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Cardiovascular Disease Risk Factors and Diabetes in Pacific Adults: The Diabetes Heart and Health Study (DHAH), Auckland, New Zealand 2002/03

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BSc, MPH (Hons)

A thesis submitted in partial fulfilment of the requirements for the degree of

Doctor of Philosophy, in Population Health

The University of Auckland
2009
Abstract

Aims
This thesis aims were to describe health related socio-economic profiles, alcohol consumption patterns, the prevalence of diabetes mellitus (known and undiagnosed) and to quantify levels of overweight and obesity and other cardiovascular disease risk factors among adults of Pacific ethnic groups and to compare these findings to Europeans in Auckland, New Zealand.

Method
The study design was a cross-sectional survey carried out in the Auckland region from January 2002 to December 2003. Cluster and electoral roll sampling recruitment procedures were used. A total of 4049 participants were surveyed of whom 1011 were of various Pacific ethnicity and 1745 were European New Zealanders aged between 35 and 74 years.

Results
Of the Pacific ethnic groups Niueans had the most favourable socioeconomic profile, followed by the Cook Island, Samoan and Tongan ethnic groups.

Approximately seventy percent (70.4%) of all Pacific people did not currently drink compared to 21.5% of the European population. Ex-drinkers comprised 6.3% of the ‘ever-drank’ population for European compared to 27.6% for Pacific. The majority of Pacific men and women drinkers (>60%) consumed alcohol ‘weekly’ or ‘less than weekly’. In contrast the majority of European men and women drinkers (>60%) consumed alcohol ‘2-3 days per week’ or ‘daily’. Pacific drinkers consumed an average of 6.9 drinks on a typical occasion and 82 mls of pure alcohol per week, compared to 3.6 drinks and 126 mls per week for Europeans.

The proportions of new/known diabetes by ethnicity were 1.8%/3.9% for Europeans, and 4.0%/19.5% for Pacific people. Pacific people were found to have a significantly greater relative risk (RR) than Europeans of being newly diagnosed with diabetes, particularly in the <45 (RR 11.6), and 45–54 year (RR 4.2) age groups. Compared to Europeans, Pacific people had a significantly greater risk of known diabetes in all age groups which ranged from RR 2.5 in those aged 65+ to RR 9.3 in the 55–64 year age group.

Approximately 95% of Pacific men and 100% of Pacific women were ‘overweight or obese’. Pacific people were as accurate at estimating their body weight as Europeans. Despite a significantly higher proportion of Pacific people reporting being heavier than a year ago (22.7%) than Europeans (17.2%), significantly fewer Pacific people (55.6%) reported thinking that they were overweight compared to Europeans (64.9%). After adjustment for possible confounding variables, older Pacific adults were more than 11 times likely to be obese than their Europeans counterparts.
Of the Pacific groups, Niueans had the lowest estimated cardiovascular disease (CVD) risk and Samoans had the highest. Individual risk factors differed between these groups. Diabetes prevalence was highest in Samoan men (26.2%) and Tongan women (35.8%). Tongan women had a diabetes prevalence over double that of their men (17.8%). Niueans had the lowest diabetes prevalence of both sexes (men 14.9%, women 10.8%). Of the Pacific groups Cook Islanders had comparably poor diabetes screening rates in spite of the high prevalence.

**Conclusion**

In conclusion, a distinct pattern emerged from the results. The Niuean and Cook Island ethnic groups generally had a similar and more favourable socioeconomic health-related profile compared to the Samoan and Tongan ethnic groups. These differences are most likely to be related to the length of residence in New Zealand.

Drinking patterns in Pacific adults tend to show substantial diversity by age (older are less likely to drink), sex (women less likely to drink), and deprivation (middle groups consume more than least and most deprived). For Europeans, a more homogenous drinking style prevailed by age, sex, and deprivation. Pacific drinkers were also approximately five times more likely to have stopped drinking compared to Europeans, citing family and social reasons as their main motivation for stopping drinking.

The prevalence of diabetes was about four times greater for Pacific people compared with Europeans and differed by Pacific ethnic group. Levels of undetected diabetes differed between the Pacific ethnic groups with Niueans having the most favourable overall diabetes health profile and Cook Islanders having the highest levels of undetected diabetes. More rigorous screening of diabetes in Cook Islanders is needed if they are to experience similar detection rates as other Pacific Island communities in New Zealand.

For every two European people with previously diagnosed diabetes there was approximately one (0.92) person in the community undiagnosed while for every five Pacific with diagnosed diabetes there was just over one (1.1) Pacific person undiagnosed. These findings demonstrate that the recent national focus on improving diabetes detection in Pacific people in New Zealand has been successful.

Almost all Pacific people in New Zealand over 35 years of age are either overweight or obese. These findings emphasise the need for health interventions on overweight and obesity to target the whole community and the obesogenic environment that is responsible for these disturbing observations.
Predicted cardiovascular disease risk factor scores also differed between the Pacific ethnic groups with Niueans again having the most favourable overall profiles. All Pacific populations had higher mean predicted cardiovascular disease risk than Europeans.

While the substantial disparities in health status and health outcomes between Europeans and the combined Pacific populations in New Zealand has been previously documented, this study has also shown significant differences in health-related characteristics between Pacific groups. These between group differences are generally consistent with the timing of their migration to New Zealand. Future research on health status of Pacific people in New Zealand would benefit from investigating each of the Pacific populations separately as well as together.
Acknowledgements

First and foremost I would like to express my sincere gratitude to Dr Patricia Metcalf, who was my supervisor and mentor over the past 4 years. Your time, expertise, support and teachings have been invaluable and dearly appreciated.

This study would not have been possible without generous funding from the Health Research Council of New Zealand. I would also like to thank all those people who participated in the study for without them this study would not have been possible.

I would also like to thank my many advisors from our department of Epidemiology and Biostatistics especially Professor Rod Jackson and Associate Professor Robert Scragg.

Other people who made this thesis possible were: Dudley Gentles (my colleague, thanks for your great insights, discussions and company), Dr Jack Grant-Mackie and Diana Grant Mackie who have mentored me throughout my academic career, Fa'asisila Savila who was one of the data managers for the study, Debbie Raroa the study Phlebotomist, Dr David Schaaf, Dr Lorna Dyall, and Associate Professor Peter Black.

Finally I would like to thank my brothers and sisters, all friends and family who have also supported me throughout this journey: especially my parents Wayne and Sola, my grandparents Phyllis and Leonard, Vesta and Gerhard, my baby daughter Sola and my wife Meliame.
Dissemination of and development from work performed for this thesis

Much of the research conducted during this thesis has been published primarily in the New Zealand Medical Journal (NZ Med J) and also the Pacific Health Dialog (PHD).


The work has also been presented at national and international health conferences as well as key stake-holder groups to whom the information is pertinent:


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<th>Description</th>
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<tr>
<td>NZ</td>
<td>New Zealand</td>
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<tr>
<td>WWII</td>
<td>World War 2</td>
</tr>
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<td>PAC</td>
<td>Pacific Access Category</td>
</tr>
<tr>
<td>DHB</td>
<td>District Health Board</td>
</tr>
<tr>
<td>SES</td>
<td>Socioeconomic status</td>
</tr>
<tr>
<td>ECA</td>
<td>Employment Contracts Act</td>
</tr>
<tr>
<td>CVD</td>
<td>Cardiovascular Disease</td>
</tr>
<tr>
<td>CHD</td>
<td>Coronary Heart Disease</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>IHD</td>
<td>Ischaemic Heart Disease</td>
</tr>
<tr>
<td>ARCOS</td>
<td>Auckland Region Coronary or Stroke Study</td>
</tr>
<tr>
<td>DHAHS</td>
<td>Diabetes Heart and Health Study</td>
</tr>
<tr>
<td>ARFS</td>
<td>Auckland Risk Factor Study</td>
</tr>
<tr>
<td>AHAHS</td>
<td>Auckland Heart and Health Study</td>
</tr>
<tr>
<td>WDS</td>
<td>Workforce Diabetes Study</td>
</tr>
<tr>
<td>NZHS</td>
<td>New Zealand Health Survey</td>
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<tr>
<td>SADP</td>
<td>South Auckland Diabetes Project</td>
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<tr>
<td>SOFP</td>
<td>Samoan Ola Fa’autauta Project</td>
</tr>
<tr>
<td>NNS</td>
<td>National Nutrition Survey</td>
</tr>
<tr>
<td>GTT</td>
<td>Glucose Tolerance Test</td>
</tr>
<tr>
<td>IGT</td>
<td>Impaired Glucose Tolerance</td>
</tr>
<tr>
<td>IFG</td>
<td>Impaired Fasting Glucose</td>
</tr>
<tr>
<td>LDL</td>
<td>Low-density Lipoprotein</td>
</tr>
<tr>
<td>NZDep2001</td>
<td>New Zealand Deprivation Index 2001</td>
</tr>
<tr>
<td>PSU</td>
<td>Primary Sampling Unit</td>
</tr>
<tr>
<td>RR</td>
<td>Relative Risk</td>
</tr>
<tr>
<td>OR</td>
<td>Odds Ratio</td>
</tr>
<tr>
<td>HDL</td>
<td>High-density Lipoprotein</td>
</tr>
<tr>
<td>BP</td>
<td>Blood Pressure</td>
</tr>
<tr>
<td>HbA$_{1c}$</td>
<td>Glycosylated (or glycated) haemoglobin</td>
</tr>
<tr>
<td>PA</td>
<td>Physical Activity</td>
</tr>
<tr>
<td>PHO</td>
<td>Primary Healthcare Organisation</td>
</tr>
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<td>PDACS</td>
<td>Pacific Drugs and Alcohol Consumption Survey</td>
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1 Background and literature review

This thesis is divided into five chapters. These consist of chapters 1) Background and literature review, 2) Introduction and aims, 3) Methods, 4) Results, and 5) Discussion and conclusions.

The purpose of this chapter is to familiarise the reader to aspects of New Zealand’s Pacific population to enable a more informed understanding of the findings of this thesis. To fulfil this purpose, the chapter has been divided into two sections. The first section will provide a broad picture of the history of the Pacific population in New Zealand and highlight key attributes unique to Pacific communities. The second section will describe the health experience of Pacific people in New Zealand specifically considering health-related determinants, alcohol, diabetes and cardiovascular disease (CVD), and overweight and obesity.

