p=0.001). There was no difference in the mental health related quality of living (p>0.05).

No difference was shown in the participants that had been hospitalised to those not hospitalised with their quality of life.

Table 5.4:- Daily activates, Quality of Life of participants hospitalised versus not hospitalised

	Total, n (column %)	Hospital admission related to infection, n (column %)		*P*-value
		Yes	No	
	n=171	**n=33**	**n=138**	
Daily Activities	Median (IQR)	Median (IQR)	Median (IQR)	
NEADL Score[1]	18 (4)	15 (6)	18 (4)	0.02
SF-12 Physical health [2]	45.6 (16.5)	36.8 (20.7)	46.9 (14.10)	0.001
SF-12 Mental health [3]	54.7 (11.4)	55.8 (16.6)	54.6 (11.0)	0.77
Self-rated QOL, n (column %)				0.18
Dissatisfied	4 (2)	2 (6)	2 (1)	
Neither satisfied/unsatisfied	7 (4)	1 (3)	6 (4)	
Satisfied	85 (50)	19 (58)	66 (48)	
Very satisfied	76 (44)	11 (33)	65 (47)	

[1]Normal everyday activities of daily life
[2] Physical health related quality of life
[3]Mental health related quality of life

5.4 Dentures

The participants that have dentures are reported in Table 5.5. Over half of the population had full mouth dentures (51%). No difference was shown in the percentage of those who had been hospitalised from infection compared to those who had not been hospitalised from infection.

Table 5.5 Participants Dentition

Areas of Dentition	Total, n (column %)	Hospital admission related to infection, n (column %)	
	n=152	**Yes n=29**	**No n=123**
Not at all	31 (20)	6 (21)	25 (20)
Upper only	36 (24)	7 (24)	29 (24)
Lower only	1 (1)	0	1 (1)
Full mouth	77 (51)	16 (55)	61 (52)
Partial	7 (5)	0	7 (6)

5.5 Access to support services

The participants that did or did not access different support services are shown in Table 5.6. The majority of participants did not receive any assistance with meals, shopping or personal care this was also shown when the groups were divided into hospitalised and not hospitalised. A higher percentage of all participants (72%) received home help cleaning which was more common amongst those who had been hospitalised (89%) compared to those who hadn't (66%).

Table 5.6: -Participants who accessed support services by hospitalised versus not hospitalised

Service	**Total , n (column %)**	**Hospital admission related to infection, n (column %)**		***p*-value**
		Yes	**No**	
Meals	**n=76**	**n= 19**	**n= 57**	**1.0**
No	71 (93)	18 (95)	53 (93)	
Yes	5 (6)	1(5)	4 (7)	
Shopping	**n=75**	**n=19**	**n=56**	**1.0**
No	67 (89)	17 (89)	50 (89)	
Yes	8 (12)	2 (11)	6 (11)	
Home help cleaning	**n=78**	**n=19**	**n=59**	**0.77**
No	22 (28)	2 (11)	20 (34)	
Yes	56 (72)	17 (89)	39 (66)	
Personal care	**n=78**	**n=20**	**n=58**	**0.26**
No	68 (87)	16(80)	52 (90)	
Yes	10 (13)	4 (20)	6 (10)	

5.6 Deprivation Index

None of the participants reside in an area where the deprivation index is rated decile 1, (the least deprived). The majority of the participants reside in areas of the lower end of the scale, deciles 6 to8. These results indicate that most of the participants residue in areas of higher deprivation there was no difference between participants that a had been hospitalised and not hospitalised (p= 0.53)

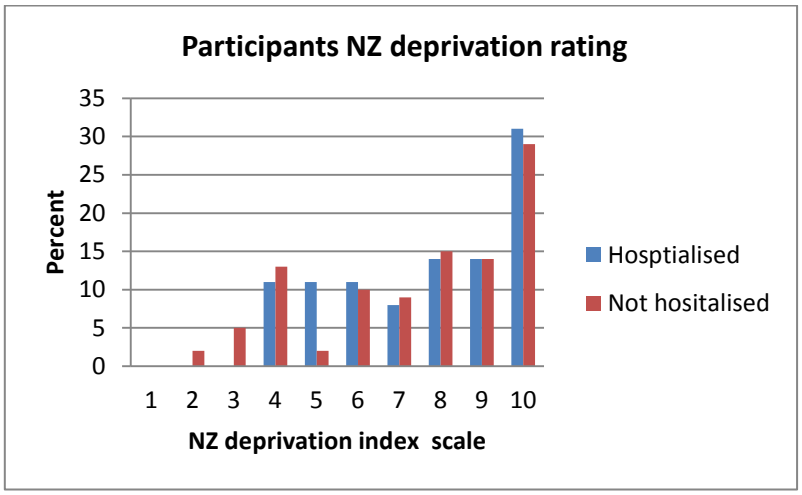


Figure 5.2: NZ deprivation index of participants hospitalised versus not hospitalised

Of those participants that had been hospitalised none reside in areas of higher than a deprivation index of 4 Figure 5.2.

5.7 Financial Security

Participant's financial situation is shown in Table 5.7. Over three quarters (76%) of participants reported having a comfortable financial situation. This figure was similar between participants who had been hospitalised (82%) to participants that had been not hospitalised (74%).

The majority of participants (96%) were able to afford to visit the doctor. Only 1% had postponed going to the doctor due to cost. Similar figures were shown between participants that have been hospitalised (93%) and those who had not been hospitalised (97%) with not having to postpone a doctor's visit due to cost.

The majority of participants (95%) did not go without fruit and vegetables because of the cost.

Table 5.7: Participants Self-reported financial security, by hospitalised versus not hospitalised

	Total, n (column %)	Hospital admission related to infection, n (column %)		*P-value*
		Yes	No	
Financial	**n= 172**	**n=33**	**n=139**	**0.22**
Can't make ends meet	2 (1)	1 (3)	1 (1)	
Enough to get along	40 (23)	5 (15)	35 (25)	
Comfortable	130 (76)	27 (82)	103 (74)	
Postponed doctor due to cost	**n=153**	**n=29**	**n=124**	**0.36**
Not at all	147 (96)	27 (93)	120 (97)	
Sometimes	5 (3)	2 (7)	3 (2)	
A lot	1 (1)	0	1 (1)	
Gone without fruit and veg due to cost	**n= 153**	**n= 29**	**n= 124**	**1.00**
Not at all	145 (95)	28 (97)	117 (94)	
Sometimes	6 (4)	1 (3)	5 (4)	
A lot	2 (1)	0	2 (2)	

5.8 Weight and Body mass index

Participant's weights and body mass index (BMI) for each 12 month period is shown in Table 5.8. There was a significant weight loss for men and woman over a 12 month period. The median BMI for both men and women were similar for both year one and two (29 kg/m^2 and 28 kg/m^2) respectively.

Table 5.8:- Participants anthropometric measures by gender.

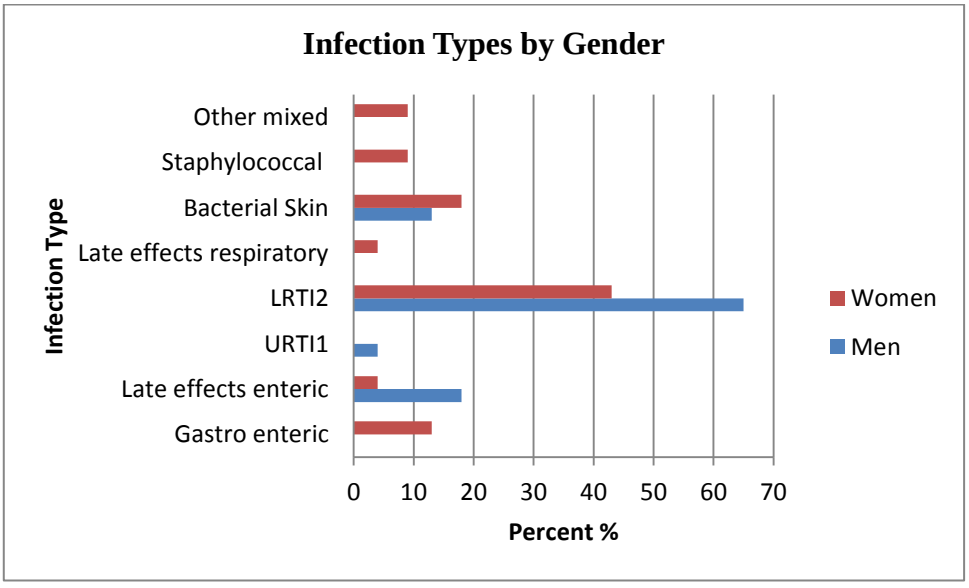
	Total Med (IQR)	Men Median (IQR)	Women Median (IQR)
Weight year 1 (kg)	n=152 73.6 (21)	**n= 51 80.7 (17)**	**n=84 68.5 (19)**
Weight year 2 (kg)	n=172 71.1 (16)	**n= 51 77.8 (15)**	**n=84 66.1 (20)**
BMI year 1 (kg/m^2)	n= 151 29 (5.6)	n=61 28.6 (6)	n=90 28.4 (7.1)
BMI year 2 (kg/$m^{2)}$	n= 169 28 (5.6)	n= 51 28.3(5.2)	n=84 28.6 (7.81)

5.9 Infection by type and number of hospital admissions.

Frequency of hospitalisations over 24 months by types of infections are shown in Table 5.9.The main causes of admission to hospital for infections were from lower respiratory tract infections (54%) followed by bacterial skin infections (15%).

