A Pilot Nutrition Survey of the Adult Niuean Population in Niue.

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Gaylene Mitikulena Tasmania

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Abstract

A pilot nutrition survey was conducted on 50 randomly selected adult Niueans aged between 18 and 60 years, living in Niue. The survey consisted of three visits per person, each encompassing a 24-hour dietary recall, body measurements and questionnaires. The body measurements included weight, height, waist and hip circumference, elbow breadth and body-fat using Bioelectrical Impedance Analysis. Other measurements taken were of blood pressure and blood glucose.

By comparison, the Niuean population have a higher percentage energy contribution from fat and protein but a lower contribution from total carbohydrates than the NZ population. These differences in energy contributions may attribute to some extent to the prevalence of overweight and obesity in the Niuean population. Some nutrient intakes were inadequate and are of some concern particularly calcium, iron, and vitamin A. Forty-four percent and forty percent of the subjects had calcium and iron intakes below two-thirds of the RDI respectively.

Alcohol consumption was much more common among the men than the women. Based on the reported volumes consumed 83% of the men who drank alcohol, drank to intoxicating levels well above the legal limit, during a drinking session.

The average weight of the Niuean men was 92 kg; some 13 kg heavier than the average in 1987 and 23 kg heavier than the average in 1953. Likewise with the women whose average weight was 87 kg; 10 kg heavier than the average in 1987 and 25 kg heavier than the average in 1953.

The prevalence of obesity and overweight in the Niuean population studied is very high, in both the men and the women. The prevalence of obesity was observed to be 1 in 2 men, an increase of at least five times the rate it was 22 years ago. Prevalence of obesity among the women over the same period has also increased to be 2 in 3 women.

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List of Abbreviations

BAC	Blood Alcohol Concentration
BIA	Bioelectrical Impedance Analysis
BMI	Body Mass Index
CHO	Carbohydrates
CVD	Cardiovascular Disease
DAFF	Department of Agriculture, Forestry and Fisheries
DALY	Disability Adjusted Life Years
EPDSU	Economic Planning, Development and Statistics Unit
HDL	High Density Lipoprotein
IGT	Impaired Glucose Tolerance
LDL	Low Density Lipoprotein
LRNI	Lower Reference Nutrient Intake
UAC	Upper Arm Circumference
MUFA	Monounsaturated Fatty Acids
NZFCD	New Zealand Food Composition Database
NCD	Non-Communicable Diseases
OA	Osteoarthritis
PIFCD	Pacific Island Food Composition Database
PUFA	Polyunsaturated Fatty Acids
RDI	Recommended Dietary Intake
RNI	Reference Nutrient Intake
SFA	Saturated Fatty Acids
SPC	South Pacific Commission
SD	Standard Deviation
SEM	Standard Error of the Mean
WHO	World Health Organisation

1. Introduction

It has been 15 years since Niue's last national nutrition survey, which was carried out in 1987 by the formerly known South Pacific Commission (SPC) and the Government of Niue. The people of Niue have a very high incidence of obesity and the associated degenerative diseases: cardiovascular disease, diabetes and gout. This is principally due to the high intake of imported foods high in fats and refined sugars and the reduction in intake of locally produced foods.

Niue does not have sufficient resources to deal with these diseases, nor does it have a qualified resident nutritionist to advise on dietary matters. The more severe cases are referred to New Zealand for treatment. In addition to these referrals, the continued immigration of Niueans into New Zealand results in access to more food, more conveniences, reduced physical activity, and subsequently a further increase in the incidence of these diseases. The overall impact of which is evident in the increased burden to the New Zealand health care system due to cardiovascular problems and other life threatening illness.

The results obtained from this survey can be used immediately to develop nutrition interventions, and identify where health resources are needed most. It will also indicate whether dietary intake and lifestyle has changed with changing times and the impact this has on the well being of Niueans not only as individuals but also as a developing nation. It is to be hoped that this Pilot Survey will later be developed into a full-scale national survey as a PhD project.

2. Literature Review

2.1 Niue: The Land And Its People

2.1.1 Geography

Niue is located 480 km east of Tonga and about 580 km South-East of Samoa. It is a single uplifted coral island, considered one of the largest in the world. It has a land area of 260 km^2, spanning 19 km from north to south and 18 km from east to west. It takes the shape of two terraces, the lower being 27 metres above sea level and the upper plateau rising to 65 metres. There are 14 villages situated around the Island. Eight are on the western side and near the coast, whilst six are on the eastern side and further inland. The largest village is sub-divided into Alofi South and Alofi North, together known as Alofi, the capital of Niue (Appendix A).

There are two distinct seasons in Niue, the hot and humid season from December to March and the cool and dry season from April to November. Most rainfall occurs during the hot season when both temperature and humidity are high. Mean annual temperature is 25°C. Niue is located on the edge of the cyclone belt and has experienced severe and destructive cyclones in some years. There is no surface water so roof catchments and artesian bores are used for domestic and agricultural water supplies. Soil fertility is relatively poor and little of the original tropical rainforest remains, with most of the Island being covered by secondary vegetation.

2.1.2 Population

Niueans are Polynesians and are not ruled by chiefs or a tribal system. Niue became a self-governing state in October 1974 but with free association with New Zealand. Niueans are British subjects and New Zealand citizens and as such are allowed to travel freely to and from New Zealand.

The 2001 Niue Census (EPDSU, 2001) recorded 1,788 people living in Niue. The 2001 Census of Population and Dwellings recorded 20,100 Niueans living in New-Zealand (Statistics New Zealand, 2001), more than 11 times as many in New Zealand than in Niue. The Niuean population is the fourth largest Pacific Island population in New Zealand. The

population deficit in Niue continues to increase with an estimated annual rate of growth of -3.8%, and an annual net migration rate of -48.7% (EPDSU, 2001). However, the estimated population in Niue includes other ethnic groups, such as Caucasians and Pacific Islanders. The mean age of the population for males and females is 28.5 years and 29.0 years respectively, with over half the population being between 15 and 59 years old.

Niue has one primary school and one high school where attendance is compulsory for all children aged five to 14 years. Until recently, further education could only be pursued overseas in either New Zealand or neighbouring Pacific Islands. Now the University of the South Pacific has established a centre in Niue to cater for those students who wish to continue their education without leaving the Island. Niue's educational indicators are amongst the highest in the Pacific with adult literacy rates almost 100%.

The Niuean people have their own indigenous language, a Polynesian tongue closely related to Tongan and Samoan. However, English is widely spoken because of the relationship with New Zealand. The monetary currency used is also the New Zealand dollar.

2.1.3 Infrastructure

Niue has its own wharf with limited resources to accommodate large ships, however a monthly cargo ship services the Island bringing in imported goods (including food) and taking some crops such as taro for the export market in New Zealand.

Until recently, bi-weekly flights were provided by Royal Tongan Airlines in which travel was made to and from Niue via Tonga. Today, Samoa's national carrier Polynesian Airlines services the Island twice a week.

2.1.4 Health Status

Health care is free and accessible to all resident Niueans. However, due to limited resources both human and technical, there are many medical referrals to New Zealand. The health indicators for Niue are generally good. The life expectancy of a male child at birth is 67 years, and for a female child at birth it is 68 years. The adult population on the other

hand have a tendency to develop health disorders in particular Non-Communicable Diseases (NCD), thereby lowering life expectancy. It is projected that NCDs will be the main cause of seven out of every 10 deaths in developing countries by the year 2020 (Khor, 2001). CVD and diabetes mellitus are major causes of premature deaths, morbidity and disability in most of these countries.

Concern for the prevalence of these diseases led to the Niue Health Department carrying out a national health survey, requesting people to attend screening sessions to determine whether there were undiagnosed cases of NCDs and whether there were people who were at risk of developing NCDs. This health survey covered 42% of the population, a total of 331 males and 393 females aged between 18 and 80+ years (Niue Health Dept., 2002).

2.1.4.1 Obesity

Past nutrition surveys conducted in Niue classified obesity according to the WHO criteria. Overweight was defined as a BMI between 25 and 30 kg/m^2 and obesity was defined as a BMI $\geq$ 30 kg/ m^2 (Niue Health Dept, 2002) (SPC, 1992) (Bennet, 1984).

The earliest non-communicable diseases study by Bennet et al (1984) found approximately 8% of the men and 32% of the women were obese. In 1987, the South Pacific Commission carried out Niue's first national nutrition and dietary survey, covering almost 75% of the population aged 15 years and older. The prevalence of obesity from that survey was 46% of the women and 15% of the men. The prevalence of overweight was 38% of the women and 34% of the men.

The most recent survey by the Niue Health Dept, showed that of all the people surveyed, 32% of the men and 26% of the women were overweight; with another 46% of the men and 58% of the women being obese. These findings indicate a relatively small percentage of adults are within the 'healthy' BMI range. However, there is growing evidence that supports the use of a higher BMI cut-off for obesity within the Pacific Island population (Swinburn, 1996a). Hence, these results may not necessarily be indicative of obesity prevalence according to the higher BMI. The differences in body measurement criteria between Caucasians and Pacific Islanders particularly BMI, have been observed by Russell et al (1999) and used in the 1997 National Nutrition Survey of New Zealand.

2.1.4.2 Diabetes

A health survey conducted in the early 1980s by Bennet et al (1984) found that diabetes incidence was higher in women (9%) than in the men (5%). The Health Survey (Niue Health Dept., 2002) found a similar trend, where 67 women and 50 men were confirmed diabetics; of whom the majority of both sexes were people aged between 60 and 69 years. This number represents people with existing diabetes and newly confirmed cases; equal to approximately 10.6% and 8.0% of women and men in the entire Niue population aged 15 years and older. The extent to which diabetes has affected the lives of the people was not recorded in a manner easily accessible for the purpose of this literature search. However, personal communication from senior staff of the Niue Health Dept. suggests an increase in the occurrence of diabetes and its associated complications. Treatment is first given by oral drugs, most commonly Gliben 5, but some cases are treated by insulin injections.

A rough draft of figures obtained from a file at the Niue Health Dept. (author unknown) showed that between 1960 and 1991 a total number of 124 people were confirmed diabetics. Of these, 15 are now living in New Zealand, 96 are living in Niue and 13 have since died. Of the people living in Niue, 89 were on oral drugs, 4 on injection and three people were being treated by diet modification only. It is not certain how accurate these figures are but it does show the trends in treatment of diabetes.

The Niue Health Survey claims some diabetics also have hypertension, cardiovascular disease or both and others also have retinopathy but the data is presented as a total and does not differentiate between these diseases, or the course of treatment.

2.1.4.3 Hypertension

The study by Bennet in the early 1980s (Bennet et al, 1984) showed the prevalence of hypertension to be 10% in the men (n=548) and 9% in the women (n=601). The Niue Health Survey (Niue Health Dept., 2002) found 57 men and 72 women were confirmed with hypertension from the people surveyed. This is equivalent to about 9.1% and 11.4% of the entire Niue population aged 15 years and older. The trend in both the prevalence of diabetes and hypertension seems to be that more women than men have these diseases. This of course coincides with the higher prevalence of obesity among the women than the men.

2.1.4.4 Cardiovascular Disease

The Niue Health Survey (Niue Health Dept., 2002) reported 22 people had confirmed cardiovascular disease, other than hypertension but were not differentiated. Whether this figure has changed over time is not apparent due to lack of consistent data recording.

2.1.4.5 Gout

There is no recent data on the prevalence of gout, but outpatient clinic records between 1 July 1998 and 30 June 1999 showed 24 people (22 men and 2 women) visited the clinic regularly for treatment of the disease (Dept. of Agriculture and Niue Health Dept., 2000).

2.1.5 Lifestyle

2.1.5.1 Cigarette Use

In 1997 the Niue population stood at 2,088 people. Of the population aged 15 years and older, 77.8% of claimed they were non-smokers; 9.0% reported they were casual or social smokers and 13.2% reported they were heavy smokers. Overall, more men than women smoked with only 6.2% of the women being heavy smokers compared to 20.2% of the men (EPDSU, 1997). Four years on, 75% of the population aged 15 years and older were non-smokers; 15.0% were casual smokers and 10% were heavy smokers. It appeared that the percentage of smokers had gone up during the four-year period but in both censuses more women than men were non-smokers. In fact, the 2001 census found 16.6% of the men were heavy smokers compared to just 4.6% of the women (EPDSU, 2001).

2.1.5.2 Alcohol Consumption

In 1997, just over half of the population aged 15 years and older were non-drinkers. Forty-three percent and 3.2% were casual and heavy drinkers respectively (EPDSU, 1997). In 2001, the percentage of non-drinkers remained the same at 53% whilst 43% and 4% of the population 15 years and older were casual and heavy drinkers respectively (EPDSU, 2001). In both surveys, more men than women drank alcohol.

More recent alcohol consumption data was not available, however, looking at the trend of beer imports over some past years (Table 2.01) it is interesting to see how much beer was consumed between 1988 and 1993. Apart from the amount consumed in 1989, for every other year Niueans consumed at least 40 litres of beer per person, per year. The highest consumption in 1990 meant that each person would have consumed at least 1 litre of beer a

week. Consumption patterns illustrated here may not necessarily reflect the true nature of the demand for beer. Other factors such as the quantity imported (at times there is a short supply), available brands and retail price may have influenced the amount of beer people consumed. Annual celebration and traditional ceremonies are other influential factors. The low figures presented for some years may be a result of inadequate data.

Table 2.01: Consumption of beer in Niue (Litres per capita)

	1988	1989	1990	1991	1992	1993	1996	1997
Beer	56.61	4.71	71.31	52.61	41.91	47.82	10.28	1.16

Source: Dept. of Agriculture and Niue Health Dept., 2000.

2.2 Niueans And Other Polynesians In New Zealand

As mentioned earlier, there are more than 11 times as many Niueans living in New Zealand than in Niue itself (20,100 vs 1,788). In fact, Niueans are the fourth largest Pacific Island population in New Zealand comprising 9% of the total Pacific Island population. Samoans are the largest (50%), followed by Cook Island Maori (23%) and Tongans (18%) (Statistics New Zealand, 2001)

In 2001, 86% of the Niueans living in New Zealand were actually born in Niue. Furthermore, 30% of the overseas-born Niueans were aged between 45 and 64, compared to only 2% of New-Zealand born Niueans. This is an indication of the migration trend where established families move from Niue to New Zealand, primarily for better job prospects or education for their children.

There is a lack of specific data on the health of Niueans in New Zealand as they are included in the overall Pacific Island health statistics. Hence, the health issues of Pacific Islanders in general will be discussed here. Research has shown that Pacific Island people experience poorer health than European New Zealanders (MOH, 1999a). The following sections make particular reference of the prevalence of certain NCDs in neighbouring Polynesian countries namely, Samoa, Tonga and the Cook Islands to give an overall picture of the trend in Polynesia.

2.3 Obesity In The Pacific

Obesity has also been documented at very high rates in the Pacific, in both men and women. Obesity rates range from around 2% in highland Papua New Guinea to nearly 80% in Nauru. In most communities, the rate of obesity is well above 20%, exceeding the level in more developed countries such as Australia and the United States of America (WHO, 2003).

The prevalence of obesity in the Pacific Island population of New Zealand is 26.2% for males and 47.2% for females, more than double the prevalence of obesity in New Zealand Europeans and Others (Russell et al, 1999). The general consensus is that Pacific Islanders have higher rates of obesity than Europeans. Also in New Zealand, an intervention study by Bell et al (2001a) measured base line data for 470 Samoan adults aged between 20 and 77 years. The mean BMI for the intervention group (n=365) was 34.8, the mean BMI for the control group (n=106) was 34.3, giving an overall mean BMI value of around 34. The same year Bell and colleagues (2001b) published results of another survey with a much higher number of Samoan subjects where the baseline mean BMI for the men (n=286) was 32.1, and the women (n=474) was 34.5. These results show a definite high BMI rate among the Samoan population. The prevalence of obesity in Samoa itself is 48% for men and 70% for women, found in studies conducted since 1990 (Hodge et al, 1996). However, further increases seem likely since these studies, as demonstrated by secular trends. In the Cook Islands, a study by Ulijaszek (2000) looked at the trend in weight changes among adult males aged 30 to 86 yrs. He found the mean BMI in the 1996 study of 142 Cook Island males was 30.3, an increase over time compared to 1969 when the mean BMI value was only 25.7.

A comparative study of body weight between Tongans and Australians found that Tongans had a higher mean BMI compared to Australians for both men (30.3 vs 26.5) and women (32.6 vs 25.8) (Craig et al, 2001). Similarly, a randomised national study of 1,024 Tongans aged 15 years and older conducted by Colagiuri et al (2002) found the mean BMI among men to be 30.2, and 33.8 among women, with an overall mean of 32.3 for all subjects.

In most Pacific Island studies, prevalence of obesity is referred to as obesity among the rural and urban population. The geographical size of Niue does not lend itself to distinguish between urban and rural communities. Development or 'modernisation' extends throughout the population and is therefore not centred in any particular area. Hence, Niue can be considered to have only an 'urban' population with its associated changes and trends in lifestyle. It is obviously apparent that these Polynesian populations, including Niue, are heavier resulting in greater BMI levels compared to Europeans.

2.4 Diabetes In The Pacific

Diabetes prevalence in the Pacific has been recorded at some of the highest rates in the world. A background paper presented at the recent Meeting of Ministers of Health for the Pacific Island countries (WHO, 2003) reported the rates of diabetes in the Pacific to range from 10% to 40%, based on different population groups. The rates were most notably higher among Fijian Indians, Nauruans, Kiribati and the Wanigela of Papua New Guinea. The paper described the lack of up-to-date, standardised, and comparative data on the prevalence of diabetes among Pacific Island countries. Data presented for the prevalence of diabetes in Niue was taken from the 1980 NCD survey by Bennet, well out of date. The WHO developed a monitoring tool known as STEPS and trialled its use in four pilot baseline surveys in Fiji, Marshall Islands, Micronesia and Samoa. It is an evidence-based standard suggested to be incorporated into each country's health surveillance system.

The prevalence of Type 2 diabetes among the Pacific Island population in New Zealand is relatively high, coinciding with the increasing prevalence of overweight and obesity (MOH, 2001). The 1996/97 Health Survey found that around 3.7% (1 in 27 adults) of the New Zealand population reported having diabetes (MOH, 1999b). The overall prevalence of diabetes is around 4-8% for Pacific Islanders.

Estimates based on the diabetes data from the 1996/97 Health Survey showed that the probability of being diagnosed with diabetes between the ages of 25 and 89 years, and within their lifetime, is only 9% for European New Zealanders. On the other hand, the probability for Pacific Islanders is 25%, more than two and a half times that of the Europeans but slightly less than Maoris (MOH, 2002). Furthermore, the incidence of

diabetes in New Zealand is estimated to increase by around 130-150% for Pacific Islanders and Maori, compared to around 58% for Europeans by the year 2011.

A national study by Colagiuri et al (2002) found the current prevalence of diabetes in Tonga to be 15.1%, of which 80% were newly diagnosed cases. The prevalence was greater in women than men (17.6% vs 12.2%). This rate is more than double that of over 25 years ago, when a similar survey found 7.5% of the population had diabetes.

The CVD risk factor study 1990-95 conducted in American Samoa and Samoa (McGarvey, 2001) found the prevalence of Type 2 diabetes to be 2.6% for men, based on fasting blood glucose levels of subjects aged 25 to 55 years. Another risk factor study of 133 Samoans found the prevalence of Type 2 diabetes mellitus among these subjects to be 17% and a further 9% had Impaired Glucose Tolerance (IGT) (Wahi et al, 1997). An earlier study of diabetes prevalence was made by Collins et al (1994) and they found that over a 13-year period (1978 to 1991), prevalence of diabetes in Apia increased from 8.1% to 9.5% for men and from 8.2% to 13.4% for women.

In the Cook Islands, Weinstein et al (1981) studied 133 subjects resident on Manihiki Atoll in 1980 and found the prevalence of diabetes to be 8% for men and 10.3% for women. Prevalence of IGT was also the same for men (8%) but around three times more for women (31%). In the same year, Bennet et al (1984) conducted a survey in Rarotonga and found the prevalence of diabetes to be 5.1% in men (n=542) and 8.0% in women (n=581). In 1987, a similar survey carried out by Taylor and colleagues (cited in Coyne, 2000) found an increase in the prevalence of obesity in men to 10.6%. The increase observed in the women was not statistically significant.

2.5 Hypertension In The Pacific

A study by Scragg et al (1993) on the prevalence of hypertension amongst a multicultural workforce in New Zealand, found that compared with Europeans, mean systolic and diastolic blood pressures were higher in Pacific Islanders by around 4 to 6 mmHg. After adjusting for BMI differences, there was still a significant difference between the Europeans and Pacific Islanders.

The 1996/97 Health Survey (MOH, 1999b) in New Zealand found that overall more than 1 in 10 people had hypertension. There were a greater proportion of Pacific Island people with hypertension compared to European New Zealanders (14% vs 11%). The 1997 National Nutrition Survey (Russell et al, 1999) found 21.6% of Pacific Island males (n=102) and 13.1% of Pacific Island females (n=165) had hypertension.

The study by Colagiuri et al (2002) in Tonga observed the mean systolic and diastolic blood pressures among the men to be 133.2 mmHg and 81.5 mmHg respectively. Among the women, the mean systolic and diastolic blood pressures were 126.8 mmHg and 79.8 mmHg respectively. Overall, 37.3% of the Tongan subjects (n=1,024) had hypertension. The risk factor study by Wahi et al (1997) in Samoa found 19% of the subjects (n=133) were hypertensive.

2.6 Smoking And Alcohol Consumption In The Pacific

The 1996/97 Health Survey (MOH, 1999b) indicated that around 25% of all New Zealanders are current smokers, with about 26.4% of the men and 23.5% of the women. Whilst on average there are more men than women who smoke; there are more women than men who smoke aged between 15 and 24 years. The Pacific Island population has the second largest proportion of smokers in their total population with 27.7%, much less than the prevalence of smoking among Maori (nearly 50%) and slightly greater than among Europeans (23.2%).

The Census of Population and Dwellings (Statistics New Zealand, 1996) found that around 33% of all Niuean adults surveyed in New Zealand were regular smokers. The prevalence of current smokers in other Polynesian nations was 38%, 29% and 28% for the Cook Island, Tongan and Samoan populations 15 years and over, respectively. All of these percentages were greater than the prevalence of smoking among the European population of New Zealand.

The 1996/97 Health Survey (MOH, 1999b) indicated that Pacific Islanders tend to drink alcohol to potentially hazardous levels, compared to Europeans. Episodes of heavy drinking are more likely to contribute to adverse health outcomes, than small amounts of

alcohol taken regularly (Kauhanen et al 1997). This type of drinking behaviour or pattern is otherwise described as binge drinking. Around 45% of the Pacific Island population report drinking alcohol, of which 36% 'binge' drink. This pattern of drinking is much higher than the European population where, of the 87% who drink alcohol, only 20% binge drink.

Generally speaking, Pacific Islanders have higher rates of obesity, diabetes, hypertension, smoking and alcohol consumption compared to Europeans or Pakeha. This tendency in Pacific populations indicates higher prevalence of risk factors for the development of cardiovascular diseases, the number one cause of mortality in many nations, including New Zealand and the wider Pacific community.

Maori and Pacific Island people have a greater burden of disease compared to their European counter-parts. A study by the Ministry of Health (2001) estimated the rates of Disability Adjusted Life Years (DALY) loss among the Maori, Pacific Island and European population in New Zealand. The age-standardised Pacific Island DALY rate was 50% greater than the DALY rate for European New Zealanders. The majority of the burden of disease was associated with chronic disease risk factors; smoking accounted for the highest rate of DALY loss among Pacific Island men whilst Type 2 diabetes (as a risk factor) accounted for the highest rate of DALY loss among Pacific Island women.

2.7 Pacific Island Diets

2.7.1 Diet Characteristics of Niue

The 1987 Food and Dietary Survey concluded that Niue was heavily dependant on imported foods, and emphasised that diets based heavily on imported foods, together with a changing lifestyle contributed to the development of many NCDs (SPC, 1992). The researchers found that imported staple foods such as breads and cereals were commonly eaten in the morning, accompanied by imported fat (margarine of butter). Consumption of fruits and vegetables was very low, with fruit consumption being almost negligible. Protein foods were commonly eaten in the evening. The amounts of food consumed were not recorded because of the methodology used in the survey. The 24-hour recall used was

similar to a food frequency questionnaire in that it asked what types of foods each subject had eaten the day before, but not the quantity of food.

The three-food groups approach is widely used in the Pacific Islands, to define a balanced diet and promote healthy eating. These three food groups are energy foods, bodybuilding foods and protective foods. The majority of foods imported by Niue are protein foods, followed by energy foods and thirdly protective foods (Dept. of Agriculture, 2000). Protein foods cover food items such as meat and poultry, as well as tinned meat and fish. Breads and cereals are classed as energy foods, which are imported in larger quantities than protective foods. Protective foods are the fruits and vegetables. Niueans enjoy an abundant supply of a variety of staple foods, mainly taro (Colocasia *esculenta*), yams (Dioscorea spp), plantain bananas (Musa *paradisica*), sweet potato (Ipomoea *batatas*), breadfruit (Artocarpus *altilis*) and cassava (Manihot *esculenta*). These foods are high carbohydrate foods that also have high levels of starch. Whilst fish is abundant, access to marine food sources is not available to all people of the Island. Fish can be very expensive to purchase from the fishermen themselves. This leads to most people opting to purchase cheaper alternatives such as imported tinned fish.

2.7.2 Diet Characteristics of other Pacific Islands

Dietary diversity is wide in the Pacific, depending on environmental limitations. For example, in the Highlands of Papua New Guinea, traditional diets derived 95% of energy from CHO and 2% from fat. In atolls such as Kiribati where diets are based on coconut and fish, energy contribution from fat can be as high as 36% (Hodge et al, 1996). Modernisation has brought about a gradual reliance on cereals and sugars, less consumption of traditional roots and tubers and increasing consumption of fats and oils (FAO, 1996).

There are a limited number of dietary studies on Pacific Islanders. The studies conducted on Pacific Islanders in New Zealand were mainly based on the Samoan population. Very little has been done on other Polynesian populations, whilst none have been carried out specifically on the Niuean population. The low response rate from Pacific people may be the primary reason for the limited number of studies, which could be a result of the lack of Pacific Island professionals in the field of nutrition.

Dietary change has been strongly associated with modernisation in many Pacific communities, encompassing modernisation within Pacific nations themselves (Galanis et al, 1999), (Kaioke et al, 1984), (Lako, 2001) and upon migration to more developed countries such as New Zealand (Vainikolo et al, 1993), (Prior et al, 1987), (Bell et al, 1999). Modernisation in Pacific Islands brings greater economic and social benefits, accompanied by a rapid change in lifestyle behaviour. Where once subsistence agriculture was the norm, modernisation has moved the focus onto cash cropping, thus providing increased monetary returns and greater purchasing power. This transition has brought about dramatic changes in diet and physical activity levels.

The most notable changes in diet due to 'modernisation' have been a shift from a larger proportion of energy from starchy carbohydrates to an increased proportion of energy from fats, animal proteins and refined or simple carbohydrates (Bathgate et al, 1994), (Drewnoski, 1997), (Gill, 2001).

Comparisons of the nutrient intakes of European, Maori and Pacific Island men and women were made in a study by Metcalf and colleagues (1998). They found overall that Pacific Islanders consume more total energy, sucrose, protein, total fat, saturated fat, monounsaturated fat and cholesterol per day compared to European New Zealanders. Pacific Island men however consumed less fibre and calcium than European men, whilst Pacific Island women consumed more carbohydrate, starch and polyunsaturated fat than European women. The ethnic differences in nutrient intakes observed in this study were due to larger portion sizes and increased frequency of consumption of most foods by Pacific Islanders (Metcalf et al, 1998).

Other studies have shown a low consumption of fruits and vegetables among Pacific Islanders (Bell et al, 1997). However, a study by Gonelevu and colleagues (1997) found no significant difference in fruit and vegetable consumption between Polynesian and European women aged 18 to 27 years. A dietary study of Samoans living in Samoa and those living in American Samoa showed that American Samoans had a significantly higher carbohydrate (47% vs 44%) and protein (18% vs 13%) contribution to energy than the Samoans living in Samoa. However, the energy contribution from total fat (36% vs 46%) and saturated fat (16% vs 30%) was significantly lower (Galanis et al, 1999). Another

study conducted in three Samoan church communities in Auckland found a higher proportion of energy intake came from soft drinks, takeaways and snacks in subjects aged less than 40 years, compared to the older group. In addition, intake of fruit and vegetables was very low (Bell et al, 1999).

2.8 Cumulative Risk: Cardiovascular Disease (CVD)

The most common CVD is coronary heart disease (CHD), otherwise known as ischaemic heart disease. CHD is the end result of narrowed coronary arteries, caused by a build-up of fatty deposits or fibrous plaque (atherosclerosis).

Narrowing of the arteries gradually develops over a long period of time, due mainly to damage to the arterial walls. The narrowed arteries starve the heart of blood and oxygen, which upon exertion, is felt as a pain in the chest known as angina because the arteries are unable to keep up with the demand for blood and oxygen (Barasi, 1997). If the coronary artery is completely blocked, the area of the heart muscle linked to that artery will fail, resulting in a heart attack or myocardial infarction. The walls of the coronary arteries are continually exposed to wear and tear by the action of the blood flowing through them, however damage can also occur from other sources. The major causes of damage to the arterial walls include; high blood cholesterol levels, high blood pressure, smoking and thrombosis (Ginsberg & Karmally, 2000).

It is believed that total and high density lipoprotein (HDL) cholesterol are major determinants of coronary heart disease. Increased saturated and trans-fatty acids result in an increased total and low density lipoprotein (LDL) cholesterol, whereas increased dietary unsaturated fatty acids have a lowering effect (Meagher & Burke, 1999). Research has shown that a diet low in salt and fat, but rich in potassium, calcium and magnesium lowers blood pressure substantially. Antioxidants such as vitamin E, vitamin C and carotenoids may protect against CVD based on their roles in preventing the oxidation of LDL lipoproteins, however insufficient evidence supports this theory (Kromhout, 2001). Cerebrovascular disease or stroke is also the end result of a blocked blood vessel supplying the brain.

In all cases, an elevated blood pressure is a major determinant of CVD (Kromhout, 2001). Prospective observational studies have shown a strong relationship between the primary incidence of stroke and blood pressure levels. Clinical trials using antihypertensive therapy have also shown this association in a reduction of primary stroke risk (Chalmers, 2000).

2.8.1 Prevalence of CVD

In 1999, CVD contributed to one-third of global deaths equal to 17 million, of which 78% occurred in low and middle-income countries. It is estimated that CVD will become the leading cause of death in developing countries by 2010 (WHO, 2001).

New Zealand, Australia, Singapore, Western Samoa and urban areas of China are classified in the 'high mortality from CVD' category, according to the proportion of total deaths from all causes. These countries represent a rate in excess of 30-35% of total deaths in the population due to CVD (Khor, 2001). Mortality statistics in Niue are limited, however between 1978 and 1982, cardiovascular disease was the second leading cause of mortality on the island (Taylor et al, 1987). Today, the leading cause of mortality in Niue is still cancer with CVD being the second leading cause of death.

Mortality statistics between 1987 and 1991 in New Zealand showed Pacific Island males of all ages accounted for 51% of deaths from CVD, whilst Pacific Island females accounted for 44% (Public Health Commission, 1994). Bell and colleagues (1996) studied the ethnic differences in the trends of CHD incidence in New Zealand and found that whilst mortality rates for Pacific Islanders were higher than those for Europeans (both men and women), they were not as high as those for the Maori population. A comparison of morbidity rates due to CHD found that the rates were similar across the three population groups in both men and women, but the morbidity rate among women was approximately half that of men.

2.8.2 Risk Factors for Cardiovascular Disease

CVD is considered a multifactorial condition, associated with a combination of risk factors. The presence of a number of risk factors in any individual increases the likelihood for the development of a CVD. The main risk factors can be classed as background or behavioural. Background risk factors include age, social class, etc whilst behavioural risk

factors include the individual's lifestyle such as smoking, weight control, high blood pressure etc (Table 2.02). It should be noted however, that there is a strong link between background risk factors and subsequent behaviour/environment risk factors. For example, a low-income earner may not afford to purchase 'healthier' foods as opposed to cheaper high-fat foods, which contribute to increased blood lipid levels.

Table 2.02: Main risk factors associated with cardiovascular disease

Background/Genetic	Behavioural/Environmental
Genetic predisposition	Smoking
Age	High blood pressure
Gender	Raised blood lipids
Social class	Weight
Geographical location/race	Physical activity
Disease eg. Diabetes mellitus.	Dietary factors

Source: Barasi, 1997.

2.8.2.1 Body Composition Indicators

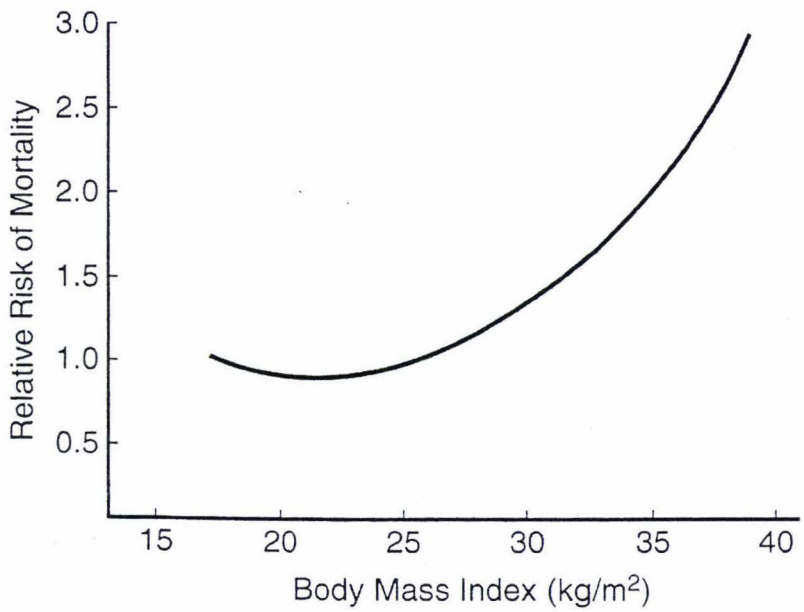
It has long been established that obesity, defined as at least 20% over ideal weight, is accompanied by complications such as hypertension, Type 2 diabetes mellitus and atherosclerosis, all of which in turn, can cause ischaemic heart disease, stroke and premature death (Lonnqvist, 1996).

In general, the risk of morbidity and mortality associated with obesity increase in direct proportion to increases in BMI. This relationship is illustrated in Figure 2.01, where all cause mortality is plotted against BMI. All cause mortality begins to increase at BMIs nearing 30 and continues to increase in a linear fashion thereafter.

Heart disease is one of the main causes of death among obese people. According to a prospective study by Manson and colleagues (1990), the risk of a fatal or non-fatal myocardial infarction among women with a BMI >29 is three times higher than that of non-obese women. In addition to high blood pressure, high triacylglycerol, and high LDL-cholesterol levels which contribute to the formation of atheromatous lesions, obese people have the added hazard of abnormalities of blood clotting factors which further increase the risk of thrombosis and myocardial formation (Garrow, 2000). Though obesity itself is

related to hypertension and stroke, these risk factors can be improved when obese people lose weight.

Figure 2.01: Relationship of BMI and relative risk of mortality



Source: Hill, Kriketos and Peters, 2000.

Weight reduction has been shown to be beneficial in reducing aberrations of the heart as a result of obesity and hypertension. Karason and colleagues (1997) in their study concluded that regression in abnormalities of heart structure is better predicted by weight loss than by reduction in blood pressure. The general consensus is that weight loss is associated with significant health benefits (Campbell, 2003).

A prospective cohort study in the U.S. showed that the risk of death from cardiovascular disease also increases throughout the range of moderate and severe overweight, for both men and women, and in all age groups (Calle et al, 1999).

A study of a Swedish sample population has shown a significant difference in CVD risk factors between those with high and low income. Persons with low income were more likely to exercise less, smoke more, have a higher BMI, and exhibit a greater prevalence of hypertension and diabetes. The researchers believed that persons who belonged to the lower

social classes were less likely to be physically active during their leisure time or eat 'healthy food', and were more likely to develop CVD as a consequence (Pudaric, 2000).

Many studies suggest that excess fat located in the visceral depots is an independent risk factor for Type 2 diabetes and cardiovascular disease. A high waist to hip ratio is associated with greater risk of impaired health than a low waist to hip ratio (Hill, Kriketos and Peters, 2000). It is believed that a high concentration of fatty acids released from visceral adipose tissue depots, may be taken up by the liver, which in turn could lead to insulin resistance and dyslipidemia, thus increasing the risk of obesity-related co-morbidities (Despres et al, 1989).

A study by Lean et al (1995) sets waist measurement criteria as a simpler way of predicting increased cardiovascular risk, with the view that the prevalence of adverse cardiovascular risk factors increase with increasing waist circumference in both men and women. Previous studies had already shown that changes in waist circumference also reflect changes in cardiovascular risk factors (Wing et al, 1992). Han et al (1995) further concluded that people with waist circumferences between 94-101 cm in men and 80-87 cm in women, are one and a half times to twice as likely to have one or more major cardiovascular risk factors. People with waist circumferences above this range are two and a half to four and a half times as likely to have one or more major cardiovascular risk factors

2.8.2.2 Hypertension

Essential hypertension is the most common form of hypertension. It is suspected that derangement of a number of physiological mechanisms involved in the maintenance of normal blood pressure may play a part in the development of essential hypertension (Beevers et al, 2001). Factors which influence hypertension that have been intensively studied include salt intake, obesity and insulin resistance.

Epidemiologic studies have demonstrated that both systolic and diastolic blood pressure have a 'strong, continuous, graded and etiologically significant' positive association with cardiovascular disease outcomes. In addition, these relationships are consistent in both men and women, in young, middle-aged and older people, among different racial and ethnic groups, and both within and between countries (Vasan et al 2001). Hypertension is

classified as a blood pressure level of equal to or greater then 140/90 mm Hg. Persons taking antihypertensive medication are especially at high risk of CVD (Ginsberg & Karmally, 2000).

A study by Vasan et al (2000) looked at the impact of high-normal blood pressure on the risk of CVD. Subjects were classified as non-hypertensive subjects with a systolic pressure of 130-139 mm Hg or a diastolic pressure of 85-89 mm Hg. The investigators found that the men and women with high-normal blood pressure at baseline had a higher incidence of cardiovascular disease on follow-up than those with optimal blood pressure.

Hypertension increases the risk of CVD because it increases the risk of damage to arterial walls and also increases the infiltration of blood components such as oxidised LDL-cholesterol into the damaged area (Thomas, 1996). Within a population, a difference in diastolic pressure of 7.5 mm Hg has been shown to be associated with a 29% difference in CHD risk and a 46% difference in stroke.

Miura and colleagues (2001) conducted a cohort study to assess the relationship between blood pressure and long-term mortality due to CHD. The study involved 10,874 men aged between 18-39 years at baseline. The study subjects were not receiving antihypertensive drugs and did not have CHD. At the end of the study, the researchers found that the age-adjusted association of systolic blood pressure to CHD mortality was continuous and graded. Men with higher systolic blood pressure (increase of 15 mm Hg) at baseline had a 26% increased risk for CHD, while men with higher diastolic blood pressure (increase of 10 mm Hg) at baseline had a 17% greater risk for CHD (Heart Disease Weekly, 2001)

Evidence suggests that a high sodium intake increases the risk of hypertension (Weinberger, 1996) and that reducing salt intake may reduce that risk (Mann, 2000). The large-scale multinational Intersalt study found positive associations between sodium intake and blood pressure. In addition the study produced strong evidence that sodium intakes account for much of the rise in blood pressure with age (Thomas, 1996). However, the debate remains in that not all people demonstrate changes in blood pressure after ingestion of increased or decreased amounts of sodium chloride, and that in many cases hypertension

is associated with other variables (Weinberger, 1996). There are other risk factors in the development of hypertension including high levels of alcohol consumption and obesity.

2.8.2.3 Diabetes Mellitus

Diabetes Mellitus is a group of metabolic diseases characterised by hyperglycemia due to defects in insulin secretion or insulin action, or both. Chronic hyperglycemia is associated with long-term damage, dysfunction or failure of various organs, resulting in complications such as retinopathy, nephropathy, and peripheral neuropathy to name a few (Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, 2003).

Studies have shown that people with diabetes and impaired glucose tolerance have an increased risk of developing CVD, which is the leading cause of death of people with diabetes. In 1998, the American Heart Association declared obesity as a major risk factor for coronary heart disease.

Type 2 diabetes is strongly associated with being overweight, the prevalence of which increases when body mass index is greater than 23 kg/m^2. It is often accompanied by hyperlipidaemia, specifically elevated serum triglyceride and LDL-cholesterol and reduced HDL-cholesterol. This increases the risk of heart disease and stroke. Eighty to 90% of people with diabetes are overweight or obese (Heart Disease Weekly, 2001).

A recent study found that even moderate weight loss brought about by diet and exercise can reduce the risk of developing diabetes. The five-year study, sponsored by the National Institutes of Health, the American Diabetes Association, and other public and private groups, involved 3,000 volunteers who participated for an average of three years. Researchers discovered that even small dietary and exercise changes that resulted in weight loss reduced the risk of developing diabetes by 58%. The study also found that preventive treatment with metformin, the oral antihyperglycemic drug, lowered the risk of developing diabetes by 31% (Bruce, 2001).

It is becoming increasingly common for Type 2 diabetes patients to develop Syndrome X, or metabolic syndrome, a cluster of coronary heart disease risk factors that include abdominal obesity, glucose intolerance, hyperlipidemia, and high blood pressure.

2.8.2.4 Hyperhomocysteinemia

It has recently been found that elevated homocysteine levels (hyperhomocysteinemia), as defined by >12umol/L are an independent risk factor for CVD (Meagher & Burke, 1999). It is suggested that for every 10% increase in plasma homocysteine levels, there is an equivalent increase in risk of developing CVD. However some other authors believe that further research needs to be undertaken in this regard (Ward, 2001) (Miller, 2001).

Hyperhomocysteinemia is thought to result from inadequate levels of one or more of the vitamins; folate, B_{12} and B_6, all of which play important roles in the metabolism of homocysteine. The exact mechanisms by which elevated homocysteine levels could lead to CVD are not known, but studies show that homocysteine plays a role in atherogenesis and thrombogenesis (Welch & Joscalzo, 1998). Fanapour and colleagues (1999) proposed two possible ways by which homocysteine might induce its harmful effects. Homocysteine can damage the endothelial cells lining the vasculature, allowing plaque formation, in addition to promoting vascular smooth muscle cell hypertrophy. Two processes which promote occlusion of the blood vessels.

No long term studies have been completed that could show whether low homocysteine levels could prevent CVD and confirm this hypothesis. However, several large-scale intervention studies are currently underway and designed to investigate whether the risk of developing CVD is influenced through supplementation of folate, vitamin B_{12} and B_6 (Miller, 2001).

Vermeulen and colleagues (2000) also conducted a study looking at the effect of folic acid and B_6 on the progression of subclinical atherosclerosis. The study subjects were healthy people with a family history of CVD and thus were also at high risk of developing clinical CVD. The researchers found that there was a lower incidence of abnormal electrocardiographic changes during exercise tests in the supplemented group (5 mg folic acid and 250 mg vitamin B_6) than in the control group. They concluded that supplementation in this case does reduce the risk of developing CVD in people with subclinical atherosclerosis and that the same effect should also be seen in young, healthy people without a family history of atherosclerotic disease.

However, the statistical significance of the results of the electrocardiography tests in this study is questioned as well as the size of the study population. Current studies investigating the relationship of homocysteine levels with atherosclerosis are designed to investigate more difficult endpoints such as heart attack and stroke with a much bigger study population and thus should provide some very interesting results.

2.8.2.5 Blood Lipid Profile

The role of elevated serum cholesterol levels as a cause of CVD, particularly ischaemic heart disease is well established. In addition, epidemiologic studies have shown dietary fat intake is positively correlated with serum cholesterol levels and mortality from CVD (Dietschy, 1998).

Studies of individuals with high triacylglycerol and lower HDL cholesterol levels have shown higher levels of small, dense LDL cholesterol, which has been proposed as the more 'atherogenic' type (Ginsberg & Karmally, 2000). The association of total cholesterol with CVD lies strongly on the low-density lipoprotein (LDL) content. Elevated LDL cholesterol (>4.1 mmol/L) poses a greater risk of developing CVD (Scaefer, 1995) because oxidised LDL is taken up by the macrophages and deposited in the atheromatous plaque (Mann, 1999).

Epidemiologic studies suggest that consumption of a diet high in n-3 fatty acids has a beneficial effect on key risk factors for CVD. The n-3 polyunsaturated fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are believed to aid in reducing the risk of CVD (Connor, 2001). Present mainly in fish and fish oils, studies have shown that populations that consume large amounts of marine food have a much lower incidence of CVD.