1.1 Pacific population in New Zealand

Migration to New Zealand of Pacific people

In 1945, Pacific people comprised a modest 0.1% of New Zealand’s population. At Census 2006, the Pacific population had grown to comprise 6.9% of the total New Zealand population.\(^1\) The growth of the Pacific population in New Zealand was fuelled by a modern industrial revolution and a dearth of unskilled workers. Immigration policies were subsequently liberalised and this saw intensified immigration from the Pacific from the 1950’s through to the early 1970’s.\(^2\) This history meant that Pacific people in New Zealand were predominantly represented in the lower end of the socio-economic scale as they were primarily recruited from the
Pacific to fill labouring roles. These roles included production line workers on car and household appliance companies, service working jobs such as cleaners, kitchen hands, laundry staff, freezing workers and as labourers for local government departments (i.e. roadworks, etc). In 1973, the largest number of Pacific immigrants were to enter New Zealand despite an impending oil crisis that would significantly alter Pacific immigration and the perception of Pacific people by the political arm of New Zealand’s government and eventually the New Zealand public.

In the subsequent harder economic climate and economic recession, levels of unemployment increased and Pacific people were seen to be unfairly taking New Zealanders jobs. These developments fuelled a tightening of immigration policy and prompted acts of state supported racism such as the “Dawn Raids” carried out at random - on Pacific people’s homes in order to identify, and deport Pacific “Over-stayers” who did not have appropriate visitor permits. In earlier, but still relatively recent, times of economic prosperity (and labour shortages), a far more relaxed regulation and enforcement with regard to work permits, visa’s and quota’s was the norm.

In 1991, the Immigration Amendment Act established a new ‘points-based’ system that would determine the likelihood of being granted New Zealand working and residency permits. Points were awarded to applicants with higher education, highly skilled professions, business interests and a higher level of English competency. This system allowed greater control of inbound migration and naturally made immigration more difficult to applicants from Pacific nations.
The four largest Pacific populations in New Zealand are those of Samoa, Cook Islands, Tonga and Niue. A map showing the geographical location of these nations is shown in Figure 1. A flight to Samoa takes approximately 4 hours and is the furthestmost island nation from Auckland, New Zealand.
Diversity of Pacific groups

The Pacific population of New Zealand has many different labels. The terms ‘Pacific Islanders’, ‘Polynesians’ and ‘Pacific People’ are used to describe these groups collectively. The collective label fails to acknowledge differences that exist between Pacific ethnic groups, and creates the assumption of one homogenous group. However, the Pacific population in New Zealand is reported to consist of over 20 different groups each with their own distinct language and culture. Although many Pacific people have many similarities with regard to migration and assimilation in New Zealand (i.e. reasons for migration, time of migration), many differences also exist (i.e. numbers that migrated, political affiliation to New Zealand, cultural differences, and language).

To date, most governmental documents assess social indicators using a combined Pacific approach for various practical and historical reasons. In New Zealand’s Pacific health sector, the call for ethnic specific Pacific information in order to generate a more accurate description of the health experience of Pacific population’s is now becoming a reality. Most large collections of social data now have the potential to be catered to specific Pacific ethnic groups, due to the more robust assessment of ethnicity, and oversampling of Pacific people.

Political history and context with New Zealand

A significant difference that exists between the various Pacific nations lies in the political relationship each Pacific nation had with New Zealand. The Cook Islands, Niue, and Tokelau are all protectorates of New Zealand whose citizens are therefore
entitled to all rights of New Zealand citizens. Samoa used to be governed by New Zealand following WWII and gained independence in 1962. Following Samoan independence, a Samoan quota scheme was formally established in 1970 allowing 1100 Samoan citizens to be granted New Zealand residency annually. Tonga has always remained an independent nation and has a strong relationship with New Zealand. Another scheme that now facilitates Pacific migration to New Zealand is the ‘Pacific Access Category’ (PAC) scheme. Established in July 2002, the PAC scheme can grant a limited number of applicants from Tonga (250), Fiji (75), Tuvalu (75) and Kiribati (75) permanent residence in New Zealand each year.

Pacific population composition and growth

In 2006, the Pacific population in New Zealand numbered approximately 265,974. The four largest Pacific ethnic groups combined comprised over 98% of the total New Zealand Pacific population. These consisted of Samoans (49%), Cook Islands (22%), Tongans (19%) and Niueans (8.5%).

The Pacific population is one of the fastest growing populations in New Zealand. Table 1 shows the size of the Pacific population from 1991 to 2006. Between 1991 and 2006, the Pacific population grew by 59%.

Table 1 The New Zealand Pacific population 1991 – 2006.

<table>
<thead>
<tr>
<th>Census year</th>
<th>Pacific peoples ethnic group population</th>
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</thead>
<tbody>
<tr>
<td>1991</td>
<td>167,070</td>
</tr>
<tr>
<td>1996</td>
<td>202,233</td>
</tr>
<tr>
<td>2001</td>
<td>231,801</td>
</tr>
<tr>
<td>2006</td>
<td>265,974</td>
</tr>
</tbody>
</table>

Source: Statistics New Zealand
Rather than immigration being the primary cause of growth (as is the case for the New Zealand’s Asian community), higher fertility is the predominant factor that has spurred population growth. Other drivers of population growth include a high proportion of inter-ethnic unions (Pacific with non-Pacific), and a relatively youthful age structure. This means that compared to other populations there are proportionately more adults in and entering a parenting, reproductive phase in their life, which ‘produces built-in momentum for population growth’. In Figure 2 below, the growth of the Pacific population in New Zealand from 1945 – 2001 is illustrated.

**Figure 2 Growth of the Pacific population in New Zealand, 1945 - 2001**

The effect of migration on population growth is now negligible. This has occurred as the number of permanent long-term arrivals verses permanent long-term departures to and from Pacific Island countries has become more balanced. For some time now there has been a downward trend in the net migration (excess of permanent long-term arrivals when permanent long-term departures are accounted for) from Pacific Island countries to New Zealand. Therefore, it is somewhat misleading or inappropriate to label the Pacific population as a migrant population. Migration now has less of a role
in population growth, as a larger proportion of Pacific people are now New Zealand-born as reported in Census 2006 (Figure 3). The Pacific population growth far exceeds national growth. Over the five-year period between 1996 and 2001, the Pacific population experienced a 14.6% growth compared to the overall 3.3% growth experienced by the country.

Figure 3 Proportion of New Zealand-born Pacific peoples for selected ethnic groups

The Pacific population is very youthful. In 2006, the median age for the Pacific population was 21.1 years, slightly higher than in 2001 (21 years). The median age for the New Zealand population is 35.9 years. In 2001, 38.9% of the Pacific population were aged 0-14 (22.3% of national in 2001), 57.8% were aged 15-64 (65.6% of national in 2001) and 3.3% were aged 65 and over (12.1% of national in 2001). Age and sex distribution charts are presented in Figure 4 and clearly show that the Pacific population is quite different to the total New Zealand population.
The age structure of the Pacific population means that dependency ratios for the aged and children contrast markedly with each other as well as with national averages. Of the Pacific population who are in the eligible workforce (those age 15-65), there are comparatively fewer elderly and considerably more youth who are required to be cared for than national averages.

Geographic Location

The majority of the Pacific population reside around urban centres. Approximately 72% of the Pacific population live within the Auckland region (Auckland District Health Board (DHB), Counties Manakau DHB, and Waitemata DHB), 15% in the Wellington region (Capital & Coast DHB, Hutt Valley DHB), 4.4% in the Waikato, and 3.8% in Canterbury. Table 2 shows the number and proportion of the total District Health Board populations that Pacific people comprise. The largest Pacific population resides in the Counties Manakau DHB where 1 in 3 people are Pacific.
Table 2 Pacific populations within District Health Boards, 2001

<table>
<thead>
<tr>
<th>District Health Board (DHB)</th>
<th>Pacific population</th>
<th>Pacific proportion of DHB total</th>
<th>District Health Board (DHB)</th>
<th>Pacific population</th>
<th>Pacific proportion of DHB total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northland</td>
<td>3156</td>
<td>1.3%</td>
<td>Midcentral</td>
<td>4135</td>
<td>1.7%</td>
</tr>
<tr>
<td>Waitemata</td>
<td>32,937</td>
<td>13.3%</td>
<td>Hutt Valley</td>
<td>10,866</td>
<td>4.4%</td>
</tr>
<tr>
<td>Auckland</td>
<td>51,231</td>
<td>20.7%</td>
<td>Capital and Coast</td>
<td>22,896</td>
<td>9.2%</td>
</tr>
<tr>
<td>Counties-Manukau</td>
<td>82,416</td>
<td>33.3%</td>
<td>Wairarapa</td>
<td>855</td>
<td>0.3%</td>
</tr>
<tr>
<td>Waikato</td>
<td>10,161</td>
<td>4.1%</td>
<td>Nelson Marlborough</td>
<td>1320</td>
<td>0.5%</td>
</tr>
<tr>
<td>Lakes</td>
<td>3615</td>
<td>1.5%</td>
<td>West Coast</td>
<td>210</td>
<td>0.1%</td>
</tr>
<tr>
<td>Bay of Plenty</td>
<td>3276</td>
<td>1.3%</td>
<td>Canterbury</td>
<td>8697</td>
<td>3.5%</td>
</tr>
<tr>
<td>Tairawhiti</td>
<td>1227</td>
<td>0.5%</td>
<td>South Canterbury</td>
<td>381</td>
<td>0.2%</td>
</tr>
<tr>
<td>Taranaki</td>
<td>1137</td>
<td>0.5%</td>
<td>Otago</td>
<td>2793</td>
<td>1.1%</td>
</tr>
<tr>
<td>Hawke’s Bay</td>
<td>4929</td>
<td>2.0%</td>
<td>Southland</td>
<td>1482</td>
<td>0.6%</td>
</tr>
<tr>
<td>Whanganui</td>
<td>1275</td>
<td>0.5%</td>
<td>Area outside DHBs</td>
<td>6</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Source: 2001 Census, Statistics New Zealand

**Socioeconomic factors**

Education, occupation and income are all interrelated. Education in many instances is a pre-requisite to many occupations, which therefore will determine income and socioeconomic status (SES). Pacific people hold fewer tertiary qualifications, are more likely to have unskilled occupations and to receive a lower income compared to the rest of the population. In 1996, 80% of Pacific people earned less than $20,000 per annum compared with 64% of other New Zealanders. The median personal income for a Pacific person in 1996 was $12,856 compared to $17,058 nationally. In 2006, the median personal income for a Pacific person was $20,500 compared to $24,400 nationally. In 2001 and 2006, 16.2% and 10.7% Pacific people, respectively, were unemployed.\(^5\)

**Family size**

Pacific people are more likely to have larger families, meaning more people are
supported by the household income. Dependency ratios are important as they reflect economic pressure placed on the productive part of the population (i.e. the workforce aged 15-65 years) to support children and elderly (those who are economically dependent). A dependency ratio is expressed as a percent, the higher the value, the greater the pressure placed of the productive part of the population.

\[
(Total) \text{ Dependency ratio} = \frac{(\text{number of people aged } 0-14) + (\text{number of people aged } 65 \text{ and over})}{\text{number of people aged } 15-64} \times 100
\]

The child dependency ratio for the Pacific population in New Zealand in 1996 was 67.7, the aged dependency ratio was 5.0 and the total dependency ratio for all ages was 72.7. This was significantly greater than the national ratio (63.1) and indicates stronger social and economic pressures that the Pacific population’s eligible workforce is put under. In 2001, the ratio’s remained similar for the Pacific population. Their child and elderly dependency ratios were 68.6 and 7.8, respectively, and the total dependency ratio was 76.4. In contrast, dependency ratios for the total New Zealand population in 2001 were child 34.0, elderly 18.5, and total 52.5.