Table 5.9 Frequency of hospital admissions by infection type.

Infection type	Frequency of admissions N (%)
Gastro enteric	3 (8)
Late effects enteric	5 (11)
Upper respiratory tract infections (URTI)	1 (3)
Lower respiratory tract infections (LRTI)	25 (54)
Late effects respiratory	1 (3)
Bacterial Skin	7 (15)
Staphylococcal	2 (4)
Other mixed	2 (4)



[1]Upper respiratory Infection [2]Lower Respiratory Infection

Figure 5.3: Hospitalisation from infections by gender

Women had higher percentages of admission to hospital for staphylococcal, Gastro enteric, late effects of respiratory, bacterial skin and other mixed infections then males. Men had higher percentages of hospital admissions for URTI, LRTI, late effects of enteric infections compared to females although none of these were statistically significant ($p > 0.05$) Figure 5.3.

5.10 Nutrient intake from 24 hour MPR

5.10.1 Energy and Macronutrients

Participant's intakes for macronutrients taken from the 2x 24 hour MPR are shown on Table 5.10. Men had higher energy and overall macronutrient intakes to women. Men and woman had very similar intakes of fibre and poly-unsaturated fats but men consumed more saturated and mono-unsaturated fat intakes.

Table 5.10:- Median energy and macronutrient intake by gender

	Men n=85	**Women n=115**
	median(IQR)	**median(IQR)**
Energy (kcal/day)	1809 (774)	1426 (568)
Carbohydrate (g/day)	184.7 (76.6)	153.4 (62.5)
Protein (g/day)	72.5 (39.0)	54.8 (25.8)
Protein (g/kg/day)	0.93	0.83
Fat (g/day)	75.8 (54.0)	59.3 (30.0)
Monounsaturated(g/day)	27.8 (17.3)	19.8 (11.8)
Polyunsaturated (g/day)	8.8 (8.5)	8.2 (5.4)
Saturated (g/day)	30.3 (27.4)	23.1(16.6)
Fibre (g/day)	20 (11.2)	18 (8.5)

5.10.2 Micronutrients

Participant's vitamin and mineral intake from the 2x 24 hour MPR is shown in Table 5.11. Men had higher intakes of all of the vitamins and minerals to that of women.

Table 5.11:- Median vitamin and mineral intake by gender

	Men n= 85	**Women n= 115**
	Median (IQR)	**Median (IQR)**
Vitamin A (ug/day)	1034 (858)	793 (642)
Vitamin B_6 (mg/day)	1.3 (0.8)	1.2 (0.9)
Vitamin B_{12} (mg/day)	3.3 (2.7)	2.7 (2.1)
Vitamin C (mg/day)	80.0 (88.3)	70.0 (80.6)
Vitamin E (mg/day)	7.7 (5.8)	6.4 (4.2)
Iron (mg/d)	11.4 (6.2)	8.8 (5.0)
Selenium (ug/d)	42.3 (31)	31.7 (35)
Zinc (mg/d)	9.0 (5.8)	7.0 (3.6)
Calcium (mg/d)	586 (430)	556 (303)

5.10.3 Macronutrient percentage from energy

Participants percentage of energy from carbohydrates, protein and fat from the 24 hour MPR is shown in Table 5.12. All participants have similar contributing percentages.

Table 5.12: -Median % energy for macronutrient intake from the 24 hour MPR by gender

	Men n=85	**Women n=115**
	Median (IQR)	**Median (IQR)**
Carbohydrate (%)	43 (11.2)	44 (10.3)
Protein (%)	16 (4.6)	16 (6.1)
Fat (%)	**38 (10.9)**	**38 (10.8)**

5.10.4 Comparison to Nutrition Reference Values

Nutrition reference values (NRV) for men and women compared the median intakes from the 24 hour MPR of the participants are shown in Table 5.13. Men and women's micronutrient intake were higher than the NRVs in vitamin A (65%, 58%), vitamin C (166%, 138%), vitamin B_{12} (65%, 36%) and iron (87%, 75%) respectively. However they were lower than the NRV's for vitamin B_6 (8%, 7%), calcium (47%, 50%) and selenium (29%, 37%) respectively. Only men had intakes lower than the NRVs for zinc (28%) and vitamin E (24%).

Table 5.13:- Median intakes of protein and minerals compared to Nutrient Reference Values

	NRV male >70years	**Male LiLAC study participants**	***% difference***	**NRV female >70 years**	**Female LiLAC study participants**	***% difference***
Protein g/kg	0.86	0.93	↑8	0.75	0.83	↑10
Protein g/day	65	72.5	↑11	46	54.8	↑19
Vitamin A (ug)	625	1034	↑65	500	793	↑58
Vitamin C (mg)	30	80	↑166	30	71.6	↑138
Vitamin E (mg)	**10**	**7.65**	↓24	**7**	6.37	↓9
Vitamin B_6 (mg)	1.4	1.3	↓7	1.3	1.20	↓8
Vitamin B_{12} (mg)	2	3.3	↑65	2	2.73	↑36
Calcium (mg)	**1100**	**586**	**↓47**	**1100**	**556**	**↓50**
Iron (mg)	6	11.23	↑87	5	8.76	↑75
Zinc (mg)	**12**	**8.95**	**↓18**	6.5	7.3	↑12
Selenium (ug)	**60**	**42.3**	**↓29**	**50**	**31.7**	**↓37**

5.11 Nutrient intakes by hospitalised versus not hospitalised participants

5.11.1 Energy and Macronutrients

Macronutrients intakes for participant who have been hospitalised and not hospitalised from the 24 hour MPR are shown in Table 5.14. The hospitalised group had a higher consumption of total fat (78.3g vs 64g) (p=0.05) and monounsaturated fat (28g vs 21g) (p=0.04) to those non-hospitalised.

Table 5.14:- Median intake of energy and macronutrient for participants who were hospitalised versus not hospitalised

	Hospitalised n= 36	**Not hospitalised n=165**	***P*-Value**
	Median (IQR)	**Median (IQR)**	
Energy kcal/d	1803.8 (905)	1494.5 (609)	0.14
Carbohydrate (g/d)	182.3 (90.3)	165.6 (71.7)	0.17
Protein g/d	62.7 (40.8)	62.9 (31.6)	0.92
Fat g/d	**78.3 (50.1)**	**64 (36.8)**	**0.05**
Monounsaturated	**28.1 (18.5)**	**21.2 (13.6)**	**0.04**
Polyunsaturated	10.1 (9.9)	8.2 (5.7)	0.08
Saturated	31.2 (29.6)	24.6 (18.8)	0.1
Fibre g/d	18.5 (10.9)	18.5 (9.5)	0.8

5.11.2 Micronutrients

The micronutrients intakes for participant who have been hospitalised and not hospitalised from the 24 hour MPR are shown in Table 5.15. There was no significant difference between the groups for vitamin and mineral intakes.