A study by Dewailly and colleagues (2001) showed that the Inuit of Nunavik (Canada) had a lower mortality rate from CVD than neighbouring populations, due mainly to the traditional Inuit diet, consisting of white whale, seal, fish etc. They found that n-3 fatty acids were positively associated with HDL-cholesterol concentration and inversely associated with triacylglycerol concentrations and the ratio of total to HDL cholesterol.

A similar relationship has also been shown in Japan, where the diet is also rich in fish and marine mammals (Yamori et al, 1985). A lower incidence of thrombotic disease was observed in this population and has been attributed to the high levels of n-3 fatty acids in the diet. Thrombosis is a complication of coronary atherosclerosis, which can result in myocardial infarction, however the n-3 fatty acids in fish have a very strong antithrombotic activity (Connor, 2001).

Studies in humans and animals also reported an inverse association between α-linolenic acid and cardiovascular disease morbidity and mortality (Djoussé et al, 2001). Thus, Djoussé and colleagues (2001) examined the relation between dietary linolenic acid and prevalent coronary artery disease (CAD) through a study of 4584 subjects with a mean (±SD) age of 52.1 ± 13.7 y in the National Heart, Lung, and Blood Institute Family Heart Study. They concluded that a higher intake of either linolenic or linoleic acid was inversely related to the prevalence odds ratio of CAD. The two fatty acids had synergistic effects on the prevalence odds ratio of CAD. Dietary intervention studies support the concept that restricting saturated fat and cholesterol and increasing the intake of essential fatty acids, especially n-3 fatty acids, reduces CHD risk (Ernst, 2002).

2.8.2.6 Age

Epidemiologic studies show that risk of developing CVD increases with age for both men and women (Schaefer, 1995). Age has a major impact with women. Premenopausal women tend to have lower total and LDL cholesterol levels, and higher HDL levels than their postmenopausal counterparts. Postmenopausal women undertaking hormone replacement therapy have lower total and LDL cholesterol levels and higher HDL cholesterol levels (Ginsberg & Karmally, 2000). Men are more at risk of CVD than women, particularly men 45 years and older. Women of 55 years or more years and those with premature menopause are at more risk.

One study that shows the association between age and risk factors for CVD was conducted by Lindeberg and colleagues (1997) on a population sample of people aged 20-86 years in Papua New Guinea. They found that although diastolic blood pressure was not associated with age, systolic blood pressure increased linearly after 50 years of age in both sexes. Body mass index decreased with age in both sexes. Serum total cholesterol, triacylglycerol,

and LDL-cholesterol increased in males between 20 and 50 years of age, whereas HDL-cholesterol decreased.

Whilst obesity is common among adults during the middle years, weight gain also appears to be associated with increased risk of a range of chronic and debilitating illness. Prevention of weight gain prevents most adult-onset diabetes, reduces the development of hypertension and reduces lipid disorders, which in turn reduces heart disease risk (Gill, 2002).

2.8.2.7 Lifestyle Factors

Lifestyle practices also have a marked effect on the risk of developing CVD, in particular smoking, alcohol consumption and lack of physical activity. Suggestions have been made of protective effects of low to moderate alcohol consumption on risk of CVD. Possible underlying mechanisms for the cardio-protective effect of alcohol include; reduced platelet aggregation, blood coagulation and fibrinolytic activity. However, controversy remains in this area due to lack of controlled human studies and other factors such as lack of clarity for the description of 'low' or 'moderate' consumption (Ginsberg & Karmally, 2000). In addition, excessive alcohol consumption can cause alcoholic cardiomyopathy. Regular alcohol consumption also raises blood pressure and contributes to the prevalence of hypertension.

Smokers tend to be relatively insulin resistant, hyperinsulinemic, and dyslipidemic increasing their risk of CVD compared with non-smokers (Reaven, 2003). Hence, the development of Type 2 diabetes is another possible consequence of cigarette smoking, in addition to the increased risk of cardiovascular disease (Wannamethee, 2001), (Eliasson, 2003).

A lack of physical activity, whilst not in itself a direct risk factor for CVD, increases the risk of developing associated risk factors such as obesity, which in turn leads to additive risk factors such as hypertension and diabetes mellitus. In New Zealand, it has been estimated that up to one-third of the deaths from coronary heart disease, diabetes and cancer of the colon can be attributed to lack of physical activity (MOH, 1999b).

Ultimately, any combination of these risk factors place women and men at high risk of cardiovascular disease and all-cause mortality (Lowe, 1998)

2.9 Gout And Osteoarthritis

Gout is characterised by chronic hyperuricemia, measured as serum urate levels >450μmol/L in men and >350μmol/L in women (Fam, 2002). Gout comprises a heterogeneous group of disorders characterized by deposition of monosodium urate crystals in the joints and tendons. Gout progresses through four clinical phases: asymptomatic hyperuricemia, acute gouty arthritis, inter-critical gout and chronic tophaceous gout. The peak incidence occurs in patients 30 to 50 years old, and the condition is much more common in men than women (Harris et al, 1999).

As a metabolic disorder, recognized associated risk factors for gout include obesity, alcohol abuse, renal dysfunction, dyslipidemia, and hypertension (Wortman, 2002), (Fam, 2002). Gout and hyperuricemia are also associated with increased risk of diabetes, but with added complications such as obesity and hypertension, can lead to the likely prognosis of cardiovascular disease (Diaz, 2002). Obesity is associated with both increased production and decreased renal excretion of urate (Emmerson, 1996).

A case control study of drinking behaviour between subjects with and without gout found a statistically significant relationship between alcohol abuse and acute gout (Sharpe, 1984 cited in Emmerson, 1996). The same study found that alcohol (particularly beer) contributes a greater quantity of purine nitrogen in gout sufferers. Hence alcohol intake whether alone or with a high purine meal produces greater effects on serum urate levels, and restriction in alcohol consumption is a key factor in the management of gout (Fam, 2002). The Insulin Resistance Syndrome (IRS) (encompassing abdominal obesity, dyslipidemia, raised serum insulin levels, and glucose intolerance) is strongly associated with hyperuricemia and gout, with an estimated 76% of gout sufferers having IRS (Dessein et al, 2000, cited in Fam, 2002).

It has been reported that Pacific Island people have a genetic predisposition to hyperuricemia, manifested as clinical gout (Bathgate et al, 1994). A study by Simmonds et

al (1994) found that Polynesian women share a genetic defect in urate handling, making them susceptible to hyperuricemia, without the added contribution of alcohol or hypertension, and hence overall more at risk of developing gout. A genetic link has also been identified in other populations, including New Zealand Maori (Wortman, 2002).

The exact aetiology of osteoarthritis (OA) is unknown, but it is by far the most prevalent joint disorder, and is strongly associated with ageing (Hunter, 2002). Recognised risk factors for knee OA include both generalised constitutional factors (eg, heredity, ageing, sex, obesity) and local adverse biomechanical factors (eg, trauma, occupational and recreational usage) (Doherty, 2001), (Hinton, 2002).

Certain physical activities repetitively performed over a long period may contribute to OA development through non-physiologic joint loading or injury (Sharma, 2001). This is related to occupational activity more than recreational physical activity. OA is more common in those who have been involved in heavy physical work, particularly jobs involving knee bending, kneeling or squatting (Hunter, 2002). Knee injury is also associated with increased risk of OA, and is the most modifiable risk factor for OA in men. It is second to obesity as the most important modifiable risk factor for OA in women (Felson, 2000).

There is a strong association between high BMI and knee osteoarthritis (Manek, 2003). Data from the first NHANES showed obese men had nearly four times the risk of OA as women within the healthy BMI range. Obese men were 4.8 times more at risk than men within the healthy BMI range (Anderson et al, 1988 cited in Hunter, 2002). Body weight is therefore the most modifiable risk factor in the development of OA, particularly knee OA. Some dietary factors have also been implicated in the development of OA, but there is insufficient evidence to conclusively support these. Bone density has also been examined in light of an inverse relationship between both osteoporosis and osteoarthritis and bone mineral density. The theory is that increasing bone density, could lead to increased mechanical load through the weight-bearing joints, thereby increasing the risk of OA (Hunter, 2002).

2.10 Inferences From The Literature

In conclusion, Pacific Island people appear to have similar lifestyle characteristics which have lead to a higher prevalence of non-communicable diseases such as diabetes, hypertension, and gout to name a few. Being lifestyle characteristics the attributable factors are modifiable, specifically diet and physical activity. Obesity is by far the most modifiable characteristic of Pacific Island people.

Modernisation as a result of national development and migration, have attributed to increased physical inactivity and availability of a wider variety of food, generally processed or refined. Identifying some of the root causes of the high incidence of NCDs and undertaking interventions that are tailored to assist people in moderating their lifestyle without compromising development, is the first step towards instigating change.

3. Aims of the Study

The overall aim of this study is to conduct a pilot nutrition survey on adult Niueans living in Niue to provide a collection of data which best describes the present nutritional status of the people of Niue.

The objectives of this research are:

1. To develop the methodologies required to investigate dietary intake, body composition, activity patterns, blood glucose levels, blood pressure, demography and lifestyle in adult Niueans in Niue.

2. To pilot these methodologies in a sample of 50 randomly selected adult Niueans in the 18 to 60 year old age group in Niue.

3. To use the data collected and experience gained, to identify what additions and modifications in methodology would be required to conduct a national survey.

4. To use the data collected to identify useful nutrition, medical and lifestyle interventions that could be implemented to improve the health of the Niuean population.

4. Methodology

4.1 Pre-Survey Preparation

It was decided that random selection of study subjects was the best way to ensure a representative sample of the Niuean people and provide results indicative of the population.

The survey would encompass three main sections; 24-hour dietary recall, body measurements and general questionnaires. These sections were further sub-divided into three parts to coincide with the three visits per study subject. Letters of introduction, information sheets and consent forms were also drafted and translated into the Niuean language. It was felt there was no need to translate the questionnaires as the subjects were not going to read the questions themselves. The researcher translated the questions as they were asked during each visit.

The survey sheets and other relevant documentation were finalised and an application to the Massey University Human Ethnics Committee was submitted and approved (see Appendix B). This approval gave way to the final printing of the required number of survey documents.

Travel to Niue was undertaken on June 10th 2002 however research equipment and materials did not arrive in Niue until 24th June 2002. The pilot survey was carried out between the 26th June and 28th August 2002 on Niue Island. The following sections detail the processes undertaken leading up to, during, and following the survey.

4.2 Promotion Of Survey

Public awareness was essential for the success of the survey. Several media avenues were used for the purpose of creating awareness of the upcoming survey that included television, radio and newspaper. An interview was broadcast on both Radio Sunshine and Television Niue; and a newspaper article was published in the Niue Star. Hence, before receiving letters of introduction and information sheets, most, if not all of the potential subjects had heard about the survey.

4.3 Selection Of Study Subjects

The names of potential subjects were held by the Department of Justice, Lands and Survey, under the National Electoral Roll. Permission was granted for access to the roll and a sample size of 50 people was randomly selected from the adult Niuean population aged 18 to 60 years.

Random selection of the subjects was made using standard random tables. To obtain a representative sample of the population, the number of subjects per village was based on the proportion of males and females in that village aged between 18 and 60 years. Based on these numbers, an initial number of 50 men and 50 women were selected. The selection of a much greater number of potential subjects was to ensure that if anyone declined to participate in the survey, there would be another potential subject available, who had also been randomly selected. The final study sample of 50 people (25 men and 25 women), were again randomly selected from the previous 100 names.

There were exclusions to the study sample, for instance, where two potential subjects were selected and were from the same household, the former name would be chosen. Other exclusions included those who were over 60 years of age, and those who were not of Niuean descent. Appendix C presents the final number of people who participated in the survey.

Upon completion of the selection, each potential subject was sent letters of introduction (see Appendix D) and information sheets (see Appendix E) in either Niuean or English, depending on their preference. Three of the originally selected potential subjects graciously declined to take part. These people were then replaced by others who had previously been randomly selected, and consented to take part.

4.4 Data Collection Programme

The small population and geographic size of Niue made the completion of the survey possible within a short period of time. Data collection was divided into three stages, entailing three visits per subject, a total of 150 visits. Each visit was further divided into three parts, namely; 24-hour diet recall, anthropometric measurements and questionnaires.

A conservative time frame for each visit was set at one hour, however, each visit ranged between 30 and 45 minutes.

Appointments were made to visit the subjects at a time and place of their choosing. Most of the subjects wanted to be visited in their own homes, whilst others preferred to have the visit at their place of work. Data collection sheets for all visits are presented in Appendix F, which includes the 24-hour dietary recall sheets, the body measurements record sheets and all the questionnaires. Each visit to the subject was broken down as follows:

4.4.1 Visit One

Before the commencement of the first visit, each of the subjects was asked to read and sign a consent form (see Appendix G). The subjects were first asked to respond to the 24-hours dietary recall which took up to 30 minutes in some cases, depending on how much detail was needed. Part two of visit one were the body measurements which were of weight, height, elbow breadth, mid-upper arm circumference, waist and hip circumference. The last part of this visit consisted of responding to questionnaires A and B regarding general demographic and health background information.

4.4.2 Visit Two

The first part of this visit consisted of responses to the 24-hour dietary recall, followed by questionnaire D on food consumption patterns. The body measurements of random blood glucose and blood pressure were left until the end of the visit so as not to cause too much discomfort to the subject whilst trying to respond to the questionnaire.

4.4.3 Visit Three

The third and final 24-hour dietary recall was administered, followed by the questionnaires C and E. The last body measurement of fat mass was made using the BIA machine at the end of this visit.

4.5 Data Collection Procedures

4.5.1 24-Hour Diet and Activity Recall

This pilot survey will be the first of its kind to detail nutrient intake of the Niuean people in a quantitative manner using the 24-hour dietary recall approach. The 24-hour dietary recall was chosen as the most appropriate method in assessing the dietary intakes of the subjects. It was felt that food records would not be appropriate because subjects generally do not like to record things, let alone what they eat. This latter method may result in a lower response rate. There are no food frequency questionnaires designed specifically for Pacific Island populations and therefore were deemed inappropriate in this case. The 24-hour dietary recall method ensured that the researcher could prompt the subject to recall all the foods they ate along with respective amounts.

At each of the three visits, a 24-hour diet recall was carried out using the multiple-pass procedure, a three-step interview process.

- The first pass, otherwise known as the quick list, involved the subjects listing all the foods they had eaten during that time frame in the last 24-hours.
- The second pass involved a detailed description of the foods previously listed. The cooking method, amount eaten and accompaniments to the food are included. In cases where the visit was taking place at the subject's home, he/she was asked to bring their cup, plate or bowl and indicate how much of the food they had eaten. For example, when subjects listed corn flakes for breakfast, lima beans were poured into their bowl to the level they indicated and confirmed. The volume of the beans were then measured in the measuring cup and later converted to weight by the foods' respective density.
- The third and final pass of the recall is the review. The foods listed by the subjects were read out in the order in which they were consumed. Further questions were asked depending on the level of detail given previously. Once the list was confirmed, the activity recall began.

At each of the three visits, physical activity over the previous 24 hours was also recalled. The same time-frames as the diet recall were used in order to gauge energy expenditure on the same day. The subjects' were asked to list only their main activities.

4.5.2 Measurements of Body Composition

The measurements taken of body composition included anthropometric measurements and estimated fat mass. All anthropometric measurements were taken in sequence, followed by a second reading, again in sequence. Results were then averaged, but when duplicate readings were not very similar, a third reading was necessary. Measurements were made according to the criteria laid down by the International Society for the Advancement of Kinanthropometry (ISAK).

4.5.2.1 Weight

Weight was measured using Tanita digital platform scales (Model 1609N). Maximum weight allowable was 200 kg. The scales were calibrated using 5 kg weights before each measurement. The subject was asked to remove their shoes if necessary and any heavy items of clothing such as overalls. Most subjects however were dressed in light clothing because of the warm weather. Subjects were asked to stand on the scales with feet together, arms hanging loosely by their side and head facing forward. Measurements were made to the nearest 0.1 kg. A second measurement was made in sequence following the completion of the other anthropometric measurements. A third measurement was necessary when duplicate readings differed by more than 0.5 kg.

4.5.2.2 Height

Standing height was measured using a portable stadiometer specially designed by Massey University. Subjects were asked to remove their shoes and stand against a wall with their feet flat on the floor, heels together and weight evenly distributed on both feet. The subjects were asked to stand so that their back was positioned as straight as possible. They were asked to breathe in deeply and stretch to their fullest height without moving their head. The stadiometer bar was then lowered onto the subject's head. The subject was asked to step away whilst the bar was held into position and a measurement taken using the attached measuring tape. Readings were taken to the nearest 0.1 cm. A second measurement was made in sequence following the completion of the other anthropometric measurements. A third measurement was necessary when duplicate readings differed by more than 0.5 cm.

4.5.2.3 Circumference Measurements

All circumference measurements were made using a Birch tape (standard tailor's type). The tape was placed horizontally, pulled firmly but not to cause an indentation, and then the measurement recorded to the nearest 0.1 cm. Duplicate measurements were taken in sequence, and a third was made when the duplicates were more than 1.0 cm and 0.5 cm apart for the waist/hip measurements and the upper arm measurement.

The waist measurement was taken at the level of the natural narrowing located approximately midway between the costal border and the iliac crest. In subjects where the waist was not apparent, an arbitrary waist measurement was taken at this level. The measurement was taken at the end of a normal expiration. The hip measurement was taken at the level of the greatest posterior protuberance and at approximately the pubis level (anterior view). Subjects were asked to stand with feet together and without contracting the gluteal muscles. The mid-upper arm circumference was taken when the subject was asked to stand upright, with arm relaxed and hanging by the sides. The mid-upper arm circumference was taken as the perimeter distance of the arm parallel to the long axis of the humerus, at the pre-measured and marked mid-acromiale-radiale distance.

4.5.2.4 Elbow Breadth

The elbow breadth was measured using vernier bone callipers and recorded to the nearest 0.1 cm. The subject was asked to stand erect with their right arm extended forward, perpendicular to the body. The subject was then asked to flex their arm until the elbow formed a 90° angle with fingers up and palm facing inwards. The researcher felt for the location of the epicondyles and applied the callipers downwards at a 45° angle. Firm pressure was exerted to minimise the influence of soft tissue and the measurement recorded. A duplicate reading was made with a third required if the difference was more than 0.5 cm.

4.5.2.5 Bioelectrical Impedance Analysis (BIA)

The BIA was measured using SEAC BMI 4 (made in Australia) with a 50kHz, 800μA device. Prior to the last visit in which the BIA was to be done, subjects were advised of the following pre-testing conditions:

1. The subject should not eat for 4-5 hours prior to testing.
2. Alcohol should not be consumed 24 hours prior to testing.

3. The subject should not have exercised for 12 hours prior to testing.
4. The subject should empty their bladder immediately before testing.
5. The female subjects were also advised that the test could not be done immediately before or during their menstrual cycle.

Subjects were asked to remove their right shoe and sock and lie in a relaxed, supine position with legs and arms slightly apart and hands resting next to the body palms down. There was no skin to skin contact with arms and inner thighs not touching any other part of the body. Testing was done on the right side of the body where the electrode sites were cleaned first with ethanol.

The electrodes were placed as follows:

1. White: placed on an imaginary line bisecting the ulner head (bone on little finger side of right wrist).
2. Red: placed on the first joint of the middle finger, third metatarsal head dorsum on the right hand.
3. Blue: placed on an imaginary line bisecting the medial mellealus (bone on big toe side of ankle).
4. Black: placed on the base of the second toe, second metatarsal head dorsum on the right foot.

The leads were attached to the electrodes and the subjects were asked to lie quietly during the entire test. The measurements of Fat Mass (FM) and Fat-Free Mass (FFM) were recorded as they were displayed on the screen. Impedance, resistance and reactance were also displayed and recorded.

4.5.3 Random Blood Glucose

Subjects were advised that the test for blood glucose was best done at least 2 hours after they had eaten. This measurement was made using a MediSense Precision Q.I.D test kit, manufactured by Abbott Diagnostics Division, Australia. The test was done according to the instructions of the manufacturer. The site for testing was cleaned with ethanol prior to each test. The results were recorded and subjects were advised to seek medical

confirmation when the results indicated possible glucose intolerance. The criterion was set at $\geq$ 7.0 mmol/L according to the WHO classification for a fasting glucose test.

4.5.4 Blood Pressure

The original mercury monitor purchased for the survey was not suitable for the majority of the subjects because the arm cuff was too small. This was an unforeseen circumstance and was not realised until after several subjects (with smaller arm girths) had been measured. The Niue Health Dept. offered the use of their aneroid sphygmomanometer model 2206KTL (made in Germany) with a 54 cm arm cuff, which was then used for all the blood pressure measurements. Previously measured subjects were measured again with the bigger arm cuff to ensure consistency. Subjects were asked to rest their arm on the table so that their inner elbow was level with their heart. Duplicate measurements were made and the average measurement used in the analysis of blood pressure.

4.5.5 Questionnaires

The questionnaires were pre-tested on five Niuean people in New Zealand prior to final printing. From the pre-test results, a few minor modifications were made. There were some questions that were specifically designed for the people in Niue and therefore were not relevant to those in New Zealand. For example, the questionnaire C on food production was designed to gauge the ability of subjects to grow or have access to local foods. Hence, whilst the response from the pre-test was poor for this section, it was not changed.

The minor modifications made were the inclusion of tables for recording subjects' responses to a number of questions. For example, table A1 of questionnaire A detailed the responses to questions A1 to A5d. The use of the table eliminated having a long list of questions and responses, as the demographic details for each household member were in separate rows. This made the information easier to read and enter into the computer. Tables of this kind were used for a number of questions.

Another slight modification was in terms of alcohol consumption. Where originally question B15 listed individual classes of alcohol as a main drink. Some of the subjects in

the pre-test responded generally having a combination of drinks. Hence some drink combinations were added to this question; namely beer and spirits, beer and wine.

There were five sets of questionnaires altogether, presented during the three visits. Questionnaires A and B were presented during visit one. Questionnaire A consisted of general questions, including household composition, occupation, education and so forth. Questionnaire B consisted of health and lifestyle questions such as current health problems, family occurrence of some diseases, smoking, and so forth. Questionnaire D was presented during the second visit, and consisted of food consumption patterns, specifically the number of helpings of different foods. Questionnaires C and E were presented at the third and final visit. Questionnaire C covered food production practices, that is, what kind of crops subjects grew in the plantations, whether they had the opportunity to fish, and so forth. Questionnaire E consisted of physical activity questions, whether subjects undertook some form of regular physical activity and to what intensity.

4.6 Data Feedback

At the completion of the data collection period, all the subjects were invited to an afternoon feedback session where they were given their individual feedback forms in the language of their preference either English or Niuean (see Appendix H). The feedback detailed the subject's body measurements with a brief description of the meaning of their results. Standards were also included so that subjects could compare their status with published standards. The afternoon feedback session included a brief overview from the researcher regarding the survey. Some nutritional information on good dietary practices was handed out, including an overview of the new food groups for the Pacific Islands.

The subjects were very pleased with the feedback commenting that this was the first time that they had been given some results with an explanation of what they meant. They were given an opportunity to make suggestions for a national survey, where most said that they were just happy to have been a part of this survey, and hoped to be included in any future ones.

4.7 Data Input and Checking

All the data excluding the 24-hour dietary recall was directly entered into Microsoft Excel Spreadsheets. The responses to the questionnaires were all coded and the codes entered into their subsequent spreadsheets. The results of the body measurements were entered directly into their subsequent spreadsheets.

The 24-hour dietary recall results were entered into Foodworks Professional Version 3 (Xyris software, Australia). The New Zealand Food Composition Database (NZFCD) was used as the basis of the foods reported in the recall. Once the results were entered, they were exported into Microsoft Excel and checked for 'outliers'. This was an important part of the analysis because it showed where some nutrients were well in excess of others. Any identified outliers were re-checked with the original data in Foodworks and corrected if necessary. There were a number of outliers, all of which were attributed to mistyping. For example, one subject had over five times as much food as others; upon re-checking the subject's data in Foodworks, it was found that 250 g had been entered as 250 cups. There were a number of other outliers which were corrected by re-checking this way. Another subject had an energy intake far in excess of the others, upon re-checking with the Foodworks data it was found to be correct and due to the subject having consumed a large amount of alcohol.

There were some Niuean foods which were not available in the NZFCD but were available in the Pacific Islands Food Composition Database (PIFCD). However, not all the nutrient composition of these foods was covered in the PIFCD. The PIFCD does not have analyses for the fatty acids (S:M:P), sugars, starch and fibre, to name a few. Therefore the NZFCD was chosen as the primary database to be used for dietary analysis.

There were some foods which were available in other databases under Foodworks, namely the Australian and the Pacific Island Databases. Some foods and their analyses were brought from these sources and added to the Foodworks list as new foods. The six foods added this way are presented in Appendix I, with their respective nutrient analyses. Some foods did not appear on any database and therefore the closest alternative had to be used. For example, the local Niuean spinach and nightshade were not in any database hence the

alternative New Zealand spinach was used. Where subjects ate particular dishes, the recipes were obtained from either the subjects themselves of from their family. There were 16 recipes provided and these too were entered into the programme. These recipes also included some of the common local dishes.

4.8 Data Analysis

Once all the data was in the form of spreadsheets in Microsoft Excel, the results were organised in the manner needed for the final presentation of results for the thesis. All the body measurements and dietary recall data were analysed for mean, median, standard deviation (SD), standard error of the mean (SEM), and range using the programme's built-in statistical tools.

Graphs and tables of the results were likewise made using the Microsoft Excel programme, including the comparative tables presented in the discussion. All analyses and final presentations were made using Microsoft Excel.

5. Results

5.1 Demographic Characteristics

5.1.1 Age Distribution

Table 5.01 illustrates the age distribution of all the study subjects, where the majority of the women (64%) were aged between 31 and 40 years, and the majority of the men (60%) were aged 41 to 50 years.

Table 5.01: Age distribution of subjects by gender

Age group	Men	Women	All
18-24	1	1	2
25-30	4	3	7
31-40	8	8	16
41-50	9	6	15
51-60	3	7	10

5.1.2 Household Size and Composition

Household size varied, but overall was very similar. Household numbers ranged from one (the subject living alone) to nine people. This was the same in the households of both the male and female subjects.

Household composition is illustrated in Table 5.02, which shows different members of the households surveyed. Children made up most of the household members. Overall, 68% of the subjects were living with their children, 60% were living with their husband or wife, followed by 28% living with their parent(s) and 24% living with other relatives.

5.1.3 Household Income Sources

Table 5.03 presents the breakdown of household members that undertake some form of paid work, and those that do not. Overall, 86% of all study subjects were in paid work, of whom 14% are employed part time and 86% full time.

Table 5.02: Number of subjects living with other household members

Household members	Men	Women	Total
Wife/Husband	14	16	30
G/Parent(s)	2	0	2
Parent(s)	9	5	14
Child(ren)	14	20	34
G/Child(ren)	3	4	7
Other Relative(s)	6	6	12
Friend(s)	1	0	1

Table 5.03: Percentage of household members undertaking paid work

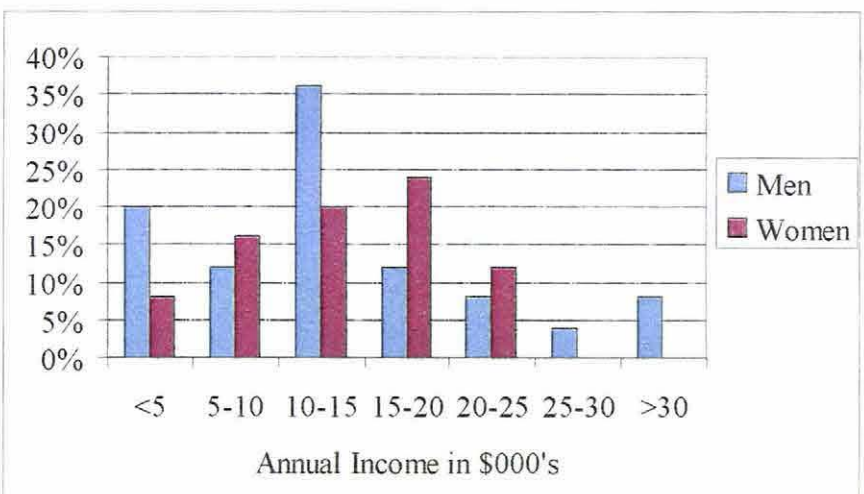
	Members in paid work	Members not in paid work
Study subject	86%	14%
Wife/Husband	67%	33%
Subjects' Mother	54%	46%
Subjects' Father	43%	57%
Subjects' Children	10%	90%
Other relatives	13%	87%
Total	**38%**	**62%**

The occupation of those in paid work was classified according to the International Standard Classification of Occupations (ISCO-88). The majority of household members were professionals such as teachers, dentists, nurses, librarians and so forth, which accounted for 34% of all the household members undertaking paid work. Legislators, senior officials and managers accounted for 21% of the household members. Examples were members of parliament (2), heads of departments (2) and other managers. Clerks accounted for 18% of those undertaking paid work and 6% were employed in elementary occupations such as cleaning. There were also other household sources of income apart from paid work. These sources include income from produce sales, handcrafts, fish sales, pension, and superannuation. Most other income was from pension payments (17%) and craft sales (10%).

5.1.4 Income Level of Study Subjects

Income levels ranged from less than $4,999 to over $30,000 per annum, graphically presented in Figure 5.01. Income levels for male subjects spread over a wider range than those of the female subjects; the majority (36%) of whom were earning between $10,000 and $15,000 per annum. Annual income of the female subjects ranged from <$5,000 to between $20,000 and $25,000, with the majority (24%) earning between $15,000 and $20,000 a year. Unlike some of their male counterparts, none of the female subjects earned more than $25,000 per annum. However, 20% of the female subjects did not know how much they were earning a year. These women were either undertaking part time employment and/or getting income from craft or produce sales.

Figure 5.01: Income level of study subjects



5.1.5 Education Level of Study Subjects

The subjects' education level was gauged by the highest level of achievement and these ranged from primary school to degree level at a tertiary institution (see Table 5.04).

Table 5.04: Highest education level attained by the study subjects

Highest education level achieved	Men	Women	All
Primary school	0%	4%	2%
Form 1-4	24%	12%	18%
Form 5	24%	36%	30%
Form 6	16%	8%	12%
Form 7	0%	4%	2%
Tertiary	36%	36%	36%

5.2 Lifestyle Characteristics

5.2.1 Physical Activity

5.2.1.1 Laundry Duties

The most common form of physical activity for women was general housework, which consisted of cleaning or sweeping the house, washing clothes or picking up rubbish outside their homes. Table 5.05 presents the breakdown of laundry duties undertaken by the subjects and the approximate MET value for each activity. A MET is defined as a multiple of the resting metabolic rate, hence 2 METs is equivalent to activity involving twice the metabolic rate (McArdle et al, 1991). Clothes were washed using three methods, namely by hand-washing, wringer machine and automatic washing machine. The majority of women (44%) wash clothes using a wringer machine with an average of four loads per week. Those using an automatic machine accounted for 36% with an average number of 8 loads per week. Hand-washing was not as common but still being performed by 16% of the women with an average of 5 loads per week.

The men in the study sample did not do as much laundry as the women. Most of the men (32%) used an automatic washing machine with an average number of two loads per week. Hand-washing and wringer machine was used by 24% and 28% of the men respectively, both averaging three loads per week. Four of the men and one woman did not do any laundry at all (Table 5.05).

Table 5.05: Subjects' involvement in laundry duties

Method	MET[1] value	Women	Men	All
Hand washing	4	16%	24%	20%
Wringer machine	3	44%	28%	36%
Automatic machine	2	36%	32%	34%

[1]A MET is defined as a multiple of the resting metabolic rate (McArdle et al, 1991).

5.2.1.2 Bush Work

Bush work is commonly regarded as a man's job, given the level of strenuous activity involved. However, women are not restricted from participating, as it is a form of

gardening and the main food production practice. Most of the women who spent some time on bush work (48%) spent less than two hours per week tending their bush gardens or plantations. A further 32% spend between three to five hours per week and only one woman reported that she spent more than 10 hours per week working in the bush (Table 5.06).

Men spent more time tending their bush gardens than women (Table 5.06). The majority (36%) of men spent more than 10 hours per week at their bush gardens. The main 'bush' day is Saturday but people also spend a few hours during the week performing tasks such as weed spraying or fertilising crops. One man in particular spent about four hours per day (24 hours per week) at the bush.

Table 5.06: Subjects' involvement in bush duties

Hours/week	Women	Men	All
0 hrs	16%	12%	14%
0-2 hrs	48%	0%	24%
3-5 hrs	32%	20%	26%
6-10 hrs	0%	32%	16%
>10hrs	4%	36%	20%

5.2.1.3 Leisure-time Activities

Table 5.07 presents the percentage of subjects who undertook different forms of regular sporting or other leisure-time activities. More than half the women walked regularly, with an average of three hours per week and only a few undertook other sporting/physical activities. The most common response when asked what other regular activities did they do, the women replied "house-work", hence household chores was added to the list of physical activities, where 68% of the women performed these on a regular basis and believed that to be a worthwhile form of physical activity.

The subjects were also asked whether they exerted enough effort in these physical activities to the point where they would 'puff'. For example, a reasonable amount of effort would be exerted during a brisk walk compared to a relaxing stroll and thus it was more likely that

the subject would 'puff'. Subjects were also asked whether they felt that their participation in physical activities had changed in any way compared to the previous year (Table 5.08).

Table 5.07: Percentage of subjects undertaking regular physical activities

Activity	MET value[1]	Women	Average hrs/week	Men	Average hrs/week	All	Reasonable effort exerted[2]
Walking	3.5	56%	3	28%	1	42%	22%
Jogging	7.0	8%	0	12%	1	10%	10%
Cycling	6.0	8%	3	0%	0	4%	2%
Weights/Gym	6.0	4%	3	24%	4	14%	16%
Rugby	10.0	4%	0	20%	5	12%	10%
Netball	6.0	8%	3	0%	0	4%	4%
Swimming	4.0	4%	1	16%	1	10%	8%
Dancing	4.5	8%	2	4%	0	6%	6%
Household chores	4.0	68%	11	4%	1	36%	14%
Spearfishing	5.0	0%	0	4%	2	2%	2%
Golf	4.5	8%	0	4%	4	6%	2%

[1]A MET is defined as a multiple of the resting metabolic rate (McArdle et al, 1991).
[2]Reasonable effort implies that subjects undertook activities to a point where they were 'puffing'.

Table 5.08: Percentage of subjects whose activity levels had been reduced or were unchanged compared to the previous year.

	Women	Men	All
Much less active	20%	8%	14%
Less active	16%	8%	12%
No change	64%	84%	74%

5.2.1.4 Sedentary Activities

Subjects were asked how many hours (in a typical 24-hour day) they would spend on sedentary activities. These activities included sleeping, sitting (at work or otherwise), watching television, reading etc. The average number of hours spent on sedentary activities is shown in Table 5.09.

Table 5.09: Hours of sedentary activity per day

	Mean	Median	SEM	Min	Max
Women	15	16	0.49	9	18
Men	14	14	0.45	11	19
All	15	15	0.34	9	19

5.2.1.5 General Activity Levels

Activity levels were also recorded during the 24-hour diet recall and results have been classified according to the three days in which the diet recall took place, namely Sunday and two weekdays (Table 5.10). On Sunday, all the subjects undertook very light activities. These included sitting in church, relaxing at home, watching videos and so forth. Sunday is considered a day of rest, both religiously and literally. There is a lot more opportunity for physical activity during the week, which is also reflected in Table 5.10. Activities during the two weekdays ranged from 'very light' to 'very heavy'. Examples of 'very light' activities included sitting at work in front of a computer. Household chores were classified as 'light' activities, compared to bush work, which was classified as either 'heavy' or 'very heavy' depending on the main bush activity. For example, harvesting taros was classified as 'heavy', whilst weed spraying (carrying a knapsack full of weed killer spray around the plantation) was classified as 'very heavy' activity.

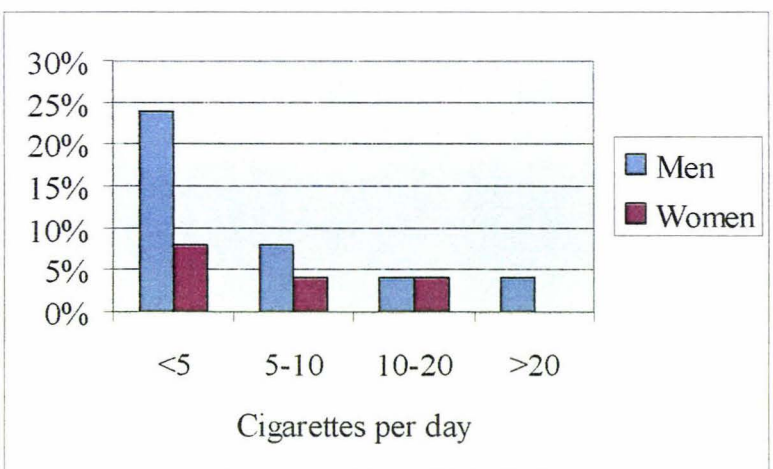
Table 5.10: General activity levels

	Activity Level	MET value	Sunday	Weekday 1	Weekday 2
Men	Very light	0.9-1.0	100%	16%	8%
	Light	2.0-3.0	0%	32%	52%
	Moderate	3.5-4.5	0%	20%	0%
	Heavy	5.0-6.0	0%	24%	40%
	Very heavy	>6.0	0%	8%	0%
Women	Very light	0.9-1.0	100%	12%	12%
	Light	2.0-3.0	0%	72%	84%
	Moderate	3.5-4.5	0%	16%	4%
	Heavy	5.0-6.0	0%	0%	0%
	Very heavy	>6.0	0%	0%	0%

5.2.2 Smoking

The majority of the subjects who smoked were men, but more on 'social' occasions than regularly. Overall, ten of the men (40%) and 4 women (16%) reported that they smoked, whilst four men (16%) and three women (12%) reported they were exposed to secondary smoke at home. Smoking during social occasions was described as smoking whilst at a party or a club with friends, where alcohol drinking was usually accompanied by cigarette smoking. The reported 'social' smokers would smoke up to five cigarettes at any one occasion, usually on a Friday or Saturday night. Thus, these people were classified as smoking less than five cigarettes per day (this may overestimate usage by some people and underestimate others). Figure 5.02 shows 24% of the men and 8% of the women smoked 'socially'. Subjects who smoked on a regular basis would smoke between five and more than 20 cigarettes per day. One of the men smoked more than 20 cigarettes per day but none of the women did.

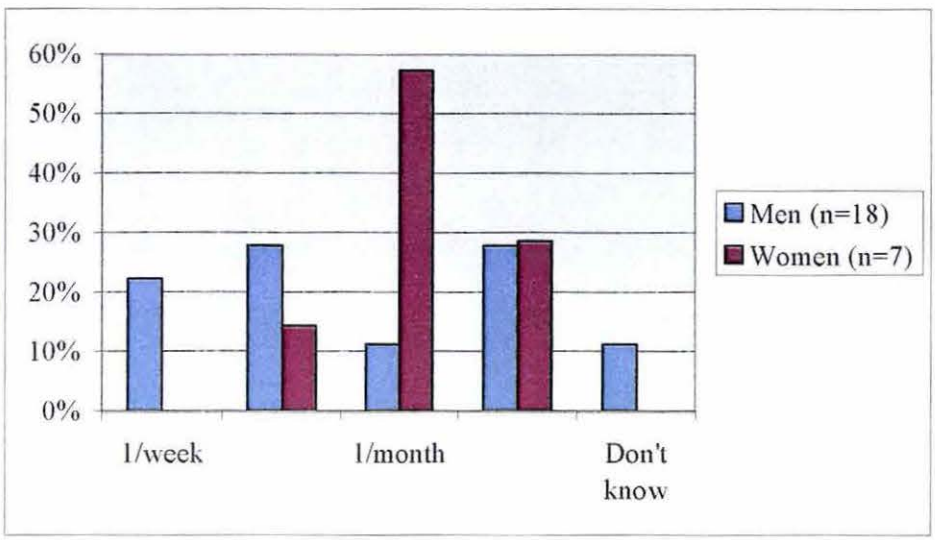
Figure 5.02: Smoking among all subjects



5.2.3 Alcohol Consumption

Men drank alcohol more than women; with 72% of all male subjects reporting that they drank alcohol. Of all the female subjects, 28% reported they drank alcohol. In addition, men drank more frequently than women. Of the subjects who drank alcohol, 50% of the men drank at least once a week, compared to only 14% of the women. Of the women who did drink, most of them (57%) drank alcohol once a month, whilst only 11% of the men drank once a month (Figure 5.03).

Figure 5.03: Frequency of alcohol consumption among subjects who drank



When asked what their main drink was, men reported beer (39%), spirits (17%) and both beer and spirits (44%). All the women on the other hand considered beer to be their main drink (Table 5.11). Women reported drinking up to two glasses of beer in a drinking session, whilst men drank alcohol in amounts ranging from two glasses to more than five litres in a given session. Most of the men (33%) would drink between three and five litres of alcohol, followed by 16% who drank between one and two litres per session. Three of the men (17%) reported they drank more than five litres per session. Drinking time was also reported in order to calculate blood alcohol levels in a drinking session.

Table 5.11: Usual alcohol consumption among subjects who drank

	Men	Women	All
Usual drink			
Beer	39%	100%	56%
Spirits	17%	0%	12%
Beer + Spirits	44%	0%	32%
Duration of usual drinking session (hrs)			
<1	0%	29%	8%
1-2	39%	14%	32%
3-4	44%	43%	44%
>5	17%	14%	16%

Given the large volume of alcohol consumed by some of the men, their blood alcohol concentrations (BAC) at time zero and at the end of their drinking session were estimated and are presented in Table 5.12. The levels for women are not presented as they are within legal limits. Results show that of the 18 men who drank, only three had blood alcohol concentrations within the legal limit of 0.8g/L at the end of an average drinking session. BAC ranged from 0.37g/L to 9.21g/L, equivalent to 46% and 1151% of the legal limit respectively. The mean and median BAC was 3.04g/L and 2.49g/L respectively.

Most of the men (22%) had BAC between 100 and 150% in excess of the legal limit. The minimum percentage in excess of the legal limit was 40% and the maximum was 1151%. Based on the reported volumes consumed, 83% of the men who drank alcohol, drank to intoxicating levels, well above the legal limit, during a drinking session.

Table 5.12: Estimated blood alcohol concentrations for the men who drink

Subject	Amount in a Session (ml)[1]	TBW (Litres)[2]	Total Alcohol (g)[3]	Blood Alcohol Conc. (Co)[4] (g/L)	Blood Alcohol Conc. (Ct)[5] (g/L)
1	563	47.68	186	3.11	2.79
2	563	45.43	186	3.27	3.14
3	785	55.87	53	0.76	0.37
4	1250	52.18	50	0.77	0.38
5	1420	42.96	57	1.06	0.80
6	1670	42.84	139	2.60	2.28
7	1710	48.61	358	5.90	5.25
8	2130	42.88	85	1.59	1.20
9	2693	52.28	271	4.14	3.95
10	3195	46.50	128	2.20	1.81
11	3550	41.01	142	2.77	2.38
12	3550	48.82	142	2.33	2.07
13	3550	40.51	142	2.80	2.61
14	3700	54.36	192	2.82	2.30
15	4410	46.02	220	3.82	3.56
16	5260	46.99	542	9.22	7.40
17	5325	48.61	213	3.51	3.31
18	9520	52.36	671	10.25	9.21

[1] Total amount of alcohol usually consumed in an average drinking session.
[2] Total Body Water (TBW): 2.447-0.09516 Age(yrs) + 0.1074 Height(cm) +0.3362 Weight(kg);
[3] Total Alcohol (A) content in beer (conversion factor = 0.04g/ml) and spirits (conversion factor = 0.33g/ml).
[4] Blood Alcohol Concentration at Time Zero: Co= (0.80/TBW) x A
[5] Blood Alcohol Concentration at end of drinking period Ct= Co-ßt (ßt is the rate of ethanol disappearance from the blood after time t)

5.2.4 Medical Background

5.2.4.1 Health Perception

Subjects were asked to describe their current health status and whether they felt there was a change from the previous year. More than half the subjects (60%) stated that they felt their health was 'good' and was 'about the same' as the previous year. Only five people (10%) felt their health was fair and somewhat worse from the previous year. Ten people (20%) felt that their health was somewhat better than the previous year (Table 5.13). When asked how often they would go to the doctor's for a medical check up, 64% reported they only visit the doctor when they feel ill. Four people (8%) went once a year, and 16% and 12% went for a check up every three and six months respectively.

Table 5.13: Subjects' health perception and frequency of medical check-up.