**Cultural factors**

Obligations to extended family in both the Pacific and in New Zealand and commitments to the Church all contribute to added expenditure. Sixty two percent of Pacific families reported usually giving to family or church, and that the act made their financial situation more difficult. Other financial pressures have included various policy changes such as the introduction of the Employment Contracts Act (ECA). The ECA encouraged a shift that decreased the number of full-time jobs offered, to an increase in the availability of part-time jobs. Other policy changes have
altered work conditions (penal rates have been dropped and in many places are virtually unheard of).

The overall effect of this is that to receive the same pay, people have to work two or three jobs for a considerably longer time. The short-lived introduction of market rentals for state housing also increased financial pressure on many Pacific families during the 1990’s. As a result of such societal changes, real disposable income of people of low socio-economic status, which includes the vast majority of the Pacific population, has diminished. To counter this, expenditure has had to be adjusted by either spending less on housing, food, clothing or health care.

1.2 Health

Pacific people are over-represented in regard to many adverse social outcomes, including health.\(^8\) Life expectancy at birth for Pacific people is 5 years less than their European counterparts (Figure 5), and they experience significantly higher levels of morbidity and mortality particularly in relation to cardiovascular disease (CVD) and diabetes mellitus.\(^{12-15}\)

From 1996 – 2000, cardiovascular diseases accounted for 3 of the 5 leading causes of death for Pacific people aged 25-44, and remained a significant cause of death in older age groupings (45-64 and 65+ years). Diabetes was found to be the 2\(^{nd}\) and 3\(^{rd}\) leading cause of death in Pacific women and men, respectively, aged 45-64 years and remained in the top 5 leading causes of death for those 65 and over.\(^8\)
Health related socioeconomic determinants

Many socioeconomic variables are commonly recognised determinants of health and have clear relationships to health outcomes; these include dwelling (housing), income, employment, education, marital status, migration characteristics, and family/household size. These determinants are known to moderate many health outcomes that include infectious diseases (meningococcal B, respiratory infections), cardiovascular diseases (heart disease, obesity, diabetes), and mental health problems (depression).

In response to socioeconomic stressors, many cost saving behaviours have included reducing expenditure on food, heating (electricity), shelter, and health care. Understandably serious adverse health effects can result. In Pacific people, such adverse effects are seen in overcrowding, living in sub-standard dwellings, high
mobility, unhealthy food choices and poor diet, delay in seeking medical attention and presentation to secondary care providers with acute avoidable illness.

Knowledge of these health related determinants will enable the development of effective strategies that aim to maintain and improve the health of populations they intend serve. There do not appear to be any previous accounts of the determinants of health that address individual Pacific groups in New Zealand.

**Alcohol**

The relationship that alcohol has on risk of mortality is U-shaped. Light-to-moderate drinkers have a lower mortality than non-drinkers and heavy drinkers. The lower mortality of the ‘light to moderate drinkers’ is attributed to lower rates of CVD, in particular coronary heart disease. Findings from the Auckland Region Coronary or Stroke study (ARCOS) found that for middle aged and older Auckland adults regular consumption of alcohol was associated with a significantly reduced risk of coronary heart disease than non-drinkers and that for men this reduction was more pronounced. For women, the protective association was only observed in ‘light to moderate drinkers rather than all drinkers.

Pacific people in New Zealand are less likely to consume alcohol than the general New Zealand population. However, those Pacific people who consume alcohol are more likely to drink more on any typical occasion and experience negative consequences of such a drinking style. In the 1992-1993 Household survey, 53% of Pacific people were estimated to be ‘non-drinkers’. Similarly, in a telephone survey carried out in 2002/03, 43% of Pacific people surveyed were ‘non-drinkers’ compared to 15% of the general New Zealand population. Pacific drinkers would
drink an average of eight drinks on a typical drinking occasion compared to four for the national population, and had consumption patterns referred to as ‘too much or nothing at all’. In this same study, Pacific people were not found to drink more frequently than their non-Pacific counterparts, but were more likely to have experienced negative consequences from drinking compared to national levels. This finding is supported elsewhere.

Research has suggested that the concept of a ‘social drinker’ was not well recognised in Pacific communities and that for most, drinking meant drinking enough to get drunk or until one could not drink anymore. This view of drinking would indeed support a ‘too much or nothing at all’ culture and was thought to have been influenced, in part, by traditional kava drinking practices. When drinking kava, an entire cup is consumed in one go, and the kava is drunk until the bowl is finished rather than when one feels that they have had enough. For other Pacific nations that have longer migration histories in New Zealand (Cook Islands and Niue) and where kava drinking is less common, an adoption of a typical New Zealand drinking culture is most likely. From 1918 – 1967, New Zealand Public Hotels had to be closed by 6pm. This gave rise to what is known as the ‘six o’clock swill’. Six o’clock closing has been seen by many commentators as teaching two generations of Kiwi men to drink as fast as possible, contributing to a binge-drinking culture. The most recent New Zealand Health Survey found that for ‘drinkers’ - the proportion engaged in ‘hazardous drinking’ in Pacific adults (39.2%) was almost double that of European/Other New Zealanders (20.1%).
Diabetes and Cardiovascular disease (CVD)

Cardiovascular diseases (CVD) are the leading cause of death in New Zealand, and accounted for 39% of all deaths in 2003. Diabetes is an important cause of premature mortality and disability for New Zealanders, and it has been estimated that diabetes contributes to one-quarter of the difference in life expectancy between Pacific and European New Zealanders.

Pacific people in New Zealand had the highest mortality rate and hospital discharge rate for cerebrovascular disease (stroke), and were found to be two times more likely to have diabetes than European New Zealanders. Tables 3 to 5 show that Pacific men and women aged 45 to 64 have 2 to 2.8 times higher risk of CVD mortality, IHD mortality, and stroke mortality than Europeans. Pacific men and women aged 45-64 years have markedly higher mortality for all these measures of CVD outcomes.

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Pacific</th>
<th>Total NZ</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45-64</td>
<td>554</td>
<td>253</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>65+</td>
<td>3145</td>
<td>2438</td>
<td>1.3</td>
</tr>
<tr>
<td>Women</td>
<td>45-64</td>
<td>235</td>
<td>100</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>65+</td>
<td>2207</td>
<td>1638</td>
<td>1.3</td>
</tr>
</tbody>
</table>

*Age-standardised within each age group to WHO standard population

Source: New Zealand Health Information Service
Table 4 Rate of IHD mortality for Pacific and Total New Zealand (NZ) by sex, and age 1996-2000 (per 100,000 people)

<table>
<thead>
<tr>
<th></th>
<th>Pacific</th>
<th>Total NZ</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-64</td>
<td>356</td>
<td>182</td>
<td>2.0</td>
</tr>
<tr>
<td>65+</td>
<td>1524</td>
<td>1487</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-64</td>
<td>85</td>
<td>50</td>
<td>1.7</td>
</tr>
<tr>
<td>65+</td>
<td>882</td>
<td>825</td>
<td>1.1</td>
</tr>
</tbody>
</table>

*Age-standardised within each age group to WHO standard population
Source: New Zealand Health Information Service

Table 5 Rate of stroke mortality for Pacific and Total New Zealand (NZ) by sex, and age 1996-2000 (per 100,000 people)

<table>
<thead>
<tr>
<th></th>
<th>Pacific</th>
<th>Total NZ</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-64</td>
<td>73</td>
<td>28</td>
<td>2.6</td>
</tr>
<tr>
<td>65+</td>
<td>840</td>
<td>492</td>
<td>1.7</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-64</td>
<td>70</td>
<td>25</td>
<td>2.8</td>
</tr>
<tr>
<td>65+</td>
<td>742</td>
<td>461</td>
<td>1.6</td>
</tr>
</tbody>
</table>

*Age-standardised within each age group to WHO standard population
Source: New Zealand Health Information Service

There is a paucity of representative data on CVD and diabetes risk factor profiles for Pacific people. What information that is available on cholesterol levels, for example, is limited to Pacific people as one group as it has been collected from insufficient numbers of Pacific participants to stratify any further, therefore making the data open to both random error and selection bias.  

Diabetes is a strong independent risk factor for CVD especially stroke and Coronary heart disease (CHD). CHD among diabetics not only occurs at an increased rate, but also has an increased case fatality. The average age of diagnoses for Pacific people (47 years) is also significantly younger than that of Europeans and others (55 years).
In 2003, one in 23 New Zealand adults had self-reported diabetes mellitus. The prevalence of diabetes was significantly higher in Pacific (males 8.0%, females 12.0%) people [mostly of Samoan, Tongan, Niuean, or Cook Islands origin; hereafter termed ‘Pacific’] than in New Zealand Europeans (males 3.4%, females 2.4%). It has been suggested that for every person diagnosed with diabetes there is another person in the community undiagnosed.

In November 2005, approximately 125,000 New Zealanders had diagnosed diabetes; therefore according to the assumption of 1:1 diagnosed:undiagnosed diabetics, the true diabetic population in New Zealand exceeds 250,000 people. It was predicted that more than 7,500 new people would be diagnosed with diabetes in 2006 and that more than 1,700 deaths would be attributable to diabetes.

For Pacific people, diabetes related-mortality rates are 10 times higher than for European people. A recent review of the epidemiology of diabetes in New Zealand collates the prevalence of known and undiagnosed diabetes from various New Zealand surveys and has called for a nationally agreed strategic plan on how to best monitor and control diabetes.