Table 5.15: Median vitamin and mineral intake for participants who were hospitalised versus not hospitalised

	Hospitalised n=36	**Not hospitalised n =165**	***P*-value**
	median (IQR)	**median (IQR)**	
Vitamin A(ug/day)	840 (995)	859 (664)	0.1
Vitamin B_6 (mg/day)	1.1 (.079)	1.2 (0.80)	0.2
Vitamin B_{12} (mg/day)	2.9 (2.6)	3.0 (2.4)	0.7
Vitamin C (mg/day)	73.1 (80.7)	71.6 (81.7)	0.67
Vitamin E (mg/day)	7.6 (6.2)	6.7 (4.4)	0.55
Iron (mg/d)	9.5 (7.54)	9.82 (5.82)	0.28
Selenium (ug/d)	40.26 (49)	36.8 (32)	0.65
Zinc (mg/d)	7.94 (4.28)	7.66 (4.49)	0.41
Calcium (mg/d)	536 (350)	569 (329)	0.29

5.11.3 Macronutrient percentage from energy

The percentage of energy from carbohydrates, protein and fats for participants who have been hospitalised and not hospitalised from the 24 hour MPR are shown in Table 5.16. There was a significant difference between the groups for percentage of energy from protein, those who were not hospitalised had higher proportion of energy from protein (17%) than those who were not hospitalised (15%) (p=0.009). There was no significant difference (p>0.05) between the groups for contribution to energy from carbohydrate or fat.

Table 5.16: -Median % energy for macronutrient intake for participants who were hospitalised versus not hospitalised

	Hospitalised n=36	**Not Hospitalised n=165**	***P*-value**
	Median (IQR)	**Median (IQR)**	
Carbohydrate	45 (11.9)	43(10.3)	0.92
Protein	**15 (3.8)**	**17 (5.5)**	**0.009**
Fat	40 (9.7)	38 (10.4)	0.18

5.11.4 Nutrient intakes for hospitalised versus not hospitalised by gender.

The energy and macronutrients intakes for participant who have been hospitalised and not hospitalised by gender from the 24 hour MPR are shown in Table 5.17. There was no significant difference (p>0.05) for men in energy or macronutrient intake. There was a significant difference in the protein intake and monounsaturated fat in women (p=0.001 and p=0.05) respectively. The mean energy, carbohydrate and protein intake is higher from the group that had been hospitalized.

Table 5.17:- Mean energy and macronutrient intake of men and women that had been hospitalised versus not hospitalised

	Men			**Women**		
	Hospitalised n=20	**Not hospitalised n=65**	***P*-value**	**Hospitalised n= 16**	**Not hospitalised n= 99**	***P*-value**
	Mean ±SD	**Mean ±SD**		**Mean ±SD**	**Mean ±SD**	
Energy kcal/day)	1830±679	1861± 615	0.80	1608±508	1405±392	0.072
Carbohydrate (g/day)	197.6±77.9	194.5±59.4	0.32	169.5± 53.9	154.6±43.8	0.11
Protein (g/day)	**70.2±28.2**	**79.9±28.4**	**0.81**	**63.2±30.1**	**58.3±19.3**	**0.001*** **
Protein (g/kg/d)	0.80	1.01		0.85	0.84	
Fat (g/day)	82.4±35.3	82.1±40.6	0.47	73.4±30.1	60.3±58.0	0.12
Monounsaturated (g/d)	**28.8±11.7**	**27.6±13.8**	**0.43**	**25.4±12.9**	**20.8±9.8**	**0.05** **
Polyunsaturated (g/d)	11.5±4.8	10.6±6.6	0.21	9.96±6.0	8.66±5.1	0.14
Saturated (g/d)	34.5±20.7	35.6±20.4	0.63	30.8±12.8	24.7±12.6	0.48
Fibre (g//d)	17.9±6.1	21.0±8.6	0.11	20.5±7.8	18.7±6.5	0.26

5.11.5 Micronutrients

Micronutrient intakes for participant who have been hospitalised and not hospitalised by gender from the 2x 24 hour MPR are shown on Table 5.18 . There was a significant difference with the intake of zinc between men who had been hospitalised and those who had not been hospitalised. There were no significant differences found between the women's group.

Table 5.18:- Vitamin and mineral intake of men and women that had been hospitalised versus not hospitalised

	Men			**Women**		
	Hospitalised n=20	**Not Hospitalised n=65**	***P*-value**	**Hospitalised n=16**	**Not Hospitalised n=99**	***P*-value**
	Mean ±SD	**Mean ±SD**		**Median(IQR)**	**Median(IQR)**	
Vitamin A (ug/day)	1060±885	1222±1425	0.95	849 (776)	790 (624)	0.65
Vitamin B_6 (mg/day)	1.39±0.78	1.51±0.76	0.96	0.94 (0.59)	1.2 (0.90)	0.13
Vitamin B_{12} (mg/day)	4.23±4.0	6.10±11.4	0.43	3.22 (3.67)	2.7 (2.16)	0.16
Vitamin C (mg/day)	80.9±68.1	100±82.2	0.47	88.8 (95.03)	67.3 (78.7)	0.63
Vitamin E (mg/day)	8.3±3.5	8.01±4.15	0.64	5.63 (5.87)	6.4 (4.09)	0.59
	Med (IQR)	**Med(IQR)**		**Med(IQR)**	**Med(IQR)**	
Iron (mg/d)	9.9 (7.5)	11.9 (5.7)	0.13	8.0 (7.2)	8.8 (4.5)	0.18
Selenium (ug/d)	49.7 (46)	41.8 (28)	0.22	26.7 (35)	32.6 (34)	0.96
Zinc (mg/d)	**7.1 (2.7)**	**9.7 (5.9)**	**0.007**	8.1 (5.4)	6.9 (3.6)	0.09
Calcium (mg/d)	455 (321)	597 (455)	0.32	633 (367)	542 (272)	0.58

5.11.6 Macronutrient percentage to energy

The percentage of energy from carbohydrates, protein and fat for participants who have been hospitalised and not hospitalised by gender from the 2x 24 hour MPR are shown in Table 5.19.There was a significant difference in the percentage of energy from protein between men who had been hospitalized (15.3%) versus men who have not been hospitalised (17.5%) p=0.02). There was no significant difference in the percentage of energy from carbohydrate, protein and fat between women.

Table 5.19: - Median % of contribution to energy intake of men and women that had been hospitalised versus not hospitalised

	Men			**Women**		
	Hospitalised n=20	**Not hospitalised n=65**	***P* value**	**Hospitalised n=16**	**Not hospitalised n=99**	***P* value**
	Mean ±SD	**Mean ±SD**		**Mean ±SD**	**Mean ±SD**	
Carbohydrate	44.1±8.4	43.0±8.0	0.66	43.2±10.5	44.5±8.15	0.15
Protein	**15.3±2.5**	**17.5± 4**	**0.02***	15.2±3.6	17.0±4.7	0.45
Fat	39.7±8.1	38.2±8.2	0.75	40.3±8.3	37.8±7.9	0.88

5.12 Weight and Body mass index for hospitalised versus not hospitalised

Participant's weights and BMI for participants who have been hospitalised and not hospitalised by gender from the 2x 24 hour MPR are shown in Table 5.20. There is no significant difference between men that have been hospitalised and men that have not been hospitalised for weight or BMI. The mean weight is higher amongst the men that have been hospitalised (89kg and 87kg) compared to those that have not been hospitalised (80kg and79kg). The mean weight for year and one and year two is higher for the group of women that had been hospitalised compared to those who have not but there was no significant difference. BMI is higher in the group that had been hospitalised compared to those who had not in year one for both genders.

Table 5.20:- Participants weight and BMI by gender for participants hospitalised versus not hospitalised.

	Men			**Women**		
	Hospitalised Mean ±SD	**Not Hospitalised Mean ±SD**	***P*-value**	**Hospitalised Mean ±SD**	**Not Hospitalised Mean ±SD**	***P*-value**
Weight year 1 (kg)	(n= 15) 89.1±17.7	(n= 46) 80.1±13.3	0.08	(n=15) 76.3 ±16	(n=76) 70.9±15.7	0.71
Weight year 2 (kg)	(n= 14) 87.4±24.2	(n= 55) 79± 12.7	0.52	(n=15) 74.6±17.6	(n=88) 68.7±15.8	0.60
BMI year 1n(kg/m^2)	(n= 15) 31.1±5.4	(n= 46) 29.1±4.7	0.31	(n=14) 31.9±6.4	(n=76) 28.7±5.7	0.58
BMI year 2 (kg/m^2)	(n= 13) 28.3±8	(n=55) 28.5±4.5	0.11	(n=14) 30.8±7.3	(n= 87) 28.3±5.9	0.59

5.12.1 Body Mass Index (BMI) classifications

Participants BMI for year 2 by classification, comparing gender that have been hospitalised or not hospitalised is shown in Table 5.21. Of all participants 71% are above the normal BMI range. Both men and women that have been hospitalised from infection were more likely to be overweight or obese compared to the others that had not been hospitalised.