Current health perception	All	Compared to previous year	All	Frequency of medical check up	All
Excellent	10%	Much better	10%	3 months	16%
Very good	20%	Somewhat better	20%	6 months	12%
Good	60%	About the same	60%	Once a year	8%
Fair	10%	Somewhat worse	10%	Only when feeling ill	64%

5.2.4.2 Medical History

Subjects' were asked whether a doctor had ever told them they had diabetes, hypertension, gout, heart disease, asthma, or any other medical illness. Table 5.14 presents responses to these questions. Six (24%) of the women had diabetes and were taking tablets, whilst only one man (4%) had diabetes and had daily injections. Four (16%) of the women also had hypertension, compared to three (12%) of the men. Not surprisingly, more men (16%) than women (4%) confirmed they suffered from gout, whilst a number of women (36%) suffered from arthritis. Of all the study subjects 17 men (68%) and nine women (36%) reported not suffering from any of the aforementioned diseases.

More women (44%) than men (32%) were taking regular medication for treatment of their associated illness. The types of medication taken were similar for men and women. Subjects' who were suffering from diabetes and hypertension were taking Gliben 5, and Accupril respectively.

Table 5.14: Subjects' reported health problems

Disease	Men	Women	All
Diabetes	4%	24%	14%
Hypertension	12%	16%	14%
Gout	16%	4%	10%
Arthritis	0%	36%	18%
Heart disease	8%	8%	8%
Asthma	0%	16%	8%

Of all the subjects who suffered from NCDs, only eight of the women (32%) and four of the men (16%) had received any dietary or lifestyle advice to assist in the control of their diseases (Table 5.15). The advice given was the same to all these subjects, namely; cut down on salt intake, alcohol consumption, cigarettes, high fat foods, and do more exercise. The women who suffered from arthritis, whilst not given any dietary advice were told to do more exercise such as walking. Overall, subjects reported 'trying' to follow the doctor's advice.

Table 5.15: Percentage of subjects on medication & subsequent lifestyle changes

	Men	Women	All
Taking medication for condition	32%	44%	38%
Received dietary/lifestyle advice	16%	32%	24%
Made dietary/lifestyle changes	16%	36%	26%

5.2.4.3 Family's Medical History

Subjects were asked whether they knew of other family members (both immediate and extended) who also suffered from similar illnesses (Table 5.16). Most of the subjects had at least one relative with some type of non-communicable disease. Overall, nearly half the subjects (46%) had one or two relatives who suffered from hypertension, followed by 34% who had 1-2 relatives with diabetes, and 32% with 1-2 relatives with gout. Some of the women reported having more than five relatives who suffered from diabetes, stating that diabetes was a 'family' disease.

Table 5.16: Percentage of subjects with at least one relative suffering from an NCD

Disease	1-2 relatives	3-4 relatives	>5 relatives
Diabetes	34%	12%	12%
Hypertension	46%	10%	0%
Gout	32%	4%	0%
Heart disease	16%	2%	0%
Asthma	30%	2%	0%

5.3 Anthropometric Measurements

The results of the anthropometric measurements of weight, height, body mass index, upper-arm circumference, elbow breadth, waist circumference, and hip circumference are presented in Tables 5.17, 5.18 and 5.19.

5.3.1 Weight and Height

Given the small sample size, both the men and the women were divided into only two age categories. The mean weight of women aged 20 to 40 years and those aged 41 to 60 years were 89.2 kg and 85.8 kg, a difference of -3.4 kg (Table 5.17). Results here show that women aged 20 to 40 years were heavier than their 41 to 60 year old counterparts.

The mean weight for the men aged 20 to 40 years and 41 to 60 years was 95.0 kg and 88.6 kg respectively, a difference of -6.4 kg (Table 5.18). Results show a higher mean weight for the men aged 20 to 40 years. When all men were considered together their mean weight of the men was 91.9 kg.

The mean height of women aged 20 to 40 years and those aged 41 to 60 years was 162.3 cm and 159.7 cm respectively, a difference of -2.6 cm (Table 5.17). There is a slight tendency for the heights to be normally distributed, and decrease with age, but with such a small sample size, it is not conclusive. The mean height of men aged 20 to 40 years was 172.3 cm, and the mean height of those aged 41 to 60 was 171.1 cm (Table 5.18). The men were on average, taller than the women by around 10 cm (Table 5.19).

Table 5.17: Women's anthropometric measurements by age group.

Measurement	Age Group	Mean	Median	SEM	Lower Quartile	Upper Quartile	Minimum	Maximum
Weight (kg)	20-40	89.2	89.9	3.10	81.4	98.0	73.2	107.3
	41-60	85.8	86.7	4.05	74.1	91.5	67.6	118.8
Height (cm)	20-40	162.3	161.2	1.84	158.9	165.0	154.0	175.1
	41-60	159.7	158.5	1.43	155.1	165.0	153.5	169.6
BMI (kg/m^2)	20-40	33.9	33.4	1.13	30.8	35.9	28.1	41.2
	41-60	33.6	33.7	1.42	29.1	36.4	26.9	43.6
UAC (cm)	20-40	37.5	36.6	1.16	35.1	40.2	31.1	45.1
	41-60	38.5	38.6	1.16	37.0	39.6	32.0	48.1
Elbow Breadth (cm)	20-40	6.6	6.6	0.09	6.4	6.9	6.1	7.1
	41-60	7.0	7.0	0.07	6.8	7.2	6.8	7.6
Waist Circumference (cm)	20-40	95.9	96.5	1.96	91.0	99.0	86.0	109.6
	41-60	97.4	97.5	3.36	86.8	105.0	80.0	117.5
Hip Circumference (cm)	20-40	116.9	117.3	2.14	113.2	123.3	102.1	126.0
	41-60	113.7	110.1	3.23	107.5	117.9	100.0	139.9
Waist:Hip ratio	20-40	0.82	0.83	0.01	0.80	0.85	0.74	0.87
	41-60	0.86	0.84	0.02	0.83	0.91	0.74	0.96

Table 5.18: Men's anthropometric measurements by age group.

Measurement	Age Group	Mean	Median	SEM	Lower Quartile	Upper Quartile	Minimum	Maximum
Weight (kg)	20-40	95.0	92.6	2.82	88.4	101.0	77.5	112.1
	41-60	88.6	87.1	3.10	82.1	94.0	73.0	109.7
Height (cm)	20-40	172.3	173.1	1.08	172.5	174.2	160.1	176.1
	41-60	171.1	170.4	1.56	168.2	175.3	160.0	178.5
BMI (kg/m^2)	20-40	32.0	31.7	0.81	29.9	33.4	27.8	37.4
	41-60	30.2	30.8	0.84	27.9	32.4	25.2	34.6
UAC (cm)	20-40	38.8	38.5	0.81	37.5	39.3	34.7	46.0
	41-60	37.8	37.7	0.71	36.6	39.3	33.5	42.0
Elbow Breadth (cm)	20-40	7.4	7.4	0.04	7.3	7.5	7.2	7.7
	41-60	7.3	7.3	0.10	7.1	7.7	6.8	7.9
Waist Circumference (cm)	20-40	96.7	97.0	2.03	92.5	103.1	85.5	110.1
	41-60	96.9	96.4	2.04	93.8	101.3	83.1	108.5
Hip Circumference (cm)	20-40	107.6	107.0	1.74	103.1	113.1	99.9	119.5
	41-60	104.5	103.3	1.68	99.7	109.3	97.6	115.0
Waist:Hip Ratio	20-40	0.90	0.90	0.01	0.86	0.92	0.86	0.97
	41-60	0.93	0.93	0.01	0.91	0.96	0.79	1.00

Table 5.19: Total anthropometric measurements of all study subjects by gender.

		Age (yrs)	Weight (kg)	Height (cm)	BMI (kg/m^2)	Upper Arm Circumference (cm)	Elbow Breadth (cm)	Waist Circumference (cm)	Hip Circumference (cm)
Men	Mean	39	91.9	171.7	31.1	38.3	7.4	96.8	106.1
	Median	38	90.1	172.6	31.1	38.1	7.3	97.0	105.0
	SD	9	10.7	4.6	3.0	2.7	0.3	7.0	6.2
	SEM	1.9	2.1	0.9	0.6	0.54	0.05	1.41	1.2
	LQ	34	84.7	170.3	29.2	37.1	7.2	93.3	101.0
	UQ	47	100.1	174.4	33.2	39.3	7.6	102.1	110.0
	Min	22	73.0	160.0	25.2	33.5	6.8	83.1	97.6
	Max	55	112.1	178.5	37.4	46.0	7.9	110.1	119.5
Women	Mean	42	87.4	161.0	33.7	38.0	6.8	96.7	115.2
	Median	41	87.2	159.5	33.7	37.5	6.9	97.5	116.6
	SD	11	12.7	5.8	4.5	4.0	0.3	9.7	9.8
	SEM	2.2	2.5	1.2	0.9	0.81	0.07	1.95	2.0
	LQ	33	77.4	157.0	30.4	35.4	6.7	90.9	107.8
	UQ	51	97.6	165.0	36.4	40.1	7.1	103.0	120.0
	Min	18	67.6	153.5	26.9	31.1	6.1	80.0	100.0
	Max	57	118.8	175.1	43.6	48.1	7.6	117.5	139.9

5.3.3 Body Size

5.3.3.1 Body Mass Index (BMI)

The Body Mass Index (BMI) is calculated as weight (kg) over height^2 (m). The BMI cut off points for Pacific Island and Maori populations are slightly higher than those for European and Asian populations. A BMI between 20 and 25 is considered healthy. A BMI between 26 and 32 is considered overweight, and a BMI greater than 32 is considered obese. The BMI classification of the study sample is presented in Table 5.20.

Considering the men sampled, 60% were classified as overweight, whilst 40% were obese. The women on the other hand were classified vice versa, with 40% overweight and 60% obese. In total, half of the study subjects were classified as overweight and half were classified as obese.

Table 5.20: The percentage of overweight and obese subjects according to BMI.

	Age group	Overweight[1]	Obese[2]
Men	20-40	54%	46%
	41-50	67%	33%
	All	**60%**	**40%**
Women	20-40	42%	58%
	41-50	38%	62%
	All	**40%**	**60%**
All Subjects		**50%**	**50%**

[1]Percentage of subjects with 26 kg/m^2 ≤ BMI <32 kg/m^2
[2]Percentage of subjects with BMI ≥ 32 kg/m^2

5.3.3.2 Desirable weight

Relative weight of each subject was taken as the percentage actual body mass (kg) over the desirable/standard weight for height (kg) as shown in the Metropolitan Height and Weight Table (Faulkner, 1983). Given the results of the BMI calculations, it was not surprising to find that all of the subjects' weights were over their desired or standard weights, based on height and frame size. The weight differences ranged from a subject whose actual weight was 4.1 kg over their desirable weight to a subject who was 41.4 kg over their desirable weight.

Body weight that is 100 to 109% of standard weight is considered optimum for health. Body weights 110 to 134% of standard weight are considered overweight and greater than 135% are obese. None of the men sampled were over 160% of their standard weights, 11 were over 110%, and 12 were over 130%. The weights of the women on the other hand were more spread out. Six of the women were over 110%, 12 were over 130% and 4 were over 160% of their standard weights.

Overall, 34% of the total study subjects were over 110% of their standard body weights, 48% were over 130%, and 8% were over 160%. The remainder were between 100 and 109% of their standard weights. Table 5.21 presents the mean and range of the subjects' actual weights in excess of their desirable weights.

Table 5.21: Subjects' actual weight (kg) in excess of their desirable weight as set out in the Metropolitan Weight/Height Tables, by age group and gender.

	Age Group	Mean	Min	Max
Men	20-40	24.2	11.3	41.4
	41-60	18.8	4.1	35.0
Women	20-40	25.0	12.5	43.0
	41-60	21.3	4.3	50.9

5.3.4 Upper arm circumference (UAC)

The mean mid-upper arm circumference of women aged 20 to 40 years was 37.5 cm, about 1 cm lower than the mid-upper arm circumference of women aged 41 to 60 years (Table 5.17). The mean mid-upper arm circumference of men aged 20 to 40 years was 38.8 cm, and unlike the women was higher than the mean mid-upper arm circumference of the men aged 41 to 60 years. The overall mean circumference was 38.3 cm (Table 5.18).

5.3.5 Elbow Breadth and Frame Size

The women aged 20 to 40 years had a mean elbow breadth of 6.6 cm, slightly lower than the mean elbow breadth of women in the older age group at 7.0 cm (Table 5.17). The men aged 20 to 40 years had a mean elbow breadth of 7.4 cm, very similar to the older men with a mean of 7.3 cm (Table 5.18).

The frame size of the subjects was estimated from their height (cm) and elbow breadth (cm). Table 5.22 illustrates the frame size of the study subjects. Of those who had large frames, 20% were men and 80% were women. Interestingly, all the women aged 41 to 60 years had large frames.

Table 5.22: Percentage of subjects classified by small, medium or large frames according to elbow breadth and height.

	Age Group	Small Frame	Medium Frame	Large Frame
Men	20-40	0%	86%	17%
	41-60	14%	29%	36%
	All	**8%**	**64%**	**28%**
Women	20-40	0%	42%	58%
	41-60	0%	0%	100%
	All	**0%**	**20%**	**80%**
All		**4%**	**46%**	**50%**

5.3.7 Waist Circumference

The mean waist measurement of women aged between 20 to 40 years (95.9 cm) was lower than the mean of the women aged between 41 to 60 years (97.4 cm), Table 5.17. The mean waist measurement of the men was very similar in both age groups (Table 5.18).

5.3.7.3 Risk Assessment by Waist

The waist measurement criteria were used to assess risk among the subjects. Table 5.23 illustrates the risk assessment. From the measurements taken, all of the women were at some risk, with 20% at increased risk and 80% already at substantial risk of developing cardiovascular disease and other complications. Fewer men were 'at risk' compared to women. The total number of men 'at risk' was 17 (68%), of which 40% were at increased risk and 28% were at substantial risk.

5.3.8 Hip Circumference

The mean hip circumference for women aged 20 to 40 years (116.9 cm) was higher than the mean hip circumference of women in the older age group (113.7), Table 5.17. The mean hip circumference for men aged 20 to 40 years (107.6 cm) was higher than the mean hip circumference of the men in the older age group (104.5 cm), Table 5.18.

Table 5.23: Percentage of subjects classified 'at risk' according to waist circumference.

	Age group	Increased Risk	Substantial Risk
Men	20-40	31%	31%
	41-50	50%	25%
	All	**40%**	**28%**
Women	20-40	33%	25%
	41-50	15%	38%
	All	**20%**	**80%**
All		**30%**	**54%**

5.3.9 Waist to Hip Ratio

The mean waist to hip ratio for women aged 20 to 40 years was 0.82 and for women aged 41 to 60 years, 0.86 (Table 5.17). The mean waist to hip ratio for men aged 20 to 40 years was 0.90 and for men aged 41 to 60 years was 0.93 (Table 5.18).

5.3.9.3 Excess Waist to Hip Ratio (WHR)

A WHR of ≥ 0.9 for males and ≥ 0.8 for females is considered indicative of cardiovascular risk (Russell et al, 1999). Sixteen men (64%) and 19 women (74%) had WHR above these thresholds. A higher percentage of these were in the 41 to 60 years age group (Table 5.24).

Table 5.24: Subjects with a WHR in excess of 0.9 for men and 0.8 for women.

	Age group	No. Subjects	Percentage
Men	20-40	5	38%
	41-60	11	92%
	All	**16**	**64%**
Women	20-40	9	75%
	41-60	10	77%
	All	**19**	**76%**
All		**35**	**70%**

5.3.10 Body Composition – Bioelectrical Impedance Analysis (BIA)

The BIA measurements of impedance, resistance and reactance and their subsequent body fat readings given by the BIA machine used are presented in Table 5.25. The percentage fat mass (%FM) readings for the women averaged at 38.3%. The percentage fat mass (%FM) readings for the men averaged at 25.4%.

Table 5.25: Bioelectrical impedance analysis

Measurement		Mean	Median	SEM	LQ	UQ	Min	Max
FM (%)	Men	25.4	25.1	1.3	20.7	30.1	14.5	41.1
	Women	38.3	38.4	1.0	35.3	41.9	28.2	49.7
FFM (%)	Men	74.5	74.8	1.3	69.8	79.2	58.8	85.4
	Women	61.6	61.6	1.0	58.0	64.6	50.2	71.8
Impedance	Men	390.1	400.9	12.6	372.6	410.5	121.2	456.1
	Women	472.6	474.4	9.2	441.9	491.8	372.1	572.1
Resistance	Men	385.6	396.1	12.6	368.5	404.9	116.2	449.8
	Women	469.2	470.8	9.2	438.4	489.0	366.9	569.2
Reactance	Men	60.1	58.2	1.3	55.7	64.7	48.0	75.5
	Women	56.6	58.0	1.1	53.2	60.6	43.9	69.7

5.4 Blood Measurements

5.4.1 Blood Pressure

The mean systolic pressure for women aged 20 to 40 years and 41 to 60 years was 109.0 and 123.2 mmHg respectively. The mean diastolic pressures for women of the same age groups were 70.8 and 83.6 mmHg respectively (Table 5.26).

The blood pressure of one of the men (aged 20 to 40 years) could not be measured as he was very muscular and had a large mid-upper arm circumference. Despite using an arm cuff of 54 cm (biggest available), a blood pressure reading was not obtained. Therefore, the blood pressure readings are based on 24 men aged between 20 and 40 years and 25 men aged between 41 and 60 years. For men in the age ranges 20 to 40 years and 41 to 60 years the mean systolic pressures were 125 and 121 mmHg, respectively. The mean diastolic pressures for men in these age ranges were 86.1 and 77.7 mmHg, respectively (Table 5.26).

5.4.2 Random Blood Glucose

All the subjects reported that they had eaten their last meal at least two hours prior to testing. The mean blood glucose results for women aged 20 to 40 years was 5.8mmol/L and for women aged 41 to 60 years, was 6.4 mmol/L. Glucose levels for the women ranged from 4.0 to 8.4, where the maximum was taken from a woman who was a confirmed diabetic. The mean blood glucose results for men aged 20 to 40 years, and 41 to 60 years were 6.3 and 5.7 mmol/L respectively. Glucose levels ranged from 3.5 to 10.1 mmol/L;

where the lowest reading was taken from a confirmed diabetic and the highest from a man who had not been previously diagnosed with diabetes (Table 5.27).

5.5 General Dietary Characteristics

5.5.1 Household Food Production

5.5.1.2 Agricultural Food Sources

Not all the subjects owned a crop plantation. Three of the women and three of the men did not have a plantation, whilst 88% of the whole study sample did. The subjects were asked what food crops including fruits and vegetables they grew for household consumption. Taro was the most widely grown crop, planted by 68% of the women and 84% of the men. Cassava was the second most common crop grown (68%), followed by plantain (64%) and yams (60%).

Fruit trees included but were not restricted to, banana, pawpaw, mango and vi. Most of these were planted around the home or other areas close to the home. Bananas and pawpaw were the most common fruit trees grown, with 84% of the total sample growing both pawpaw and bananas. Mango and vi trees were also very common and if not grown by the subjects themselves, they did have access to them on their home properties. Seventy percent and 76% of subjects grew mango and vi trees respectively. Eighty percent of subjects grew other fruit trees included avocado, mountain apple and soursop.

Vegetables were also grown by some subjects in their plantations or around the home. The most common vegetable was edible hibiscus, known locally as pele, with 82% of subjects growing them. Nightshade and taro leaves were also reported as a common source of green leafy vegetables, where 90% of the subjects used nightshade, and 62% commonly ate taro leaves. Examples of other vegetables grown were onions, corn, cucumber, tomatoes and Chinese cabbage.

Table 5.26: Blood pressure measurements.

Measurement		Age Group	Mean	Median	SEM	LQ	UQ	Min	Max
Systolic (mmHg)	Men	20-40	125.0	125.0	2.91	117.5	129.3	111.0	148.0
		41-60	121.0	113.5	4.72	111.0	123.3	109.0	166.0
		All	**123.0**	**120.5**	**2.74**	**112.0**	**129.3**	**109.0**	**166.0**
	Women	20-40	109.0	109.0	2.94	103.8	117.3	93.0	123.0
		41-60	123.2	123.0	2.83	113.0	128.0	110.0	143.0
		All	**116.4**	**116.0**	**2.47**	**109.0**	**123.0**	**93.0**	**143.0**
Diastolic (mmHg)	Men	20-40	86.1	85.5	2.53	80.5	89.5	73.0	106.0
		41-60	77.7	79.5	2.53	71.8	80.3	62.0	94.0
		All	**81.9**	**80.5**	**1.96**	**76.0**	**88.3**	**62.0**	**106.0**
	Women	20-40	70.8	68.5	2.20	64.8	79.0	62.0	85.0
		41-60	83.6	81.0	2.87	80.0	85.0	70.0	105.0
		All	**77.5**	**79.0**	**2.22**	**69.0**	**81.0**	**62.0**	**105.0**

Table 5.27: Random blood glucose levels.

Measurement		Age Group	Mean	Median	SEM	LQ	UQ	Min	Max
Blood Glucose mmol/L	Men	20-40	6.3	6.2	0.40	5.4	6.6	4.6	10.1
		41-60	5.7	5.8	0.37	5.2	6.4	3.5	7.9
		All	**6.0**	**5.9**	**0.27**	**5.2**	**6.5**	**3.5**	**10.1**
	Women	20-40	5.8	5.9	0.25	5.1	6.4	4.0	7.2
		41-60	6.4	6.2	0.34	5.3	7.4	4.9	8.4
		All	**6.1**	**6.1**	**0.22**	**5.2**	**6.8**	**4.0**	**8.4**

5.5.1.3 Marine Food Sources

Not all subjects had the means or opportunity to fish, with 7 men and 7 women reporting not having regular access to marine sources of food, whilst the other 72% of subjects did have the means and the opportunity to go fishing or do other marine activities on a regular basis. A small percentage of the subjects reported they went fishing daily however this was treated with suspicion since none of the subjects reported going fishing in any of the three days when the general activity levels were recorded. More women than men went fishing once a week, with 24% women compared to just 8% men. However, 12% of the men reported going fishing 3-5 times a week, mainly in the evening. Sixteen percent and 28% of the women and men respectively reported rarely going fishing.

5.5.1.4 Grocery Food Sources

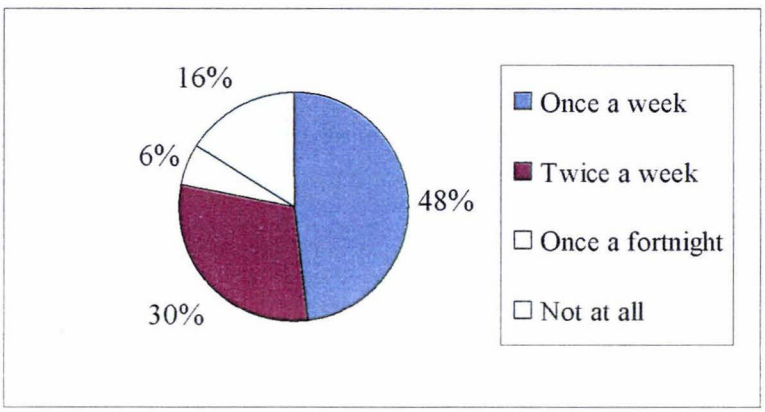
Imported food plays a large part in the Niuean diet and shopping patterns reflect this. Most subjects do some grocery/food shopping at least once a week. The majority of subjects (48%) shop once a week, with more women (64%) compared to men (32%). Shopping twice a week was also common, with 32% of the women and 28% of the men shopping twice a week, whilst only 6% of all the subjects shop once a fortnight. Sixteen percent of the subjects did not do any grocery shopping, all of whom were men (Figure 5.04).

Importance of Selected Food Products

The subjects were asked to rate between 1 and 5, the importance of including different food products as part of their regular grocery list. A rating of 1 was for the least important food item and a rating of 5 for the most important.

More than half the subjects ranked cereal products as the most important, followed by poultry products (50%) and tinned fish (40%). Dairy products were ranked fourth most important, with 36% of the subjects giving them a rating of 5. Canned meat, principally corned beef was rated rather low. Fruit was also not as highly rated, with most subjects (29%) giving it a rating of 3, and only 17% giving a rating of 5. Vegetables on the other hand were rated slightly more important with 33% of the subjects giving a rating of 4 and 31% a rating of 5. Meat products such as mince, mutton flaps and neck chops were not as highly rated, with most subjects (29%) rating them 3, followed by 26% rating them 2.

Figure 5.04: Frequency of Grocery Shopping



Nutrition Information

More than half the women (60%) reported interest in the nutritional information on the products they buy, whilst only 35% of the men reported the same interest. The common concerns among these subjects were fat and sugar content, but some men reported being more concerned about preservatives and the salt content of foods.

Food Choice

Subjects were asked what factor was most important in their decision to buy a certain food product. Most subjects reported price as the most important factor in making their food choice, 56% and 59% respectively. For the women, nutrition was the second most important factor, 28% regarding it as the most important factor in their food choice, whilst only 12% of the men regarded nutrition as important. For the men, taste was the second most important, with 24% reporting it to be the most important factor in determining their food choice compared to 14% of the women (Figure 5.05). A small number of subjects considered their medical condition as the most important factor in their food selection process.

5.5.2 Food Consumption Patterns

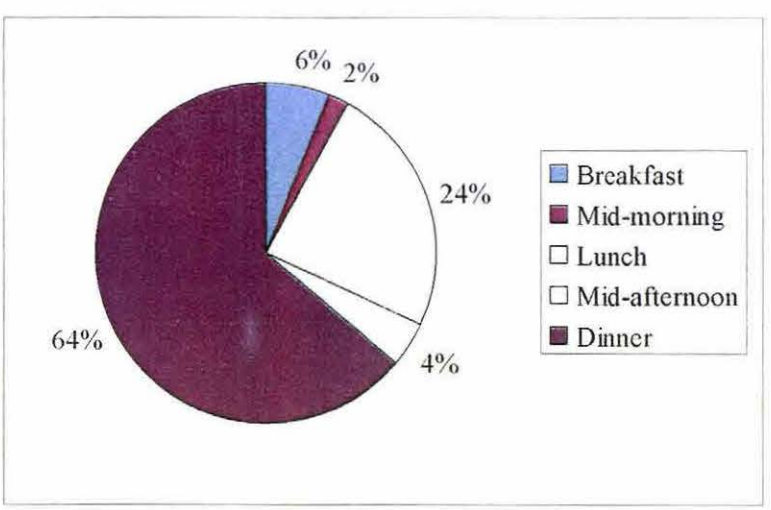
5.5.2.1 Meal Times

When asked at which meal they ate the most food, 72% of the men and 56% of the women reported dinner. Dinner was considered the most important meal of the day and therefore most food was eaten during that time. Lunch was reported by 16% of the men and 32% of

the women as the time they ate the most. Only 6% of the total study sample (2 men and 1 woman) reported they ate the most during breakfast (Figure 5.06).

Figure 5.05: Reported factors affecting food choice.

Figure 5.06: Meal-time where most food was eaten



The number of times per week subjects ate different meals varied. The majority of the men (72%) and the women (82%) ate breakfast at least five times a week. For lunch, the pattern was similar with the majority of the men (56%) and the women (84%) having lunch at least five times a week. Given that dinner is considered the main meal of the day, all subjects ate dinner every night of the week. Morning tea, afternoon tea and supper snacks were more common among the female subjects than the male subjects. For example, only 15 men had morning tea at least once a week, compared to 22 women. Afternoon tea was not common with subjects reporting that they would miss having afternoon tea and fill up during dinner.

5.5.2.2 Fat and Salt Usage

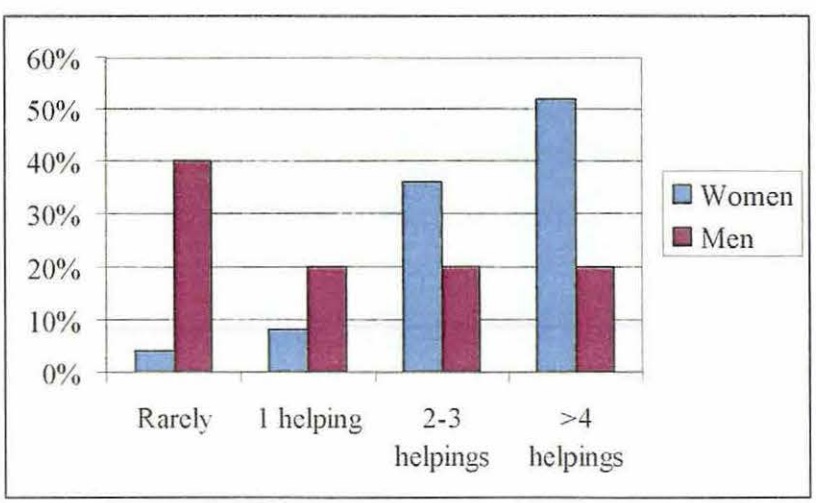
When frying foods at home, subjects reported using mainly vegetable oil, followed by margarine. One woman reported using only coconut oil as the foods were more 'flavourful' and the oil was readily available. Salt was used mainly during food preparation/cooking, where 44% of the women and 28% of the men added salt only during cooking. Salt use during a meal was more common among the men where 32% reported only using salt during a meal, compared to 20% of the women.

Only 16% of the study sample did not use salt at all. An estimation of the amount of salt used in a particular time was also made, with nearly half (44%) of the study sample reporting they generally use about half a teaspoon with food, including in cooking and with a meal. Twenty six percent used about ¼ teaspoon and 12% used between 1-2 teaspoons. One subject reportedly used more than a couple of teaspoons with a meal, including during preparation and eating.

5.5.2.3 Fruit Consumption

Fruit consumption was recorded as the number of 'helpings' per week, because most subjects don't eat fruit on a daily basis, if at all. Figure 5.07 illustrates fruit consumption by the study subjects. Nearly half the men reported they rarely ate fruit, whilst over half the women reported consuming more than 4 helpings per week

Figure 5.07: Subjects' fruit consumption per week



5.5.2.4 Vegetable Consumption

Vegetable consumption was reported as 'local' and 'imported'. Generally, consumption of the two sources was similar. Only one woman reportedly rarely ate vegetables, either local or imported. More than half the women (56%) reported eating 2-3 helpings of local vegetables per week, and 44% reported eating the same amount of imported vegetables. Twenty eight percent of women ate more than 4 helpings of local vegetables, similar to 24% who ate more than 4 helpings of imported vegetables. Men's vegetable consumption was also similar, with 48% consuming between 2 to 3 helpings per week of local vegetables and 32% of imported vegetables. Only 8% reported consuming more than 4 helpings of imported vegetables compared to 24% who reported consuming >4 helpings of local vegetables (Table 5.28).

Table 5.28: Weekly consumption of local vs imported vegetables

	Women		Men		All	
	Local	Imported	Local	Imported	Local	Imported
Rarely	4%	4%	8%	16%	6%	10%
<1 helping[1]	4%	4%	4%	16%	4%	10%
1 helping	8%	24%	16%	28%	12%	26%
2-3 helpings	56%	44%	48%	32%	52%	38%
>4 helpings	28%	24%	24%	8%	26%	16%

[1] A helping is the amount of food one can hold in the palm of their hand

The combined weekly consumption of vegetables (local and imported) is presented in Table 5.29. More women than men consume at least seven helpings of vegetables per week, equivalent to at least one helping a day.

Table 5.29: Total weekly vegetable consumption[1]

	Women	Men	All
Rarely	4%	4%	4%
1-2 helpings[2]	0%	16%	8%
3-4 helpings	36%	28%	32%
5-6 helpings	24%	40%	32%
>7 helpings	36%	12%	24%

[1] Total vegetable consumption per week (local plus imported).
[2] A helping is the amount of food one can hold in the palm of their hand.

5.5.2.5 *Consumption of Carbohydrate Foods*

Imported carbohydrate foods include cereal products such as bread and crackers, as well as potatoes and rice. Local carbohydrate foods are the staples of the Niuean diet and include taro, cassava, and other locally grown crops. Consumption of these foods was reported on a daily basis, as they are the most important part of a typical Niuean meal. Seventy two percent of women commonly ate between 1-2 helpings a day of local staples, and 40% report consuming that much of imported staples per day. Similarly, 68% of men commonly consumed 1-2 helpings of local staples per day. However, unlike the women, a higher percentage of men (72%) consumed between 1-2 helpings of imported staples daily (Table 5.30).

Table 5.30: Daily consumption of local vs imported carbohydrate foods

	Women		Men		All	
	Local	Imported	Local	Imported	Local	Imported
<1 helping[1]	0%	20%	0%	12%	0%	16%
1-2 helpings	72%	40%	68%	72%	70%	56%
3-4 helpings	28%	28%	28%	16%	28%	22%
>5 helpings	0%	12%	4%	0%	2%	6%

[1] A helping is the amount of food one can hold in the palm of their hand

The combined daily consumption of carbohydrate staples (local and imported) is presented in Table 5.31. The majority of both the women (36%) and the men (48%) consumed about four helpings a day. However 44% of women and 40% of men consumed more than six helpings a day.

Table 5.31: Total daily consumption of carbohydrate foods[1]

	Women	Men	All
3 helpings[2]	16%	8%	12%
4 helpings	36%	48%	42%
5 helpings	4%	4%	4%
6 helpings	16%	32%	24%
>7 helpings	28%	8%	18%

[1] Total carbohydrate consumption per day (local + imported)
[2] A helping is the amount of food one can hold in the palm of their hand.

5.5.2.6 Consumption of Protein Foods

More than half the women (56%) reported consuming 3-4 helpings of imported protein foods per week. The majority of men (60%) on the other hand consumed more than five helpings of imported protein per week. Subjects reportedly consumed more imported protein than local protein foods (Table 5.32).

Table 5.32: Weekly consumption of local vs imported protein foods[1]

	Women		Men		All	
	Local	Imported	Local	Imported	Local	Imported
Rarely	8%	0%	4%	0%	6%	0%
<1 helping	0%	4%	4%	0%	2%	2%
1-2 helpings	40%	20%	40%	12%	40%	16%
3-4 helpings	24%	56%	36%	28%	30%	42%
>5 helpings	28%	20%	16%	60%	22%	40%

[1] A helping is the amount of food one can hold in the palm of their hand

The combined weekly consumption of protein foods (local and imported) is presented in Table 5.33. Most of the subjects consume between six and nine helpings of protein a week, with the majority of both genders; 44% women and 44% men, reporting consuming between six to seven helpings a week.

Table 5.33: Total weekly consumption of protein foods[1]

	Women	Men	All
2-3 helpings[2]	8%	8%	8%
4-5 helpings	8%	0%	4%
6-7 helpings	44%	44%	44%
8-9 helpings	32%	40%	36%
>10 helpings	8%	8%	8%

[1]Total protein consumption per week (local plus imported).
[2]A helping is the amount of food one can hold in the palm of their hand.

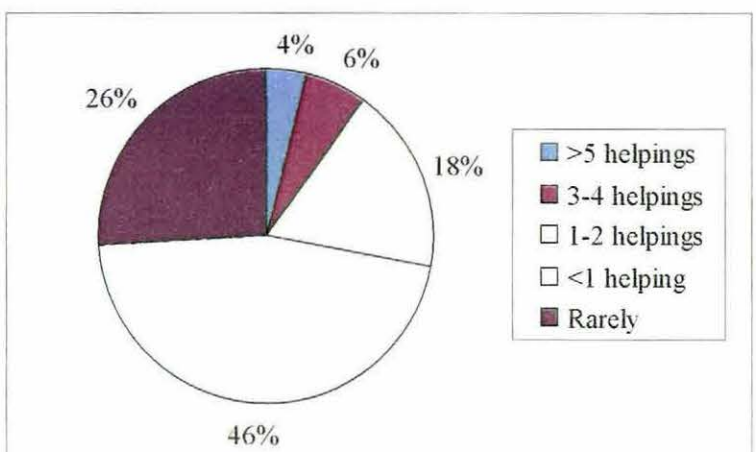
5.5.2.7 Consumption of Milk and Milk Products

The consumption of milk and milk products was very low among the subjects. A helping in this instance was described as a cup of milk, a pottle of yoghurt and so forth. Forty four percent of women and 48% of men reported consuming less than one helping a week of milk and milk products. There was also a high percentage that rarely consumed milk and milk products (24% of women and 28% of men). Only one woman and one man reported consuming more than 5 helpings per week of milk and milk products. Figure 5.08 illustrates the subjects' total weekly consumption pattern of milk and milk products.

5.5.2.8 Butter and Margarine Consumption

Consumption of butter and margarine was estimated by asking what subjects usually spread on bread. Three of the subjects did not use butter or margarine on their bread or any other food, and only one man reported using butter as a spread. Margarine was the most common bread spread. For the women, 76% reported using 1 teaspoon per slice of bread, 12% used 2 teaspoons and 4% used more than 2 teaspoons per slice of bread. The men on the other hand reported using less margarine with 84% using 1 teaspoon per slice of bread and only 8% using 2 teaspoons.

Figure 5.08: Weekly consumption of milk and milk products among all subjects

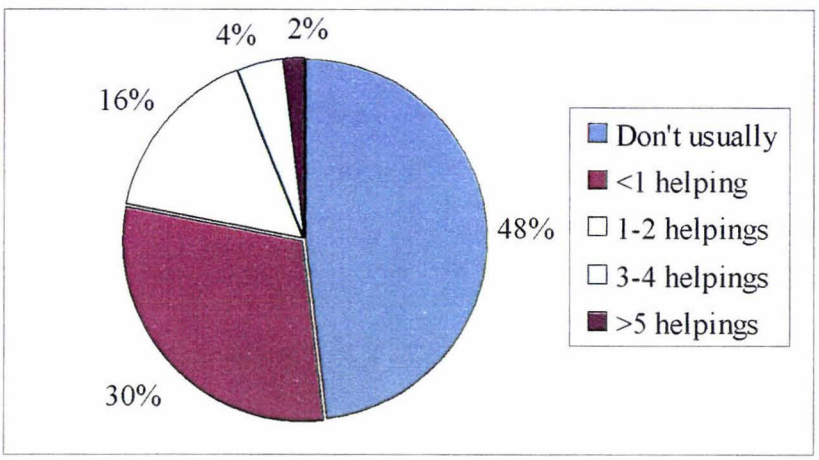


5.5.2.9 Confectionery Consumption

Consumption of confectionery products was relatively low, with the majority of both the men (56%) and the women (40%) reporting that they don't usually consume confectionery

products. Thirty two percent of women and 28% of men reported they consumed less than one helping week (Figure 5.09).

Figure 5.09: Consumption of confectionery products among subjects per week



5.5.3.0 Beverage Consumption

Beverage consumption was divided into two types; hot beverages and cold beverages. The most common hot beverage was tea, with 80% of women and 68% of men reporting tea as their main drink. Women tended to drink more cups than men, with 36% reportedly drinking at least 3 cups of tea per day. Average consumption was between one and two cups per day.

Cold beverages included fruit juice, water, coconuts and soft drinks. Fruit juice was not commonly consumed among the subjects with 52% reporting that they did not usually drink fruit juice. Water was the most common drink among all subjects, and this is reported as cups per day. Only 24% of women and 32% of men reported drinking at least eight cups of water a day. Coconuts, whilst available throughout the Island were not a common daily drink. Overall, 26% of the subjects did not usually drink coconuts. Soft drinks were also not commonly drunk, with 56% of the women and 28% of the men stating they did not drink soft drinks.

The subjects' total daily fluid intake is presented in Table 5.34. This is the sum of reported intake of both hot and cold beverages, reported weekly (in some cases), and converted to an estimated daily intake, expressed in litres. Fluid intake of the women was more widely

distributed than the men. Most of the women (32%) drank between 2 and 2.5 litres of fluid a day, whilst most of the men (48%) drank between 1 and 1.5 litres a day. There was a smaller percentage of women compared to the men who drank more than 4 litres a day.

Table 5.34: Total daily fluid consumption among subjects

Total Fluid (litres)[1]	Women	Men	All
1.0-1.5	8%	48%	28%
1.6-2.0	20%	0%	10%
2.1-2.5	32%	36%	34%
2.6-3.0	16%	0%	8%
3.1-3.5	16%	0%	8%
3.6-4.0	4%	0%	2%
4.1-5.0	4%	16%	10%

[1] Includes hot and cold beverages

5.5.3.1 Consumption of Take Away Foods

Thirty two percent of women and 24% of men reported commonly eating take-away foods once a week, whilst 20% and 36% women and men respectively ate takeaways 2-3 times a week. Two people reported daily consumption of take-away foods (Figure 5.10). Consumption of fish and chips, being the most common type of take-away food was also reported. Overall, most of the subjects who do eat fish and chips regularly consume one helping a week (Figure 5.11).

Figure 5.10: Frequency of consumption of take-away foods per week

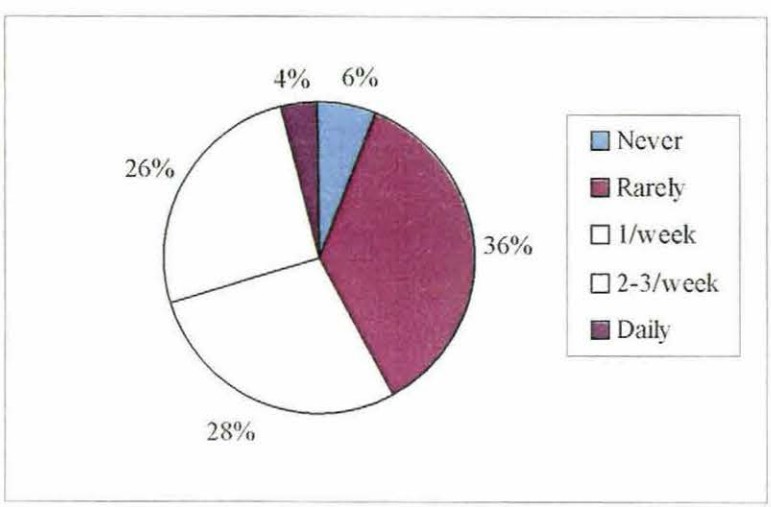
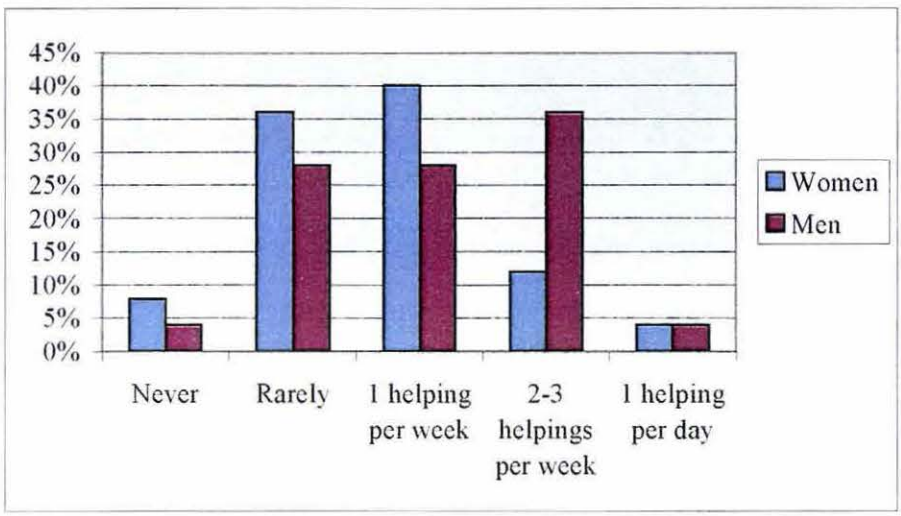


Figure 5.11: Frequency of consumption of fish and chips per week



5.6 Dietary Intake

5.6.1 Sources of Energy in the Diet

Based on weighted averages (see 6.6.4), results show that men ate more food per day than women ($P<0.05$). The women ate 2761g (2.7kg), whilst the men ate 3422g (3.4kg). Total energy intake based on these quantities was 9566kJ and 7878kJ for men and women respectively; significantly different at $P<0.05$. For women, percentage energy from protein, fat and carbohydrate was 17.5%, 38.0% and 44.9% respectively. For men, percentage energy from protein, fat and carbohydrate was 16.6%, 38.5% and 42.7% respectively. Alcohol contributed only a small amount of energy, 2.7% and only for the men (Table 5.35).

5.6.2 Carbohydrates in the Diet

Carbohydrate sources include sugars, starch and fibre. The men had a higher mean intake of total carbohydrate than the women, specifically 244g compared to 212g for the women (Table 5.36), but this did not reach statistical significance ($P>0.05$). The mean contribution of starch to the carbohydrate content of the diet was slightly higher for men (64%) than women (60%). Overall, the percentage energy contribution from total sugars and starch was similar for both men and women. Fibre intake was also similar for both men and women.

Table 5.35: Mean dietary energy sources.