Previous New Zealand studies and surveys that have been used to estimate the prevalence of diabetes have used self-report data or have been workforce surveys and most are more than a decade old. Self-report surveys are likely to underestimate diabetes prevalence as those who have diabetes but have yet to be diagnosed will be missed (under-reporting) and workforce surveys may be biased due to the ‘healthy
worker’ effect. Moreover, the majority of these surveys included insufficient samples of Pacific people to allow for meaningful ethnic comparisons.

In a study by Scragg et al\textsuperscript{46} of prevalence of diabetes in a multicultural workforce, Pacific people were not only found to have a higher prevalence of diabetes, but the relationship that body mass index (BMI) had with increased prevalence of diabetes for the Pacific sample differed compared to Māori and Asian people. When diabetes risk was further adjusted for BMI (in addition to age and income), the relative risk (RR) for diabetes of the Pacific group reduced by nearly half (48%), compared to a reduction in RR of 39% for Māori, and a 23% increase for Asian participants compared to the European reference group.

This suggests that overweight and obesity is a more significant factor associated with the increased diabetes prevalence experienced in Pacific people.\textsuperscript{46} The study found that over half of those who had diabetes were undiagnosed,\textsuperscript{46} which was a similar finding to a workforce survey conducted in Christchurch.\textsuperscript{47} The prevalence of undiagnosed diabetes in the community is thought to be even larger as those with diabetes-related risk factors are less likely to be employed.\textsuperscript{48} This combined with the commonly accepted under-enumeration of the Pacific population in statistical data of that time would disproportionately and significantly underestimate the projected prevalence of diabetes in the Pacific population compared to the non-Pacific population.
Overweight and Obesity

Overweight and Obesity is a global concern with approximately 1.6 billion adults overweight and 400 million adults obese in 2005. Simply put, the main drivers of this epidemic are a combination of an unhealthy diet, and inadequate physical activity (PA) resulting in an energy imbalance and the storing of excess energy as adipose tissue (body fat). The effects of an unhealthy diet and inadequate PA can be manifest as raised blood pressure, raised blood glucose levels, abnormal blood lipids and overweight and obesity. A staggering 2.7 million deaths worldwide have been attributed to low or inadequate consumption of fruit and vegetables and a further 1.9 million attributed to inadequate physical activity.

In New Zealand reducing obesity was listed as the third highest ‘Priority population health objective’ by the New Zealand Ministry of Health in 2000, following objectives to reduce smoking and improve nutrition. Pacific children and adults in New Zealand are 2.5 times more likely to be obese, and Pacific children are 11 times more likely to be extremely obese than their European counterparts. In light of these figures, public health interventions that not only aim to prevent, but also curb current trends of overweight and obesity are a priority area for New Zealand and especially Pacific communities in New Zealand.

Many locally and nationally funded health strategies have been developed to encourage a healthier diet and to increase physical activity as a means of addressing the obesity epidemic. Collaborative interventional research designed to impact on overweight and obesity in the community and school settings in New Zealand and in the Pacific is also being undertaken together with an evaluation into it’s effectiveness.
There has been a great deal of debate on the accuracy of using a single measure of Body Mass Index (BMI) as a measure of obesity for people of different ethnic groups. This has led to the use of different levels of BMI for ethnic groups that categorize ‘overweight’ and ‘obesity’. Ethnic specific measures should ensure greater accuracy as they account for differences observed in body type (composition). Swinburn et al found “that at any given body size Polynesians are significantly leaner than Caucasians and that specific Polynesian standards for defining obesity needed to be developed”. In response to these findings Swinburn’s recommendations were adopted for the 1997 National Nutrition Survey. For Pacific people, BMI categories were higher than for New Zealand European and others. These were ‘overweight’: Pacific people $26 \geq \text{BMI} < 32 \text{kg/m}^2$ and for New Zealand European other $25 \geq \text{BMI} < 30 \text{kg/m}^2$, and obesity for Pacific people $\text{BMI} \geq 32 \text{kg/m}^2$ compared to $\text{BMI} \geq 30 \text{kg/m}^2$ for New Zealand European and others.
2 Introduction and aims

The following chapter will outline in more detail the structure that this thesis will follow, by firstly providing a model of health that encompasses various components/themes. Secondly the ‘Health Transition’ theory will be described as it offers a theoretical framework that explains shifts in patterns of disease and mortality of populations. Finally a brief account of related studies will precede a more detailed description of specific aims related to these broad themes.

2.1 Introduction

Cardiovascular diseases (CVD) and diabetes are among the leading causes of illness and mortality in New Zealand and in many parts of the western world. Through the assessment of intermediary risk factors of CVD and diabetes, the future burden of disease can be predicted and appropriate public health strategies that aim to address CVD and diabetes health outcomes can be developed.

2.2 Structure of thesis

This thesis will endeavour to describe and comment on the Pacific people’s experience of a series of health-related socio-economic factors, risk factors and protective lifestyle factors that relate to CVD’s and diabetes. Five broad themes are used to present this information that include: i) health-related socio-economic risk factors, ii) alcohol consumption and drinking patterns, iii) prevalence of known and newly diagnosed diabetes mellitus, iv) prevalence of overweight, obesity and body mass index levels, and v) an overall description of CVD risk factors.
2.3 Theoretical constructs

The experience of health and well-being has been reported to be the result of a number of inter-related determinants. These can be observed and measured at many points on the health continuum. The model of health in Figure 6 has been adapted from Williams\textsuperscript{58} and shows the many varied aspects of health that contribute to the overall experience of health and well-being. Biopsychosocial aspects of health are located on this model as well as societal and demographic characteristics such as political / legal factors, and the provision of health services. This thesis is unable to adequately examine all these influences that are related to health, however, the author acknowledges the existence of them.
The thesis, however, does encompass a broad range of these factors. The five broad themes in the Williams model investigated in this thesis relate to multiple aspects of health. Each theme is listed below and the corresponding aspect/s of the model is mentioned. These include: 1) health-related socio-economic risk factors (basic causes/social status), 2) alcohol consumption and drinking patterns (basic causes/social status), 3) prevalence of known and newly diagnosed diabetes mellitus (surface causes/health status/biological processes), 4) overweight, obesity and body mass index (basic causes/biological processes), and 5) an overall description of CVD risk factors (biological processes/health status).

The ‘Health Transition’ has also been referred to as the ‘demographic transition’, the ‘epidemiological transition’, and the ‘mortality transition’. It is used to explain the change in a population’s health from that of high fertility and high mortality (high infectious diseases and low non-communicable diseases (NCD)) to low fertility and low mortality (high NCD and low infectious disease). Originally this transition consisted of three periods: i) an era of pestilence and famine, ii) an era of receding pandemics, iii) and finally an era of NCD – however, another period that has been suggested is the re-emergence of infectious diseases as well as NCD’s. This theory allows insights into how Pacific nations and Pacific populations that have migrated to New Zealand might transition with regard to their health with time. The World Health Organisation (WHO) stated that:

“The main driving force (of the Health Transition) includes the underlying social, economic, political and cultural factors which determine health and are responsible for, and propel, the health transition by reducing infectious disease mortality rates”
To provide a broader context of CVD related understandings, a brief description will be given of related research conducted in New Zealand. In sum these studies have provided a foundation from which the Diabetes Heart and Health Study (DHAH) was built.

### 2.4 Related studies

The DHAH builds on information collected from three major cross sectional studies that investigated a number of CVD risk factors and prevalence of diabetes. These studies have spanned more than two decades. The first of these studies the ‘Auckland Risk Factor Study’ (ARFS) was conducted in 1982 and surveyed 1,568 people aged from 35-64 years.\(^6^0\) Due to sampling methodology (electoral roll), low numbers of Pacific people participated and therefore Pacific specific findings were not reported.

From 1986 – 1988, the ‘Auckland Heart Study’ (AHS) recruited 888 participants aged 35 – 64 years of age using the same electoral roll based sampling methodology as in the ARFS described above; they were also the controls in a large case-control study.\(^4^4\) Again, few Pacific people were surveyed and were therefore excluded from any further analyses due to small numbers.

In 1993 – 1994, the ‘Fletcher Challenge - Auckland University Heart and Health Study’ (FC-AUHHS)’ combined studies surveyed approximately 10,000 participants aged 35-84 years. In total, 429 Pacific people were surveyed – however all Pacific participants were from the Fletcher Challenge survey and would therefore not be representative of the total adult Pacific population as this was a workforce survey.\(^6^1\)
Although these numbers allow for some analyses to be generated on a pan-Pacific ethnic group, inter Pacific comparisons were not achievable.

Other studies

From 1988 – 1990, the ‘Workforce Diabetes Survey’ (WDS) was conducted. This study involved health screening of 5916 workers aged 40-65 years from 46 worksite locations within the Auckland and Tokoroa regions. A total of 650 participants were of Pacific ethnicity. Many characteristics of CVD risk and diabetes were reported on the main Pacific ethnic groups and are a pre-cursor to the current study. However, the WDS being a workforce survey means that participants may be subject to a healthy worker effect/bias.

A number of ‘New Zealand Health Surveys’ (NZHS) have provided a large amount of data related to New Zealand’s Pacific population. The number of Pacific participants in these studies has increased over survey phases, consisting of 645 Pacific participants in the 1996/97 survey, 908 in the 2002/03 survey, and 1033 in 2006/07 survey. Although providing useful information, these surveys have only collected self-report data that may therefore compromise the quality of data due to information/reporter bias. The age range of participants surveyed were 15 years and over. Many comparative analyses involved averaging across this wide age range and this would result in an underestimate of risk factor prevalences as many diabetes and CVD-related risk factors present in later adulthood. Finally, Pacific data presented in these surveys does not differentiate between the various Pacific ethnic groups.
In 1991, two multi-faceted projects: the ‘South Auckland Diabetes Project’ (SADP) and the ‘Samoan Ola Fa‘autauta or Life-wise project’ (SOFP) were run to attempt to reduce diabetes incidence of Pacific people through lifestyle interventions. These two studies combined have also provided much information about a combination of CVD and diabetes risk factor measures on 1175 Pacific participants. Moreover the data for Samoan and Tongan ethnic groups have been described in more detail.

2.5 Summary

Collectively, the above studies paint a fragmented picture of CVDs and diabetes-related health among Pacific adults in New Zealand. All point to the need for a robust population-based study of Pacific people that is large enough to allow ethnic comparisons to be made. Furthermore, determination of the total prevalence of diabetes through screening would be valuable to more accurately measure the burden of this disease in Pacific people.