Table 5.21: Participants BMI classifications by gender and hospitalised versus not hospitalised.

		Men			Women		
	Total n= 161	**Hospitalised n= 14**	**Not Hospitalised n= 55**	**p-value**	**Hospitalised n= 12**	**Not Hospitalised n= 82**	**p-value**
				0.14			**0.42**
Under weight	2 (1)	1 (7)	0		0	1 (1)	
Normal	46 (29)	1 (7)	13 (18.8)		3 (25)	29 (35)	
Overweight	61 (39)	7 (50)	29 (42)		2 (17)	25 (30)	
Obese	52 (32)	5 (38)	13 (18.8)		7 (58)	27 (33)	

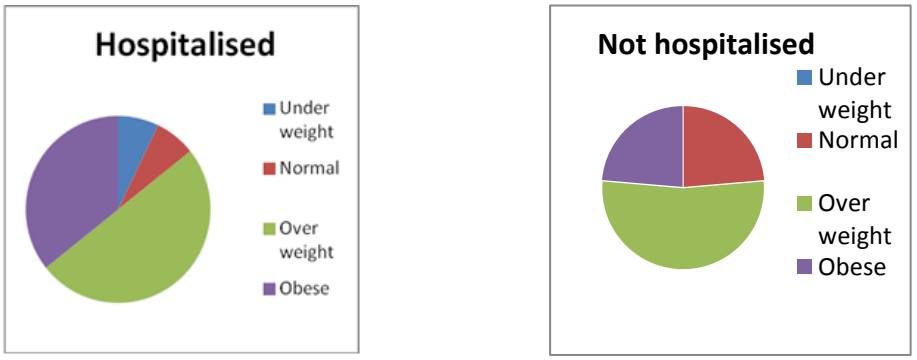


Figure 5.4. BMI classification for men hospitalised verses not hospitalised

There are no underweight men in the group that has not been hospitalised. The hospitalised participants have a larger proportion of obese participants compared to the participants that have not been hospitalised Figure 5.4.

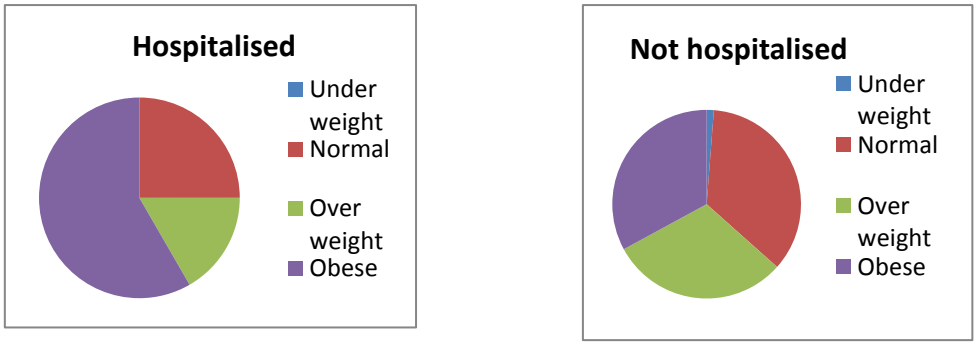


Figure 5.5. BMI classification for men hospitalised verses not hospitalised

There are no underweight women in the group that had been hospitalised. The hospitalised group have a larger proportion of obese participants compared to the participants that have not been hospitalised Figure 5.5.

5.13 Logistic Regression Model

The univariate analyses, nutrient that were associated with hospital admission ($p<0.20$) were percentage of energy from carbohydrate and fat intake. As well as monounsaturated fat (g/d), polyunsaturated fat (g/d), Vitamin B_6 (ug/day), vitamin B_{12} (ug/day), iron (mg/d) and zinc (mg/d). Multiple logistic regression models were constructed to examine the independent association between these nutrients and hospitalisation due to infection controlling for age, gender, NZ deprivation index, diabetes and CVD.

In the unadjusted and adjusted model lower energy adjusted protein intake was associated with hospitalisation due to infection (OR (95% CI) 1.17 (1.03-1.32), (p=0.015)). There was no association between hospitalisation and percent from energy from carbohydrate, fat and key micronutrient intake (Table 5.22).

Table 5.22: Logistic regression model adjusted for age, gender, NZ Deprivation Index, diabetes, CVD.

Independent variables	**Unadjusted OR (95% CI), p value**	**Adjusted OR (95% CI), p value**
% carbohydrate	1.00 (0.96 –1.05), p=0.889	0.99 (0.95 – 1.04), p=0.805
% Protein	**1.13 (1.02 –1.25), p=0.017**	**1.17 (1.03 – 1.32), p=0.015**
% Fat	0.97 (0.93–1.01), p=0.182	0.98 (0.93–1.03), p=0.389
Monounsaturated, g/d	0.97 (0.95-1.00), p=0.095	0.98 (0.95 - 1.01), p= 0.208
Polyunsaturated, g/d	0.96 (0.91-1.02), p= 0.204	0.95 (0.89- 1.01), p=0.132
Vitamin B_6 (mg/day)	1.36 (0.77-2.39), p= 0.283	1.14 (0.59-2.17), p= 0.698
Vitamin B_{12} (mg/day)	0.99 (0.95-1.03), p= 0.657	0.99 (0.95-1.04), p=0.847
Iron (mg/d)	1.05 (0.97-1.14), p= 0.237	1.06 (0.96-1.16), p=0.225
Zinc (mg/d)	1.04 (0.94- 1.16), p=0.410	1.07 (0.95-1.19), p=0.260

[±] Adjusted for age, gender, NZ Deprivation index, diabetes and CVD

6. Discussion

The aim of this study was to examine the nutrient intakes of Māori (80-90 years) and identify differences in energy and nutrient intake between participants who had been hospitalised from infection and to those who had not.

The median age of the participants was 82 (±4) years for men and 83 (±5) years for women which exceeds the average life expectancy for Māori (70 years for men and 75 years for women) (Poole 2012). Nearly two thirds of the participants lived with family members, their partner or others in the household. To live with whānau (family members) in the same household is common within the Māori culture especially in older age (Jensen et al., 2006). This may be an important indicator of successful aging. McMunn and Breeze (2006) suggest that older people with good social support networks and having close contact with family are more likely to maintain better health status.

In general the education level of the participants was low with 12% having obtained trade or tertiary qualifications, in spite of this lack of higher education most participants (94%), were satisfied with their quality of life. In contrast an to a survey which examined satisfaction with quality of life in New Zealanders only half (50%) of people over 75 years reported being satisfied with their quality of life (Statistics New Zealand., 2012). The definition of quality of life for Māori may differ to that of non-Māori. For Māori quality of life is not only associated with health and financial wellbeing, but also cultural and spiritual wellbeing, whānau wellbeing, and maintaining Māori values and traditions (Te Puni Korkiri., 2007). The high quality of life score may have also contributed to their successful aging. The participants of this study also had a high level of function with a mean ADL score of 18 out of a maximum of 22. A few participants received assistance with meals (6%) and shopping (12%) but the majority lived independently without any services to support them with daily living.

Over half of the participants in this study reported having full mouth dentures. Poor dentition can affect a person's ability to eat especially foods such as meat, fruit and vegetables (Perera and Ekanayake., 2012). These foods may be avoided and impact on t nutritional status. The scope of this study did not investigate whether or not the dentures fitted properly or if they avoided foods due to the condition of their dentures.

More than half (58%) of older Māori in this study rated their health as good or excellent; similar to the population of New Zealanders over 65 years, 60% of whom rated their health as good or excellent (Statistics New Zealand, 2007). Nearly all (99%) of the participants in this study could afford medical care and fruit and vegetables, and felt financially "comfortable" or "had enough to get along". A previous study identified 6.2% of the New Zealand population over 65 years were food insecure compared to 28% of Māori overall (Carter et al., 2010). This is similar to results of the 2002 National Children's Nutrition Survey where 26% of Māori families reported food insecurities (Parnell W., Scragg, Wilson N, Schaaf, & Fitzgerald, 2003). For older Māori in this study food insecurity was not evident.