	Weight of food eaten* (g)	Energy* (kJ)	Protein (g)	Energy from Protein[1] (%)	Fat (g)	Energy from Fat[2] (%)	CHO (g)	Energy from CHO[3] (%)	Alcohol (g)	Energy from Alcohol[4] (%)
Men	3422	9566	95	16.6%	98	38.5%	244	42.7%	9	2.7%
Women	2761	7878	82	17.5%	80	38.0%	212	44.9%	0	0.0%
All	**3091**	**8722**	**89**	**17.0%**	**89**	**38.3%**	**228**	**43.7%**	**4**	**1.5%**

[1] Percent energy from protein was calculated as the energy from protein (conversion factor = 16.7 kJ/g), divided by the total energy intake.
[2] Percent energy from fat was calculated as the energy from fat (conversion factor = 37.7 kJ/g), divided by the total energy intake.
[3] Percent energy from carbohydrate was calculated as the energy from carbohydrate (conversion factor = 16.7 kJ/g), divided by the total energy intake.
[4] Percent energy from alcohol was calculated as the energy from alcohol (conversion factor = 29.3 kJ/g), divided by the total energy intake.
* Significant difference between genders at $P<0.05$ (student's t-test).

Table 5.36: Mean dietary carbohydrate sources.

	Energy (kJ)	Total CHO (Avail) (g)	Total Sugars (g)	Energy from Total Sugars (%)	Energy from sucrose (%)	Starch (g)	Energy from Starch (%)	Fibre (g)
Men	9566	244.4	87.5	15%	10%	156.9	27%	16.4
Women	7878	212.0	84.2	18%	10%	127.7	27%	17.1
All	**8722**	**228.2**	**85.8**	**16%**	**10%**	**142.3**	**27%**	**16.8**

5.6.3 Lipids in the Diet

Mean intake of total fat per day was greater for the men than women, with 98g and 78g respectively (Table 5.37). The saturated fatty acid (SFA) content of the diets contributed to nearly half the total fat content, with 44.9% for men and 45.1% for women. Monounsaturated fatty acid (MUFA) and Polyunsaturated fatty acid (PUFA) content was very similar for both the men and women. Overall, the fatty acid ratio of saturated to monounsaturated to polyunsaturated was 3:2:1 and 2:2:1, for the men and women respectively. Mean cholesterol intake was much higher for men than women, with 322mg and 283mg respectively, but the difference was not statistically significant at $P<0.05$.

5.6.4 Minerals in the Diet

Dietary intake of the five main minerals of concern is presented in Table 5.38. The men had a higher mean sodium intake than the women, with 2929.6mg compared to 2064.1mg. This difference was highly significant ($P=0.01$). Mean calcium intake was higher for the men than the women, with 606mg compared to 567.9mg for the women. However, the difference was not statistically significant at $P<0.05$. Mean iron intake was also slightly higher for the men with 13.7mg compared to the women's 11.2mg. The differences in mean iron intake were not statistically different at $P<0.05$. Mean zinc intake was also higher for the men compared to the women, with a mean of 19.7mg for the men, and 14.9mg for the women. This difference was highly significant at $P<0.05$. Mean selenium intake was higher for the men compared to the women, with 132.9ug for the men, and 111.7mg for the women. However, this difference was not statistically significant.

5.6.5 Vitamins in the Diet

Dietary intake of the main vitamins for discussion, are presented in Table 5.39. Thiamin intake was similar for both groups, with a mean of 1.3mg for the men, and 1.1mg for the women. Intake of riboflavin had a similar trend with a mean for men of 1.4mg and for the women, 1.2mg. The mean intake of niacin for the men was 41.8mg and for the women, 37.5mg. The mean intake of folate for men was 244.7ug and 221ug for women. The mean intake of vitamin C for the men was 114.0mg and 91.1mg for women. The mean intakes of total vitamin A equivalents (A Eq) for the men was 684.4ug, and for women was 642.6ug.

Table 5.37: Mean dietary lipid sources.

	Weight of Food eaten (g)	Total Fat (g)	SFA (g)	SFA (%)	MUFA (g)	MUFA (%)	PUFA (g)	PUFA (%)	Fatty Acid Ratio[1]	Cholesterol (mg)
Men	3421.5	97.8	41.2	44.9%	32.3	37.1%	14.9	17.9%	3:2:1	322.1
Women	2760.9	79.5	30.9	45.1%	26.6	37.9%	13.4	16.9%	2:2:1	283.0
Total	**3091.2**	**88.6**	**36.1**	**44.2%**	**29.5**	**37.2%**	**14.2**	**18.5%**	**3:2:1**	**302.6**

[1]Fatty Acid Ratio calculated using weight of Fatty Acids, and expressed as SFA: MUFA: PUFA.

Table 5.38: Mineral content of the diet.

		Mean	Median	SD	SEM	LQ	UQ	Min	Max
Sodium (mg)	Men	2929.6	2392.4	1473.9	294.8	2023.3	3704.0	1081.4	6091.7
	Women	2064.1	1968.2	846.1	169.2	1483.4	2400.8	863.1	4820.4
	All	**2496.9**	**2201.6**	**1267.2**	**179.2**	**1750.2**	**2702.1**	**863.1**	**6091.7**
Calcium (mg)	Men	606.0	609.2	238.8	47.8	444.4	770.6	186.2	1084.1
	Women	567.9	561.5	217.2	43.4	425.3	685.7	219.6	1208.0
	All	**586.9**	**570.3**	**226.7**	**32.1**	**431.2**	**722.0**	**186.2**	**1208.0**
Iron (mg)	Men	13.7	11.5	7.5	1.5	9.0	18.0	5.3	38.5
	Women	11.2	11.3	3.9	0.8	8.1	13.0	5.9	21.3
	All	**12.5**	**11.3**	**6.0**	**0.9**	**8.7**	**14.1**	**5.3**	**38.5**
Zinc (mg)	Men	19.7	17.6	10.1	2.0	12.4	25.5	6.6	48.4
	Women	14.9	12.9	6.8	1.4	10.7	16.6	5.4	33.2
	All	**15.4**	**12.5**	**8.7**	**1.2**	**9.7**	**20.2**	**5.9**	**48.4**
Selenium (ug)	Men	132.9	110.9	72.9	14.6	79.4	161.4	24.7	349.5
	Women	111.7	102.3	62.9	12.6	79.3	134.5	25.6	271.6
	All	**122.3**	**103.9**	**68.3**	**9.7**	**79.3**	**153.4**	**24.7**	**349.5**

Table 5.39: Vitamin content of the Diet

		Mean	Median	SD	SEM	LQ	UQ	Min	Max
Thiamin (mg)	Men	1.3	1.2	0.7	0.1	0.9	1.5	0.4	3.4
	Women	1.1	1.0	0.4	0.1	0.8	1.3	0.6	2.5
	All	**1.2**	**1.1**	**0.6**	**0.1**	**0.9**	**1.4**	**0.4**	**3.4**
Riboflavin (mg)	Men	1.4	1.3	0.5	0.1	1.1	1.7	0.6	2.7
	Women	1.2	1.2	0.4	0.1	1.0	1.5	0.5	2.1
	All	**1.3**	**1.2**	**0.5**	**0.1**	**1.1**	**1.7**	**0.5**	**2.7**
Niacin Eq (mg)	Men	41.8	40.4	14.4	2.9	32.2	48.9	17.9	74.7
	Women	37.5	36.1	12.8	2.6	29.4	44.3	16.6	75.9
	All	**39.6**	**37.8**	**13.7**	**1.9**	**30.3**	**45.7**	**16.6**	**75.9**
Vitamin C (mg)	Men	114.0	92.6	75.4	15.1	61.1	161.9	21.6	321.4
	Women	117.1	91.1	89.5	17.9	60.7	135.9	22.7	388.5
	All	**115.5**	**91.8**	**81.9**	**11.6**	**60.8**	**156.7**	**21.6**	**388.5**
Vitamin E (mg)	Men	14.7	13.7	6.6	1.3	10.7	21.0	5.1	28.0
	Women	12.2	11.1	5.7	1.1	7.9	14.0	5.8	26.9
	All	**13.4**	**12.1**	**6.2**	**0.9**	**8.2**	**15.6**	**5.1**	**28.0**
Vitamin B6 (mg)	Men	1.7	1.4	0.7	0.1	1.2	2.0	0.8	3.1
	Women	1.8	1.8	0.8	0.2	1.3	2.2	0.8	4.0
	All	**1.7**	**1.6**	**0.7**	**0.1**	**1.2**	**2.2**	**0.8**	**4.0**
Bitamin B12 (ug)	Men	6.4	5.3	4.8	1.0	3.4	7.3	0.7	20.1
	Women	6.6	4.7	5.4	1.1	3.0	8.5	0.7	25.0
	All	**6.5**	**4.8**	**5.0**	**0.7**	**3.4**	**7.9**	**0.7**	**25.0**
Total Folate (ug)	Men	244.7	222.0	85.3	17.1	175.7	313.7	127.9	391.3
	Women	234.5	220.9	81.0	16.2	177.9	285.6	78.6	450.4
	All	**239.6**	**221.4**	**82.5**	**11.7**	**175.8**	**300.6**	**78.6**	**450.4**
Total A Eq (ug)	Men	668.4	667.0	407.9	81.6	355.4	831.1	113.3	1724.9
	Women	642.6	533.7	420.9	84.2	378.7	726.4	169.0	2015.3
	All	**655.5**	**559.0**	**410.4**	**58.0**	**361.3**	**806.7**	**113.3**	**2015.3**
Retinol (ug)	Men	303.7	273.6	173.0	34.6	209.4	358.6	70.6	839.0
	Women	214.7	212.3	98.2	19.6	120.7	264.7	72.6	400.6
	All	**259.2**	**232.3**	**146.3**	**20.7**	**173.8**	**323.8**	**70.6**	**839.0**
B-carotene (mg)	Men	2186.8	1685.1	1816.8	363.4	770.2	3125.2	68.5	6765.8
	Women	2661.3	1921.1	2400.2	480.0	1004.9	3478.4	328.0	10664.3
	All	**2424.1**	**1742.1**	**2120.4**	**299.9**	**800.9**	**3388.4**	**68.5**	**10664.3**

6. Discussion

6.1 Subject Characteristics

The majority of the study subjects were aged between 31 and 60 years, and hence had either established or were establishing their own families. Most of the subjects were either the head of their households (many of the men) or the mother of the home, who had the primary role in meal preparation and made the bulk of food decisions. The average number in a household was five, and the maximum number was nine members, however, there was certainly no reflection of overcrowding.

Whilst there were similarities in household size and composition, income and education levels were well ranged. Each household had some source of primary income, if not by way of wages or salary, then certainly through sales of produce and/or handcrafts. It was surprising that whilst education levels varied, responses to the general questionnaires showed how similar their lives were, both through dietary patterns as well as their levels of physical activity.

6.2 Lifestyle Characteristics

6.2.1 Physical Activity

With changing times, modern appliances have replaced labour-intensive activities, and subsequently reduced some forms of physical activity. Only a small number of subjects washed clothes by hand, exerting four times their metabolic rate, double the energy expenditure of those who did their laundry using an automatic washing machine, at energy expenditure twice their metabolic rate.

The most common, and undoubtedly the most intense of the physical activities was working in the plantation, or the bush. The combination of dry, rocky land and the sweltering heat adds to the intensity of slashing, digging, planting and the harvesting of food crops. It is this combination that has bush work generally regarded as a man's job. This is not so for many of the study subjects or other Niuean families. It is a duty that is shared by family members, as it is how they obtain their main staple foods.

A lot of the women reported their most regular form of physical activity was household chores. These included sweeping the house, making beds, washing dishes/clothes, sweeping/picking up rubbish and fallen leaves around the home. Regular sporting activities were not very common among the subjects. Men engaged in more sporting activities such as rugby or going to the gym. Walking was the most popular recreational activity, especially amongst the women. Overall, women tended to do less intense activity but for longer periods, whilst the men spent time on more intense activities.

Not every day of the week is the same in terms of physical activity. Saturday tended to be the day when most activity takes place, whether subjects were at home doing housework, playing a game at the sports field or working at the bush. A typical Niuean Saturday is considered a bush day, where people not only tend to their plantation but also make preparations for the week ahead by harvesting crops, collecting firewood etc. Saturday is also the day to collect or prepare materials for Sunday's traditional food preparation.

Sunday is literally a day of rest for many Pacific Island cultures, including Niueans. It is a day when food is traditionally prepared in the morning, followed by church attendance, and then by a heavy lunch of traditional dishes, and a siesta afterwards. In this respect, very little physical activity takes place on a Sunday. Changing times have brought about a few changes in terms of food preparation and lifestyle. For example not all families prepared food in the traditional umu but some used an electric convection oven, another time and labour-saving appliance. In addition, families relaxed after lunch, entertaining themselves by watching videos or playing video games. All in all, only very light activity took place on a Sunday.

It is understood that undertaking regular moderate activity is beneficial to one's health, even if it does not necessarily add to physical fitness (Pate et al, 1995). The definition of 'moderate' is activity equivalent to brisk walking. A brisk walk is further equivalent to at least 3.5 METs (Ainsworth et al, 1993). Thus, the subjects' activity levels were tabulated according to the total hours per day in which they undertook reported activities that were at least 3.5 METs (Table 6.01).

Table 6.01: Time spent by subjects on activities ≥3.5 METs per day[1]

Hours	Women	Men
0.5-1.0	16%	16%
1.1-1.5	20%	28%
1.6-2.0	28%	12%
2.1-3.0	32%	24%
>3.1	4%	20%

[1]Activities include hand-washing, bush-work and other activities, such as walking, jogging etc.

In the 1996/97 New Zealand Health Survey (MOH, 1999b), subjects were either classed as 'inactive' if they had taken part in less than 2.5 hours of leisure-time physical activity in the previous week, or 'active' if they had taken part in 2.5 hours or more of leisure-time activity. Of all the subjects surveyed in this Pilot Survey, 36% of the women and 44% of the men reported undertaking at least two hours a day of 'moderate' activities. Based on the activity definition used in the New Zealand Health Survey, 40% of subjects were 'physically active'. However, activity levels in the New Zealand Health Survey were based on a week, whilst the Pilot Survey covered a regular day. Thus, it is fair to say that all the subjects were physically active.

Strategies to promote physical activity should not focus solely on leisure-time activity such as walking, jogging, or sports activities. The National Health Committee (1998) suggests that at least 30 minutes of moderate activity a day or on most days of the week, can bring about health benefits to people of all ages. In fact, by promoting a combination of activities that are already a part of one's everyday life, for example general house work, traditional craft making etc, small contributions can be made towards an overall increased level of physical activity. In this way, time does not necessarily have to be set aside to achieve such a goal.

6.2.2 Alcohol Consumption

Of the subjects in this study, only a few women reported drinking alcohol, with beer as their main drink. Women were not heavy drinkers and reported between one and two glasses of beer per drinking session, mainly once a month.

The men on the other hand were frequent drinkers (72%), and of those who did drink, the majority of them reported drinking mainly a mix of beer and spirits. Drinking time varied from half an hour to more than 10 hours, with blood alcohol concentrations in most of the men well above the legal limit, ranging from over 40% to over 800% in excess of the legal blood alcohol level.

The Alcohol Advisory Council of New Zealand (2001) has set upper limits for alcohol consumption and as such recommends against drinking 21 standard drinks per week for men and 14 standard drinks per week for women. The recommended limit for alcohol consumption on any one occasion is six standard drinks for men and four standard drinks for women. A 'standard drink' is defined as any drink containing 10 grams of alcohol. The mean and median alcohol content of drinks consumed by the men in a typical drinking session was 210g and 164g respectively. The mean alcohol content of drinks consumed by the 'drinking' men in this study has already reached the recommended upper limit. However, given that most of these same subjects drank about twice a week, typically Friday and Saturday night, the mean alcohol consumption is double the recommended upper limit.

The median annual quantity of alcohol consumed by men in New Zealand in 1995 was 7.4 litres of absolute alcohol (Wyllie *et al*, 1996) equivalent to about 142 g alcohol per week or just over nine cans of beer a week. The median quantity of absolute alcohol consumed by men in this pilot survey was 164 g per drinking occasion, and equivalent to about 11 cans of beer. Given the assumption that all the men surveyed drank twice a week, the men in this pilot survey consumed more than double the quantity of absolute alcohol consumed by New Zealand men. This observation is not conclusive because either population could have under or over-reported their alcohol consumption. Wyllie *et al* (1996) stated in their report that "survey respondents tend to under-report consumption".

The 2002 Niue National Health Survey (Niue Health Dept, 2002) reported that of all the subjects who reported drinking alcohol (n=312), 20% of males and 15% of females were aged between 18 and 29 years, whilst 29% of males and 12% of females were aged between 30 and 59 years. These statistics, whilst not showing how much alcohol is consumed, indicate that drinking alcohol is a common leisure time activity for some Niuean people.

In New Zealand, the most common source of alcohol for women was wine, but for men it was beer (Ministry of Health, 1999). Data from the 1997 National Nutrition Survey show that in New Zealand, 69% of the men and 16% of the women usually drink beer, with the greatest percentage of male (81%) and female (48%) drinkers in the 15-18 year old bracket. This trend would most likely be similar in Niue, however study subjects for this study were aged 18 to 60 years. Also, the 2002 Niue Health Survey did not include the population under 18 years.

Alcohol has become an important item for any social gathering in Niue. It is present at traditional ceremonies such as hair-cuttings and ear-piercings, crop planting/harvesting etc, as well as weddings, birthdays and other celebrations. It is believed that where there will be more alcohol, there will be more people. Whilst not accurately reported in this Pilot Survey, few male subjects would be described as moderate drinkers. If this is a reflection of the population as a whole, then there are hardly any 'moderate drinkers' amongst the adult males of Niue.

Binge drinking appears to be a common element among not only the men in the Pilot Survey but also Pacific people in New Zealand. Subjects in this Pilot Survey reported that alcohol was drunk to intoxicating levels in the weekend, whilst during the week no alcohol or just a little was taken. Medical or health consequences of high alcohol consumption have not been promoted widely on the Island. Given the long term development of cirrhosis of the liver and the absence of symptoms which may suggest its development, in addition to the fact that many of the subjects do not visit the Doctor for a regular medical check up, the health consequences of high alcohol consumption may go unnoticed.

Family problems arising from alcohol consumption happen more frequently, such that the social consequences of alcohol seem to be more understood. For instance, frequent consumption of alcohol, coupled with its high price leads to a reduction in family or individual disposable income. This in turn reduces purchasing power, forcing the family or individual to purchase cheaper, less nutritious foods. Furthermore, due to the rough and narrow roads on Niue, the odds of causing an accident when driving intoxicated increase dramatically.

It is interesting to note that in the 1987 Niue National Nutrition Survey (South Pacific Commission, 1992), there was little data collected on alcohol consumption. In fact, alcohol consumption was only briefly mentioned. Of the women surveyed (n= 845), 1.5% consumed alcohol. Of the men surveyed (n=801), the total number who consumed alcohol was not given, however the highest consumptions were in the 20-29yr age group (n=24) where 7.4% drank alcohol and the 40-49yr age group (n=77) where 13.0% reported drinking alcohol. The overall conclusion made in the survey was that alcohol consumption was low among both the women and the men. The data collected in this Pilot Survey shows that this is no longer the case.

There is some doubt in whether the responses given for the alcohol and drinking session questions were truly reflective of the subjects' consumption patterns. The perception was that the men felt the more alcohol they could drink, the better 'drinkers' they were, and even the length of their drinking sessions seemed questionable. Most of the subjects had blood alcohol concentrations above 0.60 g/L, a level considered to be lethal. Hence, it is highly likely that the subjects were over-reporting their alcohol intake. Nevertheless, if this really is an indication of their typical drinking habits, these men are at high risk of developing health problems such as cirrhosis of the liver, hypertension, stroke and coronary heart disease.

6.2.3 Cigarette Consumption

Men smoked more often then women, however not always on a regular basis but during 'social' occasions. Many of the subjects reported smoking only in the weekend and usually when drinking alcohol. Thus, cigarette use and alcohol consumption seemed to go hand in hand during these 'social' occasions.

Nearly half of the men (40%) reported smoking, compared to only 16% of the women, and whilst the other subjects did not smoke they were exposed to second hand smoke in the home. The fact that more men than women smoke on Niue is also reflected in the Niue Health Survey (2002) that showed that 37% of men and 13% of women smoke. In New Zealand, the trend is the same; there are more men than women smokers. However, there are major differences in the prevalence of smoking among ethnic groups. Nearly half of all

Maori adults reported that they were current smokers, 23.2% of the Europeans reported smoking and 27.7% of Pacific people (Ministry of Health, 1999b)

The health consequences of cigarette smoking are more widely understood compared to alcohol, but the prevalence of smoking is not completely reflected in this Pilot Survey. If one assumes the trend in Niue is similar to New Zealand in terms of higher rates among younger age groups, then future surveys need to include younger subjects.

6.3 Food Production Characteristics

6.3.1 Agricultural Sources

Whilst both agriculture and fisheries plays a major role in the food supply of Niuean families, not everyone sampled grew their own food or went fishing. There were a few people who opted to buy food from the local market instead of growing their own crops like taro, cassava and so forth. The main reason given by these subjects was that they did not have the time to maintain a plantation.

Taro is the main crop grown on the Island, not just because it is the main staple food but it also provides income for some families. It plays an important role in traditional ceremonies and is exported to friends and families overseas. Until recently the Niue Government set up a programme to help its people by exporting taro to New Zealand. This was an incentive-driven programme which saw a lot of families establish large plantations for taro growing. The difficulties associated with taro production (including harvesting) lead to growers' demanding a higher price. This demand could not be met because of the lower market price in New Zealand caused by produce over-flooding from cheaper suppliers of Fiji taro. Hence the overall downfall of this programme. Whilst some taro is still being exported today, the numbers are not as high and are primarily to relatives in New Zealand.

Fruit trees are grown but not to the extent that could be described as an orchard. The most common being banana and pawpaw trees. Pawpaw is available all year round but it is not commonly consumed as it is traditionally described as a food for pigs. Both banana trees, specifically plantain banana, and pawpaw trees are planted among the taros and other crops in a plantation. Many families do plant banana trees around the home for easy access to the

leaves for wrapping food to be cooked in the traditional umu. All other fruit trees such as mangoes, vi, mountain apple and so forth are seasonal and whilst consumption during their season is high, outside their season, there is no consumption.

Not all families are able to grow vegetables. The most common vegetable for household consumption was edible hibiscus or pele. It is quite hardy and available all year round. Its cultivation needs little attention and it is thus very common. Taro leaves are acquired from the taro plants themselves and thus if the family grows taro, they have access to the leaves as a leafy green vegetable. Other common vegetable sources are nightshade leaves, and whilst the leaves are extremely bitter, they are considered a delicacy.

There are a number of families who plant a variety of vegetables as a source of income and are widely known as 'vegetable growers' on the Island. A number of the subjects were 'vegetable growers' whose livelihoods depended on the sale of their produce. The types of vegetables grown are Chinese cabbage, tomatoes, lettuce, eggplants and so forth. The presence of pests and diseases make vegetable gardening difficult and thus successful 'vegetable growers' are commonly those who devote themselves to full time gardening.

6.3.2 Marine Sources

Not all subjects had the means to go deep-ocean fishing that is, by boat or canoe. However the subjects that did have the means did not go fishing at any of the three times that the survey visits were carried out. Women reported going to the sea more often than men, presumably because they do not go by boat or canoe but rather hunt on, or fish from, the reef. The costs involved in going fishing do hinder fishing activities. Where petrol prices are at least $1.50 per litre, fuel for a fishing trip can be expensive particularly if nothing is caught.

6.3.3 Imported Food Sources

Nearly half the subjects reported shopping for food once a week. Their shopping trends reflected a heavy reliance on cereal products; these were mainly bread and crackers and occasionally rice. This kind of shopping pattern was reflected in their dietary recalls where breakfast was made up of some imported cereal product, again bread or crackers. Poultry

was also high on the shopping list, even though there were plenty of local chickens in all villages, some of which were common pests in crop plantations. A general attitude was "why bother to go to all the trouble of catching a local chicken, de-feathering and cleaning it, when you can easily just buy one from the shop?". Canned corned beef, a popular food item for all occasions was not highly rated among the subjects, whether this reflects the high price of the item ($6.00 for a 1lb tin) or its consideration as an 'unhealthy' food is not quite certain, but good to know.

Subjects considered price as the most important factor in their decision to buy a certain food item. Hence, a choice between a more expensive and more nutritious food, and a cheaper and less nutritious food, would result in preference for the latter. Whilst women reported nutrition as their next deciding factor, men reported taste. Considering that more women than men did the family shopping, obviously their food choices determine their family's access to nutritious food.

6.4 Anthropometric Characteristics

6.4.1 Body Size

6.4.1.1 Weight and Height Assessment

Though a complete comparison cannot be made between past studies and the Pilot Survey, it appears that the average weight of the Niuean person has increased considerably over the past 50 years. As illustrated in Table 6.02 the mean weight observed in the Pilot Survey was 92 kg for the men, 13 kg heavier than the average in 1987 and 23 kg heavier than observed in the men in Langley's 1953 nutrition study (cited in SPC, 1992). Likewise for the women, the mean weight observed in the Pilot Survey was 87 kg, 10 kg heavier than the average in 1987 and 25 kg heavier than the average in 1953.

The mean height of Niuean women observed in the Pilot Survey was 161.0 cm from subjects with a mean age of 42. In the 1987 Nutrition Survey, the mean height of women aged 40-49 years was 157.1 cm. In the absence of more comparative data, it can be assumed that over the last 15 years, there has been an increase in the height of Niuean women of around 4cm. In fact, the 1987 Nutrition Survey reported an increase in height of Niuean women of 5cm compared to 40 years earlier (SPC, 1992). A comparison in the

height of Niuean men cannot be made at this time as there is a lack of data for the same age groups studied in the Pilot Survey.

Table 6.02: Comparison of the mean weight of Niuean adults observed in some studies.

	Mean Weight (kg)	
	Males	**Females**
2002 Pilot Survey	92 (n=25)	87 (n=25)
1987 Nutrition Survey[1]	79 (n=804)	77 (n=845)
1953 Nutrition Study[2]	69 (n=?)	62 (n=?)

[1]The 1987 National Nutrition and Dietary Survey of Niue (SPC, 1992)
[2]The 1953 Nutrition Survey (cited in SPC, 1992).

A point to note is that on personal observation, the younger generation on Niue are more commonly taller than their parents, at an age range where growth is still occurring. It could be asked whether the current adult population has not meet their genetic height potential; whether this is due to dietary or environmental influences or a combination of the two is an avenue for further investigation.

6.4.1.2 Body Mass Index (BMI)

Based on the BMI cut-off points for Pacific Islanders, half of the subjects were overweight and half were obese. The nutrition studies conducted in New Zealand, specifically the 1997 National Nutrition Survey (Russell et al, 1999) and the 2001 Risk Factor Study (Bell et al, 2001), groups Niueans as part of 'other' Pacific Islanders, and hence are not specifically representative of the Niuean people. Table 6.03 makes comparisons based on the classifications used in the earlier nutrition studies conducted in Niue. The sample size and age range in each study is different, thus the data sets should only be used as indicators for further investigation.

What stands out in this comparison (using the same BMI cut-offs) is the prevalence of obesity. In the 1980 NCD Survey only 7.5% of the men were obese, equivalent to about 1 in every 14 men. In the 1987 National Survey, 15% of the men were obese, equivalent to about 1 in every 7 men. In the pilot survey, 48% of the men were obese, equivalent to about 1 in every 2 men. There has certainly been a change in obesity prevalence over time

for the men since the 1980 NCD Survey. It is reasonable to say that the prevalence of obesity among the Niuean men has increased by at least five times the rate it was 22 years ago (Table 6.03).

In the 1980 NCD Survey, 31.9% of the women were obese, equivalent to about 1 in every 3 women. In the 1987 National Survey, 46% of the women were obese, equivalent to about 1 in every 2 women. In the Pilot Survey, 72% of the women were obese, equivalent to about 2 in every 3 women. It appears that the prevalence of obesity among the women has also increased over these survey periods.

Table 6.03: Comparison of body size according to the BMI classifications used in the 1987 National Nutrition and Dietary Survey (SPC, 1992) and the 1980 Non-communicable Disease Survey (SPC, 1984) in Niue.

	Males			Females		
	N	Overweight[1]	Obese[2]	N	Overweight[1]	Obese[2]
2002 Pilot Survey	25	52.0%	48.0%	25	28.0%	72.0%
1987 Nutrition Survey	801	34.0%	15.0%	845	38.0%	46.0%
1980 NCD Survey	548	38.0%	7.5%	601	67.0%	31.9%

[1]Percentage males with 27 kg/m^2 ≤ BMI <32 kg/m^2 & percentage females with 25 kg/m^2 ≤ BMI <30 kg/m^2
[2]Percentage of males with BMI ≥32 kg/m^2 and percentage of females with BMI ≥30 kg/m^2

The question is raised of whether high alcohol intake is related to the prevalence of obesity seen here in the men. A prospective study of more than 7000 middle-aged men by Goya-Wannamethee and Shaper (2003) examined the relationship between alcohol intake and weight gain. They concluded that regular alcohol intake of more than 30g per day contributes directly to body weight and a high BMI in men. Furthermore, this relationship occurred irrespective of the type of drink consumed. The median alcohol intake of men in the Pilot Survey was 164 g per drinking session. Since most reported drinking twice a week, alcohol intake per day equates to about 47g. Hence, the increased prevalence of obesity in the men today may be related to the energy contribution of alcohol. However, without historical investigation into the trends of alcohol consumption in Niue, it cannot be conclusively assumed that men are drinking more today than 20 years ago.

Table 6.04 makes comparisons of findings from different studies that classified subjects according to the revised BMI for Pacific Island populations. In this Pilot Survey, there were more obese women than men, in fact the situation within the gender groups was reversed; where 60% of the men were overweight and 40% were obese; 40% of the women were overweight and 60% were obese. This tendency is also reflected in the other surveys previously presented in Table 6.03. Furthermore this observation is consistent with other findings where the prevalence of obesity is higher among the women (Bell, et al 2001).

Table 6.04: Comparison of body size according to the BMI classification for Pacific Island populations; findings from different studies.

	Males			Females		
	N	Overweight[1]	Obese[2]	N	Overweight[1]	Obese[2]
2002 Pilot Survey	25	60.0%	40.0%	25	40.0%	60.0%
2001 Risk Factor Study (NZ)	41	NA	42.0%	67	NA	66.0%
1997 Nutrition Survey (NZ): Pacific People	105	59.2%	26.2%	168	28.8%	47.2%

[1]Percentage of subjects with 26 kg/m^2 ≤ BMI <32 kg/m^2
[2]Percentage of subjects with BMI ≥ 32 kg/m^2

A study by Schaaf et al (2000) observed no significant differences in BMI between Cook Islanders, Samoans, Tongans and Niueans. However, Bell et al (2001) found that Tongan men and women were bigger than their counterparts from other islands. So, whilst a comparison between the prevalence of obesity in the Pacific Island subjects in the 1997 National Nutrition Survey (New Zealand) and the Pilot Survey has been made, it is not an exact comparison of the Niuean 'status of obesity'. The number of Niuean respondents in the 1997 National Nutrition Survey (New Zealand) was not known. However, the prevalence of obesity was about 1 in every 4 men, and 1 in every 2 women. The prevalence of obesity in the Pilot Survey was about 1 in every 3 men and 1 in every 2 women. Thus, whilst the prevalence of obesity among the women is the same, the Niuean men have a higher prevalence of obesity than the Pacific Island population in New Zealand.

A more recent study was conducted by Bell and associates (2001) where obesity prevalence was observed in Pacific Island populations from church communities in Auckland. The Pacific Island sample size of that study was much higher (n=1175) than the 1997 Nutrition

Survey. There were 20 Niuean subjects included in the study who were grouped under 'Other Pacific Islands' ethnic groups, along with Cook Islanders, and a mix of other Pacific Islanders, other than Samoan and Tongan (these subjects were grouped separately). The prevalence of obesity in the 'Other PI' group in that study was 1 in every 3 men and 1 in every 2 women. This finding is similar to that observed in the Pilot Survey for men but not for women, and since it comes from a similar ethnic population group, may be a better comparison than the 1997 National Nutrition Survey (New Zealand).

Overall based on these findings, it appears the prevalence of obesity in women is higher in the adult Niuean population in Niue, than the Pacific Island population in New Zealand. The prevalence of obesity in men is similar in the Niuean population in Niue, to the Pacific Island population in New Zealand.

It is well documented that excessive weight is associated with chronic diseases such as non-insulin-dependent diabetes mellitus, hypertension, stroke, and heart disease (Ravussin et al, 1992), (Feinlab, 1985), (Barrett-Conner, 1985), (Pi-Sunyer, 1993). However, these associations are not as strong in Pacific Islanders as they are for European New Zealanders (McAnultry, 1996). Thus, the subjects in this study are indeed at increased risk of developing these associated diseases, but not to the same extent as other ethnic groups, particularly European New Zealanders.

In fact some studies have shown that at a fixed percent body fat, BMI in Pacific Islanders was three to four units higher than in New Zealand Europeans (Rush, 1997). Swinburn et al (1996) also summarised that at any given body size, Polynesians seem leaner than Caucasians. A more recent study by Craig et al (2001) further supported these observations by comparing body composition between Tongans and Australians. They found that compared with Australians within the same BMI range; Tongans had significantly higher fat free mass, elbow width, mid-arm muscle area and significantly lower percent body fat.

There is indeed an emergence of studies that suggest that a BMI ≤ 30 might be 'normal' for Pacific Island populations. In addition, there is the question of the validity of body composition equations developed in predominantly white populations, for use in Pacific Island populations. Interestingly, most of the women surveyed in Niue explained that they

were told by the Doctor, on numerous occasions, to lose weight and were given a target weight to reach. When they did lose a few kilos, they felt extremely fatigued and tired at this lower weight. When they put the weight back on, they felt more energetic and thus decided that the target weight suggested was too low for them. Whether fatigue was influenced psychologically or in fact due to reduced food intake and thus energy intake is an area for further investigation.

All these factors bring into question the appropriateness of other body composition 'standards' for use in evaluating Pacific Island anthropometric measurements. The 1983 Metropolitan Life Insurance Weight for Height Table was used for determining and comparing the subjects' desirable weights to their actual observed weights in the Pilot Survey. Twenty-three of the 25 men and 22 of the 25 women surveyed weighed at least 110% of their 'desirable' weights (see section 5.3 of the results).

Weight is strongly associated with bone mineral density (Glauber, 1995), in addition, studies have shown ethnic differences in bone mass and rate of bone loss (Oritz et al, 1992). Overall, a person's frame size should be considered when determining or comparing a 'desirable' or 'healthy' weight.

Using the elbow breadth and height measurements, subjects were classified according to their frame size. Half of the subjects had large frames. In fact, 20 of the 25 women surveyed had large frames, compared to only five of the men. The women's large frame size indicates larger and heavier skeletal size, which would be included in their overall weight, thus affecting BMI.

6.4.1.3 Waist Circumference and Waist to Hip Ratio (WHR)

Studies have shown that central or abdominal obesity has a higher association with increased health risks (Larsson et al, 1984), (Ohlson et al, 1985). A waist circumference of greater than 102 cm in men and 88 cm in women is a risk factor for insulin resistance, diabetes mellitus and cardiovascular disease (World Health Organisation, 1997), (Pi-Sunyer FX, 2000). In fact, Haffner et al (1991) found that abdominal obesity is a better marker of metabolic and cardiovascular risk factors in women than men. Findings from the Pilot

Survey show more women (80%) than men (28%) had a waist circumference greater than this standard and were classed as at 'substantial' risk.

The women in the Pilot Survey with greater waist circumferences were mothers who claimed their waist girths were a result of having children and not being able to shed the extra weight afterwards. An underlying understanding was that it was 'unavoidable' fat, a consequence of pregnancy and therefore not a serious 'health' risk. These women were more concerned about their total weight rather than the distribution of weight. Thus education is a key factor in reducing the prevalence of greater waist girths.

The WHR was introduced by Krotkiewski et al (1983) as another way of determining risk apart from waist measurement alone. They showed that subjects with an increased WHR were more likely to develop metabolic complications of obesity such as hyperglycemia and hyperinsulinemia.

The WHR among the subjects was quite high. Over half the subjects in both groups exceeded the recommended 'at risk' WHR. The 1987 Nutrition Survey (Niue) did not include waist to hip measurements, thus comparison with results from that earlier study is not possible. The Pilot Survey observed 64% of the men with WHR >0.9, and 76% of the women with WHR > 0.8. This is equivalent to about 1 in every 2 men and 2 in 3 women with WHR greater than the 'at risk' criteria. The same trend was also observed among the men in the 1997 National Nutrition Survey (Russell et al, 1999), where about 1 in 2 people of the Pacific Island population surveyed had WHR greater than 0.9 and 0.8 for men and women respectively.

The use of the WHR does have its limitations due to ethnic or racial differences. Marcus et al (1998) observed that because African-Americans have smaller hips (and therefore circumferences) than Caucasian-Americans, they tend to have a greater waist to hip ratio for a given amount of abdominal fat. Thus if this occurrence is similar in Pacific Island populations then there is also the need to develop population-specific risk criteria by waist measurement for Pacific people.

An increased abdominal girth gives rise to a number of chronic diseases that lowers overall 'quality of life'. Lean et al (1998) studied the effect of increased waist circumference on prevalence of respiratory difficulties, NIDDM and CVD and found that subjects with increased waist circumference had a higher incidence of chronic diseases. In fact, studies on two Pacific populations showed that increased WHR was associated with glucose intolerance (Collins et al, 1994), (Hodge et al, 1993). With this in mind, circumference measurements should be further promoted as monitoring tools.

There seem to be advantages in the use of waist criteria as a monitoring tool in the public health arena. In practical aspects it is more convenient and easier than measuring BMI, as it is a simple measurement of waist girth that could be done by individuals themselves. There is also the knowledge that people with increased waist circumferences can also have a 'normal' BMI; so whilst their BMI classification gives the impression they are 'normal', their waist measurement places them 'at risk' because of central adiposity.

6.4.1.4 Upper Arm Circumference (UAC)

The mean UAC for the Niuean men was 38.3 cm; approximately 20% and 13% bigger than the UAC of the men in both the general population and the Pacific Island population of New Zealand. Likewise with the women where the mean UAC of the Niuean women studied was 38.0 cm. This was approximately 26% and 20% bigger than the UAC of the women in both the general population and the Pacific Island population of New Zealand (Russell et al, 1999).

These measurements show that the Niuean population surveyed have greater muscle mass than the New Zealand population for both men and women. These results are further confirmed in the following section on body composition.

6.4.2 Body Composition

Swinburn et al (1996a) studied body composition differences between Polynesians and Caucasians assessed by Bioelectrical Impedance (BIA). BIA provides a measurement of total body water, and hence fat free mass. The body fat levels of the Polynesian subjects were determined using a regression equation validated in a study by Rising et al (1991).

The study found that, in both men and women, the fat mass of Polynesians was lower than that of Caucasians at the same BMI level. However, since that validation study population was for Pima Indians, the equation will not be used for this comparison. In any case, regression equations utilising BIA readings have increased error if used on a population different from that for which it was designed/validated.

Swinburn and colleagues (1996b) carried out a study on the body composition of Samoans and developed a regression equation for that population. Table 6.05 shows a comparison between the resistance and reactance readings from that study against those of the Pilot Survey. The mean BMI levels have also been included to show the similarity in body size of the two study samples.

It is fair to say that the Niuean men show a higher resistance than the Samoan men at a similar BMI level. The Niuean women on the other hand show a lower resistance than the Samoan women, also at a relatively similar BMI level. With regard to reactance levels, the Niuean subjects show higher readings, for both the men and the women. A comparison of fat mass was made between the two groups using their mean values and Swinburn's equation (Figure 6.01) because of the proximity of ethnic characteristics between the Niueans and Samoans (both are Polynesians) (Table 6.06).

Table 6.05: Comparison of BIA measurements between subjects of the pilot survey (Niueans) and Swinburn's study on Samoans (mean ± SD).

		BMI (kg/m^2)	Resistance (ohms)	Reactance (ohms)
Men	Samoan (n=94)	31.8 ± 4.6	388.9 ± 40.0	44.2 ± 7.6
	Niuean (n=25)	31.1 ± 3.0	397.6 ± 29.1	60.1 ± 6.5
Women	Samoan (n=98)	33.4 ± 6.4	474.5 ± 66.8	48.8 ± 9.2
	Niuean (n=25)	33.7 ± 4.5	469.2 ± 46.2	56.6 ± 5.6

Figure 6.01: Swinburn's equation for estimating fat mass (kg) using Bioelectrical Impedance (BIA) in Pacific Island populations.

$$\text{Fat Mass (kg)} = 6.14+0.80(\text{Wt})-5.92(\text{sex})-0.56(\text{Ht}^2/\text{R})-0.16(\text{Xc})$$

Source: Swinburn et al, 1996b.

Table 6.06: Comparison of body composition between the Niuean and Samoan[1] subjects using Swinburn's equation.

		Weight (kg)	Height (cm)	Resistance (ohms)	Reactance (ohms)	Fat Mass (kg)	Fat Mass %
Men	Niue (n=25)	91.9	171.7	397.6	60.1	22.6	24.6
	Samoa (n=94)	94.7	172.7	388.9	44.2	26.0	27.4
Women	Niue (n=25)	87.4	161.0	469.2	56.6	36.1	41.3
	Samoa (n=98)	86.0	160.5	474.5	48.8	36.7	42.7

[1]Data obtained from Swinburn et al, 1996b.

The Niuean men were on average slightly lighter and shorter than their Samoan counterparts, whereas Niuean women were slightly heavier and taller. Regardless of the similarities in weight and height, both the Samoan men and women in Swinburn's study had higher percentage fat mass compared to the Niuean subjects in the Pilot Survey, by approximately 11% and 3% respectively

The difference in fat mass is attributable to the differences in resistance and reactance measurements. The greater the resistance and/or the lower the reactance, the lower the body water, therefore the higher the resultant fat mass provided from Swinburn's equation.

Swinburn's equation was also used to calculate and compare results with those from the BIA instrument used in the Pilot Survey (Table 6.07). According to this comparison, at the mean BMI level of 31; the mean percent fat mass of the men is lower using Swinburn's equation (23.8%) than the BIA equation (25.4%). However, the women show the exact opposite where at the mean BMI level of 33.7; the mean percent fat mass is higher using Swinburn's equation (40.5%) than the BIA equation (38.3%).

This comparison shows how different the two equations are, and whether it is likely that Swinburn's equation is underestimating the fat mass of the Niuean men whilst overestimating the women, or that the equation programmed into the BIA machine is doing the exact opposite, is not known. What the results do show is that fat mass from different BIA machines may not be directly comparable and hence needs to be treated with caution.

Table 6.07: Body composition of subjects as determined by the BIA instrument[1] and Swinburn's regression equation for Samoans[2] (mean ± SD).

		BIA Equation		Swinburn's Equation	
		Fat Mass (kg)	Fat Mass (%)	Fat Mass (kg)	Fat Mass (%)
Men	Overweight (n=15)	18.7 ± 5.2	21.7 ± 4.9	17.6 ± 4.7	20.4 ± 4.2
	Obese (n=10)	31.5 ± 6.1	30.9 ± 4.5	29.4 ± 5.6	28.9 ± 3.7
	Total (n=25)	**23.8 ± 8.4**	**25.4 ± 6.6**	**22.3 ± 7.7**	**23.8 ± 5.8**
Women	Overweight (n=10)	27.6 ± 5.3	35.4 ± 4.2	28.8 ± 4.9	37.1 ± 2.9
	Obese (n=15)	37.7 ± 5.0	40.2 ± 4.6	40.4 ± 6.6	42.8 ± 3.5
	Total (n=25)	**33.7 ± 7.1**	**38.3 ± 5.0**	**35.8 ± 8.2**	**40.5 ± 4.3**

[1]The built-in regression equation is assumed to be designed for the Caucasian population.
[2] Fat Mass (kg) = 6.14+0.80(Wt)-5.92(sex)-0.56(Ht^2/R)-0.16(Xc) (Swinburn et al, 1996b).

There is also the need to consider the sample size of the Pilot Survey and whether there would be a marked difference if the sample size were much greater. Whatever the case, this is another example of ethnic differences in body composition, well documented in other studies (Bell et al, 2001), (Swinburn et al, 1996), (Norgan, 1994) and shows the further need for ethnic- specific regression equations and standards.

6.5 Blood Measurements

6.5.1 Random Blood Glucose

The blood glucose readings were all within the 'normal' range, other than for one woman who was a confirmed diabetic. There were three other diabetic women surveyed, who were on medication but their readings were normal, representing better control of their glucose levels. There was only one man who was a confirmed diabetic and his reading was very low; he was advised to have something to eat immediately following the test. The maximum reading for the men was taken from a subject who had no prior knowledge that he could be diabetic. He was advised to visit the Doctor for confirmation of his blood glucose level.