These knowledge gaps explain the rationale that led to the development of the Diabetes Heart and Health Study (DHAH). The DHAH is the first population-based study of older adults that has surveyed large enough numbers from New Zealand’s four largest Pacific communities to generate representative ethnic specific baseline measures of CVD risk and diabetes status.
2.6 Aims

The aims of this thesis are listed below:

1) Health-related socioeconomic factors - Many socioeconomic variables are commonly recognised determinants of health and have clear relationships to health outcomes as they are known to moderate many health outcomes that include infectious diseases, cardiovascular diseases, and mental health problems. Measuring the prevalence of these factors should aid the development of any strategies used to maintain and improve the health of populations they intend to serve. There do not appear to be any accounts of the determinants of health that address individual Pacific groups in New Zealand. This section aims to describe the health-related socio-economic factors among the four largest Pacific ethnic groups in the DHAH study.

2) Alcohol consumption - The aim of this section is to describe the characteristics and prevalence of ‘drinkers’ & ‘non-drinkers’ of the pan-Pacific and main Pacific groups (Samoan, Cook Islands, Tongan, Niuean) and comment on the probable effect alcohol may have on CVD and diabetes for Pacific.

3) Diabetes – The DHAH study has attempted to overcome sampling and self-report biases (that were evident in previous research) by using a population-based study design that included Glucose Tolerance Tests (GTT) for all non-diabetic participants. Targeted sampling of Pacific people was undertaken to generated a large representative sample of these communities.
The purpose of this section is to describe and compare ethnic differences in the prevalence of new and known diabetes mellitus, impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) levels. Impaired glucose tolerance and IFG are levels of glycaemia between normal and diabetes.

4) **Overweight and obesity** - There is little information on perceptions and attitudes of body weight in New Zealand. Furthermore, information specific to Pacific ethnic groups on obesity and overweight is scarce. This section aims to address these information gaps by reporting ethnic specific proportions of overweight, obesity and average BMI by gender. Moreover, the influence that physical activity has on overweight, obesity, and average BMI was investigated.

5) **Cardiovascular disease risk factors** - The aim of this section is to describe levels of CVD risk factors and diabetes status for Pacific ethnic groups and make comparisons amongst these groups (Samoan, Tongan, Niue, Cook Islands) and with European New Zealanders.
3 Methods

The purpose of this chapter is to describe the methodology used in the DHAH. The methodology used is described in the following order:

- a general explanation of the study,
- sampling procedures: Cluster and Electoral role
- classification of ethnicity,
- procedures followed in administering the questionnaire,
- a description of key data variables and how they were used including
  - Diabetes
  - Cholesterol
  - Anthropometry
  - Physical activity
  - New Zealand Deprivation
- an account of the statistical methods used to analyse the data,
- and finally a description of the role the candidate had in the planning and carrying out of the DHAH study.

A more detailed description of methodologies and survey procedures used is included in Appendix (A) that specifically reports on how participants were recruited and the sampling / survey procedures that were used with regard to both sampling frames.
3.1 Methodology

General

The DHAH was a cross-sectional population-based study that surveyed 4049 people (aged 35–74 years) between January 2002 and December 2003. All participants were selected from within the Auckland region. Of the 4049 participants, 1014 were Māori, 1011 were Pacific, 279 were Asian, and 1745 were of European ethnicity. This thesis will focus on findings related to the Pacific sample of this study and uses the European group for comparison.

All participants received information in the mail with instructions of where and when to attend the survey centres. Participants completed questionnaires covering socioeconomic status (SES), demographic information and a series of health issues. The main focus of the study was to measure CVD and diabetes-related risk factors and these measurements took up the majority of the participants’ time. Interviews were conducted in premises close to where they lived.

Sampling

Adults were recruited from two sampling frames consisting of cluster sampling and electoral role based sampling procedures.
**Cluster sampling**

Initially, the primary method of recruitment was from door to door cluster sampling, where random starting point Auckland area addresses were obtained from Statistics New Zealand.

This involved randomly selecting a starting address (i.e. the start point) for the cluster, and then recruiting several adults from the houses next to it. This method is different from randomly selecting individual adults (i.e. individual random sampling). The main advantage of cluster sampling is that it can be cheaper than individual random sampling. The main disadvantage of cluster sampling is that the statistical power of the study is decreased because adults selected from a particular cluster are more likely to share similar characteristics compared to adults sampled individually.

**Cluster Start Points**

Start point addresses were provided by Statistics New Zealand based on mesh blocks, which are the smallest unit used by Statistics New Zealand. Statistics New Zealand has divided New Zealand into approximately 19,000 mesh blocks, formally known as Primary Sampling Units (PSUs). Each PSU contains between 50 and 100 dwellings, with an average of 65 dwellings. For this study, Statistics New Zealand randomly selected PSUs from the Auckland region, using probability proportional to size selection. This means that the probability of a particular PSU being included in the survey is proportional to the number of households in that PSU.

The Research Manager allocated start points to recruiters. Adults to be interviewed were eligible adults aged 35 years and over who lived in the 20 households to the left
of (facing the road from the starting point house), including the start point. The recruiter completed the list of eligible adults in the 20 households at each start point within 7 days of its allocation from which participants were then offered an invitation to participate.

Cluster sampling allows costs to be minimised in relation to a simple random sample, but at the same time maximises the dispersion of the sample throughout the community, in order to represent the diversity that exists. A cluster sample does not require a listing of individuals from a particular area, but merely requires a list of areas. This is advantageous, as common lists such as the electoral roll or telephone directory do not include everyone from a particular area, are always out-of-date, and contain mistakes.

Table 6  Cluster sample by ethnic group, gender and age-group

<table>
<thead>
<tr>
<th></th>
<th>European</th>
<th></th>
<th>Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>35-39</td>
<td>57</td>
<td>55</td>
<td>40</td>
</tr>
<tr>
<td>40-44</td>
<td>62</td>
<td>86</td>
<td>24</td>
</tr>
<tr>
<td>45-49</td>
<td>71</td>
<td>73</td>
<td>12</td>
</tr>
<tr>
<td>50-54</td>
<td>58</td>
<td>79</td>
<td>19</td>
</tr>
<tr>
<td>55-59</td>
<td>59</td>
<td>62</td>
<td>13</td>
</tr>
<tr>
<td>60-64</td>
<td>42</td>
<td>59</td>
<td>15</td>
</tr>
<tr>
<td>65-69</td>
<td>44</td>
<td>52</td>
<td>11</td>
</tr>
<tr>
<td>70-74</td>
<td>55</td>
<td>49</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>448</td>
<td>515</td>
<td>149</td>
</tr>
</tbody>
</table>

Of the European and Pacific sample there were a total of 1331 individuals selected from cluster sampling, as shown in Table 6.
As the study progressed, Electoral based random sampling was also used. This was used mainly due to the inability of the cluster sampling to generate large enough numbers in the time allocated for data collection due to lower than expected response rates (=61.3%).

**Electoral roll sampling**

The electoral roll sample was taken from the November 2000 Auckland electoral rolls stratified into 5-year age bands and included all people living in the Auckland area, with the exception of the Franklin and Rodney electorates (response rate 60%). Ethical approval was obtained from the Auckland Ethics Committees.

For the electoral roll sample of Pacific people, a program was written that excluded surnames that contained characters not used in standard Pacific alphabets. Polynesian languages use fewer letters of the alphabet than English. For example, Tongan uses 16 letters and Samoan 14 letters. Then these names were viewed by a person knowledgeable of Pacific languages, and any names that were clearly not Polynesian were excluded.

A limitation of this is that Pacific people who have names that are not obviously Pacific are excluded from this form of selection. Thus, the Pacific group was formed. However, the application of this selection method allowed the electoral roll to be practically used to select Pacific participants. Furthermore there was no evidence that there would be any significant differences between Pacific people with non-traditional names.
Three groups of people (Māori, Pacific and Other) were further divided into eight 5-year age bands. The electoral roll gives a person’s age as of a certain date (1 August 2001); this information was used to construct the bands. These age bands were 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, and 70-74 years. Therefore, the electoral roll was divided into 24 strata. Within each stratum, simple random sampling was used at different rates to form the sample using the SAS procedure SURVEYSELECT. Persons selected into the sample were sent a letter inviting them to participate in the study. Those responding were posted the same material as was posted to people selected from the cluster sample. Of the European and Pacific sample there were a total of 1425 individuals selected from the electoral roll, as shown in Table 7.

**Table 7 Electoral roll sample by ethnic group, gender and age-group**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>European Male</th>
<th>European Female</th>
<th>Pacific Male</th>
<th>Pacific Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-39</td>
<td>24</td>
<td>19</td>
<td>47</td>
<td>41</td>
</tr>
<tr>
<td>40-44</td>
<td>49</td>
<td>37</td>
<td>38</td>
<td>50</td>
</tr>
<tr>
<td>45-49</td>
<td>45</td>
<td>23</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>50-54</td>
<td>36</td>
<td>38</td>
<td>61</td>
<td>46</td>
</tr>
<tr>
<td>55-59</td>
<td>59</td>
<td>53</td>
<td>47</td>
<td>40</td>
</tr>
<tr>
<td>60-64</td>
<td>59</td>
<td>62</td>
<td>47</td>
<td>36</td>
</tr>
<tr>
<td>65-69</td>
<td>78</td>
<td>80</td>
<td>38</td>
<td>25</td>
</tr>
<tr>
<td>70-74</td>
<td>63</td>
<td>57</td>
<td>25</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>782</td>
<td>643</td>
<td>343</td>
<td>300</td>
</tr>
</tbody>
</table>
Table 8 describes how each ethnic group's sample was selected. Proportions are given in the form of percentages. Percentages have been rounded to the one decimal place.

**Table 8 Sampling frame proportions by ethnic group**

<table>
<thead>
<tr>
<th>Sample Frame</th>
<th>European % (n)</th>
<th>Pacific % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster</td>
<td>55.2% (963)</td>
<td>36.4% (368)</td>
</tr>
<tr>
<td>Electoral Role</td>
<td>44.8% (782)</td>
<td>63.6% (643)</td>
</tr>
<tr>
<td>Grand Total</td>
<td>1745</td>
<td>1011</td>
</tr>
</tbody>
</table>

**Classification of ethnicity**

Classification of ethnicity first gave priority to Māori ethnicity and followed an ‘ever-Māori’ approach used to improve undercounts in health data sets, followed by Pacific and Asian while all other participants formed the European comparison group, as used by Statistics New Zealand.