Participants in this study were more likely to live in areas of high deprivation. Over half (58%) lived in decile areas ratings between 8-10 and a third (30%) lived in the most deprived area (decile 10). There were no participants who lived in the least deprived area (decile1). Tatau Kura Tangata report (Ministry of Health., 2011) also showed higher proportions of older Māori (26%) aged 50 years and over lived in areas of high deprivation (decile10) with only 3% living in the least deprived areas (decile 1). People living in most deprived areas may be more likely to have an unmet need in health care, be unable to access health care and to have a higher rate of chronic disease such as diabetes and cardiovascular disease (Ministry of Health., 2012a). However among the older Māori in this study participants reported a satisfactory quality of life, they were financially comfortable and they had fair health.

The majority of the participants in this study were free from chronic health conditions. Less than one quarter (23%) had self-reported diabetes, a quarter (25%) had chronic lung disease and 18% suffered from asthma. The most prevalent condition amongst the participants was cardiovascular disease (CVD) (69%). The Tatau Kura Tanagata report (Ministry of Health, 2011) showed 25% of Māori over the age of 65 years with self-reported diabetes. This is nearly two times higher compared to overall New Zealanders aged 75 years and with 13% with self- reported diabetes (Ministry of Health., 2012a). Cardiovascular disease (CVD) is reported in the 2011/12 Health of New Zealand Adults in terms of indicators such as blood pressure, cholesterol and ischemic heart disease. From this report 54% of Māori aged 65 years and older were diagnosed with high blood

pressure and 38% with high cholesterol (Ministry Of Health, 2012b). These are conditions are contributing factors in CVD. The Health of New Zealand Adults 2011/12 survey reported indicators of CVD are relatively high amongst Māori aged 65 years and older. The current study doesn't investigate the indicators of CVD however mortality rate from CVD is three times higher for Māori than non-Māori (Bramley, Riddell, et al., 2004). Chronic health conditions amongst the Māori population are of concern. They contribute to co-morbidities and may impact nutritional status and affect hospitalisation rates.

The participants in this study tended to be overweight according to the cut-off points set by the World Health Organisation, with a median BMI of 28kg/m^2 for men and women (World Health Organization., 2006) . In the NNS 2008/09 the BMI for Māori men and women aged 51 years was 31kg/m^2 and 32kg/m^2 respectively. For men and women 71 years and older the NNS 2008/09 reported BMI (28kg/m^2) which was the same as the participants in this study (University of Otago and Ministry of Health, 2011). New evidence suggests the BMI cut-offs for older people may need to be increased as a higher BMI in older age is not associated with higher mortality (Janssen and Mark., 2007). The high BMI of the participants in this study may be protective.

In this study 18% of the participants were hospitalised from infections; slightly lower than the 22% reported in the Ministry of Health hospital admission rates for 2010/11 for Māori aged 75 years and older (Ministry Of Health., 2013b). The main types of infections reported in this study were from the lower respiratory tract, gastro-enteric and bacterial skin infections, similar to those reported in the Ministry of Health 2010/11 hospital discharge report.

Examination of the 24 hour MPR data showed the participants had energy and protein intake within the NHMRC recommendations for their age range (NHMRC., 2006). The median energy intakes for women and men were 1809 kcal/day, 1426 kcal/day respectively. This is similar to the energy intake of all New Zealanders over 71 years reported in the NNS 2008/9 (1887 kcal/day and 14331kcal/day of men and women respectively). However the NNS 2008/9 showed the median energy intake of Māori over 51 years was higher (2,118 kcal /day for men and 1,543 kcal/day for women) (Ministry

of Health, 2012a). As energy intake declines with older age due to a decrease in appetite and physical activity (Wakimoto and Block., 2001) these findings are to be expected.

The macronutrient distribution from carbohydrate, protein and fat was 43%, 16% and 38% of energy respectively, similar to results from the NNS 2008/9 survey where Māori over 51 years were (43%, 17% and 37%) respectively (University of Otago and Ministry of Health, 2011). However the macronutrient distribution for those 71+ years in the NNS 2008/9 survey was (48%, 16%, 34%) respectively. Indicating that Māori appear to have a relatively higher percentage of energy from fat and lower percentage of energy from carbohydrates, compared to non-Māori (Ministry of Health, 2012a). Higher fat intakes for Māori have been reported over the past three national nutrition surveys compared to non-Māori with saturated fat being the highest contributor (Horwarth C, 1991; Russell et al., 1999; University of Otago and Ministry of Health, 2011). The NNS2008/9 reports patterns in older people which were established earlier in life are continued in later life (Ministry of Health., 2010). If younger Māori consume a high fat diet, with high saturated fats intakes it is likely that as they advance in age they will continue the same pattern.

The participants had adequate intakes of protein (0.93 g/kg/day and 0.83 g/kg/day for men and women respectively) and are above the estimated average requirement (EAR) of 0.86g/kg/day for men and 0.75g/ kg/day for women over 70 years (NHMRC., 2006). The participants in this study appear to have adequate protein intakes to assists in maintaining healthy bodily function (Tucker and Buranapin, 2001).

Men in this study showed median intakes of zinc, selenium, vitamin E and calcium below the EAR by 18%, 29%, 23% and 47% respectively (University of Otago and Ministry of Health, 2011). Actual median intakes for men were; zinc 9 mg/day, selenium 42 mg/day, vitamin E 7.7 mg/day calcium 586 mg/day. Similar to men over 71 years in the NNS 2008/9 ; zinc 10mg/day, selenium 40 mg/day, vitamin E 10mg/day and calcium 743mg/day. For Māori men over 51 years the NNS 2008/9 reported median intakes of zinc selenium and calcium which were also inadequate (University of Otago and Ministry of Health, 2011). Therefore this study adds to the body of evidence that older Māori men appear to have sub-optimal intakes of zinc and calcium. This may indicate

that older Māori men need to consume foods that are good sources of zinc and calcium such as meat and dairy products.

Women in this study had inadequate intakes of selenium 32mg/ day and calcium 556 mg /day below the EAR (selenium, 50mg/day and calcium 1100mg/day) (NHMRC., 2006). These micronutrients were also seen to be inadequate amongst women aged 71 years and older in the NNS2008/9; selenium (39mg /day) and calcium (676mg/day) yet in Māori women aged 51 years and older only calcium (676mg/ day) was inadequate, selenium (50mg/ day) was just within the recommendations (University of Otago and Ministry of Health, 2011). Foods that provide good sources of calcium such as need special attention in advanced age.

Other nutrients examined in this study such as vitamin B_6, vitamin B_{12}, vitamin C, vitamin A, and iron were within or above the acceptable ranges for men and women.

Participants who had been hospitalised were more like to have smoked (75% vs 52%) compared to those that had not been hospitalised. Those who had not been hospitalised also suffered from fewer health conditions (20% diabetes, 19% chronic lung disease and 64% CVD) compared to those who had been hospitalised (40% with diabetes, 53% chronic lung disease and CVD 89%). The increased incidence of comorbidity appears to have increased the likelihood of older people being hospitalised for infections.

In this study protein as a percentage of total energy intake in hospitalised participants (15%) was lower than those who had not been hospitalised (17%) (p0.05). For men and women the recommendation for protein as a percentage of total energy intakes is 15-25% (NHMRC., 2006). Hospitalised men reported lower median protein intake (70g) than those not hospitalised (80g). Conversely women who had been hospitalised had higher median protein intakes (63.2 g /day) compared to those not hospitalised (58.3 g/day) (p=0.001). Further investigation into the contribution of protein food sources is warranted but was outside the scope of this study.

Median fat intakes (78g/day) were higher in the hospitalised participants compared to those non-hospitalised (64g/day) (p=0.05). Women who had been hospitalised had a higher median monounsaturated fat consumption (28 g/day) compared to those non –

hospitalised (21 g/day) (p=0.05). The median intakes of monounsaturated fat were comparable to those reported in women over 71 years in the NNS (24g/day). The NNS 2008/9 reported the main source of dietary monounsaturated fat was from butter and margarine (University of Otago and Ministry of Health, 2011). Food sources of fat were not explored in the current study.