There were no subjects with impaired glucose tolerance, hence the prevalence of Type 2 diabetes observed in the Pilot Survey is based on the number of confirmed diabetics; equivalent to 1 in 5 women, and 1 in 13 men. The 2002 Niue Health Survey (Health Dept.,

2002) showed the same prevalence of Type 2 diabetes in both women and men at 1 in 6 women/men. This is more than double the prevalence observed in the Pilot Survey. This observation could be due to classification levels.

The 1980 Non-communicable Disease Survey in Niue (Bennet et al, 1984), observed that the prevalence of diabetes was higher in women (9%) than men (5%); equivalent to 1 in 11 women, and 1 in 20 men. It appears that the prevalence of diabetes in both the women and the men is much higher today than over 20 years ago.

Though the readings observed in the Pilot Survey were within the normal range, risk factors for developing Type 2 diabetes were present in many subjects. Some subjects were concerned that Type 2 diabetes was a family 'illness' and were keen to have their blood glucose tested.

6.5.2 Blood Pressure

The subjects' blood pressure measurements were categorised into three groups, namely normotensive, borderline and hypertensive (Table 6.08). The majority of the men and women in both age groups were normotensive (83% of men and 92% of women) Few subjects' had borderline or hypertensive pressures, with just one woman (4%) and several men (8%) in both categories.

Of the men in the hypertensive category, one did not realise he had high blood pressure and the other was a confirmed hypertensive taking medication. The female subject in the hypertensive category was also a confirmed hypertensive on medication. The results in Table 6.08 do not distinguish confirmed hypertensives whose blood pressures were under control through medication. Hence, overall, nearly all the subjects were categorised as 'normotensive'.

The results of the Pilot Survey show that the prevalence of hypertension is quite high; a ratio of about 1 in 7 for both men and women (based on all hypertensive subjects). Different results were found in the Niue Health Survey with 1 in 5 men and 1 in 6 women having hypertension. The study by Bennet et al (1984) observed the prevalence of

hypertension in Niue as 1 in 10 people (the same for men and women). Based on the results of both the Pilot Survey and the Niue Health Survey, it seems the prevalence is higher today than it was nearly 20 years ago.

The 1997 National Nutrition Survey (New Zealand) observed hypertension rates in the Pacific Island sample of about 1 in 5 men, and 1 in 8 women, relatively high compared to the levels observed in the Pilot Survey.

Table 6.08: Percentage of subjects classified by blood pressure levels

	Age group	Normotensive	Borderline	Hypertensive
Men	20-40	83%	8%	8%
	41-50	83%	8%	8%
	All	**83%**	**8%**	**8%**
Women	20-40	100%	0%	0%
	41-50	85%	9%	9%
	All	**92%**	**4%**	**4%**
All Subjects		**88%**	**6%**	**6%**

[1]Normotensive: systolic <140 mmHg and diastolic <90 mmHg.
[2]Borderline: 140 mmHg ≤ systolic ≤ 160 mmHg, and/or 90 mmHg ≤ diastolic ≤ 95 mmHg.
[3]Hypertensive: systolic ≥ 160 mmHg or diastolic ≥ 95 mmHg.

6.6 Dietary Assessment

6.6.1 General Food Consumption Patterns

This section on the general food consumption patterns presents the responses from the subjects regarding their 'usual' food intake. An attempt has been made to compare, wherever possible, these findings with those of the previous survey in 1987. The design of the 1987 National Nutrition Survey (Niue) was limited and results of the subjects' usual dietary intake were based on one 24-dietary recall, which was for only the previous day, and not quantifiable. Hence, the following comparisons may not reflect any true changes in dietary intake because of the design differences.

Dinner was the most important meal of the day for all participants, considered so because nobody missed dinner and over half the subjects ate the most food during this time. In terms of the amounts of food eaten, breakfast, lunch, dinner was the order of increasing

food intake. Having three main meals a day was important to the majority of the study subjects. It would have been interesting to find whether there were people who tended to skip morning meals and compensate with big meals for lunch or dinner. The design of the questionnaire in this Pilot Survey did not allow for this. Whether this pattern of food consumption contributes to any extent to the BMI levels recorded, is an issue that can be further investigated.

The most common type of fat used in the home was vegetable oil, either peanut, soybean or canola oil. A pleasing result considering vegetable oils are more expensive compared to other fat sources such as lard or dripping. Margarine was also commonly used for frying foods because of its availability. Most subjects used margarine at home, primarily as a spread and hence its availability for use in frying foods.

Determining salt usage by the subjects was difficult because of the method in which it is applied to food, ie from a shaker. In addition, some men who reported using salt during a meal, were not so sure if, and how much, salt was used during cooking. Thus, estimates of how much was used during cooking were obtained from the wives or children of these subjects.

6.6.1.1 Fruit Consumption

The questionnaire on food consumption was designed to gauge how many helpings of different foods the subjects ate on a daily basis. In terms of total fruit consumption, including imported and local fruit, none of the subjects reported having fruit on a daily basis. Thus, responses were recorded as 'weekly' consumption. Women ate more fruit than men but nevertheless fruit consumption was very low. Subjects reported that fruit consumption was more important for their young children than themselves and therefore would purchase imported fruit from the supermarket especially for the children.

The low intake of fruit by Niueans is not new. It was also noted in the 1987 Nutrition Survey in both the men and women surveyed. The survey showed about 1 in 2 women consuming at least seven fruits per week, whilst the same number of women in the Pilot Survey consumed around four or more fruits per week. None of the women in the Pilot

Survey reported consuming one fruit a day. This difference can be attributed to the design of the previous survey as the recall was based on just one day. The men reported an even lower consumption of fruit, with hardly any change from findings of the 1987 Nutrition Survey, where one in three men rarely ate fruit.

There are several explanations for the low intake of fruit amongst these subjects and Niueans in general. For instance, the availability of local fruit is seasonal and whilst consumption of local fruits is high during these seasons, the rest of the year consumption is low. Fruits that are not seasonal and widely available such as pawpaw are not a popular source of fruit among the subjects and the wider population. Imported fruit is expensive and there is little variety, therefore they are considered a treat when available.

6.6.1.2 Vegetable Consumption

Likewise with fruit consumption, vegetable consumption was recorded on a weekly basis, and was overall higher than fruit consumption. Judging from the responses given, consumption of local vegetables was similar to imported vegetables. Whilst most subjects were consuming at least three helpings of vegetables a week, there were some who rarely ate vegetables or consumed between 1-2 helpings a week. A higher percentage of women (36%) then men (12%), consumed more than seven helpings a week, an average of one helping a day.

In 1987, vegetable consumption was moderate with around 40% (1 in 3) of the women reporting having eaten vegetables (local and imported) at least once a day. The women in the Pilot Survey were similar, with one in three women consuming at least one helping of vegetables a day. The vegetable consumption of the men seems to have increased over the years. The 1987 Nutrition Survey reported 70% of the men did not eat any vegetables. The Pilot Survey only found one man (4%) who rarely ate any vegetables. Hence, men are now eating more vegetables than 16 years ago.

Most of the vegetables were imported in their frozen state. Fresh vegetables include head cabbage, carrots, cauliflower, broccoli and sometimes celery. Unlike fruit, local vegetables are not seasonal with edible hibiscus being the most common and widely grown green leafy

vegetable. Given the availability of local vegetables, it was surprising to find that their consumption was not higher. It could be that the convenience of frozen vegetables makes them easier to be used in meal preparation, or that people have limited knowledge of preparation methods for the local vegetables. In fact, most of women claimed that they only used local vegetables on Sunday when preparing the traditional dishes. Men too reported eating a lot of local vegetables on Sunday.

Whatever the case, there is the need to promote wider use of local vegetables. Not only are they free (if grown around the home), they are more nutritious than the imported frozen vegetables. Introduction of different preparation methods for the local vegetables could bring about higher consumption rates.

The very low intake of both fruit and vegetables may contribute to the increasing prevalence of non-communicable disease in Niue. Fruits and vegetables are not only excellent sources of nutrients, but they also contain non-nutrients or phytochemicals. Examples of phytochemicals include phenolic compounds, organosulfides, salicylates, glucosinolates, bioflavonoids and phytoestrogens. These non-nutrients are found in apples, oranges, cabbages, carrots, tomatoes, soybeans, onions and spinach to name a few. Associations have been made between the biochemical functions of these non-nutrients and some diseases, particularly in cancer prevention (Swanson, 1998). Bioflavonoids are radical trapping antioxidants that prevent the conversion of glucose and galactose to their polyols, processes that have been linked to diabetes and cataract formation (Linder, 1991), (Bender, 2000).

6.6.1.3 Consumption of Carbohydrate Foods

Carbohydrates are the main item in a typical Niuean meal. This remains similar to the trend seen in the 1987 Nutrition Survey where all the women and men ate some carbohydrate food at least once a day, in the form of both local and imported carbohydrate staples. There is a wide range of local carbohydrate sources, the main one being taro. Other sources include cassava, yams, kumara, plantain and breadfruit. No meal is considered complete without one of these staples. Imported carbohydrates include potato, rice and other cereal products such as bread and crackers.

Subjects reported that breakfast was the only meal of the day where imported carbohydrates were the main item. Examples included imported breakfast cereals, cream crackers and bread. There was the perception that local carbohydrates were not as healthy as imported carbohydrates because they add 'bulk'. Cereal products, being lower in weight were considered 'lighter'. In reality, local carbohydrates were less energy-dense and had more fibre which in turn made the recipient feel full, mistaken as 'bulk'. Sadly this perception still exists and extends to dietary advice given to subjects with diabetes, hypertension and other people with diet-related disease.

6.6.1.4 Consumption of Protein Foods

There was a similar pattern of protein consumption in both men and women. Several women and one man rarely ate local protein foods, but none of the subjects reported rarely eating imported protein, showing the high contribution this makes to the protein intake of these people. Local protein foods include fish (most common), coconut crab, pork, chicken and in-season pigeons, fruit bats and land crabs. Imported protein being more widely available, includes tinned fish and corned beef, poultry and other meat products and a range of other foods such as ham and luncheon.

The limited range and seasonality of local protein sources has resulted in lower consumption. Again, the convenience of imported protein foods such as tinned fish has meant their higher consumption. Subjects reported that tinned fish was cheap and easy to prepare for any meal, whether at home or at work because it was well contained in the can and ready to eat. The higher consumption of imported protein foods had been previously noted in the 1987 Nutrition Survey.

6.6.1.5 Consumption of Dairy and Related Products

The consumption of milk and milk products was very low. The majority of the subjects consumed less than a helping a week, that is less than 250 ml a week. The main use of milk was reported to be as a whitener in hot beverages. None of the subjects reported drinking milk on its own as a cold beverage. Those who reported consuming at least five glasses a week were using milk for their breakfast cereals. Consumption of other dairy products was

non-existent among the subjects, who claimed that like fruit, foods like yoghurt and cheese were mainly for their children.

Margarine was the most widely used form of fat, especially on bread but also, as mentioned earlier, for frying foods. There may have been under-reporting of the amounts used. The majority of the women reported using one teaspoon per slice of bread, whilst most of the men reported using less than a teaspoon. It was general knowledge that margarine, being a source of fat, should be limited. Knowing this may have influenced the reporting of margarine use by the subjects. Subjects were shown the measuring spoons to help them in their reporting. When tested, one teaspoon of margarine was not enough to cover a slice of bread, hence the possibility of under-reporting.

6.6.1.6 Beverage Consumption

The most common hot beverage was tea, which was consumed in greater amounts by women then men. Other hot drinks such as milo, coffee and cocoa were not as common among the subjects but all had at least one cup of hot beverage a day and almost always at breakfast. This was not surprising as a hot beverage is the common accompaniment for breakfast and early morning temperature is cooler than the rest of the day.

Cold beverages were consumed in large quantities. Water was the main drink where most men and women drank between three and five glasses a day. A higher percentage also drank at least eight glasses a day. Fruit juice consumption was quite low. Total fluid intake was between two and two and a half litres a day for the majority of the subjects. These levels reflect a good intake of fluids among the subjects helping to compensate for hydration losses due to sweat.

6.6.1.7 Consumption of Take-Away Foods

There are only a few take-away food outlets on Niue and the most common foods sold are fish and chips. Whilst most of the subjects reported rarely consuming take-away foods, those who did, consumed at least one helping a week. It was assumed that consumption of take-away foods was not limited to the individual subject but also included his/her family members, especially in the weekend. If so, then in all likelihood, the whole family was

consuming a helping of fish and chips each, on average. There are other factors besides dietary to be considered in this respect. The cost of a single serving of fish and chips was $4.50, equivalent to $18 for a family of four per occasion. The same amount of money could purchase a variety of foods for a number of balanced meals, on more than one occasion. There were no take-away food outlets that served fresh salads or less energy dense meals.

6.6.2 Trends in Meal Patterns

A typical dietary pattern consisted of the consumption of average meals during the week including Saturday, and a well prepared traditional Sunday lunch. During the week, most people enjoyed food cooked the conventional way particularly by boiling, especially the staple foods. The most convenient protein source to accompany weekday meals was tinned corned beef, served straight from the tin or cooked as a soup or other dish. Imported protein was eaten more often during the week; sources include tinned fish, chicken wings etc. Whether vegetables were included in an every weekday meal depended on their availability. Typically, imported mixed vegetables were the most convenient source of vegetables for these meals.

Sunday was the only day where people take time to prepare traditional dishes for lunch. The materials and food ingredients were obtained the day before (Saturday), whilst families were working at their plantation. Local green leafy vegetables such as taro leaves, nightshade, edible ferns or local spinach (sinapi) were picked for food preparation. Traditional dishes are best 'experienced' when cooked in an underground oven (umu), where foods are wrapped in banana leaves and steamed/baked for a couple of hours. Most, if not all, dishes included some type of leafy vegetables, providing both a nutritional balance as well as added coverage for the food when wrapped. Fresh coconut cream was a common ingredient in these dishes, and whilst most people believe it adds flavour and character to the dish, it was not essential for all dishes.

The time and effort required for a traditional umu was a disadvantage for some, particularly smaller families. More and more people were choosing the alternative to traditional food preparation by using electric ovens or by just boiling their food for Sunday lunch. Where a

typical weekday meal consisted of one dish to accompany a staple food like taro, a Sunday meal offered a wider variety of dishes, ranging from fish and chicken to delicacies like shell-fish and pigeons, to also accompany a variety of staple foods. Hence, a typical Sunday meal provided a wider variety of nutrients. All subjects reported Sunday as the one day where they ate the most food, whether it was prepared traditionally or not. It was in this respect that the daily dietary intake patterns of the study subjects were also viewed in terms of a Sunday versus a weekday diet and nutrient intakes calculated as a weighted average.

This trend or eating pattern has also been observed in other Pacific Islands. Pollock (2001) studied the people of Wallis and Futuna and noted that Sundays marked a change in the menu. On Sunday an umu was prepared with ample supply of several different root and tree starches, together with some meat. The researcher indicated a lower average energy intake for the weekdays compared to Sunday. The following section of the discussion looks at which nutrients were different between Sunday and during the week.

6.6.3 Differences in nutrient intake between Sunday and a week day

Given the nature of a typical Niuean dietary pattern, there may be differences in nutrient content and therefore nutritional status between Sunday and other weekdays (including Saturday). In fact, the intake of some nutrients was significantly higher on a Sunday compared to during the week ($P<0.05$) (Table 6.09).

The most notable point was the absence of any significant difference in the overall weight of food consumed on Sunday and during the week. Both men and women showed no significant difference in the total weight of food consumed, surprising, considering the subjects themselves reported they ate more on a Sunday than during the week. This could have been due to two factors; first, the conversion of intake values to a weighted average and second, food intake during the Sunday recorded for the 24-hour recall was lower than usual. The type of beverages consumed on Sunday could also be different than during the week, typical Sunday drinks may include fresh coconuts, fruit juices or soft drinks.

Table 6.09: Significant differences in mean nutrient intake between Sunday & Week-day diets (P<0.05)

	Males			Females		
Nutrient	**Weekday**	**Sunday**	**Difference**	**Weekday**	**Sunday**	**Difference**
Protein (g)	90.31	122.29	+35%	77.17	113.62	+47%
Cholesterol (mg)	305.26	423.36	+39%	264.33	395.23	+50%
Potassium (mg)	3900.98	5452.15	+40%	3181.62	4171.25	+31%
Magnesium (mg)	571.14	796.88	+40%	427.09	621.43	+46%
Calcium (mg)	583.77	739.08	+27%	**	**	**
Phosphorus (mg)	1367.46	1807.8	+32%	1155.52	1606.1	+39%
Iron (mg)	12.87	19	+48%	9.72	20.27	+109%
Zinc (mg)	18.84	24.54	+30%	**	**	**
Selenium (ug)	126.05	174.13	+38%	**	**	**
Riboflavin (mg)	1.37	1.76	+28%	**	**	**
Niacin Eq (mg)	40.15	51.53	+28%	35.38	50.03	+41%
Vitamin C (mg)	**	**	**	107.05	117.43	+10%
B-Carotene (ug)	234.38	306.72	+31%	2360.06	4469.06	+89%

Protein was the only macronutrient where intake was at least 30% higher on Sunday than during the week for both men and women. This was possibly due to the variety of dishes on offer as part of a traditional Sunday meal; dishes can range from fish and chicken to pigeons and other delicacies, all during the one meal.

Cholesterol intake was also significantly higher on a Sunday. Considering its presence in animal food sources, the higher protein intake resulted in greater cholesterol levels. Likewise, higher magnesium and phosphorus levels on Sunday corresponded to the higher protein intake, with some foods like pigeons and land crabs (common delicacies during the time of the recall) providing around 30 mg of magnesium per 100 g of food each. One land crab (kalahimu) weighs approximately 30 g; for an intake of six crabs per two meals (lunch and dinner), that amounts to around 110 mg of magnesium. In addition there was the high magnesium content in taro, contributing about 115 mg per 100 g of taro. Phosphorus content was also associated with protein content; with the main protein sources of chicken and seafood contributing at least 200 mg of phosphorus per 100 g of food.

Calcium intake on Sunday was significantly higher for men but not women. This could be explained by their higher intake of green leafy vegetables compared to during the week.

For example, cooked taro leaves and edible hibiscus (pele) provided 206 mg and 431 mg calcium per 100 g of food; whilst an average sized coconut provided about 176 mg calcium. It may be that because most Sunday dishes were prepared using some green leafy vegetables, whether they were taro leaves, edible hibiscus (pele) or local spinach (sinapi), the men tended to consume more of these with their meal.

The women on the other hand may have a more balanced weekly calcium intake. It could be that women generally consumed green leafy vegetables during the week as well as on Sunday. However, even in the absence of greater quantities of green leafy vegetables, the next best source of calcium was ultra heat-treated (UHT) milk used in hot beverages, which women tended to consume more often than the men. It should be noted that the edible hibiscus (pele) which was grown by almost all subjects around the home, has over four-times the calcium content of UHT milk.

This same trend seems to provide a possible explanation for significant differences in zinc, selenium and riboflavin intake of the men between Sunday and during the week. A common difference in some of the men's Sunday diet compared to the week day diet was the higher consumption of seafood on Sunday. Of particular interest was the high selenium content of skipjack tuna, whether raw or cooked, which a number of the men consumed a lot of on Sunday. Differences in zinc and riboflavin intake were indicative of the greater intake of green leafy vegetables on a Sunday, as well as some local protein foods.

Iron intake was significantly higher for both groups, again due to the higher intake of protein foods. Little red meat was consumed as part of the Sunday diet; however the local pigeon, which was commonly consumed during the diet recall period, contains over 19 mg of iron per 100 g. In addition to iron contributions from some of the green leafy vegetables like pele, there appeared to be better food sources of iron during a Sunday meal.

Vitamin C intake was significantly higher on Sunday, but only for the women. This was again likely due to higher intakes of fruit and vegetables. A popular traditional dish called 'takihi' was made using thinly sliced pieces of taro and pawpaw arranged in layers. The vitamin C content of pawpaw was 62 mg per 100 g, more than twice the Recommended Dietary Intake (RDI) for women. In addition to this dish taro leaves also had a high iron

content, around 47 mg per 100g. Some of the beverages consumed by the women, particularly the Raro drink sachets, provided more vitamin C than the RDI, in just one cup. The B-carotene and niacin levels were also associated with higher fruit and vegetable consumption on a typical Sunday.

6.6.4 The Use of Weighted Averages

The general consensus of the study subjects was that they had a tendency to consume more food in greater variety on Sunday compared to any other day during the week. With the exception of any celebrations being held on Saturday, there is typically only one day where more food is consumed. With this in mind, and in order to provide a better picture of the subjects' nutritional status, the mean daily intake of the nutrients was based on the calculation of the 'weighted average' (Figure 6.02). The following sections on nutrient intake are based on the calculated weighted average.

Figure 6.02: Calculation of mean daily nutrient intake

$$\text{Weighted average} = \frac{(\text{weekday mean} \times 6) + \text{Sunday mean}}{7}$$

This Pilot Survey was the first of its kind in Niue to incorporate a 24-hour dietary recall; therefore quantifiable comparisons with dietary intake in previous surveys conducted in Niue cannot be made. Where possible, an attempt has been made to compare the median nutrient intakes in this survey with findings from the general New Zealand population surveyed in the 1997 National Nutrition Survey (Russell et al, 1999). In addition, comparison with the mean intakes from the unadjusted results of the Pacific Island subjects has also been made. Though these comparisons are not accurate they are intended to give a broad estimation of the 'real' picture in terms of nutritional status.

6.6.5 Overall Food Intake

Whilst there is no significant difference in the amount of food consumed by the either the men or the women between Sunday and a weekday, there was a statistically significant difference in the daily average weight of food consumed by the study subjects.

The women consumed a daily average of 2,761 g food; approximately 24% less than the daily average of the men at 3,421.5 g (P=0.02). It is not surprising that men consume more food than women, given their larger body weights and greater levels of activity.

6.6.6 Energy Intake

The usual daily median energy intake for males and females in Niue was 8886.2 kJ and 7707.5 kJ respectively. The difference observed was significant at P<0.05. The usual daily median energy intake for males in New Zealand was 11,631 kJ (Russell et al, 1999), nearly 31% more than the daily median energy intake for males in Niue. The median energy intake for females in New Zealand was 7701 kJ, slightly less than the median energy intake of females in Niue.

The daily mean energy intake of the men and women in the Pacific Island population living in New Zealand was 11,726 kJ and 8,630 kJ respectively (Russell et al, 1999). Their intakes were about 23% and 10% more than the mean energy intake of the men (9,565.9 kJ) and women (7,878.0 kJ) surveyed in Niue. Overall, these comparisons show a higher energy intake in both the Pacific Island and general population of New Zealand, compared to the people in Niue.

Whilst steps were taken to ensure the most accurate dietary intake data was obtained, there was the possibility of under-reporting by the subjects, particularly in terms of the amounts of food consumed. Foods such as taro were eaten in varying sizes, from round slices to triangular chunks. Food shapes were shown to the subjects to aid their estimations of the quantities of such foods. Lima beans were used to estimate the quantities of other foods such as rice or soup. Illustrating the height of a 'heaped' pile of food on a plate was difficult because of the nature of the lima beans.

Table 6.10 presents a comparison of the total energy contribution of the macronutrients in the Pilot Survey and the 1997 National Nutrition Survey of New Zealand. There appears to be a similar trend in energy contribution between these populations.

A nutrition survey conducted in two villages on Niue (n=32 households) by Langley in 1953 (cited in Coyne, 2000) found approximately 70% of the mean energy contribution was from carbohydrates, 20% from fat and 10% from protein. As a point of comparison, the results of the Pilot Survey show an increase in energy contribution from both fat and protein but a decrease in energy contribution from carbohydrates, indicating the changes in dietary intake in Niue over nearly a 50 year period. However, this statement is not entirely accurate because it is uncertain how the dietary analyses were made in Langley's study.

Table 6.10: Comparison of percent energy contribution of the macronutrients from different populations.

	Protein		CHO		Fat	
	Men	Women	Men	Women	Men	Women
Pilot Survey (Niue)[1]	16%	17%	43%	45%	39%	38%
General population (New Zealand)[2]	15%	16%	45%	47%	35%	35%
Pacific Island population (New Zealand)[3]	16%	15%	45%	51%	35%	33%

[1]Males n=25, females n=25
[2]Males n=1927, females n=2709 (Russell et al, 1999)
[3]Males n=116, females n=191 (Russell et al, 1999)

6.6.7 Protein Intake

The difference in daily mean protein intake between men (94.9 g) and women (82.4 g) was not statistically significant at $P<0.05$. The daily median protein intake of the men and women in Niue was approximately 19% and 13% less than the daily median protein intake of the men and women in the general New Zealand population. The daily mean protein intake compared to the New Zealand Pacific Island population was about 18% less for the men (112 g vs 94.9 g). The women on the other hand had a higher mean intake than the Pacific Island women in New Zealand; about 6% more (78 g vs 82.4 g).

The Recommended Dietary Intakes (RDIs) for adults for protein intake is 55 g for men and 45 g for women (MOH, 1999b). Under these guidelines, the mean protein intake of men (94.9 g) and women (82.4 g) was well in excess of the RDI for protein. The Nutrition Taskforce (1991) recommends protein intake should not exceed twice the RDI for all ages. The mean protein level in both groups surveyed is nearly twice the RDI level for their gender, indicating high protein intakes. Eighteen percent of subjects had protein intake levels below the RDI.

The Nutrition Taskforce (1991) further recommends protein intake in the range of 0.8 to 1.6 g per kg of body weight per day. Table 6.11 shows the status of protein intake against the recommended protein intake based on individual body weight. According to this guideline, the majority of the subjects (78%) had protein intakes that were within the recommended levels. There were only two people who exceeded their recommended protein intake level based on body weight.

Table 6.11: Protein intake compared to RDI[1]

	<RDI	RDI	>RDI
Women	12%	72%	4%
Men	24%	84%	4%
All	18%	78%	4%

[1]The recommended intake for protein is approximately 0.8g/kg body weight. Adults should be in the range of 0.8-1.6g/kg of body weight per day

6.6.8 Carbohydrate (CHO) Intake

The daily median intake of total CHO of the subjects was about 4% higher for men (211.5 g) than women (203.1 g). This difference was not significant at $P<0.05$. In contrast, in the general New Zealand population the median intake for the men was 40% higher.

The mean contribution to total energy from CHO was higher in the women (44.9%) than men (42.7%). This trend was similar to that found in the general New Zealand population where the mean contribution to energy from CHO was higher in women (47%) than men (45%). The mean energy contribution from CHO observed in the New Zealand Pacific Island population was also higher in the women (51%) than the men (45%).

The target percent energy contribution from total CHO is 50-55% (Nutrition Taskforce, 1991) and was met by 14% of the total study subjects (12% men and 16% women), equivalent to 1 in 6 women and 1 in 8 men. There were two men (8%) and four women (16%) whose CHO contributions to energy exceeded the target. Seventy two percent of the men and 76% of the women had intakes below the target level (Table 6.12).

The proportion of subjects meeting the target in Niue was lower than that observed in both the general New Zealand population and the New Zealand Pacific Island population; where 1 in 3 men and 1 in 2 women have CHO intakes that are within the recommendation (Russell et al, 1999).

Table 6.12: CHO intake compared to the Nutrition Task Force recommendation[1]

	<2/3rds RDI	RDI	>RDI
Women	4%	16%	8%
Men	4%	12%	16%
All	**4%**	**14%**	**12%**

[1] The recommended intake for CHO is 50-55% of total energy (Nutrition Taskforce, 1991).

6.6.8.1 Starch

Starch contributed over half the total energy from dietary CHO. Mean daily starch intake by men was 23% higher than that of women, a statistically significant result at $P<0.05$. The daily median intake for the New Zealand population was 172 g and 112 g for the men and women respectively (Russell et al, 1999), compared to 151 g and 127 g for men and women in Niue.

The percent of CHO energy contributed by starch was (64%) in the men and 60% in women, considerably higher than the contribution to CHO energy in both the New Zealand general and Pacific Island population. This outcome is a result of the dietary sources of starch in Niue. The many staple foods of taro, cassava, yam, and breadfruit to name a few, have a much higher starch content per 100gm than potato or rice. For example, boiled taro and cassava contain 25.3 g and 32 g of starch per 100 g of food; compared to boiled rice and potato, which contain 17.5 g and 17.9 g starch per 100 g of food respectively (New Zealand Institute for Crop and Food Research, 2001).

6.6.8.2 Total Sugars

The daily median intake of total sugars was 69.2 g for the men and 78.6 g for the women; about 67% less than the median intake of New Zealand men and about 43% less than the median intake of New Zealand women (Russell et al, 1999). The daily mean intake of total

sugars in the Pacific Island population in New Zealand was nearly 250% higher in the men, and about 206% higher in the women than the daily mean intake of the survey subjects.

The overall total sugar contribution to CHO intake was 38% in the subjects studied. The Nutrition Taskforce recommends intake of sucrose and other free sugars to be restricted to no more than 15% of total energy. The daily mean contribution of sucrose to energy intake was 10.2% and 10.4% for the men and women respectively. Whilst the daily mean contribution for all subjects was within the recommended guideline, 20% of the men and 12% of the women had percentage energy from sucrose alone greater than the recommended guideline.

6.6.8.3 Dietary Fibre

Intake of dietary fibre does not differentiate between insoluble non-starch polysaccharides and soluble non-starch polysaccharides. The usual daily median intake of total dietary fibre was 14.3 g for the men and 15.1 g for the women. The intake of dietary fibre by the women is higher than the men in Niue, whilst in New Zealand median total dietary fibre intakes were higher for men (23 g) than the women (18 g).

The overall median dietary fibre intake observed in the study subjects was less than half the Nutrition Taskforce (1991) guideline of 25-30 g dietary fibre per day. Of the individual subjects, only one man and one woman's dietary fibre intake met the guideline.

The main sources of dietary fibre are the Island's staple foods; whilst not extremely high in dietary fibre, cassava, taro and breadfruit contribute 1.4, 2.3 and 3.4 g dietary fibre per 100 g. If an average daily consumption of 3 servings of taro (300g) contributes only 6.9 g dietary fibre; in the absence of additional good sources of dietary fibre, overall intake is low. This low intake can be attributed to low consumption of fruit and vegetables and whole grain products.

Well-known physiological effects of a high fibre diet include increased satiety, reduced post-prandial plasma glucose and triglyceride levels, and reduced plasma cholesterol levels.

The very low fibre intake in Niueans may contribute to the high incidence of CVD and diabetes in the population.

6.6.9 Alcohol

Alcohol was only consumed by few men during the 24-hour dietary recall, and only on one occasion, therefore the information given was not enough to gauge usual intake. Alcohol consumption during a drinking session was obtained from the lifestyle questionnaire and has been discussed in Section 6.2.2.

6.6.10 Fat Intake

The mean energy contribution of total fat was very similar between men and women with only a 0.5% difference (38.5% men, 38.0% women) and about 9% more than the Nutrition Taskforce (1991) guideline of 30-33% of energy. Eighty percent of the men and 76% of the women had total fat intakes above the recommended level (Table 6.13). The daily median fat intake of the men and women was 83.5 g and 74.8 g respectively. Whilst the intake of the women in Niue was similar to that of women (72 g) in the general New Zealand population, the fat intake of men in Niue was about 32% less than that of men in New Zealand (Russell et al, 1999).

Table 6.13: Percentage of subjects whose total energy contribution from fat exceed the recommended guidelines[1]

	Men		Women		Total	
	No.people	Percent	No. people	Percent	No. people	Percent
Total Fat	20	80%	19	76%	39	78%
SFA	19	76%	18	72%	37	74%
MUFA	0	0%	0	0%	0	0%
PUFA	0	0%	3	12%	3	6%
Cholesterol	11	44%	7	28%	18	36%

[1]The Nutrition Task Force recommend not more than 30-33% of total energy should come from fat, of which 8-12%, 6-10% and up to 12% should come from saturated, polyunsaturated and monounsaturated fatty acids respectively

Saturated fatty acids (SFA) were the main contributor to fat intake providing nearly half (44.2%) of the total fat intake. The women had a lower saturated fat intake than the men

but the difference was not significant at P=0.05. The overall mean percentage energy contribution of saturated fat was 15.6% (16.3% for the men and 14.8% for the women). This contribution was similar to that of the general New Zealand population and the Pacific Island population with 15% and 14% respectively (Russell et al, 1999). The mean contribution of monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) was also similar (Table 6.14).

Table 6.14: Energy contribution of fatty acids[1]

	Total Energy (kJ)	SFA (g)	Energy from SFA (%)	MUFA (g)	Energy from MUFA (%)	PUFA (g)	Energy from PUFA (%)	Fatty Acid Ratio
Men	9565.9	41.2	16.3%	32.3	12.7%	14.9	5.9%	3:2:1
Women	7878.0	30.9	14.8%	26.6	12.7%	13.4	6.4%	2:2:1
All	**8721.92**	**36.1**	**15.6%**	**29.5**	**12.7%**	**14.2**	**6.1%**	**3:2:1**

[1]Percent energy from SFA, MUFA & PUFA was calculated as the energy from fat (conversion =37.7 kJ/g) divided by the total energy intake.

More than half of both women and men had SFA intakes above the recommended levels, and overall 74% of the study sample exceeded recommended SFA intake levels. Coconut cream is the major source of saturated fat in the Niuean diet, contributing 28.7 g per 100 g. Sunrise margarine is the major source of polyunsaturated fat in the diet, contributing 34 g per 100 g. The main sources of monounsaturated fatty acids were animal foods, such as chicken, pork and corned beef.

Whilst the overall mean energy contribution from saturated fat is slightly over the Nutrition Taskforce (1991) guideline, the energy contributions of monounsaturated and polyunsaturated fatty acids are within these guidelines.

6.6.11 Cholesterol

The daily median intake of cholesterol was 270 mg for both the men and the women; a 33% lower intake than New Zealand men, and about 11% higher than New Zealand women. Forty four percent of men and 28% of women had excessive cholesterol intakes. Overall, 36% of the total study sample had cholesterol intakes above the recommended 300mg (American Heart Association, 2001), providing an overall mean intake of 302 mg, just over the recommended level. However, the overall mean intake for the men was 322 mg

suggesting that some men had high cholesterol intakes that pushed the mean up, whilst the median intake was much lower. Likewise for the women where their mean intake was about 13 mg higher than the median.

6.6.12 Mineral Intake

A comparison between dietary intake of calcium, iron, zinc and selenium by the subjects and the recommended intake levels are presented in Table 6.15. The levels of intake used were the Australian Recommended Dietary Intake (RDI), and the United Kingdom's Reference Nutrient Intake (RNI) and Lower Reference Nutrient Intake (LRNI).

The Nutrition Taskforce recommends the use of the Australian RDIs which are defined as the levels of intake of essential nutrients considered, in the judgement of the National Health and Medical Research Council, on the basis of available scientific knowledge to be adequate to meet the known nutritional needs of practically all healthy people (NHMRC, 2002). In this discussion, a level of two-thirds the RDI has also been included as a cut-off for defining inadequate intakes. Using RDI alone would result in classing subjects with marginally lower (within 2/3rd of the RDI) intake as having inadequate intakes.

The RNI of the United Kingdom (UK) is the amount of a nutrient which is sufficient for almost all individuals (97.5%). The LRNI is the amount of nutrient or energy that is sufficient for only a few individuals (2.5%). Habitual intakes below the LRNI by an individual will almost certainly be inadequate (Department of Health, 1991).

Sodium

Intake of added sodium was not accurate because of its method of measurement. Whilst everyone used a saltshaker, amounts used are estimated by a measuring spoon, which can both overestimate and underestimate actual amounts. Therefore whilst attempts have been made to quantify use of added sodium, the results are not totally accurate. Sodium intake was evaluated by the percentage of subjects whose intake was above the RDI (920-2300 mg) for sodium. Mean sodium intake for men and women was 2929.6 mg and 2064.1 mg respectively. More men than women exceeded the RDI for sodium; with just over half of men (52%) having sodium intakes above the RDI and 88% with intakes above the RNI. On the other hand, less than half the women (32%) had intake levels above the RDI, and 68%

above the RNI. Overall, 42% of subjects had sodium intakes above the RDI and 78% above the RNI.

Table 6.15: Percentage of subjects with mineral intakes less than 2/3rds RDI[1], the RDI[2], LRNI[3] and RNI[4]

		2/3rds RDI	RDI	LRNI	RNI
Calcium (mg)	Men	44%	76%	20%	64%
	Women	44%	88%	24%	76%
	All	**44%**	**82%**	**22%**	**70%**
Iron (mg)	Men	0%	8%	0%	24%
	Women	36%	92%	20%	72%
	All	**18%**	**50%**	**10%**	**10%**
Zinc (mg)	Men	12%	24%	-	16%
	Women	8%	44%	-	4%
	All	**10%**	**34%**	**-**	**10%**
Selenium (ug)	Men	4%	32%	4%	16%
	Women	16%	24%	12%	16%
	All	**10%**	**28%**	**8%**	**16%**

[1] 2/3rds RDI: Arbitrary cut-off point for inadequate intake
[2] RDI = Recommended Dietary Intake
[3] LRNI= Lower Recommended Nutrient Intake
[4] RNI= Recommended Nutrient Intake

Tropical climates such as in Niue result in high losses of sodium from the body via sweat. Thus, any increased dietary sodium intakes may be counter-balanced by this sweat loss. Whilst there have been studies implicating habitual high sodium intake with the development of hypertension (Stamler, 1997) (Weinberger, 1996), the effect of high sodium intake with hypertension in some of these subjects may be small. Studies involving dietary salt restriction for the reduction of blood pressure have also shown some beneficial effects, which were dependant on the subjects' age, degree of sodium restriction and initial blood pressure (Reusser et al, 1994).

Calcium

The daily median intake of calcium was 40% higher in men in the general New Zealand population (857 mg) than the Niuean men (609 mg). Calcium intake for the women was also 23% higher in women in the New Zealand population (691 mg) than the Niuean women (561.3 mg). Pacific Island men in New Zealand had slightly higher calcium intakes than men in Niue, and Niue women had higher mean calcium intake (16% more) than Pacific Island women in New Zealand.

A greater percentage of women than men had calcium intakes below the RDI (88% compared to 76%). Likewise when compared to the RNI, more than three-quarters of the women had calcium intakes below this level, compared to 64% of the men. Forty four percent of subjects had calcium intakes below 2/3rds of the RDI. Twenty percent of men and 24% of women had intakes below the LRNI level. Overall, 82% of the study sample had calcium intake levels below the RDI, 70% had intake levels below the RNI, and 22% had intakes below the LRNI (Table 6.15).

It is not certain what effect low calcium intakes, especially of the women in this study, will have on their bone physiology. When there is insufficient calcium in the diet, the body draws calcium stores from the bone by increasing bone resorption. This loss results in partially demineralised and subsequently weakened bones (Bronner and Pansu, 1999). However, ethnic differences in bone mass have been reported. A comparative study of Polynesian and European New Zealanders found that Polynesian women had 20% greater bone mineral content than New Zealand women (Reid et al, 1986). This evidence suggests that lower dietary calcium in Pacific Islanders does not make them susceptible to osteoporosis due to loss of bone mass.

Particular attention was given to the women since peak bone mass is lower in women than in men, and thus subsequent bone loss is greater (Smith, 2000). However, 20 of the 25 women in this study were classified as having a large frame size, indicating heavier and higher skeletal mass. In addition, a cursory look at relevant documentation obtained from the Niue Health Dept., showed little incidence of hip, arm or ankle fracture in the older age groups. Thus, the Niuean men and women may not be as genetically susceptible to osteoporosis as their European counterparts. However, studies have shown an inverse relationship between calcium intake and hypertension (Jorde and Bønaa, 2000), which may contribute to high levels of hypertension in the population.

Concern has been raised over the high incidence of osteoarthritis among the women. Nine out of 25 women (equivalent to 1 in 3 women) reported being told by their doctor that they had arthritis of the knees and regularly take painkillers (Voltaren) for the pain. Osteoarthritis is the most common form of arthritis whose aetiology encompasses both

biomechanics and biochemistry (Doherty, 2001) and is strongly associated with age (Sharma et al, 2000).

There is evidence for the role of systemic factors such as genetics, dietary intake and bone density, and of local biochemical factors such as obesity and muscle weakness in osteoarthritis (Felson et al, 2000). Increased body weight or obesity does provide increased risk for developing hyperuricemia and gout and osteoarthritis (Khaodhiar et al, 1999) (Coggon et al, 2001). Although osteoarthritis affects both men and women, women are more likely to be symptomatic (Coggon et al. 2001). The results of the pilot survey show that of the nine women who suffered from knee osteoarthritis, six were obese, the other three were overweight; their ages ranging from 33 to 57 years. Of the men who suffered from gout, three out of the four were obese, the other was overweight and all were 50 years and older. Thus, whilst the incidence of osteoarthritis in these women may be primarily caused by obesity, there is the possibility that hyperuricemia may be another cause but is more apparent in the men than the women. There is indeed further need for more research in this area.

Iron

The mean intake for the Niuean men was about 5% lower than the mean intake of the Pacific Island men in New Zealand (13.7 mg vs 14.4 mg). The usual daily median intake of iron for the men was 11.5 mg and 11.3 mg for the women, with an overall 11.3 mg for all the subjects. This intake was around 6% less than the daily median intake of the general population of New Zealand, at 12.0 mg. The median intake for the Niuean women was actually around 14% higher than the median intake for women in the general population of New Zealand, but the same as the intake of the Pacific Island women in New Zealand.

Many more women than men failed to meet the recommended iron intake levels (Table 6.15). Only 8% of men had iron intakes below the RDI, compared to 92% of women. None of the men had iron intakes below 2/3rds of the RDI, however, 36% of the women did. There were also some women (20%) whose iron intake was below the LRNI for their respective age groups. The prevalence of women with iron intakes below the LRNI was 1 in 5.

Actual iron intake may in fact be lower still because the main source of iron in the diet is non-heme iron as found in green leafy vegetables. Absorption of non-heme iron is inhibited by a number of compounds including phytates and phenolic compounds. Hence, whilst the iron content of some of the green leafy vegetables is very high, the presence of these inhibiting compounds lowers its absorption.

Unfortunately, funding was not available to measure iron status in this study. However, these results indicate iron depletion in women may be common and this may explain the tiredness felt by women when they reduced their food intake. This has several implications for women of childbearing age and their children and warrants further investigation.

Zinc

The usual daily median intake for zinc was 17.6 mg for men and 12.9 mg for women, contributing to an overall 12.5 mg; around 5% more than the median intake for the general New Zealand population at 11.9 mg. The mean intake for the Niuean men was 15% higher than the mean intake of the Pacific Island population in New Zealand and the mean intake for the Niuean women was 17% higher. At the time of the survey, land crabs (kalahimu) were in season and were eaten often during the time of the dietary recall. The land crabs contributed 9.1 mg zinc per 100 g food, which could explain the higher zinc levels, in addition to the seafood eaten during that time.

However, the recommended zinc intake level was not met by some of the subjects (Table 6.15). Forty-four percent of the women and 24% of the men did not meet the RDI for zinc intake, and 8% of the women and 12% of the men did not meet 2/3rds of the RDI. Sixteen percent of the men and 4% of the women did not meet the RNI for zinc intake. However no subjects had intake levels below the LRNI.

Selenium

The usual daily median intake of selenium by the Niuean population was 103.9 ug. The men had a higher median intake than the women (110.9 ug vs 102.3 ug). Niuean men had an intake of nearly twice the median intake of men (56 ug) in the general New Zealand population. The median intake for the Niuean women on the other hand was nearly three times as much as the intake of the women in the general New Zealand population. Even compared to the Pacific Island population in New Zealand, the mean selenium intake was

nearly three times higher in the Niuean men and women respectively. Seafood, in particular tuna (raw or cooked) contributes a large intake of selenium, which may explain in part the higher median intake for the Niuean population.

The selenium content of Niuean soils has not been measured and is presumed to be similar to that in New Zealand soils, which are particularly low in selenium and as such dietary assessment is based on the New Zealand food composition database. This assumption may well be wrong, in addition there are discrepancies in the assessment of selenium intake due to the uncertainty of the origin of ingredients for some foods. Hence, the comparisons made in this section are not entirely appropriate but useful in view of the lack of other suitable comparative data.

There were a number of subjects who did not meet the recommended intake levels for selenium. Overall, 28% of the subjects did not meet the RDI, 16% did not meet the RNI and 8% had selenium intake levels below the LRNI. Four percent and 12% of the men and women respectively had selenium intakes below the LRNI.

6.6.13 Vitamin Intake

The following discussion compares the vitamin intakes of the study subjects to those of the general New Zealand population (see Appendix J) and the Pacific Island population of New Zealand (see Appendix K). The median has been used for comparison rather than the mean as extreme nutrient levels can influence the mean. Therefore, the comparisons of median daily intakes are based on the general New Zealand population data. Comparisons of mean daily intakes are based on the unadjusted Pacific Island data, because the median was not analysed for that population sample. The vitamin intake of the study subjects compared to recommended levels is presented in Table 6.16.