Participants were assigned to one ethnic group only. This meant that those Pacific participants who indicated that they belonged to more than one Pacific ethnic group were assigned the smaller Pacific group (within New Zealand) as done by census 2001. This gave priority firstly to Niuean, followed by Cook Island, Tongan, and lastly Samoan ethnicity. Small numbers of Fijian (n=27) and ‘Other Pacific’ (n=27) participants meant that analysis of their results could not generate reliable findings.

Analyses were performed for the entire Pacific cohort (n=1011) which included ‘Fijian’ and ‘Other Pacific’ participants, and ethnic specific analyses were carried out for the main Pacific ethnic groups (Samoan, Cook Island, Tongan and Niuean). Translated versions of the questionnaire were used when requested by participants and
translators were available if required, to better explain what was asked of the questions.

**Interview procedure**

Whilst completing the self-administered general health questionnaire (GHQ) a series of physical health measurements were also taken. These included two blood pressure readings that were taken after the participant had been sitting for at least 10–15 minutes, pulse was recorded, a lung function test and anthropometrical measurements (height, weight, waist and hip circumferences) were also taken.

**Demographic and Socioeconomic variables**

The general health questionnaire included a number of questions related to socioeconomic and demographic characteristics. These questions included country of birth, length of residence in New Zealand if not born in New Zealand, marital status, household and family composition, dwelling type (circumstances), estimated annual household income, employment, and education.

**Alcohol measures**

Four components of alcohol consumption and drinking patterns were measured. These include ‘drinker’ & ‘non-drinker’, the frequency of drinking (i.e. days per week/month), the number of drinks consumed on a typical drinking occasion, and the type of alcohol consumed. Showcards were used for participants to identify the size of the glass, can or bottle that was consumed (Appendix D). From these measures an overall estimate of total pure alcohol consumed weekly was determined. ‘Ex-drinker’ questions included reasons why they stopped drinking. ‘Drinkers’ and ‘non-drinkers’
were analysed separately. The ‘non-drinkers’ group consisted of i) ‘never-drinkers’, ii) ‘ex-drinkers’, and iii) ‘occasional drinkers, not monthly’. The alcohol survey used a 3-month recall questionnaire to allow comparisons to be made to previous surveys that also used the 3-month recall questionnaire.

**Biochemical measures**

All participants received information in the mail with instructions not to eat any food from 10pm onwards the night before their interview was scheduled and to drink water only. Included in the information pack was a sterile urine container that was used to collect an early-morning urine sample (midstream).

Most participants were contacted by phone prior to their interview appointment where instructions were explained again and any queries answered. On arrival at the survey location (from 8am to 10am) and after informed consent was given, a fasting blood sample was taken from all participants.

Participants were then asked whether they had been diagnosed with diabetes, and if so how old they were when they were first diagnosed, and what their current treatment was.

Those who did not have previously diagnosed diabetes mellitus were then asked to complete a 2 hour Glucose Tolerance Test (GTT). This involved having a drink consisting of 75g glucose after their initial blood test. A final blood test was then scheduled to be taken 2 hours after the first. The 19 people who refused to have a GTT were excluded from the diabetes status analyses.
During the waiting time, participants were asked to fill in the general questionnaire and to not physically exert themselves in any way or consume any food or drink with the exception of water. Blood tests were collected into fluoride tubes and stored on ice until taken to the lab for analyses.

Fasting blood samples were assayed using enzymatic methods, plasma glucose was measured using commercial reagents (Roche Products [New Zealand]), HbA1c was measured by high performance liquid chromatography, and micro-albumin was measured using an immunoturbidmetric method.

Categorisation of glucose tolerance status was by 1998 WHO criteria using fasting glucose $\geq$ 7.0 mmol/L or 2-hour post glucose load of $\geq$ 11.1 mmol/L for diabetes; fasting glucose $< 7.0$ mmol/L and 2-hour glucose between 7.8 and 11.0 mmol/L for Impaired Glucose Tolerance (IGT) and fasting glucose of 6.1-6.9 mmol/L for Impaired Fasting Glucose (IFG). All participants were then classified as ‘known’ (from their past history), ‘new’-ly diagnosed, having ‘IGT’ or ‘IFG’ or ‘normal’ glucose tolerance.

**Lipids**

Measurement of cholesterol and triglycerides was done using enzymatic methods. LDL cholesterol was estimated by the Friedewald formula.\(^{65}\)
**Anthropometry measures**

A number of body measurements were taken (height, weight, waist and hip circumference). Initially, participants were asked if they knew what their body weight was, following this height and weight measurements were taken. Further questions asked whether they thought they were lighter, heavier or the same as one year ago, and if they thought they were underweight, overweight or just right. These estimations were then classified as correct if they were within (+/-) 2 kg of their measured weight. The (+/-) 2 kg range used to assess correct estimation of weight was determined by the author.

Overweight and obesity were classified using standard BMI cut-offs as well as ethnic specific BMI cut-offs. The ethnic specific BMI cut-offs used to classify overweight were: European 25.0 – <30.0 kg/m², Pacific 26.0– <32.0 kg/m²; and obesity: European ≥ 30.0 kg/m², Pacific ≥ 32.0 kg/m². Justification for the use of higher BMI cut-offs for Pacific is due to a greater lean body mass found in Pacific people at any given BMI compared to European.56

**Physical activity measure**

Leisure-time exercise was assessed using a three-month physical activity recall questionnaire that has previously been validated.66 One question asked if participants had engaged in any vigorous activity at least once a week, in the past three months, long enough to cause them to breathe hard or sweat. The other question asked if they had engaged in any regular moderate activity (that did not cause them to breathe hard or sweat).
Those who answered no to both were categorised as inactive. Further analyses measured and quantified exercise time in minutes per week.

**New Zealand Deprivation measure**

NZDep2001 score was determined for each participant based on their area of domicile and was classified in quintiles. Quintile 1 represents areas with the least deprivation and quintile 5 areas with the most deprivation. The New Zealand Index of social deprivation (NZDep20001) was created from Census 2001 data; it describes the deprivation by small geographic areas and is used as a proxy for individual deprivation.

**CVD Risk**

Absolute CVD risk over a 5-year period was estimated using the Framingham equation. This model includes age, gender, systolic blood pressure, smoking, total cholesterol:high density lipoprotein (TC:HDL) ratio, diabetes, and interaction terms of age by gender, and diabetes by gender. It is recommended that an additional 5% risk be added to the calculated 5-year CVD risk for the Pacific population in New Zealand as the New Zealand Guidelines Group believe that the Framingham equation underestimates their risk. The predicted CVD risk scores presented in this thesis, however, do not include the 5% added to the CVD risk scores for Pacific people, so that this measure can be compared to past surveys.

**Data entry and cleaning**

After the questionnaires were coded and the coding was double checked, data was entered from the questionnaires into SAS databases using an electronic template.
data were entered twice into two separate databases and then the two databases were compared for differences using the PROC COMPARE procedure in SAS. Any discrepancies between the databases were noted by PROC COMPARE using the corresponding survey numbers (i.e. the unique identification codes for the participants). Discrepancies were resolved by checking with the original questionnaire. The incorrect database was then edited and rechecked to ensure the same value was entered in both databases. Questionnaires were stored in file boxes in a securely locked room.

**Statistical methods**

Statistical analysis was undertaken using SAS version 9.1. Participant data were weighted according to the sampling frame that they were obtained from and means, standard errors and prevalence’s calculated using dual frame sampling methodology.\(^69^{71}\) SAS survey procedures (SURVEYMEANS, SURVEYREG, SURVEYFREQ AND SURVEYLOGISTIC) were used to calculate weighted means, adjusted means, percentages and odds ratios, respectively.\(^72\) The Rao-Scott modified Pearson Chi squared test was used where appropriate. Odds Ratios were converted to Relative Risks as described by Zhang and Yu.\(^73\) The dual frame estimation method used in this thesis was developed by Dr P A Metcalf and Professor A J Scott.\(^74\)

Analyses have compared all Pacific ethnic groups to their European and Samoan counterparts. Samoans were used as the intra-Pacific reference group as they comprised the largest Pacific sample.
Candidates role in Study

The candidate joined the study in August 2003 and did not contribute to the study design. At the time of the candidate began researching on the DHAH approximately half of the Pacific sample had already been surveyed. The candidate was involved the recruitment of participants selected using the electoral role, where phone calls were made to make booking times for interviews. During the interview (data collection) the candidate took physical measures including blood pressure, spirometry readings, and anthropometrical measurements as well as assisting participants with any queries they had regarding the self-administered questionnaires. Following data collection the candidate also contributed to data coding, data entry, and data cleaning procedures.
4 Results

The following chapter is divided into 5 sections. These sections will present results relevant to the i) health-related socioeconomic status, ii) alcohol consumption patterns, iii) diabetes status, iv) overweight, obesity and body mass index, and finally v) cardiovascular risk. Results have been presented in a number of ways. These include assessment of the Pacific population as a whole, the Pacific ethnic groups, and sex and age stratified results. Determination of presentation type is the result of assessment of the health topic in question, and constraints of the available data.

Table 9 Characteristics of survey participants

<table>
<thead>
<tr>
<th>Age range</th>
<th>European Men</th>
<th>European Women</th>
<th>Pacific Men</th>
<th>Pacific Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 45</td>
<td>193</td>
<td>196</td>
<td>148</td>
<td>188</td>
</tr>
<tr>
<td>45-54</td>
<td>211</td>
<td>212</td>
<td>133</td>
<td>147</td>
</tr>
<tr>
<td>55-64</td>
<td>219</td>
<td>236</td>
<td>119</td>
<td>110</td>
</tr>
<tr>
<td>65+</td>
<td>240</td>
<td>238</td>
<td>87</td>
<td>79</td>
</tr>
<tr>
<td>Total</td>
<td>863</td>
<td>882</td>
<td>487</td>
<td>524</td>
</tr>
<tr>
<td>Grand Total</td>
<td>1745</td>
<td></td>
<td>1011</td>
<td></td>
</tr>
</tbody>
</table>

Sample numbers are presented by sex and age group for Europeans and Pacific ethnicity in Table 9. Proportionately fewer Pacific participants were sampled in the older age group (65+) which is, in part, due to the age distribution of this population. Of the total DHAH survey of 4049 individuals, 48.0% were male; 27.0% aged <45 years, 26.4% aged 45–54 years, 24.4% aged 55–64 years, and 22.3% aged 65+ years; 46.3% were of European, 26.8% were Pacific, 24.8% were Māori and 2.1% were of Asian ethnicity. Results reported in subsequent sections exclude both Māori and Asian participants whose results are detailed in a separate report.
4.1 Health related socio-economic profiles

Of the Pacific sample, 93% reported sole ethnicity. Of those who reported multiple ethnicities (7%), half also identified with European ethnicity (3.5% of total), while 41% identified with another Pacific ethnicity (2.9% of total). The remainder identified with Chinese ethnicity (0.6% of total).