Hospitalised women had a greater median energy intake (1608 kcal/day) compared to non-hospitalised women (1405 kcal/day) p=0.07. The NNS 2008/9 reported women over 71 years had a median energy intake of 1,431 kcal /day (University of Otago and Ministry of Health, 2011), similar to the energy intake of non- hospitalised women. Since women who had been hospitalised had higher total fat intakes (73g/day) compared to those non-hospitalised (60g/day), this may account for the higher total energy intake of the hospitalised women. However there was no difference in total energy and total fat intakes between men who were hospitalised and those who were not hospitalised.

A linear regression model showed that when age, gender, CVD, diabetes and deprivation were controlled for the contribution to energy from protein was lower in those hospitalised due to infection compared to those not hospitalised (15% vs 17%) p=0.05. This is an important finding. Protein is a crucial nutrient in the body's immune response to effectively protect against infection. Lowered protein intakes can result in impaired immunodeficiency and can prolong or extend time for healing (Forster et al., 2012; Mata et al., 1977).

It should be mentioned that the contribution to energy from protein for participants that had been hospitalised met the EAR for protein (15%-25%); although they were at the lowest end of the range. In this study participants that had not been hospitalised from infection had only a 2% higher contribution to energy from protein (17%-15%) which indicates that the participants that have been hospitalised are only consuming a small proportion less of protein compared to those not hospitalised.

The finding that contribution to energy from protein intake was significantly different between participants that had been hospitalised to those not hospitalised (p =0.05) may contribute to the current notation that protein requirements are too low to meet the needs of older people to maintain a healthy function (Tieland et al., 2012). It was not within

the scope of this study to investigate the protein food sources between hospitalised and non- hospitalised participants. Nutrient intake is one of the modifiable factors that could decrease the severity of infections (Scrimshaw and San-Giovanni., 1997). Resolving nutrient deficiencies can improve immune responses and reduce infection risk (Lesourd., 2006). This study shows that protein intake in particular may compromise the risk of infection. Further research is needed to elucidate this important finding.

Future studies may want to investigate which food sources contributed to the increase in protein whether and or not protein is from high biological source such as animal protein.

6.1 Limitations

A limitation of this study was that the chosen population was limited to Māori aged 80-90 years and the results can- not be applied to non-Māori of this age range. The participants are not representative of the Māori population as a whole and the information in this study cannot be used to make generalisations about Māori in advanced age. This study was conducted in a limited geographical area and the nutrient intakes of Māori in other regions of New Zealand may be different to those in this study.

This study had a relatively small sample size of participants with hospital admissions. The range of infections documented also excluded some infection types. The infections focused on in this study were more prevalent amongst Māori. A wider scope of infection types may have captured a larger sample size. A larger population size would be able to detect more significant differences between participants that had been hospitalised compared to those who had not been hospitalised. The option to limit infections to hospital admissions the accuracy of infection types but may have limited the prevalence of infection overall. Infection may have also been present during hospitalisation but not reported on admission.

Determining dietary intake from two 24 hour MPR has limitations with regards to the participants ability to recall information accurately. Although it has been used in other studies in those over 85 years there are some potential errors that may occur. The respondent may have an impaired memory which may affect the accuracy or the detail in which intake is reported and may lead to over or under reporting. Also the participant

may not be the person preparing the food and this may lead to inaccurate reporting of foods. There may be limitations in the participant's food knowledge also the ability to explain food preparation methods.

6.2 Strengths

This is a sub study of a large cohort study in which used a robust methodology and strict protocols were followed. There was an opportunity to access data that has been collected over two points in time 12 months apart with a vast range of variables to investigate. There are opportunities for future investigations leading on from this study.

7. Conclusion

The participants in this study were in relatively good health; the majority were satisfied with their quality of life and despite living in areas of higher deprivation, food insecurity was not evident. These may attribute to successful aging and may be indicative of the extended life expectancy the Māori participants have endured.

The participant's nutrient intakes were similar to the nutrient intakes of other New Zealanders aged 71 years and over. The study found that men and women had inadequate intakes of calcium and selenium and men had inadequate intakes of zinc.

Based on the WHO cut-off points the participants in this study were classed as overweight with a median BMI of 28kg/m^2 for both men and women. However men and women over 71 years in the NNS 2008/9 are also reported to have a mean BMI of 28kg/m^2.

Eighteen percent of participants were hospitalised from infections. The participants that had been hospitalised had a lower contribution to energy from protein intake compared to the participant's that had not been hospitalised. Protein intake is an important factor in nutritional health. Protein may protect older people from hospitalisation due to infection and strategies need to be developed to ensure older people are consuming high quality protein foods over the day.

7.1 Recommendations

Further studies are warranted to explore the different dietary contributors of protein between older people that had been hospitalised due to infection compared to those not hospitalised from infection.

Low intakes of zinc found in older Māori men were similar to findings reported in the National Nutrition Survey and may warrant further investigation.

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9. Appendix

i) **Ethics approval**
ii) **Participants consent form from wave II**
iii) **Dietary assessment – 24 hour multiple pass recall form**

Health and Disability Ethics Committees

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Northern X Regional Ethics Committee
Ministry of Health
3rd Floor, Unisys Building
650 Great South Road, Penrose
Private Bag 92 522
Wellesley Street, Auckland
Phone (09) 580 9105
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Please note postal address is : Northern X Regional Ethics Committee, C/o Ministry of Health, PB 92 522 Wellesley St Auckland

17 December 2009

Dr N Kerse
Dept of General Practice
University of Auckland
Private Bag 92019
Auckland 1142

Dear Ngaire

NTX/09/09/088	**Study title: Life and living in advanced age: the cohort study. Te Puawaitanga O Nga Tapuwae kia ora tonu: PIS/Cons V#4, 5/10/09**
Principal Investigator:	Dr Ngaire Kerse
Co-Investigators	Ms Karen Hayman, Dr Mere Kepa, Dr Lorna Dyall, Prof. Martin Connolly, A/Prof Tim Wilkinson, A/Prof Robert Scragg, Dr Carol Wham, Dr Valerie Wright St-Claire, Prof. Peter Davis, Ruth Teh, Dr Santosh Jatrana, Dr Sally Keeling, Dr Kathy Peri, Dr Janine Wiles
Localities:	University of Auckland, Bay of Plenty DHB, Lakes District Health Board

Thank you for your letter and Committee requirements, received 16 December 2009. The above study has been given ethical approval by the **Northern X Regional** Ethics Committee.

Approved Documents

- Participant Information Sheet/Consent Form: V. ISPA V#4 dated 5/10/09
- Participant Information Sheet/Consent Form: V. ISKM V#4 dated 5/10/09
- Participant Information Sheet/Consent Form: V. ISFW V#4 dated 5/10/09
- Participant Information Sheet/Consent Form: V. ISMR V#4 dated 5/10/09
- Questionnaires 4/11/09

Certification

The Committee is satisfied that this study is not being conducted principally for the benefit of the manufacturer or distributor of the medicine or item in respect of which the trial is being carried out.

Accreditation

The Committee involved in the approval of this study is accredited by the Health Research Council and is constituted and operates in accordance with the Operational Standard for Ethics Committees, April 2006.

Progress Reports

The study is approved until 31 October 2019 However, the Committee will review the approved application annually and notify the Principal Investigator if it withdraws approval. It is the Principal Investigator's responsibility to forward a progress report covering all sites prior to ethical review of the project on **17 December 2010**. The report form should be forwarded to you but if not received, it is available on http://www.ethicscommittees.health.govt.nz (forms – progress reports). Please note that failure to provide a progress report may result in the withdrawal of ethical approval.

Final Report

A final report is required at the end of the study. The report form is available on http://www.ethicscommittees.health.govt.nz (progress reports) and should be forwarded along with a

summary of the results. If the study will not be completed as advised, please forward a progress report and an application for extension of ethical approval one month before the above date.

Requirements for SAE Reporting
The Principal Investigator will inform the Committee as soon as possible of the following:

- Any related study in another country that has stopped due to serious or unexpected adverse events
- all serious adverse events occurring during the study NZ/worldwide which are considered related to the study

All SAE reports must be signed by the Principal Investigator and include a comment on whether he/she considers there are any ethical issues relating to this study continuing due to this adverse event. It is assumed by signing the report, the Principal Investigator has undertaken to ensure that all New Zealand investigators are made aware of the event.