Vitamin A

The usual daily median intake of vitamin A equivalents in the Niuean diet was about 40% lower (559 μg) than the median intake of the general New Zealand population (939 μg). The intake for Niuean males was higher than that of the females, a similar trend to the vitamin A intake of the general New Zealand population. The usual daily median intake of ß-carotene was 1742 μg; where unlike the total A intake, the women had a higher median

intake (1921 μg) than the men (1685 μg), indicating greater consumption of plant sources of vitamin A. Good sources of provitamin A carotenoids in the Niuean diet include pele, taro leaves and sweet potato. The mean vitamin A intake for the Niuean men was 46% less, and for the Niuean women was 9% less than the mean intake of the Pacific Island men in New Zealand.

Table 6.16: Percentage of subjects with vitamin intakes less than 2/3rds RDI[1], the RDI[2], LRNI[3] and RNI[4]

		2/3rds RDI	RDI	LRNI	RNI
Thiamin (mg)	Men	12%	36%	-	20%
	Women	0%	12%	-	12%
	All	**6%**	**22%**	**-**	**16%**
Riboflavin (mg)	Men	16%	72%	12%	48%
	Women	12%	36%	12%	64%
	All	**14%**	**54%**	**12%**	**56%**
Niacin Eq (mg)	Men	0%	4%	-	0%
	Women	0%	0%	-	0%
	All	**0%**	**2%**	**-**	**0%**
Vitamin C (mg)	Men	4%	4%	0%	4%
	Women	4%	4%	0%	8%
	All	**4%**	**4%**	**0%**	**6%**
Vitamin E (mg)	Men	16%	20%	-	-
	Women	0%	12%	-	-
	All	**8%**	**16%**	**-**	**-**
Vitamin B6 (mg)	Men	0%	36%	-	40%
	Women	0%	8%	-	20%
	All	**0%**	**22%**	**-**	**30%**
Vitamin B12 (ug)	Men	8%	8%	4%	8%
	Women	4%	8%	4%	8%
	All	**6%**	**8%**	**4%**	**8%**
Total Folate (ug)	Men	4%	32%	0%	32%
	Women	4%	36%	4%	36%
	All	**4%**	**34%**	**2%**	**34%**
Total A Eq (ug)	Men	40%	72%	20%	60%
	Women	40%	76%	12%	60%
	All	**40%**	**74%**	**16%**	**60%**

[1]2/3rds RDI=Arbitrary cut-off point for inadequate intake,
[2]RDI = Recommended Dietary Allowance
[3]LRNI= Lower Recommended Nutrient Intake,
[4]RNI= Recommended Nutrient Intake

There was a high percentage of subjects who did not meet the recommended requirements for total A equivalent (total vitamin A) intake. Eighteen (72%) of the men and 19 (76%) of the women did not meet the RDI (Table 6.16). Of these subjects, 10 of the men (40%) and 10 of the women (40%) had intakes below 2/3rds the RDI. Sixty percent of the subjects in

both groups did not meet the RNI. There were also some subjects whose intakes were below the LRNI, 20% and 12% of men and women respectively.

Considering the number of subjects whose intakes were below the LRNI, there is certainly a high prevalence of inadequate vitamin A intake, equivalent to approximately 1 in 6 people. The main source of vitamin A in the study sample was B-carotene, however with its low availability and low efficiency of conversion to retinol, there is further support of inadequate intake. Inadequate vitamin A intakes are a nutritional concern in a number of Pacific Island countries, particularly among children (Morbidity and Mortality Weekly Report, 2001), (Schaumberg et al, 1995). Whilst there is little indication of vitamin A deficiency among Niuean children, these findings among the adults certainly indicate grounds for suspected vitamin A deficiency among the Niuean population and the need for further investigation.

Vitamin E

The daily median intake of vitamin E in the Niuean population was about 25% higher than the median intake of the general population of New Zealand (Appendix J). The Niuean men and women have 22% and 29% higher median intakes than their New Zealand counterparts. The mean vitamin E intakes are also higher compared to the Pacific Island population in New Zealand. The Niuean men and women have 21% and 24% higher mean intakes than their New Zealand counterparts (Appendix K).

The RDI for vitamin E was not met by 20% of the men and 12% of the women; resulting in 16% of the overall study sample with intakes below the RDI. Four of the five men below the RDI also had intakes below 2/3rds of the RDI, whilst none of the women did. Whilst some of the men may have inadequate vitamin E intakes, the prevalence of inadequacy is quite low, 1 in 13 people (Table 6.16).

Vitamin C

The daily median intake of vitamin C in the Niuean population was about 10% lower than the median intake of the general population of New Zealand (Appendix J). Both the Niuean men and women had lower median intakes compared to their Pacific Island New Zealand counter-parts by approximately 17% and 4% respectively (Appendix K). A small percentage of subjects had vitamin C intakes below the RDI, with both genders having only

one subject (4%) each with intakes below 2/3rds of the RDI. Four percent of men and 8% of women had intakes below the RNI, whilst none of the subjects' had intakes below the LRNI (Table 6.16).

General consumption of fruits and vegetables was low but the vitamin C intakes shown here do not reflect a high prevalence of inadequate dietary intake. The local foods contribute more to vitamin C intake, for example boiled taro contributes 10.5 mg vitamin C per 100 g. Edible hibiscus or pele contributes 108 mg of vitamin C per 100 g; whilst pele may not be eaten in large quantities, the frequency of consumption adds to overall daily intake.

Thiamin

The usual daily median intake of thiamin for the Niuean population was about 21% lower than the median intake of the general population of New Zealand (Appendix J). The difference between the Niuean men and women was only 0.2 mg, and may be due to the quantity of food eaten. The mean thiamin intake of the Niuean men was only slightly lower (7%) than the mean intake of the Pacific Island men in New Zealand. The women on the other hand have the same mean intake (Appendix K).

Thirty six percent of men and 12% of women did not meet the RDI for thiamin. Of the men whose intakes were below the RDI, 12% had intakes below 2/3rds of the RDI. The RNI was also not met by 20% of the men and 12% of the women (Table 6.16).

The lack of unrefined or whole grain cereal products contributes to the lower thiamine levels. Whilst there has recently been an introduction of locally baked wholemeal bread, the popularity of white bread remains. In addition, cream crackers that are a popular breakfast item contribute little to thiamine intake. Fortified cereals are a good source of thiamin but the costs of such products are a disadvantage. There is definitely a need to promote a shift in consumption from refined foods to more wholesome foods, and not just to ensure adequate thiamin intake but for also for the other B-group vitamins.

Riboflavin

The daily median intake of riboflavin among the Niuean population was about 33% less than the median intake of the general population of New Zealand (Appendix J). The

Niuean men and women had intakes 35% and 20% lower than their New Zealand counter-parts. The mean riboflavin intakes were also lower by 17% and 8% for both the Niuean men and women compared to their Pacific Island counter-parts in New Zealand.

Twice as many men (72%) had riboflavin intakes below the RDI than women (36%). Sixty-four percent of the women and 48% of the men had intake levels below the RNI. Both groups had 12% of subjects' whose riboflavin intakes were below the LRNI (Table 6.16).

Subjects generally reported low consumption of dairy products that may help to explain the low riboflavin intakes. Meat and fish may be the main contributors of dietary riboflavin, in addition to some green leafy vegetables such as the taro leaves and edible hibiscus. The carbohydrate staple foods (taro, cassava, yams etc) contribute very little riboflavin.

Niacin equivalents

The usual daily median intake of niacin equivalents was 8% higher in the Niuean population compared to the general population of New Zealand (Appendix J). Whilst the Niuean men had a lower median intake than the New Zealand men, the Niuean women were vice-versa, with a median intake approximately 24% higher than their New Zealand counter-parts. The difference in median niacin intakes between the women in Niue and the general New Zealand population may be due to differences in energy and protein intake.

The mean intake of niacin equivalents was also lower for the Niuean men (42 mg) compared to the Pacific Island population in New Zealand (48 mg). The Niuean women however have a higher mean intake (38 mg) compared to the Pacific Island women in New Zealand (32 mg).

In terms of adequate intake, all of the women had adequate intakes when compared to the RDI, RNI and LRNI. Whilst 4% of the men did not meet the RDI for niacin, none of them were below 2/3rds of the RDI. Overall the high consumption of meat or high protein foods accounts for the adequacy of dietary niacin in the Niuean population.

Vitamin B6

The usual daily median intake of vitamin B6 was about 14% higher for the Niuean population than the general New Zealand population. The median intake for the Niuean men (1.4 mg) was lower than that of the New Zealand men (1.7 mg), whereas the Niuean women have a higher median intake (1.8 vs 1.2 mg). The Niuean men had the same mean intake as the Pacific Island men in New Zealand, whilst again the Niuean women had a slightly higher mean intake compared to the Pacific Island women (Appendix K).

Thirty six percent of men and just 8% of the women did not meet the RDI requirement for vitamin B6. However, none of them were below 2/3rds of the RDI. The RNI level was not met by 40% of the men and 20% of the women respectively. These levels of vitamin B6 intakes show that the Niuean population appears to have adequate intakes of dietary vitamin B6.

Vitamin B12

The usual daily median intake of vitamin B12 was slightly higher in the Niuean population (4.8 μg) compared to the New Zealand population (4 μg) (Appendix J). Both the Niuean men and women had median intakes higher than their New Zealand counter-parts by about 6% and 57% respectively. The mean vitamin B12 intake for the Niuean population was also higher than the Pacific Island population in New Zealand.

When compared to the recommended intakes, only a small percentage of the subjects did not meet the vitamin B12 requirements. Only two men (8%) and one woman (4%) had vitamin B12 intakes below 2/3rds of the RDI.

Folate (Folic Acid)

The daily median intake of folate for the Niuean population was approximately 9% less than the median intake of the general population in New Zealand. The Niuean men have a lower median intake compared to the New Zealand men (278 μg vs 212 μg). The Niuean women however have a higher median intake than the New Zealand women (221 μg vs 212 μg). The mean intake of folate was higher in both the Niuean men and women compared to the mean intake of their Pacific Island counter-parts in New Zealand (Appendix K).

The RDI level for the intake of folate was not met by eight of the men (32%) and nine (36%) of the women. However, only one man and one woman were below 2/3rds of the RDI. The RNI level for folate was not met by 32% of the men and 36% of the women. Four percent of the women also had folate intakes below the LRNI (Table 6.16). Given these results, there does not appear to be any folate deficiency among the Niuean population.

6.7 Limitations And Errors Associated With The Pilot Survey And Its Scale Up To A National Survey

The five questionnaires presented collected much information, ranging from demographic information to food production. Whilst all the information obtained provides insight into the overall nutritional status of the subjects, including all these questions in a national survey may be time consuming. In compiling the questionnaires, it was felt that the more information obtained the better, because there had not been any similar survey previously conducted in Niue. The questionnaires were designed to encompass agricultural food production, which in hindsight may not have been necessary in this pilot. The primary focus should have been on obtaining information that would be used for dietary assessment. Once the assessment was made, further investigation into the root cause of any identified issues could be carried out.

For example, questionnaire C (Appendix F) on food production was worded to determine the family's access to food crops, fruits and vegetables. However, it may have been better worded to determine whether the subjects actually used and/or how much they used (percentage) of the crops they grew for food, as opposed to selling them. The nutritional status of the subjects was also governed by his/her ability to procure, or have access to food. This was the underlying reason for attempting to address this issue in the Pilot Survey however it may be better addressed in another survey perhaps in relation to household food security.

Information on physical activity was included as part of the 24-hour recall in order to determine relative energy expenditure accompanying the food consumed that same day. The time frames given were the same as those for the diet recall but only asked for the main

activities undertaken during those time frames. For example, people who were working at their plantation reported whether they were slashing, burning, planting etc. Energy expenditure was evaluated using METs but an association with the subjects' diet was not made. The inclusion of this question with the 24-hour dietary recall was not appropriate and therefore should not be included in a national survey, unless more specific energy expenditure questions were developed to link energy expenditure with dietary intake.

Some of the questions on food consumption patterns were totally inappropriate for Niue. Questionnaire D (Appendix F) includes questions to gauge how much of different types of food the subjects usually ate. When pre-tested in New Zealand, the questions read well and subjects responded accordingly. For example, Question 7 read "how many helpings of fruit.....do you usually eat per day?" All the subjects responded that they would be very lucky to have one fruit a day, it was more appropriate to ask how many in a week. Therefore, all such questions were changed to weekly consumption, excluding staple foods and some beverages, as they were consumed at least once a day.

The subjects' reporting of their consumption patterns and amounts of foods eaten was also prone to error. Trying to recall approximate quantities of food was difficult. For example, most staple foods like taro, cassava, and yams are sliced differently. The subjects were shown a series of food shapes from a folder of shapes prepared by Massey University, and asked to select the shape that best fitted what they had eaten the day before. The resultant weight of food was calculated from the previously determined area of the selected shape and the density of the food in question. This was the best estimation of food consumption without weighing the food itself but errors are introduced when the subject either over-estimates or under-estimates what they ate.

Another area of suspected misreporting was in relation to usual alcohol consumption. As mentioned in the discussion, there was the possibility that the men felt the more alcohol they could drink, the better 'drinkers' they were hence the reported high intake levels. Judging from the blood alcohol levels calculated most of the subjects were highly intoxicated. Whether this truly was reflective of their usual drinking manner is questionable. To take this as an indication of their typical drinking habits leads one to

believe that these people are indeed at high risk of developing health problems such as cirrhosis of the liver, hypertension, stroke and coronary heart disease to name a few.

The greatest errors occurred with dietary assessment because of the limited analysis of Niuean foods. Even with the Pacific Island database, there were some common Niuean foods which were not included hence the need for substitution with some New Zealand foods. For example the Niuean sinapi was substituted with New Zealand spinach. The mineral content, particularly selenium may be underestimated because New Zealand soils have lower levels of this mineral.

7.0 Conclusions

As a random survey, findings from this study show trends that are indicative of the Niuean population in Niue and have identified areas of concern and the need for further investigation.

Dietary Assessment

The subjects claimed to eat more on a Sunday than during the week; however the amount of food eaten was not significantly different between Sunday and during the week according to the 24-hour dietary recall. There were some differences in some of the nutrients, most notably protein where intake on a Sunday was about 30% higher than during the week. The higher protein intake on Sunday resulted in higher contributions of some associated nutrients such as cholesterol, magnesium and phosphorus. Cholesterol intake for both men and women increased by 40-50% on a Sunday. Other nutrient differences were attributed to higher consumption of vegetables on a Sunday, particularly green leafy vegetables and seafood. These nutrients include calcium, zinc, selenium, riboflavin, niacin eq, vitamin C and iron.

By comparison, the average energy intake of the Niuean population was lower than the average energy intake of the general New Zealand population; however the Niuean population had a higher percentage energy contribution from fat and protein but a lower contribution from total carbohydrates than the New Zealand population. These differences in energy contributions may contribute to the prevalence of overweight and obesity in the Niuean population.

Whilst protein contribution to energy is higher on average, none of the subjects were consuming more than double their protein requirements per kilogram body weight. Total carbohydrate contribution to energy was low, where the average of all subjects was only 44%. Starch intake alone accounted for over half the energy contribution of total carbohydrates, with men consuming significantly more than women. The median intake of total sugars was much lower than that of the New Zealand population and the contribution of sucrose to energy was within the recommended intake. Subjects reported rarely

consuming any confectionary or sugar snacks, suggesting that the main source of sucrose was white sugar used in hot or cold beverages, baking and so forth. Dietary fibre intake was very low; the overall median intake was less than half of the RDI with only two people who had intake levels that met the guideline. This is another issue that needs attention. Dietary fibre, particularly soluble fibre has been associated with various health benefits. A study by Brown and colleagues (1999) found various soluble fibres reduce total and LDL cholesterol. Furthermore, a study conducted on patients with type 2 diabetes found the intake of dietary fibre improved glycemic control and decreased hyperinsulinemia in addition to lowering of plasma lipid concentrations (Chandalia et al, 2000).

The contribution of fat intake to energy was very high among the subjects, with 78% of the study sample consuming more than the RDI for total fat. This resulted in an average energy contribution from fat of 38%. Saturated fatty acids were the main contributor to fat intake providing nearly half of the total fat intake. The mean cholesterol intake of all subjects was just over the recommended level set by American Heart Association. Based on the energy contribution of the macronutrients, there is a real need to increase carbohydrate intake, especially dietary fibre, and reduce fat intake in the Niuean population.

Alcohol consumption was much more common among the men than the women. The men tended to drink to intoxicating levels once or twice a week, otherwise described as 'binge drinking'. Based on the reported volumes consumed 83% of the men who drank alcohol, drank to intoxicating levels well above the legal limit, during a drinking session. The contribution of energy from alcohol based on these drinking sessions may add to the increased prevalence of obesity seen in men today compared to earlier studies in Niue.

More men than women had sodium intakes above the recommendations for sodium; with just over half of the men (52%) having sodium intakes in excess of the recommendations. The levels consumed are not necessarily alarming because of the increased losses through sweat. Calcium intake was very low. Nearly half of all men and women surveyed had calcium intakes below two-thirds of the RDI and around 22% of the subjects had intakes below the LRNI level. Whilst calcium is the most important mineral in bone, the Niuean people are not genetically susceptible to diseases associated with calcium loss due to aging

eg osteoporosis. However, decreased calcium intake has been associated with increased incidence of hypertension, another factor that may influence hypertension rates in Niue. Furthermore, it is an important mineral for a number of other functions within the body hence increased intake of this mineral should be encouraged. Osteoarthritis has been identified by a number of the women in this study, and whether this is attributable to low calcium intakes or associated with gout is an area for further investigation.

Iron intake was also very low, more so for women than men. None of the men but 36% of the women had intakes below two-thirds of the RDI, with 20% of the women having iron intakes below the LRNI. These low intakes were associated with the high price of red meat coupled with the low intake of green leafy vegetables. Low iron intakes will affect the growth requirements of young children and women of childbearing age. Children less than 24 months of age are at increased risk of deficiency due to rapid growth and women of childbearing age have increased iron requirements due to menstrual blood losses. Pregnant women who are not able to meet their iron requirements will also affect the ability of the foetus to store iron. Iron deficiency has been associated with cognitive performance in infants. In fact, studies have suggested that severe iron deficiency in infants have long lasting, adverse effects on normal development (Andraca et al, 1997), (Lozoff et al, 2000).

The Niuean population had both a higher median zinc and median selenium intake than the general New Zealand population. However, about 10% of the subjects had both zinc and selenium intakes below two-thirds of the RDI. Median intake of vitamin A were 40% lower in the Niuean population compared to the New Zealand population, with approximately 40% of the subjects having vitamin A intakes below two-thirds of the RDI, equivalent to 1 in 6 people with inadequate vitamin A intake. The prevalence of low vitamin A intake found in this study sample warrants further investigation because of associated nutrition disorders. Median intake of vitamin E was higher in the Niuean population by 25% compared to the New Zealand population. Only four of the subjects had inadequate intakes of vitamin E, equivalent to about 1 in 13 people.

The median intakes of vitamin C, thiamine, riboflavin and folate were all lower in the Niuean population compared to the New Zealand population. Four percent, 6% and 14% of the subjects had inadequate intake levels of vitamin C, thiamin and riboflavin respectively.

The low intake of less refined cereal foods may explain these low intakes, particularly of thiamin and riboflavin. Four percent and 2% of the subjects had folate intakes below two-thirds of the RDI and below the LRNI. These percentages suggest a low prevalence of inadequate intake of these vitamins.

The median intakes of niacin, vitamin B6 and B12 were all higher in the Niuean population compared to the New Zealand population. However, median intake of B12 was only slightly higher which could explain the prevalence of inadequacy of this vitamin. Where none of the subjects had inadequate intakes of niacin and vitamin B6; 6% and 4% of the subjects had vitamin B12 intakes below two-thirds of the RDI and the LRNI respectively.

There is a real possibility that the very low intake of fruit and vegetables may contribute to the prevalence of chronic diseases in Niue because of the inadequate intake of some nutrients and non-nutrients. Numerous studies have already shown the beneficial health effects of phytochemicals, which are only found in plant foods. Fruits and vegetables contain a wide variety of these phytochemcials that may help protect cellular systems from oxidative damage, thereby reducing the risk of chronic diseases (Liu, 2003). A study by Joshipura et al (2001) concluded that green leafy vegetables and vitamin C–rich fruits and vegetables, appears to have a protective effect against coronary heart disease, particularly at more than four servings a day

Body Composition

Overall, the subjects surveyed were tall, heavy and had relatively large frames, particularly the women. A far cry from a much earlier description of Niueans in 1922 by Jumper (cited in SPC, 1992); who described them as 'of average height, well proportioned, slight and muscular rather than fat'.

The average weight of the Niuean men was 92 kg; some 13 kg heavier than the average in 1987 and 23 kg heavier than the average in 1953. Likewise with the women whose average weight was 87 kg; some 10 kg heavier than the average in 1987 and 25 kg heavier than the average in 1953. The prevalence of obesity and overweight in the Niuean population studied was very high, in both men and women. In 1980, prevalence of obesity was 1 in 13 men, in 1987 prevalence was 1 in 7 men; the Pilot Survey shows prevalence of obesity to

be 1 in 2 men, an increase of at least five times the rate it was 22 years ago. Prevalence of obesity among the women over the same period has also increased. In 1980, obesity prevalence was 1 in 3 women and in 1987, prevalence was 1 in 2 women. The Pilot Survey found the prevalence of obesity to be 2 in 3 women.

Based on comparative findings, it appears the prevalence of obesity in women was the same in the Niuean population in Niue, and the Pacific Island population in New Zealand. The prevalence of obesity in men was slightly higher in the Niuean population in Niue, than the Pacific Island population in New Zealand. These high prevalence rates of obesity are a great concern because of their associated health risks. Whilst this association is not as strong for Pacific Islanders, they are still at increased risk of developing the associated diseases, but not to the same extent as other ethnic groups, particularly European New Zealanders.

The evidence in favour of raising the BMI cut-offs for Pacific Islanders was further supported by the findings of this survey. Anthropometric measurements of elbow breadth and mid-upper arm circumference show larger skeletal size and muscle mass in the Niuean population. The BIA measurements taken show Niueans to have a higher percent fat free mass than a neighbouring Polynesian population, using the same regression equation. However, without further statistical analysis, one cannot conclude a statistical significance.

Through testing blood glucose levels and high blood pressure, two of the study subjects were suspected of having diabetes and hypertension and were advised to seek medical confirmation. The prevalence of NIDDM and hypertension were relatively low and can be attributed to good control of these conditions by the subjects who were on associated medication.

Studies have shown that there are grounds for evaluating the appropriateness of equations and criteria for measuring body size developed for the European population and their use in Pacific Island populations. This could mean the prevalence of obesity in Pacific Island populations may not be as high as currently estimated. However, there is a wealth of information to support that increasing body weights leads to an increasing risk of

developing metabolic disorders. So regardless, there are increasing health risks accompanying increasing weight and that is why control of obesity is of great importance.

This Pilot Survey has provided a more comprehensive study of the food and nutrition aspects of the Niuean people and their associated lifestyle. It has long been overdue and whilst it is not complete, it has identified areas of concern and prompted ideas for further investigation.

8.0 Recommendations

8.1 Improvement Of The Wellbeing Of Adult Niueans

These recommendations are based solely on findings of this Pilot Survey. Whether or not they have already been considered or are being implemented by other researchers; it is only appropriate to offer some suggestions that may help address nutritional issues in Niue.

Dietary Issues

There is a great reliance on imported foods in Niue because there is limited local food production. This could be advantageous given that there is only one main grocery store in Niue. By importing healthier food such as wholegrain breads, cereals, and low-fat products, the consumer has little choice, but the cost associated with these products is the hindering factor. There is always the possibility of legislation to regulate the importation of certain food products but there are economic and other factors that come into play.

For a small island state like Niue, the most workable measure is to look at ways of improving the local food supply. This study has shown there is a great need to increase consumption of fruit and vegetables. There are many other local sources of vegetables such as kumara and pumpkin tips, which are commonly used by other Pacific Island communities but not Niueans. There is a need to educate by demonstrating to the community ways to use these vegetable sources. Importation of seeds/seedlings from neighbouring Islands of other vegetable sources like the drumstick tree (*Moringa oleifera*) should also be considered.

Methods to improve the availability of seasonal fruits should be addressed. Preservation practices should be promoted to ensure a household supply of out-of-season fruit, for example mangoes and vi. The greatest obstacle to overcome would be changing the belief that consumption of imported food is a sign of wealth. It is this mentality that has seen the consumption of traditional fruits and berries diminish to the point where the younger generation consider them as 'old fashioned' foods. There are now some crops that are so rarely grown that they could possibly become extinct.

This Pilot Survey has shown there is a great need to increase dietary intake of iron and calcium. Increased consumption of iron rich foods such as red meat, as well as milk and milk products can achieve this. Increased consumption of fruit and vegetables is needed to gain the health benefits of phytochemicals with their potent antioxidant effects. Phytochemicals are present in many common fruit and vegetables, most of which are widely available in Niue. There is also a need to reduce dietary fat intake, specifically saturated fatty acids. Increased carbohydrate and dietary fibre intake can be achieved through greater consumption of local staple foods. Alcohol intake as shown in this survey is extremely high among the men and needs to be reduced.

Lifestyle Issues

There is a need for increased community awareness of the health consequences of excessive alcohol consumption, particularly in relation to binge drinking. Future surveys should also include data from younger respondents, especially in reference to the use of cigarettes and alcohol consumption. In addition, consumption of alcohol during pregnancy should also be included in the questionnaire to ascertain whether women who usually drink continue to do so during pregnancy.

Different forms of physical activity need to be continually encouraged. Exercise is commonly interpreted as a sporting activity, which in turn suggests intense effort resulting in lack of participation. Activities that can be incorporated into everyday life may be the most appropriate, including workplace activities.

Food and Nutrition Promotion

Food and Nutrition and Health Promotion Programmes implemented in the past should be re-evaluated and improved upon. The Island's small population should be used as an advantage for pilot programmes, whether they are to be for nutrition research or nutrition interventions.

The Pilot Survey has identified an imbalance of energy in that fat contributes more energy than carbohydrates in the Niuean diet. The increased intake of traditional root crops

should be continually promoted in order to increase dietary carbohydrates, reduce fat intake and thereby reduce obesity prevalence.

The Government needs to take an active role in obtaining funding for nutrition projects and/or encourage Niue's participation in regional and international programmes.

8.2 Recommendations For Further Study

The results of this Pilot Survey show there is a need for further studies of this nature to be made in Niue with its biggest advantage being its population size. It is recommended that a national survey be implemented to compliment and further confirm the preliminary findings of this study.

It may be best to implement a national survey in a number of mini-surveys by concentrating on different aspects of nutrition. This survey was structured so that other than the 24-hour dietary recall, each visit would be different. In this way, subjects were not bored with the same routine each visit. The biggest disadvantage however was the duration of the visits, which may hinder its success on a national scale. Also the period between each visit should be considered. Most subjects wanted all their visits to be made within one week however this was not possible because only one surveyor, trying to see all the subjects exactly as they wished, did not work out. The subjects' main reason for wanting visits close together was to have the survey 'over and done with', which was a fair enough request but not always possible.

Hence, time is important and so to be more appropriate for a national survey, there are sections that can be reduced, if not omitted altogether. It may be best to concentrate only on the anthropometric measurements first and later a diet recall. In this Pilot Survey, resources were limited and hence cholesterol levels of the subjects were not tested. Having found dietary cholesterol levels to be high compared to the recommended level suggests further investigation into this area. Therefore, testing of blood cholesterol levels should be included in a national survey.

Having found that nearly all the women had iron intake levels below the RDI, it is recommended that a test for serum ferritin concentration should be included when implementing the national survey. Vitamin A intake was also found to be insufficient in about 75% of the study population therefore the need for a further test for vitamin A deficiency should also be included.

The prevalence of osteoarthritis in the women is quite high. There is the possibility that as most of the women were obese, their weight may be the primary cause of the arthritis. However, as gout is also a common NCD, there is also the possibility that hyperuricemia may be another cause of the arthritis in the women and hence should be further investigated.

There is also the need for more accurate dietary intake data, hence the need for nutrient analysis of some of Niue's indigenous foods.

References

Ainsworth, B.E., Haskell, W.L., Leon, A.S., Jacobs, D.R., Montoye, H.J., Salis, J.F. and Paffenbarger, R.S. (1993). Compendium of physical activities: classification of energy costs of human physical activities. *Medicine and Science in Sports and Exercise* **25 (1)**: 71-80.

Alcohol Advisory Council of New Zealand (2002) Policy: Upper Limits for responsible Drinking. Alcohol Advisory Council, Wellington, New Zealand.

Alcohol Advisory Council of New Zealand. (1997b). The Place of Alcohol in the Lives of People from Tokelau, Fiji, Niue, Tonga, Cook Islands and Samoa living in New Zealand. Research Monograph Series,No 2. Alcohol Advisory Council, Wellington, New Zealand.

Arroll B, Swinburn B. (1994). Moving the nation: current approaches to physical activity. *New Zealand Medical Journal* **107**: 370–371.

Barasi, M.E. (1997) Human Nutrition: a health perspective. Arnold (Hodder Headline Group, London).

Barrett-Conner, E. L. (1985). Obesity, atherosclerosis, and coronary artery disease. *Annals of Internal Medicine*. **103**:1010-1019.

Bathgate, M., Alexander, A., Mitikulena, A., Borman, B., Roberts, A., and Grigg, M. (1994). The Health of Pacific Islands people in New Zealand. Public Health Commission, Wellington, New Zealand.

Beevers,G., Lip, G.Y.H., and O'Brien, E. (2001). ABC of hypertension: The pathophysiology of hypertension. *British Medical Journal* **322**: 912-916.

Bell, C., Swinburn, B., Stewart, A., Jackson, R., Tukuitonga, C., and Tipene-Leach, D. (1996). Ethnic differences and recent trends in coronary heart disease incidence in New Zealand. *The New Zealand Medical Journal.* **109**: 66-68.

Bell, A.C., Amosa, H., and Swinburn, B.A., (1997). Nutrition knowledge and practices of Samoans in Auckland. *Pacific Health Dialog* **4**: 26-32.

Bell, A.C., Swinburn, B.A., Amosa, H., Scragg, R., and Sharpe, S.J. (1999). The impact of modernisation on the diets of adults aged 20-40 years from Samoan church communities in Auckland. *Asia-Pacific Journal of Public Health* **11**: 4-9.

Bell, A.C., Swinburn, B.A., Amosa, H., and Scragg, R.K (2001a). A nutrition and exercise intervention program for controlling weight in Samoan communities in New Zealand, *International Journal of Obesity and Related Metabolic Disorders* **25**:920-927.

Bell, A.C. Swinburn, B.A., Simmons, D. et al (2001b). Heart disease and diabetes risk factors in Pacific Island communities and associations with measures of body fat. *New Zealand Medical Journal* **114**: 208-213.

Bennet, P.H., Taylor, R., Uili, R. (1984). Epidemiological studies of cardiovascular disease and diabetes in Polynesians from Rarotonga (Cook Islands) and Niue. Technical Paper No. 185. South Pacific Commission, Noumea, New Caledonia.

BHF (2000). Coronary heart disease statistics. British Heart Foundation statistics database 2000. Annual compendium.

Bronner, F., and Pansu, D. (1999). Nutritional aspects of calcium absorption. *Journal of Nutrition* **129**: 9-12.

Brown, L., Rosner, B., Willett, W.W. and Sacks, F.M. (1999). Cholesterol-lowering effects of dietary fiber: a meta-analysis. *American Journal of Clinical Nutrition* **69**: 30-42.

Bruce, B (2001). Managing diabetes and cardiovascular risk. *Drugs Topics* **145**: 27-29.

Calle, E.E., Thun, M.J., and Petrelli, J.M., Rodriguez, C., and Heath, C.W. (1999). Body mass index and mortality in a prospective cohort of U.S. adults. *The New England Journal of Medicine* **341**: 1097-1105.

Campbell, I. (2003). The obesity epidemic: can we turn the tide? *Heart* **89**(Supplement 2): 22-24.

Chalmers, J. (2000). Global impact of stroke. *Heart Disease* **2**: S13-S17.

Chandalia, M., Garg, A., Lutjohann, D., von Bergmann, K., Grundy, S.M. and Brinkley, L.J. (2000). Beneficial effects of high dietary fiber intake in patients with type 2 diabetes mellitus. *New England Journal of Medicine* **342**:1392–1398.

Coggon, D., Reading, I., Croft, P., McLaren, M., Barrett, D., and Cooper, C. (2001). Knee Osteoarthritis and Obesity. *International Journal of Obesity Related Metabolic Disorders* **25**: 622-627.

Colagiuri, S., Colagiuri, R., Na'ati, S., Muimuiheata, S., Hussain, Z., Palu, T. (2002). The prevalence of diabetes in the kingdom of Tonga. *Diabetes Care* **25**: 1378-1383.

Collins, V R., Dowse, G.K., Toelupe, P.M., Imo, T.T., Aloaina, F.L., Spark, R.A., Zimmet, P. (1994). Increasing prevalence of NIDDM in the Pacific Island population of Western Samoa over a 13-year period. *Diabetes Care* **17**: 288-296.

Connor, W.E (2001). n-3 Fatty acids from fish and fish oil: panacea or nostrum? *American Journal of Clinical Nutrition* **74**: 415-416.

Coyne, T. (2000). Lifestyle diseases in Pacific communities; edited by Robert Hughes and Sarah Langi. Secretariat of the Pacific Community (SPC), Noumea, New Caledonia.

Craig, P., Halavatau, V., Comino, and E. Caterson I. (2001). Differences in body composition between Tongans and Australians: time to rethink the healthy weight ranges? *International Journal of Obesity & Related Metabolic Disorders* **25**: 1806-1804

de Andraca, I., Castillo, M.S. and Walter, T. (1997). Psychomotor development and behaviour in iron-deficient anemic infants. *Nutrition Reviews* **55**(4): 125-132.
Department of Agriculture, Forestry and Fisheries (DAFF) (2000). *National Food and Nutrition Briefing Paper*. Government of Niue, Niue.

Department of Health (1991). Report on Health and Social Subjects No.41. *Dietary Reference Values for Food Energy and Nutrients for the United Kingdom.* Committee on Medical Aspects of Food Policy. HMSO, London.

Despres, J.P., Nadeau, A., Tremblay, A., Ferland, M., Morrjani, S., Lupien, P.J., Therlault, G., Pinault, S., amd Bouchard, C. (1989). Role of deep abdominal fat in the association between regional adipose tissue distribution and glucose tolerance in obese women. *Diabetes* **38**: 304-309.

Dewailly, E., Blanchet, C., Lemieux, S., Sauvé, L., Gingras, S., Ayotte, P., and Holub, B.J. (2001). n-3 Fatty acids and cardiovascular disease risk factors among the Inuit of Nunavik. *American Journal of Clinical Nutrition* **74**: 464-473.

Díaz, M.E. (2002). Hypertension and obesity. *Journal of Human Hypertension.* **16** (Supplement 1): S18-S22.

Dietschy, J.M. (1998). Dietary fatty acids and the regulation of plasma LDL cholesterol concentrations. *Journal of Nutrition* **128**: 444S-448S.

Djousse, L., Pankow, J. S, Eckfeldt, J. H, et al (2001). Relation between dietary linolenic acid and coronary artery disease in the National Heart, Lung, and Blood Institute Family Heart Study. *American Journal of Clinical Nutrition,* **74**: 612-619.

Doherty, M. (2001). Risk factors for progression of knee osteoarthritis. *The Lancet* **358**: 775-776.

Drewnowski, A., and Popkin, B.M. (1997). The nutrition transition: new trends in the global diet. *Nutrition Reviews* **55**: 31-43.

Eliasson, B.T. (2003). Cigarette smoking and diabetes. *Progress in Cardiovascular Diseases* **45**: 405-413.

Emmerson, B.T. (1996). The management of gout. *The New England Journal of Medicine* **334**: 445-451.

EPDSU-Economic Planning, Development and Statistics Unit (2001). *Niue 2001 Census of Population and Housing.* Premier's Department, Government of Niue.

Expert Committee on the Diagnosis and Classification of Diabetes Mellitus (2003). The Report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care* **26** (Supplement 1): S5-S20.
Fam, A.G. (2002). Gout, diet and the Insulin Resistance Syndrome. *The Journal of Rheumatology* **29**: 1350-1354.

Fanapour, P.C., Yug, B. and Kochar, M.S. (1999). Hyperhomocysteinemia: an additional cardiovascular risk factor. *Wisconsin Medical Journal* **98**: 51-54.

Feinlab, M. (1985). Epidemiology of obesity in relation to health hazards. *Annals of Internal Medicine.* **103**: 1019-1024.

Felson, D.T., Lawrence, R.C., Dieppe, P.A., Hirsch, R., Helmick, C.G., Jordan, J.M., Kington, R.S., Lane, N.E., and Nevitt, M.C. (2000). Osteoarthritis: new insights. Part 1: the disease and its risk factors. *Annals of Internal Medicine* **133**: 635-646.

Food and Agriculture Organisation (FAO) (1996). *Policies for sustaining food and agriculture in the South Pacific – Part One.* Food and Agriculture Organisation of the United Nations.

Galanis, D.J., McGarvey, S.T., Quested, C., Sio, B., Afele-Fa'amuli, S.A. (1999). Dietary intake of modernizing Samoans: implications for risk of cardiovascular disease. *Journal of the American Dietetic Association* 99: 184-190.

Garrow, J. (2000). Chapter 34: Obesity. In: *Human Nutrition and Dietetics* 10th edition. Editors: JS Garrow, WPT James, and A Ralph. pp 527-545. Churchill Livingstone: London.

Gill, T. (2002). Importance of preventing weight gain in adulthood. *Asia Pacific Journal of Clinical Nutrition* **11**(Supplement 3): S632-S636.

Gill, T.P. (2001). Cardiovascular risk in the Asia-Pacific region from a nutrition and metabolic point of view: abdominal obesity. *Asia Pacific Journal of Clinical Nutrition* **10**:85-89.

Ginsberg, H.N. and Karmally, W. (2000). Chapter 41: Nutrition, Lipids, and Cardiovascular Disease. In: *Biochemical and Physiological Aspects of Human Nutrition* Editor: M.H. Stipanuk, pp917-944. W.P. Saunders: London.

Glauber, H.S., Vollmer, W.M., Nevitt, M.C., Ensrud, K.E., and Orwoll, E.S (1995). Body weight versus body fat distribution, adiposity, and frame size as predictors of bone density. *Journal of Clinical Endocrinology & Metabolism* **80**:1118-1123.

Gonelevu, S., Rush, E., and Laulu, M., (1997). Fruit, vegetable and cereal intake of Polynesian and European women in Auckalnd. *Pacific Health Dialog*, **4**: 11-19.

Haffner, S.M., Mitchell, B.D., Hazuda, H.P. and Stern, M.P. (1991). Greater influence of central distribution of adipose tissue on incidence of non-insulin-dependent diabetes in women than men. *American Journal of Clinical Nutrition* **53:** 1312–1317.

Han, T.S., van Leer, E.M., Seidell, J.C., and Lean, M.E.J. (1995). Waist circumference action levels in the identification of cardiovascular risk factors: prevalence study in a random sample. *British Medical Journal* **311**:1401-1405.

Harris, M.D., Siegel, L.B. and Alloway, J.A. (1999). Gout and Hyperuricemia. *American Family Physician* **59**:925-935.

Hill, J., Kriketos, A., and Peters, J. (2000). Disturbances of energy balance. In: *Biochemical and Physiological Aspects of Human Nutrition.* Editor: M. Stipanuk. W.B. Saunders; London.

Hinton, R., Moody, R.L., Davis, A.W., and Thomas, S.F., (2002). Osteoarthritis: diagnosis and therapeutic considerations. *American Family Physician* **65**:841-848.

Hodge, A.M., Dowse, G.K. (1996). Obesity in Pacific Populations. *Pacific Health Dialog* **3**: 77-86.

Hodge, A.M., Dowse, G.K., and Zimmet, P.Z. (1993). Association of body mass index and waist-hip circumference ratio with cardiovascular disease risk factors in Micronesian Nauruans. *International Journal of Obesity* **17:** 399-407.

Hunter, D.J., March, L. and Sambrook, P.N. (2002). Knee osteoarthritis: The influence of environmental factors. *Clinical and Experimental Rheumatology* **20**: 93-100.

Jorde, R., and Bønaa, K.H. (2000). Calcium from dairy products, vitamin D intake and blood pressure: the Tromoso study. *American Journal of Clinical Nutrition* **71**: 1530-1535

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

Karason, K., Wallentin, I., Larsson, B. and Sjöström, L. (1997). Effects of obesity and weight loss on left ventricular mass and relative wall thickness: survey and intervention study. *British Medical Journal* **315**: 912-916.

Kauhanen, J., Kaplan, G.A., Goldberg, D.E., and Salonen, J.T. (1997). Beer binging and mortality: results from the Kuopio ischaemic heart disease risk factor study, a prospective population based study. *British Medical Journal* **315**: 846–851.

Khaodhiar, L., McCowen, K.C., and Blackburn, G.L (1999). Obesity and its comorbid conditions. *Clinical Cornerstone* **2**:17-31.

Koike, G., Yokono, O., Iino, S., Adachi, M., Yamamoto, T., Puloka, T., Suzuki, M. (1984). Medical and nutritional surveys in the Kingdom of Tonga; comparison of physiological and nutritional status of adult Tongans in urbanized (Kolofo-ou) and rural (Uiha) areas, *Journal of Nutritional Science and Vitaminology* **30**: 341-356.

Kromhout, D. (2001). Epidemiology of cardiovascular diseases in Europe. *Public Health Nutrition* **4**: 441-457.

Krotkiewski, M., Bjorntorp, P. (1983). Impact of obesity on metabolism in men and women: importance of regional adipose tissue distribution. *Journal of Clinical Investigation* **72**: 1150-1162.

Lako, J.V. (2001). Dietary trend and diabetes: its association among indigenous Fijians 1952 to 1994. *Asia Pacific Journal of Clinical Nutrition* **10**: 183-187.

Langly, D (1953). Nutrition Survey: Niue Island, 1953. South Pacific Commission, Noumea, New Caledonia.

Larsson, B.K., Svarsudd, L., Welin, L., Wilhemsen, L., Björntorp, P., and Tibblin, G (1984). Abdominal adipose tissue distribution, obesity, and risk of cardiovascular disease and death: 13 year follow up of participants in the study of men born in 1913. *British MedicalJournal* **28**: 1401–1404.

Lean, M.E.J., Han, T.S., and Morrison, C.E. (1995). Waist circumference indicates the need for weight management. *British Medical Journal* **311**:158-61.

Lindeberg, S., Berntorp, E., Nilsson-Ehle, P., Terent, A., and Vessby, B. (1997). Age relations of cardiovascular risk factors in a traditional Melanesian society: the Kitava Study. *American Journal of Clinical Nutrition* **66**: 845-852.

Linder, M.C. (1991). Nutritional Biochemistry and Metabolism (2nd edition), Appleton & Lange: Connecticut.

Liu, R.H. (2003). Health benefits of fruit and vegetables are from additive and synergistic combinations of phytochemicals *American Journal of Clinical Nutrition* **78**: 517-520.

Lonnqvist, F. (1996). The obese (ob) gene and its product leptin – a new route towards obesity treatment in man? *Quarterly Journal of Medicine.* **80:** 327-332.

Lowe, L.P., Greenland, P., Ruth, K.J., Dyer, A.R., Stamler, R., and Stamler, J. (1998). Impact of major cardiovascular disease risk factors, particularly in combination, on 22-year mortality in women and men. *Archives of Internal Medicine.* **158**: 2007-2014.

Manek, N.J., Hart, D., Spector, T.D., and MacGregor, A.J. (2003). The association of body mass index and osteoarthritis of the knee joint: an examination of genetic and environmental influences, *Arthritis and Rheumatism* **48**:1024-1029.

Mann, J (2000). Diseases of the heart and circulation: the role of dietary factors in aetiology and management. In "Human Nutrition and Dietetics". 10th edition. Editors: Garrow, J.S., James W.P.T and Ralph, A. Churchill Livingstone, Edinburgh.

Manson, J.E., and Spelsberg, A. (1994). Primary prevention of non-insulin-dependent diabetes mellitus. *American Journal of Preventive Medicine* **10**: 172–184.

Manson, J.E., Willett, W.C., Stamfer, M.J. et al (1990). A prospective study of obesity and risk of coronary heart disease in women. *New England Journal of Medicine* **333**: 677-685.

Marcus, M.A., Wang, J., Pi-Sunyer, F.X., Thornton, J.C., Kofoloulo, I. and Pierson, R.N. Jr (1998). Effects of ethnicity, gender, obesity, and age on central fat distribution: comparison of dual x-ray absorptiometry measurements in white, black, and Puerto Rican adults. *American Journal of Human Biology* **10:** 361–369.