Table 10 shows the percentages of participants surveyed by Pacific ethnic group and the ethnic composition of both Auckland and the New Zealand Pacific population from Census 2001. A comparison of the Pacific ethnic composition of participants to that of Auckland’s Pacific population found no significant difference (p=0.0921).

Table 10 Comparison of number (% of total survey sample) in each Pacific ethnic group with the Auckland and New Zealand (NZ) Pacific population aged 35–74 years

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Sample (%) n=1011</th>
<th>Auckland Pacific Population* (%) n=42,486</th>
<th>NZ Pacific Population* (%) n=64,209</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samoan</td>
<td>46 %</td>
<td>49%</td>
<td>47%</td>
</tr>
<tr>
<td>Tongan</td>
<td>24%</td>
<td>19%</td>
<td>15%</td>
</tr>
<tr>
<td>Cook Island</td>
<td>11 %</td>
<td>18%</td>
<td>20%</td>
</tr>
<tr>
<td>Niuean</td>
<td>10 %</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>Fijian</td>
<td>5%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Other Pacific</td>
<td>4%</td>
<td>1%</td>
<td>3%</td>
</tr>
</tbody>
</table>

*Aged 35–74 years.

The place of birth and average length of residence of New Zealand Pacific participants are shown in Table 11. Of the total sample, 84% of participants were born in their home nation, 11% were born in New Zealand, and 5% were born elsewhere. Tongan participants were significantly less likely to have been born in New Zealand than Samoans. Cook Island and Niuean participants were significantly less likely to have been born in their home islands than Samoans. Niueans had the longest average residence in New Zealand for non-New Zealand born participants of 30.5 years. Tongans had the shortest average length of residence in New Zealand of 14.2 years.
Table 11 Place of birth (%) and average length (SE) of residence in New Zealand (NZ) if born overseas

<table>
<thead>
<tr>
<th>Ethnic group</th>
<th>(% ) born in Home Island n=820</th>
<th>(% ) born in NZ n=108</th>
<th>(% ) born elsewhere n=36</th>
<th>Mean† stay in NZ (years) of non-NZ born (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samoan</td>
<td>82.4%</td>
<td>13.1%</td>
<td>4.5%</td>
<td>22.9 (0.96)</td>
</tr>
<tr>
<td>Tongan</td>
<td>98.4%‡</td>
<td>0.4%‡</td>
<td>1.2%</td>
<td>14.2 (1.24)‡</td>
</tr>
<tr>
<td>Cook Island</td>
<td>61.5%†</td>
<td>34.5%</td>
<td>3.9%</td>
<td>25.9 (1.46)‡</td>
</tr>
<tr>
<td>Niuean</td>
<td>64.0%*</td>
<td>18.3%*</td>
<td>18.3%</td>
<td>30.5 (1.04)‡</td>
</tr>
</tbody>
</table>

*p<0.05; †p<0.01; ‡p<0.0001 compared to Samoan ethnic group at birth.

The mean age of the entire Pacific sample was 48.4 years. Compared to the average age for Samoans of 47.5 years, no Pacific ethnic group was significantly different (p>0.14). In all ethnic groups, with the exception of the Samoans, females comprised a slightly greater proportion in each ethnic group (p=0.31).

Table 12 shows the percentage of married, never married, in de facto relationships, and those separated/divorced or widowed by ethnic group. Compared to Samoans, marriage was significantly more common among Tongans, and was less common for Cook Islanders and Niueans. De facto relationships were more common for Cook Islanders and significantly less common among Tongans. Those never married and separated, divorced or widowed were significantly less common among Tongans. Niueans were most likely to never have been married.
Table 12 Proportion of participants married, never married, in de facto relationships, and separated/divorced or widowed by Pacific ethnic groups

<table>
<thead>
<tr>
<th>Ethnic group</th>
<th>Married (%) n=677</th>
<th>Never married (%) n=82</th>
<th>De-facto relationship (%) n=51</th>
<th>Separated, Divorced, Widowed (%) n=154</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samoan</td>
<td>71.5%</td>
<td>6.2%</td>
<td>8.3%</td>
<td>14%</td>
</tr>
<tr>
<td>Tongan</td>
<td>86.5%†</td>
<td>1.5%†</td>
<td>0.5%†</td>
<td>11.4%†</td>
</tr>
<tr>
<td>Cook Island</td>
<td>54.3%</td>
<td>10.2%</td>
<td>13.4%</td>
<td>22%</td>
</tr>
<tr>
<td>Niuean</td>
<td>58.3%</td>
<td>15.7%</td>
<td>8.4%</td>
<td>17.6%</td>
</tr>
</tbody>
</table>

†p<0.01 compared to Samoan ethnic group.

The family and household characteristics of the Pacific ethnic groups are shown in Table 13. Tongans had the highest average number of both children and adults and household size (6.9 members). Cook Islanders had the smallest household size of 6 members and also reported the lowest average number of adults in a household.

Niueans reported having, on average, the fewest children and were most likely not to have had any children (16.1%).

Table 13 Mean (SE) or %, family and household characteristics of the Pacific ethnic groups

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Number of children (SE)</th>
<th>Number of adults (SE)</th>
<th>Total per household (SE)</th>
<th>(%) Childless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samoan</td>
<td>3.5 (0.13)</td>
<td>3.0 (0.09)</td>
<td>6.5 (0.17)</td>
<td>5.3%</td>
</tr>
<tr>
<td>Tongan</td>
<td>3.8 (0.28)</td>
<td>3.1 (0.17)</td>
<td>6.9 (0.39)</td>
<td>7.0%</td>
</tr>
<tr>
<td>Cook Island</td>
<td>3.4 (0.63)</td>
<td>2.6 (0.17)*</td>
<td>6.0 (0.71)</td>
<td>14.5%</td>
</tr>
<tr>
<td>Niuean</td>
<td>3.2 (0.22)</td>
<td>2.9 (0.14)</td>
<td>6.1 (0.29)</td>
<td>16.1%</td>
</tr>
</tbody>
</table>

*p<0.05 compared to the Samoan ethnic group.

Rented accommodation was the most common type of dwelling for all of the Pacific ethnic groups, except for Niueans, who were most likely to live in owned (mortgaged/freehold) accommodation (Table 14).
Table 14 Type of dwelling by Pacific ethnic group (%)

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Rented (%) n=398</th>
<th>Mortgage (%) n=398</th>
<th>Freehold (%) n=79</th>
<th>Family / friends / boarding &amp; other (%) n=84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samoan</td>
<td>44.6%</td>
<td>41.6%</td>
<td>5.6%</td>
<td>8.2%</td>
</tr>
<tr>
<td>Tongan</td>
<td>55.9%</td>
<td>28.8%</td>
<td>2.6%</td>
<td>12.8%</td>
</tr>
<tr>
<td>Cook Island</td>
<td>55.8%</td>
<td>33.2%</td>
<td>5.6%</td>
<td>5.5%</td>
</tr>
<tr>
<td>Niuean</td>
<td>33.5%</td>
<td>50.5%</td>
<td>7.3%</td>
<td>8.7%</td>
</tr>
</tbody>
</table>

In Figure 7, the estimated total annual household income by Pacific ethnic group is shown. Cook Islanders had the highest estimated annual household income and Tongans had the lowest. This difference means that an average-sized Cook Island household will receive $38 per household member per week more than an average-sized Tongan household.

Figure 7 Estimated annual household income by ethnicity

Other measures of income found that 37% of Tongans reported a household income of less than $20,000 per annum, compared to only 21% of Samoans and Niueans. For
household incomes that exceeded $80,000 per annum, Cook Islanders had the highest (11%), followed by Tongans and Niueans (8%), and Samoans (7%).

Cook Islanders had the greatest proportion that indicated being financially ‘comfortable’. Niueans had the greatest proportion that indicated their financial situation allowed them to ‘get by’. A larger proportion of Tongans (32%) indicated not having enough money to ‘make ends meet’.

Employment characteristics by Pacific ethnic group are shown below in Table 15. Niueans were most likely to participate in both full and part time paid employment. Tongans were least likely to participate in full time work and Cook Islanders were least likely to participate in part time work. A larger proportion of Tongans participated in ‘home duties’. Over a quarter of Cook Islanders surveyed were beneficiaries.

Table 15 Employment characteristics by Pacific ethnic group aged <65 years

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Full time (%) n=425</th>
<th>Part time (%) n=70</th>
<th>Unemployed/Redundant (%) n=34</th>
<th>Beneficiary (%) n=161</th>
<th>Home duties (%) n=80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samoan</td>
<td>59.4%</td>
<td>9.8%</td>
<td>4.3%</td>
<td>15.1%</td>
<td>11.4%</td>
</tr>
<tr>
<td>Tongan</td>
<td>53.5%</td>
<td>11.4%</td>
<td>4.7%</td>
<td>13.5%</td>
<td>16.8%</td>
</tr>
<tr>
<td>Cook Island</td>
<td>57.5%</td>
<td>5.2%</td>
<td>2.6%</td>
<td>25.4%</td>
<td>9.4%</td>
</tr>
<tr>
<td>Niuean</td>
<td>64.2%</td>
<td>11.7%</td>
<td>3.5%</td>
<td>14.5%</td>
<td>6.1%</td>
</tr>
</tbody>
</table>

Table 16 lists qualifications by ethnic group. Niueans were most likely to have continued with further education (39.7%); Cook Islanders were least likely to have done so (28.4%). Of those who gained further education, there were marked differences in the types of qualifications that were attained. Tongans were most likely to gain degrees, Niueans were most likely to gain diploma qualifications, and Samoans were most likely to have obtained a certificate.
Table 16 Education type by Pacific ethnic group

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Degree (%)</th>
<th>Diploma (%)</th>
<th>Certificate (%)</th>
<th>Other (%)</th>
<th>Further education (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=45</td>
<td>n=108</td>
<td>n=129</td>
<td>n=44</td>
<td>n=326</td>
</tr>
<tr>
<td>Samoan</td>
<td>9.9%</td>
<td>31.3%</td>
<td>45.8%</td>
<td>13.1%</td>
<td>34.9%</td>
</tr>
<tr>
<td>Tongan</td>
<td>26.9%</td>
<td>22.0%</td>
<td>40.9%</td>
<td>10.3%</td>
<td>34.5%</td>
</tr>
<tr>
<td>Cook Island</td>
<td>6.3%</td>
<td>40.1%</td>
<td>43.1%</td>
<td>10.5%</td>
<td>28.4%</td>
</tr>
<tr>
<td>Niuean</td>
<td>7.0%</td>
<td>44.7%</td>
<td>37.3%</td>
<td>11.0%</td>
<td>39.7%</td>
</tr>
</tbody>
</table>

Key: Degree=MA, PhD, BA, BSc, Medicine; Diploma=Teaching, Nursing, Business, Management; Certificate=Trade or Technicians, apprenticeship, typing.