Amendments
All amendments to the study must be advised to the Committee prior to their implementation, except in the case where immediate implementation is required for reasons of safety. In such cases the Committee must be notified as soon as possible of the change.

Please quote the above ethics committee reference number in all correspondence.

The Principal Investigator is responsible for advising any other study sites of approvals and all other correspondence with the Ethics Committee.

It should be noted that Ethics Committee approval does not imply any resource commitment or administrative facilitation by any healthcare provider within whose facility the research is to be carried out. Where applicable, authority for this must be obtained separately from the appropriate manager within the organisation.

We wish you well with your study.

Yours sincerely

Pat Chainey
Administrator
Northern X Regional Ethics Committee

CONSENT FORM (Wave II)

for Participants in the LILACS NZ study

Project title:

Life and Living in Advanced Age: A Cohort Study

Te Puāwaitanga o Ngā Tapuwae Kia ora Tonu

The LILAC study

Researcher Name:

Professor Ngaire Kerse, Dr Lorna Dyall

School of Population Health
Private Bag 92019, Auckland,
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	WHAKAWHITI KAI KORERO/ **REQUEST FOR INTERPRETER**		
Turi/**Deaf**	Kai te hiahia mo tetahi Tutohu Reo o Aotearoa, mehemea kai konai tetahi/ **I wish to have a New Zealand Sign Language Interpreter, if one available**	Ae/**Yes**	Kao/**No**
English	I wish to have an Interpreter.	Yes	No
Maori	E hiahia ana ahau ki tetahi kaiwhakamaori/kaiwhaka pakeha korero.	Ae	Kao
Samoan	Oute mana'o ia iai se fa'amatala upu.	Ioe	Leai
Tongan	Oku ou fiema'u ha fakatonulea.	Io	Ikai
Cook Island	Ka inangaro au i tetai tangata uri reo.	Ae	Kare
Niuean	Fia manako au ke fakaaoga e taha tagata fakahokohoko kupu.	E	Nakai

Kua riti ahau, a kau te marama nga korero i runga i tenei pepa 19th January 2011 **mo nga Koroheke kua tonu atu kia uru mai ki roto i enei uiuitanga Akoranga mo te noho ki te koroheketanga. /** I have read and I understand the Information Sheet 19th January 2011 for older people invited to participate in the interview study about living to advanced age.

I waitea au ki te korerorero mo tenei Akoranga maua me taku Kairangahau. I te whakahoki mai ana ki ahau./ I have had the opportunity to discuss this study with the Researcher. I am satisfied with the answers I have been given.

Kai te marama ki ahau i ahau e uru atu ana ki enei Akoranga naku tena, ana ka watea ahau kit e puta mai i enei Akoranga i te wa e hiahia ana ahua, ano kahore tenei e kati ana te huarahi mo etahi hauora awhina, i ko atu. / I understand that my taking part in this Study is voluntary (my choice) and that I may withdraw from the study at any time and this will in no way affect my continuing or future Health care.

Kai te marama ki ahau mehemea kai te hiahia au ki te kume mai i etahi wahi o aku korero mai i te Akoranga tae ki te wa./ I understand that I may withdraw any part of my information from the study up until (6 months from the interview).

Kai te marama ki ahua ko taku uru atu ki enei Akoranga ka nohotapu, kahore e kore re he aha atu ka mohio ko hau tera ka uru atu ki tahi tuhituhi i roto i tenei mahi Akoranga. / I understand that my participation in this Study is confidential and that no material that could identify me will be used in any reports on this Study. **Kai te marama ki ahau ko te whakawateatanga ki tenei whakataputanga, ka watea mehemea mo taku oranga me etahi atu. /** I am aware that the exception to confidentiality will be if the Interviewer has significant concerns about the safety of myself or others.
Kai te marama ki ahua ko te kai whakapataitai me etahi atu whakatau, ka mutu mehemea ka kitea ka pa mai ki ahua e mea raruraru. / I understand that the Interview or Assessment will be stopped if it should appear harmful to me.
Kai te marama ahau e whakaritenga ano mo enei Akoranga./ I understand the compensation provisions for this Study.
Kua whakaarotia ahau mo te tahi wa, mehemea ka uru atu ahau ki enei mahi./ I have had time to consider whether to take part.
Kai te mohio ahau ko wai taku e tata atu, mehemea e patai aku mo tenei Akoranga./ I know whom to contact if I have any questions about the Study.

Kai te tohu atu ahau ki taku whakaetanga mo enei e whai ake enei./ I indicate my approval (or otherwise) for the following:

Ki te uru atu ki enei patai whakarite. To participate in the full interview	Ae/**Yes** Kao/**No**
OR	
Kit e uru atu ki enei patai whakarite iti. To participate in a partial interview	Ae/**Yes** Kao/**No**
Kit e uru atu ki etahi atu e korerotia ana tinana To participate in a physical assessment including talking about food	Ae/**Yes** Kao/**No**
Ko te Rōpū Rangahau, ka korero atu ki toku Takuta mo etahi atu mate ka kitea./ That the Research Team will inform my GP of any unusual findings	Ae/**Yes** Kao/**No**
Kai te hiahia ahau kia homai ki ahau era kiteatanga./ I wish to receive a copy of the results.	Ae/**Yes** Kao/**No**

I understand that there may be a significant delay between data collection and the publication of the study results.

Toto me te tataritanga**/ Blood for analyses**

~~**Ka whakaeatu au ki te hoata oku Toto me te mahi Tataritanga./** I give~~ permission to take **a** sample of blood and to conduct analyses.

Ae/**Yes**
Kao/**No**

Kai te marama au akuni pea ka roa te wa, mai i wai tuku Toto ki te wa ka otu na whakatataritanga./ I understand that there may be a delay between the blood being taken and analyses being completed.

Ka te hiahia ahau kia whakahokia mai oku Toto kahore e tataritia./ I wish to receive back any blood not used in analyses.

Ae/**Yes**
Kao/**No**

Kai te marama ahau akuni pea ka rere ke te ahua, i muri o te tataritangatia./ I understand the Blood may look different as it has been processed.

Ae/**Yes**
Kao/**No**

~~Etahi atu Matauranga/~~**~~Further studies~~**

Ka whakaea ahau mo aku kitenga, ka whakaritea atu ki te Newcastle University Study. Ki te Koroheketanga me etahi atu akoranga kite whakapai atu whakamatautau ka tukua ma te tahi ano tono ki te Rōpū Mahi Whakatikatika ana e kore e taea kite kite ko wai ena, etahi atu mahi akoranga./ I give permission for my Results to be combined with the Newcastle Study on ageing and any other studies to improve the health of older people. Further studies would be guided by a separate application to an ethics committee and I would not be able to be identified individually in any further studies

Ae/**Yes**
Kao/**No**

Ko au I konei ka whakae au kia uru atu ki roto I te LILACS Mahi Akoranga Taumatatuarua.

/ I _____ hereby consent to participate in the LILAC study Wave II.

Tohu/**Signature**..... Tohu o Kai Awhina/
..... **Signature of**

witness……..…… Te ra/**Date**:

..... Ingoa/**Name of**

witness……..……

Kai Whakamarama/**Project explained by**

..... Tu nga/**Project role**

……..……

Tohu/**Signature**..... Te ra/**Date**
……..……

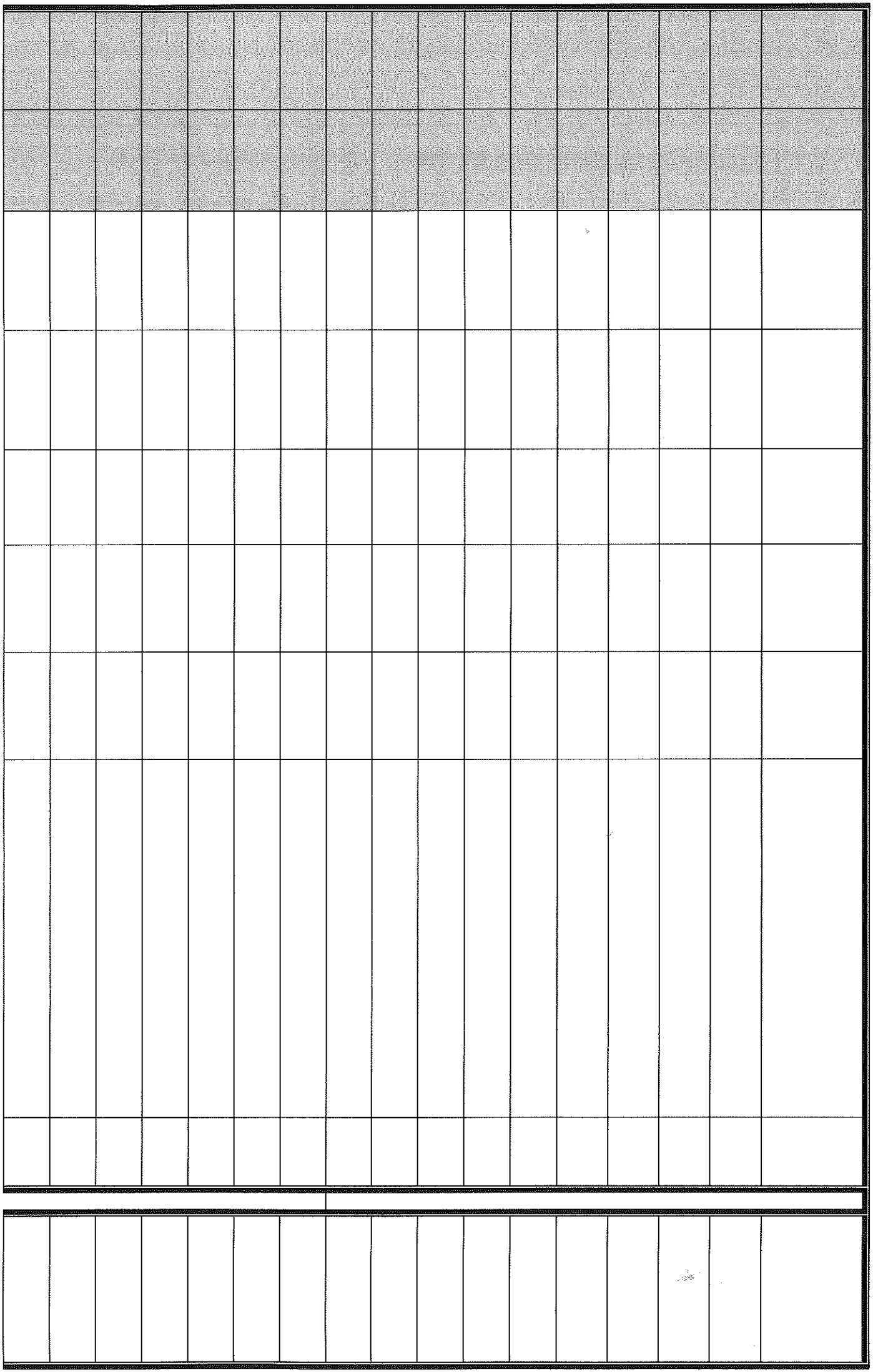
DIETARY ASSESSMENT: 24 HOUR MULTIPLE PASS RECALL

LILACS NZ

PARTICIPANT'S NAME	
PARTICIPANT'S ID NUMBER	
GENDER	
DATE OF BIRTH	
DAY OF WEEK RECALLED	
TODAY'S DATE	
STUDY NURSE NAME	
START TIME	

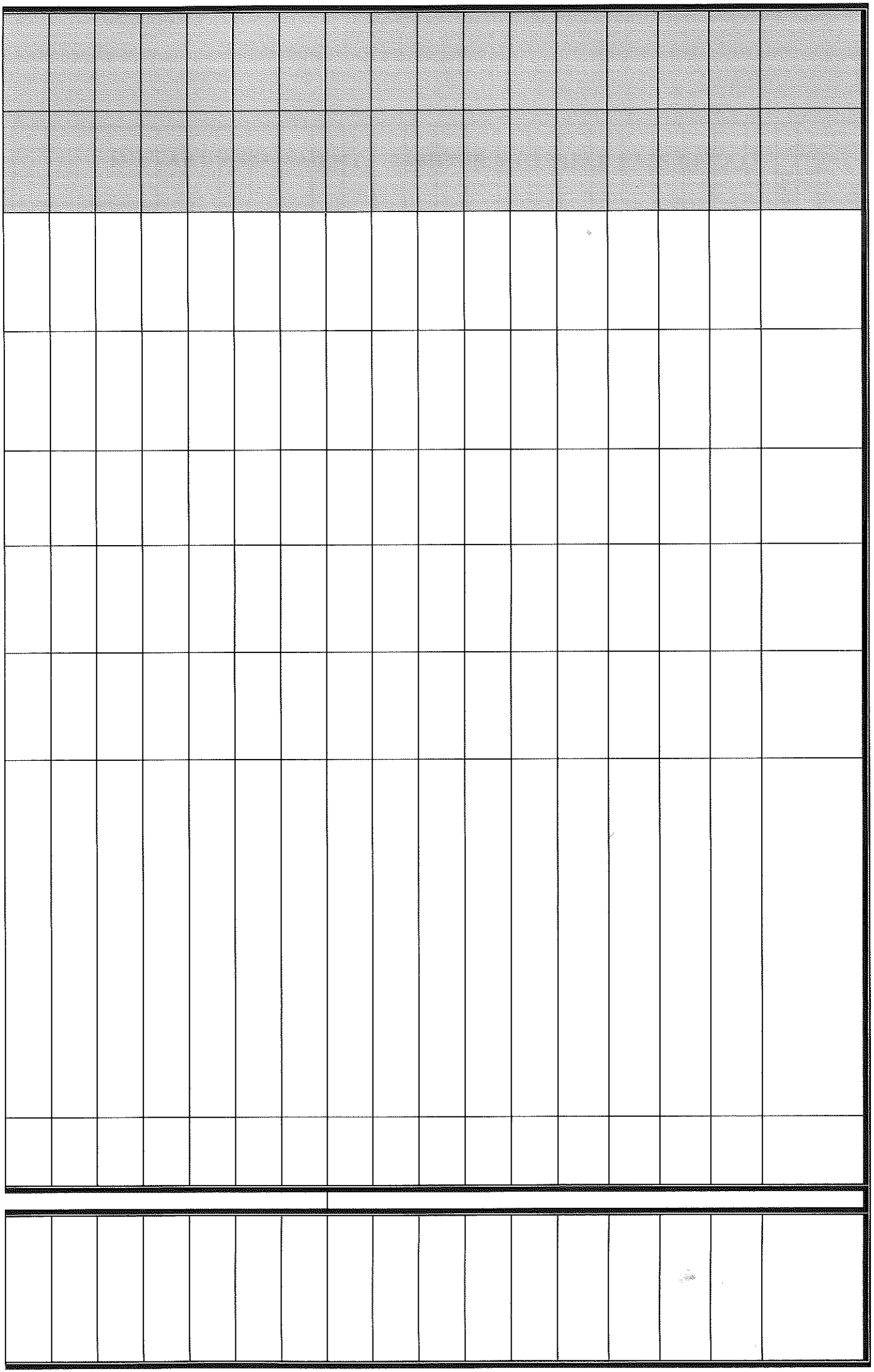
Quick List

Time (24 hr)	Description of food or drink (as much detail as possible)	Homemade / retail Homemade: H Retail: R Not Appl: NA If H: Prompt for recipes	Cooking method Oven : O Fried : F Grilled : G Boiled: B Steamed: S Not Appl: NA	Brand	Amount served Preface with W: Weight P: Photo code H: Household	Leftover Preface with W: Weight P: Photo code H: Household AA: Ate All	To be completed by nutritionist Food code	Weight



Quick List

Time (24 hr)	Description of food or drink (as much detail as possible)	Homemade / retail Homemade: H Retail: R Not Appl: NA If H: Prompt for recipes	Cooking method Oven : O Fried : F Grilled : G Boiled: B Steamed: S Not Appl: NA	Brand	Amount served Preface with W: Weight P: Photo code H: Household	Leftover Preface with W: Weight P: Photo code H: Household AA: Ate All	To be completed by nutritionist	
							Food code	Weight



RECIPE 1:
Name of home-made dish:_____

Ingredients	Amount
Cooking method	

RECIPE 2:
Name of home-made dish:_____

Ingredients	Amount
Cooking method	

RECIPE 3:
Name of home-made dish:_____

Ingredients	Amount
Cooking method	

RECIPE 4:
Name of home-made dish:_____

Ingredients	Amount
Cooking method	