McAnultry, J.and Scragg, R. (1996). Body mass index and cardiovascular risk factors in Pacific Islands Polynesians and Europeans in New Zealand. *Ethnicity and Health* **1**: 187-195.

McArdle, W.D., Katch, F.I. and Katch, V.L. (1991). Exercise Physiology: energy, nutrition and human performance. Lea and Febiger, Philadelphia.

Meagher, E.A. & Burke, F. (1999). Cardiovascular Disease. In: *Medical Nutrition & Disease.* 2nd Edition (Editors: Morrison, G and Hark, L.), Blackwell Science Inc; Massachusetts.

Metcalf, P.A., Scragg, R.K., Tukuitonga, C.F., Dryson, E.W., (1998). Dietary intakes of middle-aged European, Maori and Pacific Islands people living in New Zealand. *The New Zealand Medical Journal* **111**: 310-313.

Miller, J.W. (2001). Does lowering plasma homocysteine reduce vascular disease risk? *Nutrition Reviews* **59**: 7 242-244.

Ministry of Health (1997). Diabetes Prevention and Control: The public health *issues.* A background paper. Ministry of Health, Wellington, New Zealand.

Ministry of Health. (1999a). *Our Health Our Future: The health of New Zealanders 1999*. Ministry of Health, Wellington, New Zealand.

Ministry of Health (1999b). Taking the Pulse: The 1996/97 New Zealand Health Survey. Ministry of Health, Wellington, New Zealand.

Ministry of Health (2001). Priorities for Maori and Pacific Health: Evidence from Epidemiology. Public Health Intelligence (PHI) Occasional Bulletin No. 13. Ministry of Health, Wellington, New Zealand.

Ministry of Health (2002). Modelling Diabetes: A Summary. *Public Health Intelligence (PHI)* Occasional Bulletin No. 11. Ministry of Health, Wellington, New Zealand.

Morbidity and Mortality Weekly Report (2001). Vitamin A deficiency among children--Federated States of Micronesia. *Morbidity and Mortality Weekly Report* **50**: 509-512.

National Health Committee (1998). Active for Life. A call for action: the health benefits of physical activity. National Health Committee, Wellington.

Neich S, Park J. (1988). The place of alcohol in the lives of some Samoan women in Auckland. Report No.12. Department of Anthropology, University of Auckland, New Zealand.

New Zealand Institute for Crop and Food Research (2001). The Concise New Zealand Food Composition Tables. 5th Edition. Wellington, New Zealand.

New Zealand Health Information Service (NZHIS) (2000). Mortality and Demographic Data 1997, New Zealand Health Information Service, Ministry of Health, Wellington, New Zealand.

Niue Health Department (2002). Report on the Nationwide Health Survey, April-May 2002. Government of Niue, Alofi, Niue.

Norgan, N.G. (1994). Population differences in body composition in relations to the body mass index. *European Journal of Clinical Nutrition* **48 (Suppl 3)**: S10-S27.

Nutrition Taskforce (1991). Food for Health: Report of the Nutrition Taskforce. Department of Health, Wellington, New Zealand.

Ohlson, L.O., Larsson, B., Svardsudd, K., Welin, L., Eriksson, H., Wilhelmson, L., Björntorp, P., and Tibblin, G (1985). The influence of body fat distribution on the incidence of diabetes mellitus, 13·5 years of follow-up of the participants of the study of men born in 1913. *Diabetes* **34**: 1055–1058.

Pate R, Pratt M, Blair S, et al. 1995. Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association* **273**: 402–407.

Pi-Sunyer, F.X. (1993). Medical hazards of obesity. *Annals of Internal Medicine*. **119**: 655-660.

Pi-Sunyer, F.X. (2000). Obesity: criteria and classification. *Proceedings of the Nutrition Society* **59**: 505-509.

Pollitzer, W.S. and Anderson, J.B. (1989). Ethnic and genetic differences in bone mass: a review with a heredity vs environmental perspective. *American Journal of Clinical Nutrition* **50**: 1244-1259.

Prior, I.A.M., Welby, T.J., Ostbye, T., et al (1987). Migration and gout: the Tokelau Island Migrant Study. *British Medical Journal* **295**: 457-461.

Pudaric, S., Sundquist, J. and Johansson, S. (2000). Major Risk Factors for Cardiovascular Disease in Elderly Migrants in Sweden. *Ethnicity & Health* **5**: 137-151.

Ravussin, E. and Swinburn, B.A. (1992). Pathophysiology of obesity. *Lancet* **340**: 404-408.

Reaven, G., and Tsao, P.S. (2003). Insulin resistance and compensatory hyperinsulinemia: the key player between cigarette smoking and cardiovascular disease? *Journal of the American College of Cardiology* **41**: 1044-1047.

Reid, I.R., Mackie, M., and Ibbertson, H.K. (1986). Bone mineral content in Polynesian and white New Zealand women. *British Medical Journal* **292**: 1547-1548.

Reusser, M.E. and McCarron, D.A. (1994). Micronutrient effects on blood pressure regulation. *Nutrition Reviews* **52**:367-375.

Rush, E.C. Plank, L.D., Laulu, M.S. and Robinson, S. (1997). Prediction of percentage body fat from anthropometric measurements: comparison of New Zealand European and Polynesian young women. *American Journal of Clinical Nutrition* **66**: 2-7.

Russell, D.G., Parnell, W.R. and Wilson, N.C. (1999). NZ Food: NZ People. Key results of the 1997 National Nutrition Survey. Ministry of Health, Wellington, New Zealand.

Schaaf, D., Scragg, R., and Metcalf, E (2000). Cardiovascular risk factors levels of Pacific people in a New Zealand multicultural workforce. *New Zealand Medical Journal* **113:** 3-5.

Schaefer, E.J. (2002). Lipoproteins, nutrition and heart disease. *American Journal of Clinical Nutrition* **75**: 191-212.

Schaumberg, D.A., Linehan, M., Hawley, G., O'Connor, J., Dreyfuss, M., and Semba, R.D. (1995). Vitamin A deficiency in the South Pacific. *Public Health* **109**:311-317.

Sharma, C. Lou, S. Cahue and D.D. Dunlop (2000). The mechanism of the effect of obesity in knee osteoarthritis. *Arthritis Rheumatism* **43**: 568–575.

Simmonds, H.A., McBride, M.B., Hatfield, P.J., Graham, R., McCaskey, J., and Jackson, M. (1994). Polynesian women are also at risk for hyperuricaemia and gout because of a genetic defect in renal urate handling. *British Journal of Rheumatology* **33**: 932-937.

Simmons, D. (1996). Diabetes and its complications in New Zealand: an epidemiological perspective. *New Zealand Medical Journal* **109**: 245–247.

Smith, R (2000). Chapter 11: Bone mineral. In: *Human Nutrition and Dietetics*, 10th edition. Edited by: J.S. Garrow, W.P.T James, and A. Raplh. p 165-175. Churchill Livingston: London.

South Pacific Commission (SPC) (1992). The 1987 National nutrition and dietary survey of Niue. Technical Paper No. 202. South Pacific Commission, Noumea, New Caledonia.

Sowers, M (2001). Epidemiology of risk factors for osteoarthritis: systemic factors. *Current Opinion in Rheumatology* **13**: 447-451.

Stamler, J. (1997). The INTERSALT Study: Background methods, findings, and implications. *American Journal of Clinical Nutrition* **65(Suppl)**: 626S-642S.

Statistics New Zealand (2001). Census of Population and Dwellings http:www.stats.govt.nz

Swinburn, B.A., Carmichael, H.E. and Plank, L. (1996b). Body Composition in Samoans. *Report to the Ministry of Health.* University of Auckland, New Zealand.

Swinburn, B.A., Craig, P.L., Daniel, R., Dent, D.P.D., and Strauss, B.J.G. (1996a). Body composition differences between Polynesians and Caucasians assessed by bioelectrical impedance. *International Journal of Obesity* **20**: 889-894.

Taylor, R,, Nemaia, H., and Connell, J. (1987). Mortality in Niue, 1978-82. *The New Zealand Medical Journal.* **100**: 477-481.

Thomas, B. (1996). Nutrition in Primary Care: A handbook for health professionals. Blackwell Science: U.K.

Vainikolo, F., Vivili, P., Guthrie, B.E. (1993). Food consumption patterns and beliefs of Tongans living in New Zealand. *Journal of the New Zealand Dietetic Association* **47**: 6-9.

Vasan, R.S., Martin, M.D., Larson, G., Leip, E.P., Evans, J.C., O'Donnell, C.J., Kannel, W.B. and Levy, D. (2001). Impact of high-normal blood pressure on the risk of cardiovascular disease. *The New England Journal of Medicine* **345**: 1291-1298.

Vermeulen, E.G.J., Stehouwer, C.D.A., Twisk, J.W.R., van den Berg, M., de Jong, S.C., Mackaay, A.J.C., van Campen, C.M.C., Visser, F.C., Jakobs, C.A.J.M., Bulterijs, E.J. and Rauwerda, J.A. (2000). Effect of homocysteine-lowering treatment with folic acid plus vitamin B_6 on progression of subclinical atherosclerosis: a randomised, placebo-controlled trial. *Lancet* **355**: 517-522.

Wahi, S., Gatzka, C.D., Sherrard, B., Simpson, H., Collins, V., Dowse, G., Zimmet, P., Jennings, G., and Dart, A.M (1997). Risk factors for coronary heart disease in a population with a high prevalence of obesity and diabetes: a case-control study of the Polynesian population of Western Samoa. *Journal of Cardiovascular Risk* **4**: 173-178.

Wannamethee, S.G. and Shaper, A.G (2003). Alcohol, body weight, and weight gain in middle-aged men. *American Journal of Clinical Nutrition* **77**: 1312-1317.

Wannamethee, S.G., Shaper, A.G., and Perry, I.J. (2001). Smoking as a modifiable risk factor for type 2 diabetes in middle-aged men, *Diabetes Care* **24**: 1590-1595.

Watford, M. and Goodridge, A.G. (2000). Chapter 16: Regulation of Fuel Utilisation. In: *Biochemical and Physiological Aspects of Human Nutrition*. Editor M.H. Stipanuk. pp 384-407. W.P. Saunders: London.

Weinberger, M.H. (1996). Salt sensitivity of blood pressure in humans. *Hypertension* **27**: 481-490.

Weinstein, S., Sedlak-Weinstein, E., Taylor, R., and Zimmet, P. (1981). The high prevalence of impaired glucose tolerance and diabetes mellitus in an isolated Polynesian population, Manihiki, Cook Islands, *The New Zealand Medical Journal* **94**: 411-413.

Welch, G.N., and Joscalzo, J. (1998). Homocysteine and atherothrombosis. *New England Journal of Medicine* **338**: 1042-1050.

Wing, R.R., Jefferey, R.W., Burton, L.R., Kuller, L.H., Thorson, C., and Folsom, A.R. (1992). Change in waist-hip ratio with weight loss and its association with change in cardiovascular risk factors. *American Journal of Clinical Nutrition* **55**: 1086-1092.

World Health Organization (WHO) (1997). Obesity: Preventing and Managing the Global Epidemic. *Report of a WHO Consultation on Obesity*. World Health Organisation, Geneva.

World Health Organisation (WHO) (2000). Obesity: preventing and managing the global epidemic. Report of a WHO consultation, *World Health Organization Technical Report Series,* **894**.

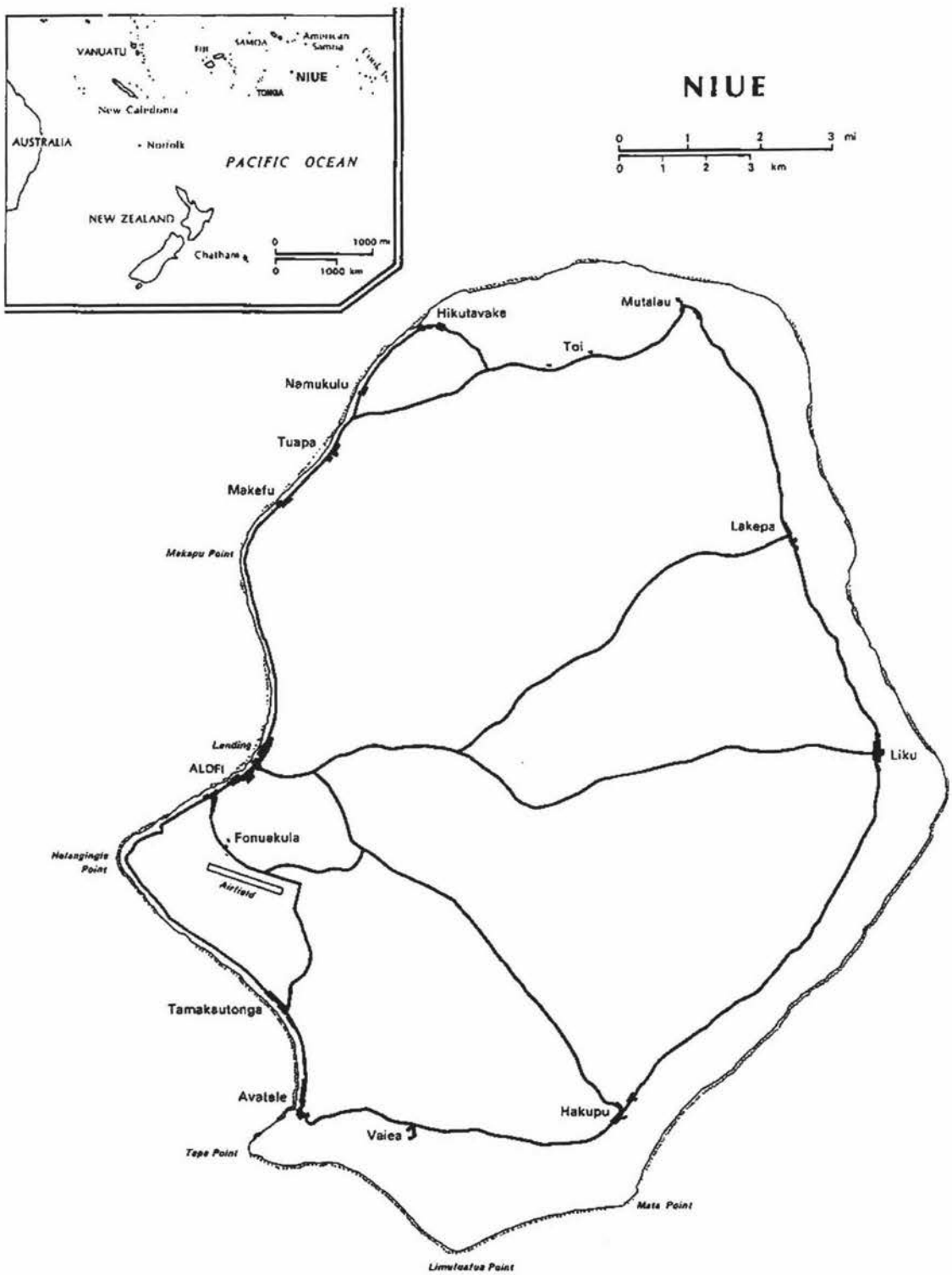
World Health Organisation (WHO) (2001). WHO Cardiovascular Disease Programme. http://www.who.int/ncd/cvd/index.htm

Wortman, R.L. (2002). Gout and hyperuricemia. *Current Opinion in Rheumatology* **14**: 281-286.

Wyllie, A., Millard, M. and Zhang, J.F. (1996). Drinking in New Zealand: a National Survey 1995. Alcohol and Public Health Research Unit, University of Auckland: Auckland, New Zealand.

Appendix A

Map of Niue


VANUATU
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Makefu
Lakepa
Makapu Point
Liku
Landing
ALOFI
Fonuekula
Halangingie Point
Airfield
Tamakautonga
Avatele
Hakupu
Vaiea
Tepa Point
Mata Point
Limuloafoa Point

Appendix B

Letter of Approval from the Human Ethics Committee

Massey University, Albany

Massey University

Office of the Principal
Massey University
Albany Campus
Private Bag 102 904,
North Shore MSC,
Auckland,
New Zealand
Principal: 64 9 443 9799 ext 9517
Campus Registrar: 64 9 443 9799 ext 9516
Facsimile: 64 9 414 0814

1 May 2002

Gaylene Tasmania
C/o Patsy Watson
Institute of Food Nutrition and Human Health
Massey University
Albany

Dear Gaylene

HUMAN ETHICS APPROVAL APPLICATION – MUAHEC 01/029
"Pilot Nutrition Survey of the Adult Niuean Population in Niue"

Thank you for your application. It has been fully considered, and approved by the Massey University, Albany Campus, Human Ethics Committee.

If you make any significant departure from the Application as approved then you should return this project to the Human Ethics Committee, Albany Campus, for further consideration and approval.

Yours sincerely

Associate-Professor Kerry Chamberlain
Chairperson,
Human Ethics Committee
Albany Campus

CC Patsy Watson
Institute of Food Nutrition and Human Health,
Massey University, Albany

Appendix C

Study Subjects from each Village

Appendix C: Final number of study subjects (aged 18-60 yrs), by village

Village	Men	Women
Makefu	1	1
Tuapa	2	2
Namukulu	0[1]	1
Hikutavake	1	1
Toi	1	1
Mutalau	2	2
Lakepa	3	1
Liku	1	1
Hakupu	3	3
Vaiea	1	1
Avatele	2	2
Tamakautoga	2	2
Alofi South	3	4
Alofi North	3	3
Total	**25**	**25**

[1]All the men (3) from Namukulu who met the selection criteria declined to take part in the survey.

Appendix D

Letters of Introduction

English and Niuean

MASSEY
UNIVERSITY

ALBANY CAPMUS, NEW ZEALAND

INSTITUTE OF FOOD, NUTRITION AND HUMAN HEALTH

To: _____,

As part of my Master of Science Degree at Massey University, I am conducting a pilot nutrition survey of the adult Niuean population. You may have already heard or read about this survey on Radio Sunshine or in the Niue Star.

This letter is to advise that you have been randomly selected as a potential participant of this survey, and thus I am inviting you to take part. However, like all invitations you have the choice of accepting or declining. Attached is an information sheet that outlines what will be involved in the survey. Please read this information thoroughly before making your decision.

If you have any questions, please do not hesitate to contact me at the Department of Agriculture, Forestry and Fisheries on ph: 4032.

Thank you for your time.

Yours Sincerely,

Gaylene M Tasmania

MASSEY
UNIVERSITY

ALBANY CAPMUS, NEW ZEALAND

INSTITUTE OF FOOD, NUTRITION AND HUMAN HEALTH

Kia: _____,

Fakaalofa lahi atu. Kua amanaki au ke taute e taha kumikumiaga ke lata mo e taha vala he haaku a tau fakaakoaga he Master of Science he aoga pulotu ko e Massey University. Liga kua fitā ni he logona e koe e falu a tau talahauaga hagaao ia ke he kumikumiaga nei he Leotaogo Niue poke Tohi Tala Niue.

Ko e tohi nei ke fakailoa atu kua fifili mai e higoa haau mai he tokologa ke lata mo e kumikumiaga nei. Ole atu ke totou e koe e falu a fakamaamaaga ne kua lafi atu ke he tohi nei hagaao ia ke he kumikumiaga nei. Kaeke kua fiafia a koe ke eke mo taha tagata he kumikumiaga nei, fakaamolemole ti fakailoa mai kia au.

Kaeke foki kua fai hūhū a koe, kia matutaki mai kia au he Faahi Gahua Fonua he numela telefoni 4032.

Fakaaue Lahi Mahaki.

Haau a fakamooli,

Gaylene M Tasmania

Appendix E

Information Sheets

English and Niuean

MASSEY
UNIVERSITY

ALBANY CAMPUS, NEW ZEALAND
INSTITUTE OF FOOD, NUTRITION AND HUMAN HEALTH

Pilot Nutrition Survey of The Adult Niuean Population

STUDY INFORMATION FOR PARTICIPANTS

This survey is being conducted by Gaylene M Tasmania, as part of her MSc (Nutritional Science) Degree at Massey University, Albany. She is a permanent resident of Niue Island, and is fluent in the Niuean language. This survey is being conducted under the supervision of Patsy Watson, Programme Leader in Human Nutrition at Massey University.

OUTLINE OF THE STUDY

This study is a pilot nutrition survey of the adult population of Niue. It has been 15 years since Niue's last national nutrition survey, which was carried out in 1987 by the formerly known South Pacific Commission (SPC) and the Government of Niue.

The participants of this study will be randomly selected from the adult population, considered as those people aged 18 to 60 years. The random selection will be made from the Electoral Roll held by the Department of Justice, Lands and Survey, Government of Niue. The random sample will consist of a total of 50 people, with an equal number of female and male subjects.

The results obtained from this survey will be used in various ways. For example, developing nutrition interventions, identifying where health resources are needed most, and comparing results from the previous survey. We need to find out whether dietary intake and lifestyle has changed with changing times and what impact this has on our wellbeing, not only as individuals but also as a developing nation.

The following information outlines the requirements for this survey and what is going to be involved. The researcher will personally explain or clarify any points that you may not understand and answer any questions you may have. It is strictly and entirely your decision whether or not you choose to participate in this study.

WHAT WILL YOU BE ASKED TO DO AS A STUDY SUBJECT?

There are three main parts to this study, which will involve three separate home visits by the researcher, conducted over a period of 6-8 weeks.

1. <u>VISIT ONE: Duration 60 minutes</u>

This first visit has three parts, explained as follows:

(a) 24-hour dietary recall

The researcher will ask you about the foods and drinks you ate during the day and night before the visit. If she visits you on Monday, she will ask you what you ate or drank on Sunday and also how much. You will be given a form at the beginning of the survey to help you with this dietary recall. Your answers will help to determine how much of different nutrients you are getting from your daily diet.

(b) Body measurements

The next part of the visit will involve taking body measurements from you such as;

Your weight -	this is a measurement of how heavy you are.
Your height -	this is a measurement of how tall you are.
Upper arm circumference-	this measurement will be made using a measuring tape around the middle of your upper arm.
Elbow breadth-	this measurement will be made using a bone calliper, to give an indication of frame size.
Your waist circumference-	this measurement will also be made using a tape measure around your waist.
Your hips circumference-	this measurement will also be taken using a measuring tape but this time around your hips.

The last two measurements are needed to determine your waist:hip ratio, which in turn indicates the distribution/location of adipose tissue around this area of your body

(c) Questionnaires

The final part of the visit will involve the researcher asking you two sets of questions. The first set is general background questions such as your age, your household, your income and so on. The second set of questions relate to your medical background, for example, how often do you go for a medical check up and so on.

2. VISIT TWO: Duration 60 minutes

The second visit also has three parts, explained as follows:

(a) 24-hour dietary recall

Again, the researcher will ask you about the foods and drinks you ate during the day and night before the visit. If she visits you on Monday, she will ask you what you ate or drank on Sunday and also how much.

(b) Body measurements

The next part of the visit will involve taking the following two measurements:

Your glucose level - this measurement will be taken using a glucometer, just like the one used at the hospital. This measures the glucose level in your blood. You may feel a slight prick on the finger whilst the blood is being drawn.

Your blood pressure -this measurement will be taken using a blood pressure monitor, just like the ones used at the hospital.

(c) Questionnaires

The final part of the visit will involve the researcher asking you only one set of questions. These questions are focussed on your eating patterns. The majority of the questions relate to how much of certain foods or groups of foods you eat on a daily basis. For example, how many helpings of milk or milk products do you eat per day and so forth.

3. VISIT THREE: Duration 60 minutes

The third and final visit also has three parts, explained as follows:

(a) 24-hour dietary recall

Again, the researcher will ask you about the foods and drinks you ate during the day and night before the visit. For example, if she visits you on Thursday, she will ask you what you ate or drank on Wednesday and also how much.

(b) Body measurements

The next part of the visit will involve the use of a technique/tool known as Bioelectrical Impedance or BIA:

BIA - this measurement will be taken using a set of electrodes connected to the hands and feet. The reading given will be used to estimate body-fat levels.

(c) **Questionnaires**

The final part of this visit will involve the researcher asking you two sets of questions. The first set of questions relates to food production or how you obtain the food you eat. The second set of questions is focussed on physical activity. For example, how many hours do you spend on a regular physical activity such as walking or jogging and so forth.

CONFIDENTIALITY

All the information you provide and the measurements taken from you will be used only for the statistical analysis required for the completion of the researcher's written report (thesis). Your identity will be presented as a code number, which only the researcher can identify. All your details will be kept in a separate file, under lock and key, by Patsy Watson, Programme Leader of Human Nutrition and supervisor of the study. In no way will your identity be revealed in any results, thesis, research papers or other publications that may result from this survey.

YOUR RIGHTS AS A PARTICIPANT

You have been randomly chosen to be a participant in this study, however you are under no obligation to accept and therefore participate in the study. If you do decide to accept and take part in this study, your participation is deemed entirely voluntary, and as such you have every right to the following:

- Refuse to answer any question(s) if you wish.
- Choose not to have any or certain body measurements taken.
- Cease taking part in the survey at any time.
- Ask as many questions as you need to, and at any time during the survey.
- Have any family member(s) present during each study visit.

CONFIRMATION OF PARTICIPATION

Please take time to thoroughly read and understand this information sheet so that you will know what will be involved in the study. If you are satisfied with the information provided and feel that you will be/not be able to participant in the study, please contact the researcher, Gaylene Tasmania on phone: 4099 or 4032 with your decision. For those of you who do not have a phone, the researcher will contact you personally a week from the day you received this information sheet.

Before the study can commence, you will be asked to sign a consent form, which is states that you are fully aware of the requirements of the study, your rights as a participant and has accepted to participate in the study.

SUMMARY OF YOUR RESULTS

At the completion of the study you will receive a summary of your personal results. The summary will include the results of all your body measurements. Your intake of important nutrients, based on your dietary recall information will not be made available until a later date as these data need to be analysed in New Zealand. An additional summary will also be provided with the results of the study as a whole to give you an indication of the 'national' picture.

If you have any questions at any time, please contact any one of us:

Gaylene Tasmania	Sauni Tongatule	Patsy Watson
Project Facilitator	Director, DAFF	Project Supervisor
Ph: 4099	Ph: 4032	Ph: (64) (9) 443 9755
Alofi, Niue	Alofi, Niue	Email: P.Watson@massey.ac.nz

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ALBANY CAMPUS, NEW ZEALAND
INSTITUTE OF FOOD, NUTRITION AND HUMAN HEALTH

Ko e kumikumiaga ke he faahi he tau huhua mena kai he tau tagata lalahi he motu ko Niue

KO E TALAHAUAGA KE HE KUMIKUMIAGA NEI

Ko e kumikumiaga nei kua taute ai e Gaylene M Tasmania, ke lata mo e taha vala he haana MSc (Nutritional Science) mai he aoga pulotu ko e Massey University, Albany i Niu Silani. Ko ia ko e matua fifine nofo mau ke he motu ko Niue mo e maama e ia e vagahau mo e totou faka Niue. Ko e kumikumiaga nei ha ha I lalo hifo ke he levekiaga ha Patsy Watson, ko e takitaki ke he tau fakaakoaga Human Nutrition he aoga pulotu ko e Massey University.

KO E KAKANO HE KUMIKUMIAGA NEI

Ko e kumikumiaga ke fuafua he tau huhua mena kai mae puke tagata lalahi ha Niue. Kua 15 tuai e tau tau kua mole he fuafua ai e tau huhua mena kai mae motu katoa, ne taute ai he tau 1987, he matakau ne fakahigoa (he magahala ia) ko e South Pacific Commission (SPC) mo e Fakatufono Niue. Ko lautolu to fifili fakatokaki mai ia lautolu e tau tagata lalahi, ne 18 kehe 60 e tau tau he moui. Toko 50 e katoatoa ha lautolu ia mo e tatai ni e tokologa he tau tagata taane mo e tau fifine.

Ko e katoatoaaga he kumikumiaga nei to kehekehe e tau fakaaogaaga, ke kitia mo e fifili ko e hafē e veveheaga mena ke gahua fakamalolo ki ai, mo e fakatatai aki e tau fua he tau kumikumiaga fakamua. Kua fia manako ke iloa ko e fefe e tau mena kai pihia mo e tau momoui ha kua hikihiki fano e tau magahala. Ko e heigoa foki e tau mena lalahi kua aofia ai ha tautolu a tau momoui faka tagata, pihia foki mo e fakalaulahiaga he Kautū.

Ko e tau fakamaamaaga nei ke fakakite aki e tau mena ke taute. Ko ia ne kumikumi to fakamaama mo e fakamahino atu e ia e tau mena kua ai maama ki ai mo e tali atu e tau hūhū ha mutolu. Ko e haau na fifiliaga faka tagata ni ke talia ko koe taha tagata he kumikumiaga nei.

KO E HEIGOA HAAU KA TAUTE KAEKE KUA TALIA E KOE KE LAGOMATAI E KUMIKUMIAGA NEI?

Ko e tolu (3) la e vala ke he kumikumiaga nei. Ko e mena ia, to finatu laga tolu a Gaylene ke he haau a kaina ke taute ai e tau kumikumiaga nei.

1. <u>AHIAHI FAKAMUA:</u> (Ko e fuafua ke he 60 e miniti).

Tolu e tau vala kehekehe ka taute he magaaho ka ahiahai atu a ia. Ko e hanei e tau vala ia:

(a) Tau mena ne kai mo e inu he 24-tulā kua mole atu.

To huhu atu a ia kia koe, ko e heigoa e tau mena haau ne kai mo e tau mena haau ne inu he aho mo e po fakamua. Fakatatai pehē, kaeke kua finatu a ia ke ahiahi atu he aho Gofua, to hūhū atu a ia kia koe, ko e heigoa e tau mena haau ne kai mo e inu he aho, mo e po Tapu. To hūhū foki na ia ko e fiha e lahi he tau mena haau ne kai mo e inu. Ko e tau tali haau ka fakaaoga mo fuafua ko e mitaki nakai, poke katoatoa nakai e tau huhua poke tau kakano ne moua mai he tau mena kai mo e tau mena inu haau ke lata ia moe haau a tino.

(a) Tau fuafua tino

Ko e vala ke ua ko e tau fuafua tino.

(i) Ko e haau a mamafa.

(ii) Ko e haau a loa.

(iii) Ko e laulahi he haau a lima.

(iv) Ko e loa he haau a tuli lima.

(v) Ko e laulahi he haau a kupu manava.

(vi) Ko e laulahi he haau a paka pule.

(c) Tau hūhū

Ko e mogo fakahiku to hūhū atu e falu hūhū fakaku hagaao ia ke he haau a malolo tino, tau he moui, ko hai ne nofo foki he kaina, mo e falu a hūhū pihia. Kaeke kua fai hūhū ne nakai manako a koe ke tali, to matutaki ke he falu hūhū foki.

2. <u>AHIAHI KE UA:</u> (Ko e fuafua ke he 60 e miniti).

(a) Tau mena ne kai mo e inu he 24-tulā kua mole atu.

Ko e tatai ni e tau mena ka hūhū atu he magaaho nei mo e tau mena ne hūhū atu he magaaho ne finatu fakamua a ia kia koe. To huhu atu a ia kia koe, ko e heigoa e tau

mena haau ne kai mo e tau mena haau ne inu he aho mo e po fakamua. Fakatatai pehē, kaeke kua finatu a ia ke ahiahi atu he aho Falaile, to hūhū atu a ia kia koe, ko e heigoa e tau mena haau ne kai mo e inu he aho, mo e po Tuloto.

(b) Tau fuafua tino

Ko e magaaho nei to fua ai e toto haau mo e suka. To fua ni tuga ne fa fua e lautolu he Fale Gagao.

(c) Tau hūhū

Ko e magaaho fakahiku to ole atu kia koe ke tali e falu hūhū hagaao ia ke he tau puhala faofao tino haau mo e tau puhala taute mena kai he kaina mo e falu a hūhū foki. Kaeke kua fai hūhū ne nakai manako a koe ke tali, talahau haau a manatu ke maeke ke matutaki mo e falu hūhū foki.

3. <u>AHIAHI KE TOLU:</u> (Ko e fuafua ke he 60 e miniti).

(a) Tau mena ne kai mo e inu he 24-tulā kua mole atu.

Ko e tatai ni e tau mena ka hūhū atu he magaaho nei mo e tau mena ne hūhū atu he tau magaaho ne finatu fakamua a ia kia koe. To huhu atu a ia kia koe, ko e heigoa e tau mena haau ne kai mo e tau mena haau ne inu he aho mo e po fakamua.

(b) Tau fuafua tino

Ko e magaaho nei to fua ai e haau a tino ke maeke ke kitia ko e lahi fefe e gako ne hahā he tino haau. To ole atu kia koe ke takoto ke lata mo e matini hila ka fakapiki aki e haau a lima mo e hui.

(c) Tau hūhū

Ko e magaaho fakahiku to ole atu kia koe ke tali e falu hūhū hagaao ia ke he tau puhala kai haau. Fakatatai pehē, ko e laga fiha e kai he aho, laga fiha e inu he tau apa inu mo e falu a tau hūhū pihia. Kaeke kua fai hūhū ne nakai manako a koe ke tali, talahau haau a manatu ke maeke ke matutaki mo e falu hūhū foki.

KO E PUIPUIAGA HE HAAU A HIGOA

To nakai tohia e haau a higoa ke he ha laupepa he kumikumiaga nei. Ko e tau laupepa hūhū ka tohia ai haau a tau tali, to nakai tohia ai e haau a higoa. To hukui aki e falu numela e haau a higoa, ko ia ni ne takitaki e kumikumiaga nei ka iloa e haau a higoa. Ko e tau higoa oti to toka ai ke he ofisa ha Patsy Watson he aoga pulotu ko e Massey University.

KO E HAAU A TUTONUHIA

Ko e higoa haau kua fifili fakapouli mai he tau higoa he tau tagata vili ha Niue, ke lagomatai e kumikumiaga nei. Ole atu ke fifili ni e koe mai he haau a loto ke lagomatai poke nakai

lagomatai mai ke he kumikumiaga nei. Kaeke kua talia fiafia e koe ke lagomatai e kumikumiaga nei, kua tu tonuhia a koe ke;

- Nakai tali ha hūhū kua nakai manako a koe ke tali.
- Nakai talia ke fuafua e haau a tino.
- Fakaoti e haau a lagomataiaga ke he kumikumiaga nei.
- Tau hūhū kaeke kua nakai maama ia koe e falu mena kua amanaki ke taute.
- Fai tagata mai he haau a magafaoa ke nofo mo koe he tau magaaho ke ahiahi atu e tagata kumikumi.

FAKAMOOLIAGA HE HAAU A LAGOMATAI

Kua ole atu ke totou e koe e tau fakamaamaaga oti hagaao ia ke he kumikumiaga nei. Kaeke kua fai mena ne nakai maama mitaki ia koe, fakamolemole ti vilo atu kia Gaylene Tasmania he tau numela telefoni ko e 4099 poke 4032. Kaeke ni kua maama mitaki e koe e tau talahauaga nei mo e iloa haau a manatu ke lagomatai po ke nakai lagomatai e kumikumiaga nei, to matutaki atu a Gaylene ke iloa haau a manatu he faahi tapu i mua.

To nakai maeke ke fakahoko e kumikumiaga nei a to oti e saini e koe e taha laupepa ne tohia ai e haau a taliaga ke lagomatai e kumikumiaga nei.

KO E KATOATOA HE TAU KUMIKUMIAGA

Kaeke kua oti e taute he kumikumiaga nei to foaki atu kia koe e katoatoaaga he tau mena ne moua he fuafua he haau a tino. Ko e tau mena nei ko e haau a mamafa, haau a loa, fuafua he toto tokoluga, fuafua he suka mo e falu foki. To nakai moua he magaaho nei e katoatoaaga he tau huhua mena kai ne moua kehe tau mena haau ne kai he 24 tulā ne mole. Ko e kakano ha ko e mena liuaki ki Niue Silani e tau kumikumiaga ia ke onoono e falu tagata pulotu ki ai. To fakahu atu he tau magaaho i mua.

Kaeke kua fai hūhū a koe, kia matutaki atu ke he taha ia mautolu nei:

Gaylene Tasmania	Sauni Tongatule	Patsy Watson
Researcher	Director, DAFF	Project Supervisor
Ph: 4099	Ph: 4032	Ph: (64) (9) 443 9755
Alofi, Niue	Alofi, Niue	Email: P.Watson@massey.ac.nz

Appendix F

Data Collection Sheets

- **24-Hour Dietary Recall**
- **Body Measurements**
- **Questionnaires**

INSTITUTE OF FOOD, NUTRITION AND HUMAN HEALTH

Pilot Nutrition Survey of The Adult Niuean Population

VISIT ONE: 24-HOUR DIETARY & ACTIVITY RECALL

Subject CODE Number: _____	**Coding:** ☐☐☐
Gender: _____ (F = 1, M = 2)	
Time of Interview: _____ (am = 1, pm = 2)	
Date of Interview: _____	

BEFORE ADMINISTERING QUESTIONNAIRE

SAY: I'd like you to tell me everything you had to eat and drink all day yesterday (NAME THE DAY), from midnight to midnight. Include everything you ate and drank at home and away – even snacks, tea or coffee, and alcoholic beverages. I would also like to ask you about the activities you did yesterday.

SHEET Number:

CODE Number: _____ Date of Interview: _____

What did you eat and drink yesterday from: **Midnight to Rising?**

Food and Beverage Name, Brand, Description, Preparation ie. boiling, frying, microwave etc (& recipe if necessary)	**Amount or volume consumed**

SHEET Number:

CODE Number: _____ **Date of Interview:** _____

What did you eat and drink yesterday from: **Rising to Midday?**

Food and Beverage Name, Brand, Description, Preparation ie. boiling, frying, microwave etc (& recipe if necessary)	**Amount or volume consumed**

SHEET Number:

CODE Number: _____ **Date of Interview:** _____

What did you eat and drink yesterday from: **Midday to 5pm?**

Food and Beverage Name, Brand, Description, Preparation ie. boiling, frying, microwave etc (& recipe if necessary)	**Amount or volume consumed**

SHEET Number:

CODE Number: _____ **Date of Interview:** _____

What did you eat and drink yesterday from: **5pm to Retiring?**

Food and Beverage Name, Brand, Description, Preparation ie. boiling, frying, microwave etc (& recipe if necessary)	**Amount or volume consumed**

SHEET Number:

CODE Number: _____ **Date of Interview:** _____

What did you eat and drink yesterday from: **Retiring to Midnight?**

Food and Beverage Name, Brand, Description, Preparation ie. boiling, frying, microwave etc (& recipe if necessary)	**Amount or volume consumed**

SHEET Number:

CODE Number: _____ **Date of Interview:** _____

Q1: At what time did you wake up/rise yesterday? _____

Q2: What were the main physical activities that you did yesterday?

TIME FRAME	MAIN ACTIVITIES
Rising to Midday	
Midday to 5pm	
5pm to Retiring	

Q3: At what time did you go to sleep/retire last night? _____

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Pilot Nutrition Survey of The Adult Niuean Population

VISIT ONE: BODY MEASUREMENTS

Subject CODE Number: _____	**Coding:** ☐☐☐
Gender: _____ (F = 1, M = 2)	
Time of Interview: _____ (am = 1, pm = 2)	
Date of Interview: _____	

BEFORE COMMENCING WITH THE MEASUREMENTS

SAY: This next part of my visit involves taking your body measurements. These measurements include weight, height, arm circumference and so forth. I will explain each measurement before I take it. If at any time you do not want me to take a certain measurement, please let me know.

CODE Number: _____ **Date of Interview:** _____

Body measurements

NB: Take all the measurements in sequence and repeat. If necessary, take a third measurement, again in the same sequence.

1. Weight

   (i) _____ kg

   (ii) _____ kg Weight : _____ kg

   (iii) _____ kg

2. Height

   (i) _____ cm

   (ii) _____ cm Height : _____ cm

   (iii) _____ cm

3. Mid-upper arm circumference

   (i) _____ cm

   (ii) _____ cm Arm circumference : _____ cm

   (iii) _____ cm

4. Elbow breadth

   (i) _____ cm

   (iii) _____ cm Elbow breadth : _____ cm

   (iii) _____ cm

5. Waist circumference

   (i) _____ cm

   (ii) _____ cm Waist circumference : _____ cm

   (iii) _____ cm

6. Hip circumference

   (i) _____ cm

   (ii) _____ cm Hip circumference : _____ cm

   (iii) _____ cm

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Pilot Nutrition Survey of The Adult Niuean Population

QUESTIONNAIRE A:

GENERAL BACKGROUND

Subject CODE Number: _____	**Coding:** ☐☐☐
Gender: _____ (F = 1, M = 2)	
Time of Interview: _____ (am = 1, pm = 2)	
Date of Interview: _____	

BEFORE ADMINISTERING QUESTIONNAIRE

SAY: Anything that you tell me is anonymous and will remain confidential. Your name will not appear on any forms. If you do not want to answer a particular question just say so at the time and we will continue with another question.

Pilot Nutrition Survey of The Adult Niuean Population

SECTION A: GENERAL BACKGROUND

TABLE A1

Code Number: _____ **Date of Interview:** _____

Tick a line for each person (incl. subject)	Tick a line for each preschool child	Tick a line for each school-age child	Identity of other people living in the home	Tick a line next to each person undertaking paid work	Type of work: FT= Full time PT= Part time S=seasonal NA = Not applicable DK = Don't Know	Specify occupation	Main source of income if no paid work
I	II	III	IV	V	VI	VII	VIII

Firstly I would like you to tell me about the people who live in your house.

A1. How many people usually live with you in your home? Write answer(s) in table A1, column I.	**A1: Person(s) living in the same house** 1 person = 1 2 people = 2 3 people = 3 etc Total person(s) ☐
A2. How many under school age children are there? Write answer(s) in table A1, column II.	**A2: No. Preschoolers** Total No. ☐
A3. How many children in your home go to school? Write answer(s) in table A1, column III.	**A3: No. School Children** Total No. ☐
A4. Who are the people who live in your home? Write answer(s) in table A1, column IV.	**A4: Relationship of other people in house** Husband/Wife = 1 Female Partner = 2 Male Partner = 3 Mother = 4 Father = 5 Child = 6 Sibling = 7 Grandparent = 10 Other relative = 11 Friends/flatmate = 12
THE FOLLOWING QUESTIONS ARE TO BE ASKED FOR EACH PERSON IDENTIFIED IN TABLE A1, COLUMN IV, BEGINNING WITH THE SUBJECT.	
A5a. Do you do any paid work either at home or outside the home? Does (name of person) do any paid work? Write answer in Table A1, column V. If YES, ask next question. If NO, go to question A5d.	**A5a. Paid work subject** Yes = 1 No = 0 ☐

A5b. Do you work full time or part time? **Does (name of person) work full time or part time?** Write answer(s) in Table A1, column VI.	**A5b. Type of work subject** Full time = 1 Part time = 2 Seasonal = 3 NA = 8 Don't know = 9 ☐
A5c. What type of job do you do? **What type of job does (name of person) do?** Write answer(s) in Table A1, column VII. I. Legislators, senior officials and managers II. Professionals III. Technicians and associate professionals IV. Clerks V. Service workers and shop and market sales workers VI. Skilled agricultural and fishery workers VII. Craft and related trades workers VIII. Plant and machine operators and assemblers IX. Elementary Occupations X. Armed Forces	**A5c. Occupation subject** Coding from ISCO-88 I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 VII. = 7 VIII. = 10 IX. = 11 X. = 12 ☐
A5d. If you are not employed, what is your main source of income? **If (name of person) is not employed, what is their main source of income?** I. Family member(s) who is/are employed II. Pension III. Superannuation IV. Craft sales V. Produce sales VI. Fish sales VII. Other (specify) _____ Write answer(s) in Table A1, column VIII.	**A5d. If unemployed, main source of income** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 VII. = 7 NA = 8 ☐
PRESENT THE SUBJECT WITH THE RELEVANT SHOW CARDS FOR EACH OF THE FOLLOWING QUESTIONS AND NOTE DOWN THEIR RESPONSE.	
A6. What range is your annual income? I. < $4,999 II. $5,000 - $9,999 III. $10,000 - $14,999 IV. $15,000 - $19,999 V. $20,000 - $24,999 VI. $25,000 - $29,999 VII. > $30,000	**A6. Annual Income** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 VII. = 7 NA = 8 DK = 9 ☐

A7. Which age group do you belong to? I. 18-20 years II. 21-30 years III. 31-40 years IV. 41-50 years V. 51-60 years	**A7: Age** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
A8. What is your highest level of education? I. Primary school II. Form 1-4 III. Form 5 IV. Form 6 V. Form 7 VI. Tertiary (Go to next question)	**A8: Education level** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 ☐
A9. What formal qualification (if any) have you been awarded? I. Certificate II. Diploma III. Degree IV. Masterate V. Doctorate	**A9: Formal Qualification** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
A10. Have you at any time in the past 12 months attended a workshop or meeting about food and nutrition? YES NO (Go to the conclusion)	**A10. Workshop attendance** YES = 1 NO = 0 ☐
A11. Did you find the information shared was useful to you? YES NO If YES, how was it useful? Write down _____ _____ _____ _____ _____ If NO, why not? Write down _____ _____ _____ _____ _____	**A11. Usefulness of nutrition workshops** YES = 1 NO = 0 ☐

A12. Of all the workshops you went to, which ones did you like the most and which ones did you like the least?

Like Most _____

_____

_____

_____

_____

Like Least _____

_____

_____

_____

_____

CONCLUSION

SAY: That is the end of the questionnaire. Thank you very much for your time and patience in helping with this research today.

IMPORTANT: Remember to staple Table A1 to the questionnaire.

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Pilot Nutrition Survey of The Adult Niuean Population

QUESTIONNAIRE B:

MEDICAL BACKGROUND

Subject CODE Number: _____	**Coding:** ☐☐☐
Time of Interview: _____ (am = 1, pm = 2)	
Date of Interview: _____	

BEFORE ADMINISTERING QUESTIONNAIRE

SAY: Anything that you tell me is anonymous and will remain confidential. Your name will not appear on any forms. If you do not want to answer a particular question just say so at the time and we will continue with another question.

Firstly I would like you to tell me a little bit about your health and general wellbeing.
NB: Interviewer to circle each response.

B1 In general, how would you describe your health? I. Excellent II. Very Good III. Good IV. Fair V. Poor	**B1: General Health** I. =1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
B2 Compared to one year ago, how would you rate your health now? I. Much better now II. Somewhat better now III. About the same IV. Somewhat worse now V. Much worse now	**B2: Health one year ago** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
B3. How often do you go to hospital for a regular medical check-up? I. Once every three months II. Once every six months III. Once a year IV. Only when feeling ill	**B3: Frequency of medical check-up** I. = 1 II. = 2 III. = 3 IV. = 4 ☐
FOR THE FOLLOWING QUESTIONS, PRESENT THE SUBJECT WITH THE RELEVANT SHOW CARDS AND NOTE THEIR RESPONSES IN THE APPROPRIATE TABLES	
B4. Have you been told by a doctor that you have: I. Diabetes YES NO II. Hypertension YES NO III. Gout YES NO IV. Heart Disease YES NO V. Asthma YES NO VI. Other major illness (specify) _____ If all answers are NO, go to question B9	**B4. Diseases of the subject** YES NO I. 1 0 ☐ II. 1 0 ☐ III. 1 0 ☐ IV. 1 0 ☐ V. 1 0 ☐ VI. 1 0 ☐
B4a. Have any other members of your immediate and extended family been told by a doctor that they have any of these diseases? Write answers in Table B1.	**B4a. No. Relatives with the same diseases** I. Diabetes _____ II. Hypertension_____ III. Gout _____ IV. H Disease _____ V. Asthma _____ VI. Other illness _____

B5. Do you take any medication for your condition YES NO If YES, write down _____	**B5. Medication taken** YES = 1 NO = 0 NA = 8 ☐
B6. Have you ever been admitted to hospital for treatment of your condition? YES NO If YES, how many times in the past 12 months? I. 1-2 times II. 3-5 times III. >5 times	**B6. Admitted to hospital for treatment** YES = 1 NO = 0 NA = 8 DK = 9 ☐ I. = 1 II. = 2 III. = 3 ☐
B7. Has anyone given you dietary advice to help with your condition? YES NO If YES, what sort of advice? Write down _____ _____ _____ _____ _____	**B7. Dietary Advice given to subject** YES = 1 NO = 0 NA = 8 DK = 9 ☐
B8. Have you tried to make any dietary or lifestyle changes because of your condition(s)? YES NO If YES, what sort of changes? Write down _____ _____ _____ _____ _____	**B8. Dietary or lifestyle changes undertaken** YES = 1 NO = 0 NA = 8 ☐

B9. Do you smoke? YES NO (go to question B12)	**B9. Smoker or Non-smoker?** YES = 1 NO = 0 ☐
B10. How many cigarettes do you smoke per day? I. Under 5 II. 10 III. 20 IV. 30 V. 40 VI. Over 40 VII. Don't Know	**B10. Number of cigarettes** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 VII. = 9 ☐
B11. Does anyone else smoke inside your home? YES NO	**B11. Smokers in the home** YES = 1 NO = 0 ☐
B12. Do you usually drink alcoholic drinks? PROMPT like beer, wine, gin, whiskey etc. YES NO (Go to the conclusion)	**B12. Drinking habits** YES = 1 NO = 0 ☐
B13. How often would you drink alcohol? I. Daily II. 1/week III. 2-3/week IV. 1-2/month V. Less than 1/month VI. Don't know	**B13. Frequency** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 9 ☐
B14. When you drink alcohol, what do you drink most often? Write down _____	**B14. Usual drink** Beer = 1 Wine = 2 Spirits = 3 Beer & wine = 4 Beer & spirits = 5 Other = 6 Don't know = 9 ☐

B15. When you drink this drink, how much do you usually drink? PROMPT. How many glasses, cans, bottles or jugs? Write down: Container _____ No. Consumed _____ _____ _____ _____ _____	**B15. Volume consumed in a drinking session (ml)** ☐☐☐☐
B16. How long would it usually take you to drink this amount? PROMPT. A quarter of an hour, half an hour, an hour. Write down: _____	**B16. Drink time (hours)** ☐☐.☐☐

CONCLUSION

SAY: That is the end of the questionnaire. Thank you very much for your time and patience in helping with this research today.

IMPORTANT: Remember to staple Tables B1 and B2 to the questionnaire.

Pilot Nutrition Survey of The Adult Niuean Population

SECTION B: MEDICAL BACKGROUND

TABLE B1

Code Number: _____ **Date of Interview:** _____

Interviewer to tick a YES or NO response for each relation with any of the following diseases.

Relationship of person to subject eg. mother, brother etc	Diabetes (Type I or II)		Hypertension		Gout		Heart Disease		Asthma		Other major illness	
	I	II	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO

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VISIT TWO: 24-HOUR DIETARY & ACTIVITY RECALL

Subject CODE Number: _____	**Coding:** ☐☐☐
Gender: _____ (F = 1, M = 2)	
Time of Interview: _____ (am = 1, pm = 2)	
Date of Interview: _____	

BEFORE ADMINISTERING QUESTIONNAIRE

SAY: I'd like you to tell me everything you had to eat and drink all day yesterday (NAME THE DAY), from midnight to midnight. Include everything you ate and drank at home and away – even snacks, tea or coffee, and alcoholic beverages. I would also like to ask you about the activities you did yesterday.

SHEET Number:

CODE Number: _____ **Date of Interview:** _____

What did you eat and drink yesterday from: **Midnight to Midnight?**

Food and Beverage Name, Brand, Description, Preparation ie. boiling, frying, microwave etc (& recipe if necessary)	**Amount or volume consumed**

SHEET Number:

CODE Number: _____ **Date of Interview: _____**

Q1: At what time did you wake up/rise yesterday? _____

Q2: What were the main physical activities that you did yesterday?

TIME FRAME	MAIN ACTIVITIES
Rising to Midday	
Midday to 5pm	
5pm to Retiring	

Q3: At what time did you go to sleep/retire last night? _____

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VISIT TWO: MEASUREMENTS OF BLOOD PRESSURE & GLUCOSE LEVELS

Subject CODE Number: _____	**Coding:** ☐☐☐
Gender: _____ (F = 1, M = 2)	
Time of Interview: _____ (am = 1, pm = 2)	
Date of Interview: _____	

BEFORE COMMENCING WITH THE MEASUREMENTS

SAY: This final part of my visit involves taking your blood pressure and blood glucose levels. I will explain each measurement before I take it. If at any time you do not want me to take the measurement, please let me know.

CODE Number: _____ **Date of Interview:** _____

Blood Pressure

1. First Reading

   systolic _____ mm Hg

   diastolic _____ mm Hg

   pulse _____

2. Second Reading

   systolic _____ mm Hg

   diastolic _____ mm Hg

   pulse _____

Average BP: _____ mm Hg

Blood Glucose

1. _____ mmol/L

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QUESTIONNAIRE D:

FOOD CONSUMPTION PATTERNS

Subject CODE Number: _____	**Coding:** ☐☐☐
Time of Interview: _____ (am = 1, pm = 2)	
Date of Interview: _____	

BEFORE ADMINISTERING QUESTIONNAIRE

SAY: Anything that you tell me is anonymous and will remain confidential. Your name will not appear on any forms. If you do not want to answer a particular question just say so at the time and we will continue with another question.

The following questions are being asked to find out how much of a particular food you eat or how often. This will help provide a picture of your general eating pattern.
NB: Interviewer to circle each response.

D1. Who usually prepares the meals most of the time in your home? I. Self II. Partner III. Mother IV. Father V. Daughter VI. Son VII. Other (specify) _____	**D1: Person who usually prepares the meals** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 VII. = 7 ☐
D2. How many times a week is dinner prepared the following ways? **Read from list of methods in Table D1 and record answers**	**D2: Most common method of cooking** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 VII. = 7 ☐
D3. What type of fat is usually used for frying foods in your home? I. Vegetable oil (specify: _____) II. Coconut oil III. Lard IV. Dripping V. Butter VI. Margarine	**D3: Type of fat used for frying** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 ☐
D4. How many times a week would you eat during the following meal times? I. Breakfast _____ II. Morning tea/snack _____ III. Lunch _____ IV. Afternoon tea/snack _____ V. Dinner _____ VI. Evening snack/supper _____	**D4. Meal times** I. = ☐ II. = ☐ III. = ☐ IV. = ☐ V. = ☐ VI. = ☐

D5. At which mealtime do you eat the most? I. Breakfast II. Mid-morning III. Lunch IV. Mid-afternoon V. Dinner	**D5. Time most food eaten** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
D6. When do you tend to add salt to your food? I. During cooking II. During a meal III. Not at all **D6a. When you do use salt, how much do you usually use on your food?** I. Half a teaspoon II. 1-2 teaspoons III. >2 teaspoons	**D6. Salt usage** I. = 1 II. = 2 III. = 3 ☐ I. = 1 II. = 2 III. = 3 ☐
THE FOLLOWING QUESTIONS ARE BEING ASKED TO FIND OUT HOW MUCH OF CERTAIN TYPES OF FOODS YOU USUALLY EAT. A 'HELPING' IS THE AMOUNT OF FOOD YOU CAN HOLD IN THE PALM OF ONE HAND, UNLESS OTEHRWISE STATED.	
D7. How many helpings of fruit, including fresh or canned, do you usually eat per day? (A helping = 1 banana, 1 mango etc) I. Rarely eat fruit II. <1 helping per day III. 1 helping per day IV. 2-3 helpings per day V. > 4 helpings per day	**D7. Fruit intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
D8. How many helpings of Niuean vegetables do you usually eat per day? (A helping = half a cup of pele, luku etc) I. Rarely eat vegetables II. <1 helping per day III. 1 helping per day IV. 2-3 helpings per day V. > 4 helpings per day VI.	**D8. Niuean vegetable intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐

D9. How many helpings of imported vegetables do you usually eat per day? (A helping = half a cup of veges) I. Rarely eat vegetables II. <1 helping per day III. 1 helping per day IV. 2-3 helpings per day V. > 4 helpings per day	**D9. Imported Vegetable intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
D10. How many helpings of Niuean staples do you usually eat per day? I. Rarely eat Niuean staples II. <1 helping per day III. 1-2 helping per day IV. 3-4 helpings per day V. > 5 helpings per day	**D10. Niuean staples intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
D11. How many helpings of imported staples do you usually eat per day? I. Rarely eat Imported staples II. <1 helping per day III. 1-2 helping per day IV. 3-4 helpings per day V. > 5 helpings per day	**D11. Imported staples intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
D12. How many helpings of milk and milk products (includes cheese, yoghurt, ice-cream etc) do you usually eat per day? A helping = 1 cup of milk, 1 pottle yoghurt, 2 single cheese slices, 1 scoop ice-cream,) I. Don't eat milk or milk products II. <1 helping per day III. 1-2 helpings per day IV. 3-4 helpings per day V. > 5 helpings per day	**D12. Milk & milk products intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐

D13. What do you use most often on your bread? I. Butter II. Margarine	**D13. Butter or Margarine** I. = 1 II. = 2 NA = 8 ☐
D13a. How much butter or margarine do you use on one slice of bread? I. 1 teaspoon II. 2 teaspoon III. >2 teaspoons	**D13a. Quantity used on Bread** I. = 1 II. = 2 III. = 3 ☐
D14. How many helpings of Niuean protein foods do you usually eat per day? I. Don't eat Niuean protein foods II. <1 helping per day III. 1-2 helping per day IV. 3-4 helpings per day V. > 5 helpings per day	**D14. Niuean protein intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
D15. How many helpings of Imported protein foods do you usually eat per day? I. Don't eat Imported protein foods II. <1 helping per day III. 1-2 helping per day IV. 3-4 helpings per day V. > 5helpings per day	**D15. Imported protein intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
D16. How many helpings of confectionery (high sugar) foods do you usually eat per day? (A helping = 1 chocolate bar, 2 lollies, 1 ice-block etc) I. Don't eat confectionery products II. <1 helping per day III. 1-2 helping per day IV. 3-4 helpings per day V. > 5helpings per day	**D16. Confectionery intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
D17. How many glasses/cups of fruit juice (incl. Raro sachets) do you usually drink per day? I. Don't usually drink any fruit juice II. <1 per day III. 1-2 per day IV. 3-4 per day V. > 5 per day	**D17. Fruit juice intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐

D18. How many glasses/cans/bottles of soft drinks do you usually drink per day? **Container:** **Number:** _____ _____ _____ _____ _____ _____	**D18. Volume of soft drinks consumed (mls)** ☐☐☐☐ NA = 8
D19. How many glasses/cups of water do you usually drink per day? I. Don't usually drink water II. <1 per day III. 1-2 per day IV. 3-5 per day V. 6-8 per day VI. >8 per day	**D19. Water intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 ☐
D20. How many fresh coconuts do you usually drink? I. Don't usually drink coconuts II. 1 per day III. 2-3 per day IV. > 4 per day V. 1-2 per week VI. 3-4 per week VII. >5 per week	**D20. Coconut juice intake** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 VII. = 7 ☐
D21. Which, if any, of the following drinks do you drink most often? I. Tea II. Coffee III. Milo IV. Other (specify) _____ **D21a. How many cups of the above beverage do you usually drink?** I. 1 per day II. 2 per day III. 3-4 per day IV. >5 per day	**D21. Beverage** I. = 1 II. = 2 III. = 3 IV. = 4 ☐ **D21a. Beverage intake** I. = 1 II. = 2 III. = 3 IV. = 4 ☐
D22. How often do you eat take-away foods? (incl. pizza, fish & chips etc) I. Never II. Rarely III. Daily IV. Once a week V. 2-3 times a week VI. 4-5 times a week VII. >5 times a week	**D22. Take-away foods** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 VII. = 7 ☐

D23. How many helpings of fish & chips do you usually eat? (A helping = a single serve)	**D23. Fish & Chips intake**
I. Rarely eat Fish & Chips II. 1 helping per day III. 1 helping per week IV. 2-3 helpings per week V. 4-5 helpings per week VI. >5 helpings per week	I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 ☐

CONCLUSION

SAY: That is the end of the questionnaire. Thank you very much for your time and patience in helping with this research today.

IMPORTANT: Don't forget to staple Table D1 to the questionnaire.

Pilot Nutrition Survey of The Adult Niuean Population

SECTION D: FOOD CONSUMPTION PATTERNS

TABLE D1

Code Number: _____ **Date of Interview:** _____

Interviewer to tick a YES response for the frequency of using each method of cooking.

Cooking Method	Daily	1/week	2-3/week	>4/week	Rarely
Boil					
Steam					
Fry					
Grill (includes BBQ)					
Bake					
Umu					
Roast					

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VISIT THREE: 24-HOUR DIETARY & ACTIVITY RECALL

Subject CODE Number: _____ **Gender:** _____ (F = 1, M = 2) **Time of Interview:** _____ (am = 1, pm = 2) **Date of Interview:** _____	**Coding:** ☐☐☐

BEFORE ADMINISTERING QUESTIONNAIRE

SAY: I'd like you to tell me everything you had to eat and drink all day yesterday (NAME THE DAY), from midnight to midnight. Include everything you ate and drank at home and away – even snacks, tea or coffee, and alcoholic beverages. I would also like to ask you about the activities you did yesterday.

SHEET Number:

CODE Number: _____ **Date of Interview:** _____

What did you eat and drink yesterday from: **Midnight to Midnight?**

Food and Beverage Name, Brand, Description, Preparation ie. boiling, frying, microwave etc (& recipe if necessary)	**Amount or volume consumed**

SHEET Number:

CODE Number: _____ **Date of Interview: _____**

Q1: At what time did you wake up/rise yesterday? _____

Q2: What were the main physical activities that you did yesterday?

TIME FRAME	MAIN ACTIVITIES
Rising to Midday	
Midday to 5pm	
5pm to Retiring	

Q3: At what time did you go to sleep/retire last night? _____

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VISIT THREE: BIOELECTRICAL IMPEDANCE ANALYSIS

Subject CODE Number: _____	**Coding:** ☐☐☐
Gender: _____ (F = 1, M = 2)	
Time of Procedure: _____ (am = 1, pm = 2)	
Date of Procedure: _____	

BEFORE ADMINISTERING QUESTIONNAIRE

SAY: I am now going to perform what is called a Bioelectrical Impedance Analysis, which is a measure of your body's resistance to the flow of an electric current, which will be used to estimate your body fat mass. This procedure is not painful, but can only be performed while you are lying down. If you do not want to have the BIA done, please tell me now.

BIOELECTRICAL IMPEDANCE ANALYSIS

CODE Number: _____ **Date of Interview:** _____

Gender:_____

Age: _____ Height(cm): _____ Weight(kg): _____

Record BIA readings as follows:

1. Fat Mass _____
2. % Fat Mass _____
3. Fat Free Mass (FFM) _____
4. % FFM _____
5. Impedance _____
6. Resistance _____
7. Reactance _____

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QUESTIONNAIRE C:

FOOD PRODUCTION

Subject CODE Number: _____	**Coding:** ☐☐☐
Time of Interview: _____ (am = 1, pm = 2)	
Date of Interview: _____	

BEFORE ADMINISTERING QUESTIONNAIRE

SAY: Anything that you tell me is anonymous and will remain confidential. Your name will not appear on any forms. If you do not want to answer a particular question just say so at the time and we will continue with another question.

The following questions are being asked to find out how you obtain the food you and your family eat. *NB: Interviewer to circle each response.*

C1 Do you have a plantation or vegetable garden? YES NO (go to question C5)	**C1: Vegetable Garden** YES = 1 NO = 0 ☐
C2 What crops do you grow for food? ***I.*** ***Taro*** ***II.*** ***Cassava*** ***III.*** ***Yams*** ***IV.*** ***Kumara*** ***V.*** ***Plantain*** ***VI.*** ***Other (specify)*** _____	**C2: Crops grown for food** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 All the above = 7 NA = 8 ☐
C3. What fruit trees do you grow for food? ***I.*** ***Banana*** ***II.*** ***Pawpaw*** ***III.*** ***Mango*** ***IV.*** ***Vi*** ***V.*** ***Other (specify)*** _____	**C3: Fruit trees grown** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 All the above = 7 NA = 8 ☐
C4. What vegetables do you grow for food? ***I.*** ***Pele (edible hibiscus)*** ***II.*** ***Cassava (tips)*** ***III.*** ***Kumara (tips)*** ***IV.*** ***Nightshade*** ***V.*** ***Taro leaves (lu)*** ***VI.*** ***Tomatoes*** ***VII.*** ***Lettuce*** ***VIII.*** ***Cabbage*** ***IX.*** ***Other (specify)*** _____	**C4. Diseases of the subject** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 VII. = 7 VIII. = 8 IX. = 9 ☐
C5. Which of the following reasons best describes why you do not have a vegetable garden? ***I.*** ***Do not have the time to manage a garden*** ***II.*** ***Do not have enough land*** ***III.*** ***Soil is not good*** ***IV.*** ***Pests and diseases are too much of a problem*** ***V.*** ***Prefer to buy local foods from the market*** ***VI.*** ***Prefer to buy imported foods*** ***VII.*** ***Am not a skilled gardener***	**C5. Reasons why subject has no garden** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 VII. = 7 ☐

C6. Do you or any members of your household fish? ***(EXPLAIN whether by canoe/boat or off the reef)*** YES NO If YES, how often do you or any members of your household fish? I. Daily II. 1-2 times a week III. 3-5 times a week IV. 1-2 times a month V. Rarely	**C6. Opportunity to fish** YES = 1 NO = 0 ☐ I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐
C7. How often do you go shopping for food? I. Once a week II. Twice a week III. Once a fortnight VI. Other (specify) _____	**C7. Frequency of shopping** I. = 1 II. = 2 III. = 3 IV. = 4 ☐
C8. On a scale of 1-5 with 1 being not very important and 5 being of vital importance, please give a score for the importance of the following foods to be included in your regular shopping: I. Diary products eg milk, cheese, yoghurt _____ II. Cereal products eg bread, rice, pasta _____ III. Canned meat eg corned beef _____ IV. Fruit (canned or fresh) _____ V. Vegetables (fresh or frozen) _____ VI. Poultry _____ VII. Sausages _____ VIII. Lamb chops _____ IX. Other _____ _____	**C8. Importance of buying certain food products** I. = ☐ II. = ☐ III. = ☐ IV. = ☐ V. = ☐ VI. = ☐ VII. = ☐ VIII= ☐ IX. = ☐
C9. Do you read or take any notice of nutrition information on the products you buy? YES NO If YES, what sort of information are you concerned about on the nutrition panel? Write down _____ _____ _____	**C9. Nutrition labels** YES = 1 NO = 0 ☐

C10. What is the most important factor in your decision to buy a certain food product?	C10. Factor affecting food choice
I. Price II. Nutritional content III. Taste IV. Medical condition V. Other (specify) _____	I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 ☐

CONCLUSION

SAY: That is the end of the questionnaire. Thank you very much for your time and patience in helping with this research today.

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QUESTIONNAIRE E:

PHYSICAL ACTIVITY

Subject CODE Number: _____	**Coding:** ☐☐☐
Time of Interview: _____ (am = 1, pm = 2)	
Date of Interview: _____	

BEFORE ADMINISTERING QUESTIONNAIRE

SAY: Anything that you tell me is anonymous and will remain confidential. Your name will not appear on any forms. If you do not want to answer a particular question just say so at the time and we will continue with another question.

The following questions are being asked to find out how much physical activity you undertake which will help to determine your level of energy expenditure. *NB: Interviewer to circle each response.*

E1. How do you wash your clothes? I. By hand II. Wringer washer machine III. Automatic washing machine	**E1: Method of washing** I. = 1 II. = 2 III. = 3 ☐
E2. How many loads of washing do you do per week? Write down _____	**E2: Loads of washing per week** NA = 8 DK = 9 ☐
E3. How many hours per week do you spend working in your plantation/garden? I. <2 hours II. 3-5 hours III. 6-10 hours IV. >10 hours	**E3: Time spent working in plantation** I. = 1 II. = 2 III. = 3 IV. = 4 NA. = 8 ☐
FOR THE FOLLOWING QUESTIONS, RECORD ANSWERS IN TABLE E1	
E4. Do you do any of the following activities regularly? **Read from list of activities in Table E1 and record answers in column I** *For each activity mentioned, ask:* **E4a. How many hours per week do you spend on each activity?** **Record answers in Table E1, column II** **E4b. Which of the activities mentioned do you perform to a point where you 'puff'?** **Record answers in Table E1, column III**	**E4. Regular physical activities** I. = 1 II. = 2 III. = 3 IV. = 4 V. = 5 VI. = 6 VII. = 7 VIII. = 8 IX. = 9 X. = 10 XI. = 11 XII. = 12 XIII. = 13
E5. Have your physical activities changed because of any medical condition you have? YES NO ***If YES, in what way have they changed?*** ***Write down*** _____ _____	**E6. Change in activities** Much less active = 1 Less active = 2 More active = 3 Much more active = 4 NA = 8 Don't know = 9 ☐

E6. On a typical day, how many hours do you usually spend:	**E7. Sedentary activity**
I. Sleeping/lying down _____ II. Sitting watching TV _____ III. Sitting/riding in a car _____ IV. Sitting weaving _____ V. Sitting at work/computer etc _____	Total No. hours per day ☐

CONCLUSION

SAY: That is the end of the questionnaire. Thank you very much for your time and patience in helping with this research today.

IMPORTANT: Remember to staple Table E1 to the questionnaire.

Pilot Nutrition Survey of The Adult Niuean Population

SECTION E: PHYSICAL ACTIVITY

TABLE E1

Code Number: _____ **Date of Interview:** _____

Regular Activity	**Yes**	**No**	**Code**	**Duration (hours/week)**	**Intensity** (tick if performed to 'puff')
	I			**II**	**III**
Walking					
Jogging					
Cycling					
Weightlifting					
Bodybuilding					
Power lifting					
Volleyball					
Rugby (union, touch, league)					
Netball					
Cricket					
Dancing					
Swimming					
Other (specify)					

Appendix G

Consent Forms

English and Niuean

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CONSENT FORM

I _____ of the Village of _____,

assert that:

- I have read, heard and understand the explanation of the study I have been randomly selected to participate in.
- I have had an opportunity to ask questions and to have them answered, and I understand that I can continue to do so throughout the study.
- I have been assured that my identity, and that of my family, is strictly confidential and that in no way will be revealed in relation to the results obtained from me.
- I have read and I understand my rights as a participant in this study, being able to decline not to answer any question or to cease participation at any time.

I hereby freely give my consent to be a participant in the 'Pilot Nutrition Survey of the Adult Niuean Population' conducted under the approval of the Massey University Human Ethics Committee, Albany Campus, Auckland, New Zealand.

SIGNATURE: _____

Date: _____

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Ko e kumikumiaga ke he faahi he tau huhua mena kai he tau tagata lalahi he motu ko Niue

KO E TALIAAGA KE HE KUMIKUMIAGA NEI

Ko au nei ko _____ mai he maaga ko _____,

Kua talia e au;

- Kua totou mo e maama ia au e tau fakamaamaaga kua tohia hagaao ia ke he kumikumiaga nei kua fifili au ke fakalataha ki ai.
- Kua foaki mai e taha magaaho ke fai huhu au mo e tali e haaku a tau huhu.
- Kua maama ia au to ai fakakite fakahanoa ha talahauaga kia au mo e haaku a magafaoa, ne moua mai ha ko e kumikumiaga nei.
- Kua totou mo e maama kia au e haaku a tutonuhia ko e taha kua potosia ke he kumikumiaga nei, ke nakai tali oti e tau hūhū, mo e fakaoti ne au a au he ha magaaho ni.

Kua fakaataina haaku a higoa ke fakalataha atu ke he "Kumikumiaga ke he faahi he tau huhua mena kai he tau tagata lalahi he motu ko Niue", ne kua fakatokatoka mo e fakamooli ki ai e aoga pulotu ko e Massey University.

HIGOA: _____

Aho: _____

Appendix H

Feedback Information

English and Niuean

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Pilot Nutrition Survey of The Adult Niuean Population

SUMMARY OF RESULTS FOR:

_____

Below are the results of your body measurements taken throughout the study.

BODY MASS:

Weight _____ kg

Height _____ cm or _____ m

Body Mass Index (BMI) _____

The Body Mass Index gives an indication of how heavy you are in relation to your height. There are also cut-off points for the BMI. For Pacific people, a healthy weight is taken to be a BMI between 22 and 27. Overweight is taken to be a BMI between 27 and 32. A person with a BMI higher than 32 is considered obese. However, BMI is not entirely indicative of body fat.

The classification of BMI is important because a lot of non-communicable diseases such as diabetes, hypertension and heart disease are related to a person's BMI. A person with a high BMI, for example over 30, has a greater risk of developing these non-communicable diseases.

People with a high BMI should do more physical activity and decrease the amount of food they eat. Such an effort will result in weight loss, which in turn lowers the risk of developing non-communicable diseases.

Waist girth _____ cm

Hip girth _____ cm

Waist: Hip Ratio _____

The waist:hip ratio is a measure of body fat distribution. A high waist:hip ratio is indicative of a greater store of abdominal fat, which is a known risk factor for coronary heart disease, stroke and diabetes. A person whose weight is in the normal range but who has a high waist:hip ratio is also considered at greater risk of developing heart problems. It is generally considered that obesity-related health problems such as hypertension, are more likely among women whose ratio is 0.80 or higher, and among men with a ratio of 1.0 or higher.

Waist Measurement Criteria

	Increased Risk	**Substantial Risk**
Men	≥ 94 cm	≥ 102 cm
Women	≥ 80 cm	≥ 88 cm

Mid-upper arm circumference _____ cm

Elbow Breadth _____ cm

Mid-upper-arm circumference is indicative of muscle mass, whereas the elbow breadth is an indication of body frame size, termed small, medium or large. The following table highlights the body frame size for both men and women based on height and elbow breadth.

Height and Elbow Breadth for Men and Women

Height (cm)	**Small Frame Elbow breadth (cm)**	**Medium Frame Elbow breadth (cm)**	**Large Frame Elbow breadth (cm)**
MEN			
155-159	<6.3	6.3-7.3	>7.3
160-169	<6.7	6.7-7.3	>7.3
170-179	<7.0	7.0-7.6	>7.6
180-189	<7.0	7.0-7.9	>7.9
> 190	<7.3	7.3-8.3	>8.3
WOMEN			
145-149	<5.7	5.7-6.3	>6.3
150-159	<5.7	5.7-6.3	>6.3
160-169	<6.0	6.0-6.7	>6.7
170-179	<6.0	6.0-6.7	>6.7
>180	<6.3	6.3-7.3	>7.0

A large frame is indicative of large skeletal mass and therefore low risk of degenerative bone disease such as osteoporosis.

BODY FAT (from BIA)

Fat Mass _____ % Fat _____

Muscle and Bone Mass _____ % FFM _____

Generally, body fat greater than 31% for men, and greater than 41% for women is considered obese.

BLOOD PRESSURE & GLUCOSE LEVEL

Blood Pressure: Systolic _____ mm Hg Diastolic _____ mm Hg

Blood Glucose: _____ mmol/L

The following table shows the classification of blood pressure for adults aged 18 years and older:

Category	Systolic (mm Hg)	Diastolic (mm Hg)
Optimal	Less than 120 and	Less than 80
Normal	Less than 130 and	Less than 85
High Normal	130-139 or	85-89
Hypertension	More than 140	More than 90

If your blood pressure level is in the hypertension range, it is best to have your blood pressure re-checked by a medical professional for confirmation. The normal range for blood glucose is generally between 3.5 and 7.0 mmol/L.

Attached is some information on dietary guidelines and food groups that you should use as a guide to achieving and maintaining a healthy and desirable weight. By choosing the right types of foods and the correct amounts to eat, you will be helping yourself to protect your body from degenerative diseases such as diabetes, gout, high blood pressure, and heart disease. Enjoy your Pacific lifestyle without the burdens of illness and disease.

I would like to convey my utmost appreciation and gratitude for your time and patience in participating in this study. I trust that you have learnt as much from me as I have from you and hope that the information I have shared with you will be of benefit to the health of you and your family.

FAKAAUE LAHI MAHAKI

Gaylene M Tasmania

MASSEY
UNIVERSITY

ALBANY CAMPUS, NEW ZEALAND
INSTITUTE OF FOOD, NUTRITION AND HUMAN HEALTH

Ko e kumikumiaga ke he faahi he tau huhua mena kai he tau tagata lalahi he motu ko Niue

KO E KATOATOAAGA HE TAU KUMIKUMIAGA KIA

Hanei e katoatoaaga he haau a tau fuafua tino;

Haau a Mamafa _____ kg

Haau a Loa _____ cm poke _____ m

Ko e numela mamafa he tino haau fakatatai atu ke he haau a loa _____
(Body Mass Index = BMI)

Ko e numela nei ne fakahigoa ko e BMI, fakakite ai e mamafa he tino haau. Ko e mena kehekehe e tau vehega BMI ne tohia ke lata mo e tau tagata he Pasifika. Kaeke ko e numela BMI haau he vahaloto he 22 kehe 27, mitaki e mamafa haau ke lata mo e haau a loa. Ko e numela BMI he vahaloto he 27 kehe 32, ko e fakakiteaga ko e mamafa a koe ke lata mo e haau a loa. Kaeke kua molea e 32 e haau a BMI, kua molea atu lahi e haau a mamafa ke lata mo e haau a loa.

Ko e mukamuka lahi e tau tagata ne tokoluga e numela BMI ke moua he tau gagao tuga e gagao suka, toto tokoluga mo e falu gagao ke he ate vili. Ko e mena ia, kua lata e tau tagata ne molea e tau tino mamafa ke tukutuku hifo e tau mamafa, ke lagomatai ke puipui e tau tino he tau gagao pehe nei.

Ko e laulahi he haau a kupu manava _____ cm

Ko e laulahi he haau a paka pula _____ cm

Ko e fakatataiaga he laulahi he kupu manava mo e paka pula _____
(Waist: Hip Ratio)

Ko e tau numela fakahiku ne fakahigoa ko e Waist:Hip ratio, ko e fakatataiaga he laulahi he haau a kupu manava mo e paka pula. Kua lata e tau fifine ke moua e numela (ratio) ki lalo hifo he 0.80. Ko e tau tagata taane, kua lata ke moua e numela (ratio) ki lalo hifo he 1.0. Ko e ratio ne molea, ko e fakakiteaga a ia ko e molea lahi e gako ne haha ke he kupu manava ke he gako ne hahā ke he paka pula. Ko e tau tagata ne molea e lahi he gako ne hahā ke he kupu manava, mua atu e mukamuka ha lautolu ia ke moua e tau gagao ke he ate vili, tuga e heart attack, stroke moe falu foki.

Ko e laulahi he haau a lima (upper arm) _____ cm

Ko e laulahi he haau a tuli lima (elbow) _____ cm

Ko e fua e loa he tuli lima ke fakatatai aki e loa he tagata ati maeke ai ke kitia e vehega matapatu tino (body frame size).

Ko e tau vehega matapatu tino ke lata mo e tau tagata taane mo e tau fifine

Ko e Loa he tagata (cm)	Tose Tuli lima (cm)	Vahāloto Tuli lima (cm)	Lahi Tuli lima (cm)
TAANE			
155-159	<6.3	6.3-7.3	>7.3
160-169	<6.7	6.7-7.3	>7.3
170-179	<7.0	7.0-7.6	>7.6
180-189	<7.0	7.0-7.9	>7.9
> 190	<7.3	7.3-8.3	>8.3
FIFINE			
145-149	<5.7	5.7-6.3	>6.3
150-159	<5.7	5.7-6.3	>6.3
160-169	<6.0	6.0-6.7	>6.7
170-179	<6.0	6.0-6.7	>6.7
>180	<6.3	6.3-7.3	>7.0

KO E GAKO NE HĀHĀ KEHE HAAU A TINO

Ko e mamafa he gako ne hāhā kehe tino (Fat Mass): _____

Ko e pasene gako he tino (% Fat): _____

Ko e mamafa he tau vala he tino ne nakai fai gako (Fat Free Mass): _____

Ko e pasene he tau vala he tino ne nakai fai gako (% FFM): _____

KO E FUA HE TOTO MO E SUKA

Ko e fuafua he toto:

Systolic: _____ mm Hg Diastolic: _____ mm Hg

Ko e fuafua he suka:

_____ mmol/L

Ko e tau vehega he tau toto tokoluga ke lata mo e tau tagata ne molea e 18 e tau Tau.

Vehega	Systolic (mm Hg)	Diastolic (mm Hg)
Mitaki lahi (optimal)	Ki lalo hifo he 120	Ki lalo hifo he 80
Mitaki (normal)	Ki lalo hifo he 130	Ki lalo hifo he 85
Tokoluga fakatose (high normal)	130-139	85 kehe 89
Toto tokoluga	Molea e 140	Molea e 90

Kua lata ke fakatatai e koe haau a tau numela he fuafua he haau a toto mo e tau numela he tau vehega i luga. Kaeke kua kitia e koe, ko e vehega he toto tokoluga e haau a numela, kua lata a koe ke finatu ke he Fale Gagao ke liu ke fuafua e haau a toto, to moua e fakamooliaga mai he Ekekafo.

Ko e uhoaki ke fifili e tau mena kai motu ke kai mo e fifili fakamitaki e lahi he mena ka kai. Kua lata foki ke taute he falu gahua tuga e faofao tino, laka hui he falu a tau magaaho poke taholi pasikala, kae ua tua tumau ke he tau peleō afi. Ko e falu a tau puhala a nei ke lali ke lagomatai aki e tau momoui he tau tagata Niue, ke fiafia e tau loto mo e nakai tupetupe ke he tau gagao tuga e gagao suka, toto tokoluga, gugu mo e tau gagao ke he ate vili.

Kua manako au ke tuku atu haaku a tau Fakaaue Lahi Mahaki kia koe, ha ko e haau a tau magaaho ne foaki mai ke lagomatai aki e kumikumiaga nei. Amanaki ni au kua fai mena foou a koe ne moua mai he kumikumiaga nei ke lagomatai aki e tau malolo tino haau mo e haau a magafaoa katoa.

FAKAAUE LAHI MAHAKI

Gaylene M Tasmania

Appendix I

Foods added to the Food Composition Database

Nutrient composition of new foods added to the Foodworks Database

Food	Weight (g)	Energy (kJ)	NoDF	Protein (g)	Total Fat (g)	Saturated Fat (g)	Mono-unsaturated Fat (g)	Poly-unsaturated Fat (g)	Cholesterol (mg)	Carbohydrate (Avail) (g)	Sugars (g)
Crab (Kalahimu)	100	254		13	0.6	0.1	0.1	0.1	84.0	1.2	1.2
Edible Hibiscus (Pele)	100	229		3	2.0	0.1	0.1	0.1	0.0	2.9	2.6
Herring, canned	100	799		13	14.4	3.8	4.6	5.3	46.0	3.0	28.0
Mackerel, baked	100	813		25	10.4	2.9	2.3	4.7	67.0	0.3	0.3
Neck chops, cooked	100	1478		27	27.5	4.0	3.6	0.6	110.0	0.0	0.0
Seaweed, raw (Limu)	100	41		2	0.4	0.1	0.1	0.0	0.0	0.1	0.1

Food	Weight (g)	Glucose (g)	Fructose (g)	Sucrose (g)	Lactose (g)	Maltose (g)	Starch (g)	Water (g)	Alcohol (g)	Fibre (Englest) (g)
Crab (Kalahimu)	100	1.2	0.0	0.0	0.0	0.0	0.0	8.3	0.0	0.0
Edible Hibiscus (Pele)	100	1.2	1.2	0.2	0.0	0.0	0.3	77.0	0.0	3.3
Herring, canned	100	0.0	0.0	0.0	0.0	0.0	0.3	67.4	0.0	0.0
Mackerel, baked	100	0.3	0.0	0.0	0.0	0.0	0.0	62.9	0.0	0.0
Neck chops, cooked	100	0.0	0.0	0.0	0.0	0.0	0.0	44.0	0.0	0.0
Seaweed, raw (Limu)	100	0.0	0.0	0.0	0.0	0.0	0.0	81.5	0.0	49.2

Food	Weight (g)	Sodium (mg)	Potassium (mg)	Magnesium (mg)	Calcium (mg)	Phosphorus (mg)	Iron (mg)	Zinc (mg)	Manganese (ug)	Copper (mg)
Crab (Kalahimu)	100	389.0	19.0	27.0	173.0	215.0	1.0	9.1	88.0	0.8
Edible Hibiscus (Pele)	100	7.0	376.0	363.0	431.0	39.0	4.3	0.7	1410.0	0.1
Herring, canned	100	380.0	320.0	31.0	45.0	170.0	0.8	1.5	40.0	0.2
Mackerel, baked	100	115.0	536.0	36.0	10.0	285.0	1.6	0.4	13.0	0.1

Food	Weight (g)	Sodium (mg)	Potassium (mg)	Magnesium (mg)	Calcium (mg)	Phosphorus (mg)	Iron (mg)	Zinc (mg)	Manganese (ug)	Copper (mg)
Neck chops, cooked	100	56.0	210.0	19.0	20.0	200.0	2.4	7.7	12.0	0.1
Seaweed, raw (Limu)	100	150.0	76.0	77.0	119.0	100.0	5.9	1.6	3960.0	0.6

Food	Weight (g)	Selenium (ug)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Niacin Eq (mg)	Vitamin C (mg)	Vitamin D (ug)	Vitamin E (mg)	Vitamin B6 (mg)
Crab (Kalahimu)	100	53.0	0.0	0.0	0.0	2.1	0.0	0.0	1.8	0.2
Edible Hibiscus (Pele)	100	0.3	0.1	0.3	0.9	1.5	108.0	0.0	2.4	0.3
Herring, canned	100	42.0	0.0	0.2	4.2	6.6	1.0	5.6	1.9	0.2
Mackerel, baked	100	56.0	0.1	0.1	5.5	10.1	1.0	4.0	0.3	0.1
Neck chops, cooked	100	2.4	0.0	0.2	2.9	7.4	0.0	0.4	0.2	0.2
Seaweed, raw (Limu)	100	0.0	0.0	0.3	0.5	1.1	2.0	0.0	0.0	0.3

Food	Weight (g)	Vitamin B12 (ug)	Total Folate (ug)	Total A Eq (ug)	Retinol (ug)	B-Carotene Eq (ug)
Crab (Kalahimu)	100	0.0	20.0	7.0	0.0	40.0
Edible Hibiscus (Pele)	100	0.0	49.0	673.0	0.0	4040.0
Herring, canned	100	6.9	24.0	114.0	67.0	285.0
Mackerel, baked	100	0.7	2.0	88.0	84.0	25.0
Neck chops, cooked	100	2.0	1.0	6.0	6.0	0.0
Seaweed, raw (Limu)	100	0.0	170.0	10.0	0.0	61.0

Appendix J

Dietary intake of the general New Zealand population

Results of the 1997 Nutrition Survey

Appendix J: Daily median nutrient intake of the general New Zealand population

Nutrient	Men	Women
Energy (kJ)	11631	7701
Protein (g)	105	71
Carbohydrate (g)	305	214
Dietary Fibre (g)	23	18
Total Fat (g)	110	72
Cholesterol (mg)	359	243
Calcium (mg)	857	691
Iron (mg)	14.6	9.9
Zinc (mg)	14.5	9.8
Selenium (ug)	56	39
Vitamin A eq.(ug)	1076	842
Vitamin E (mg)	11.2	8.6
Vitamin C (mg)	111	95
Thiamin (mg)	1.7	1.2
Riboflavin (mg)	2	1.5
Niacin Eq (mg)	43	29
Vitamin B6 (mg)	1.7	1.2
Vitamin B12 (ug)	5	3
Total Folate (ug)	278	212

Source: Russell et al, 1999

Appendix K

Dietary intake of the Pacific Island population in New Zealand

Results of the 1997 Nutrition Survey

Appendix K: Unadjusted mean nutrient intake of the Pacific Island population of New Zealand[1]

Nutrient	Men	Women
Energy (kJ)	11726	8630
Protein (g)	112	78
Carbohydrate (g)	306	528
Dietary Fibre (g)	20	19
Total Fat (g)	109	80
Cholesterol (mg)	450	298
Calcium (mg)	616	489
Iron (mg)	14.4	11.2
Zinc (mg)	17.1	12.7
Selenium (ug)	92	49
Vitamin A eq.(ug)	976	703
Vitamin E (mg)	12.1	9.8
Vitamin C (mg)	118	103
Thiamin (mg)	1.4	1.1
Riboflavin (mg)	1.7	1.3
Niacin Eq (mg)	48	32
Vitamin B6 (mg)	1.7	1.6
Vitamin B12 (ug)	6.3	4.1
Total Folate (ug)	234	209

[1] These data were not adjusted for intra-individual variation due to the small sample size (Russell et al, 1999)

Nutrient	Men	Women
Energy (kJ)	11726	8630
Protein (g)	112	78
Carbohydrate (g)	306	528
Dietary Fibre (g)	20	19
Total Fat (g)	109	80
Cholesterol (mg)	450	298
Calcium (mg)	616	489
Iron (mg)	14.4	11.2
Zinc (mg)	17.1	12.7
Selenium (ug)	92	49
Vitamin A eq.(ug)	976	703
Vitamin E (mg)	12.1	9.8
Vitamin C (mg)	118	103
Thiamin (mg)	1.4	1.1
Riboflavin (mg)	1.7	1.3
Niacin Eq (mg)	48	32
Vitamin B6 (mg)	1.7	1.6
Vitamin B12 (ug)	6.3	4.1
Total Folate (ug)	234	209