4.2 Alcohol

Non-drinkers

Non-drinking was significantly more common in Pacific people (p<0.0001) compared to Europeans. More than seventy percent (70.4%) of all Pacific people reported that they did not drink compared to one fifth (21.5%) of the European population. All Pacific ethnic groups followed this pattern as 70% of Samoan, 67% of Cook Islanders, 80% of Tongans, and 58% of Niueans did not drink. Non-drinking was more common amongst women for all groups. Samoan women (89%) were most likely to report that they did not drink, followed by Tongan (72%), then Cook Island and Niuean (both 77%) and European (28%) women. For men, non-drinking was most common in Tongans (72%), followed by Cook Islands and Samoans (both 52%), Niueans (36%) and Europeans (15%).

The proportion of ‘non-drinkers’ by age group is presented in Table 17. Non-drinking was more common in older Pacific age groups, whereas for Europeans the proportion of ‘non-drinkers’ remained similar throughout the age categories.
Table 17 Proportion of non-drinkers by age group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>European (%)</th>
<th>Pacific (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>&lt;45</td>
<td>15.5</td>
<td>23.5</td>
</tr>
<tr>
<td>45-54</td>
<td>10.9</td>
<td>25.9</td>
</tr>
<tr>
<td>55-64</td>
<td>17.4</td>
<td>29.2</td>
</tr>
<tr>
<td>65+</td>
<td>14.2</td>
<td>33.6</td>
</tr>
</tbody>
</table>

Note all Pacific people’s statistics were significantly different to their European counterparts.

For both Pacific and European people, ex-drinkers comprised approximately half of the non-drinking group (Pacific 53%, European 51%). ‘Never Drinking’ was significantly more common in Pacific compared to Europeans (Pacific 40%, European 13%; p<0.0001). Pacific were also significantly less likely to be occasional drinkers (Pacific 7%, European 36%; p<0.0001).

Ex-drinkers comprised 6.3% of the ‘ever-drank’ population (excluding ‘Never Drinking’) for European compared to 27.6% for Pacific. This shows that not only are Pacific people less likely to drink alcohol; those that start are approximately 5 times more likely to stop compared to Europeans.

**Reasons for stopping drinking**

‘Social/Family’ reasons were the main reasons reported for stopping drinking among both the pan-Pacific population (52%) and Europeans (37%). The leading reason for stopping drinking for Samoans and Niueans was ‘Other health reasons’. Significantly more Pacific people (29%) named ‘Other health reasons’ as their leading reason for stopping drinking compared to Europeans (14%), (p<0.05). Concerns regarding heart disease were not a significant reason for stopping drinking for either Pacific (6%) or Europeans (3%).
Type of alcohol consumed

The types of alcohol consumed by ethnicity and gender are presented in Table 18.

Beer was the leading drink consumed by men (more than 80% of Pacific male drinkers drank beer) and Spirits/Liqueurs were the leading type of alcohol consumed by Pacific women, while wine was the leading drink for European women.

<table>
<thead>
<tr>
<th>Types of Alcohol consumed</th>
<th>Men (%)</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>European (n = 738)</td>
<td>Pacific (n = 215)</td>
</tr>
<tr>
<td>Beer</td>
<td>60.0</td>
<td>82.1*</td>
</tr>
<tr>
<td>Spirits/Liqueurs</td>
<td>11.0</td>
<td>5.7*</td>
</tr>
<tr>
<td>Table wine or similar</td>
<td>28.0</td>
<td>10.5*</td>
</tr>
<tr>
<td>Fortified wine</td>
<td>1.1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

*p<0.05 compared to European

Frequency of drinking

Drinking frequencies of Pacific and European men and women are shown in Table 19.

The majority of Pacific men and women drinkers (>60%) consumed alcohol ‘weekly’ or ‘less than weekly’. In contrast, the majority of European men and women drinkers (>60%) consumed alcohol ‘2-3 days per week’ or ‘daily’. Pacific men were most likely to drink ‘weekly’ and Pacific women ‘less than weekly’.

<table>
<thead>
<tr>
<th>Frequency of Drinking</th>
<th>Men (%)</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>European (n = 738)</td>
<td>Pacific (n = 215)</td>
</tr>
<tr>
<td>Daily</td>
<td>36.2</td>
<td>11.6‡</td>
</tr>
<tr>
<td>2-3 days a week</td>
<td>41.0</td>
<td>20.3‡</td>
</tr>
<tr>
<td>Weekly</td>
<td>12.3</td>
<td>35.1‡</td>
</tr>
<tr>
<td>&lt; Weekly</td>
<td>10.6</td>
<td>33.0‡</td>
</tr>
</tbody>
</table>

‡p<0.0001 compared to European
In Table 20, ethnic specific drinking frequencies are shown. For all Pacific groups more than 55% of drinkers consumed alcohol ‘weekly’ or less compared to 22.8% of European men and 38.6% of European women. ‘Weekly’ consumption was the leading drinking frequency for Samoans, Cook Islands and Niuean men, whilst ‘< weekly’ was the leading drinking frequency for Samoan, Tongan and Niuean women.

### Table 20 Frequency of Drinking in Pacific groups and European, age adjusted

<table>
<thead>
<tr>
<th></th>
<th>European (%)</th>
<th>Samoan (%)</th>
<th>Cook Island (%)</th>
<th>Tongan (%)</th>
<th>Niuean (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=738)</td>
<td>(n=118)</td>
<td>(n=22)</td>
<td>(n=34)</td>
<td>(n=32)</td>
</tr>
<tr>
<td>Daily</td>
<td>36.2</td>
<td>7.6‡</td>
<td>6.9‡</td>
<td>28.1</td>
<td>12.9‡</td>
</tr>
<tr>
<td>2-3 days a week</td>
<td>41.0</td>
<td>23.5*</td>
<td>16.0*</td>
<td>16.3†</td>
<td>19.5*</td>
</tr>
<tr>
<td>Weekly</td>
<td>12.3</td>
<td>36.8†</td>
<td>42.0*</td>
<td>20.2</td>
<td>37.3†</td>
</tr>
<tr>
<td>&lt; Weekly</td>
<td>10.6</td>
<td>32.1†</td>
<td>35.2*</td>
<td>35.4</td>
<td>30.2*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>European (%)</th>
<th>Samoan (%)</th>
<th>Cook Island (%)</th>
<th>Tongan (%)</th>
<th>Niuean (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=632)</td>
<td>(n=27)</td>
<td>(n=16)</td>
<td>(n=17)</td>
<td>(n=14)</td>
</tr>
<tr>
<td>Daily</td>
<td>22.3</td>
<td>14.4</td>
<td>7.0‡</td>
<td>5.2‡</td>
<td>9.1‡</td>
</tr>
<tr>
<td>2-3 days a week</td>
<td>38.3</td>
<td>8.9†</td>
<td>7.9†</td>
<td>6.8‡</td>
<td>16.3</td>
</tr>
<tr>
<td>Weekly</td>
<td>18.6</td>
<td>23.9</td>
<td>65.8*</td>
<td>6.0</td>
<td>7.2</td>
</tr>
<tr>
<td>&lt; Weekly</td>
<td>20.8</td>
<td>52.8†</td>
<td>22.4</td>
<td>82.1‡</td>
<td>67.5†</td>
</tr>
</tbody>
</table>

*p<0.05; †p<0.01; ‡p<0.0001 compared to European

### Consumption levels

This study found that the average Pacific drinker consumed 6.9 drinks per sitting (age and sex adjusted) compared with 3.6 drinks in Europeans. In Table 21, ethnic specific information on alcohol consumption with regard to i) the average number of drinks consumed per ‘sitting’ and also ii) the average amount (in mls) of pure alcohol consumed weekly are presented. Pacific drinkers consumed an average of 82 mls of pure alcohol per week, compared to 126 mls per week for Europeans. Caution is advised when interpreting sex-specific statistics due to small sample sizes (as indicated by the large standard errors). Samoan, Cook Islands, and Niuean men consumed significantly more drinks in an average sitting compared to their European counterparts. Samoan
and Cook Island men consumed significantly lower amounts of pure alcohol per week compared to their European counterparts. In all groups fewer drinks were consumed in the older age category. This pattern was also reflected in total weekly alcohol consumption with exception of European women, who consumed more total alcohol than their younger counterparts.
Table 21 Consumption characteristics of drinkers by ethnic group, gender and age group

<table>
<thead>
<tr>
<th>Ethnic Group</th>
<th>MEN (se) n=738</th>
<th>Pacific (se) n=215</th>
<th>Samoan (se) n=118</th>
<th>Cook Island (se) n= 22</th>
<th>Tongan (se) n= 34</th>
<th>Niue (se) n= 32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinks on an average sitting</td>
<td>4.3 (0.13)</td>
<td>7.8 (0.54)</td>
<td>7.8 (0.63)*</td>
<td>8.0 (1.38)*</td>
<td>7.1 (7.07)</td>
<td>8.7 (1.71)*</td>
</tr>
<tr>
<td>Average alcohol consumption per week (mls)</td>
<td>158 (10.07)</td>
<td>107 (13.36)</td>
<td>87 (11.39)*</td>
<td>74 (16.82)*</td>
<td>169 (54.73)</td>
<td>150 (53.22)</td>
</tr>
</tbody>
</table>

**WOMEN**

<table>
<thead>
<tr>
<th>Ethnic Group</th>
<th>MEN</th>
<th>Pacific</th>
<th>Samoan</th>
<th>Cooks</th>
<th>Tongan</th>
<th>Niue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinks on an average sitting</td>
<td>n=632</td>
<td>n= 84</td>
<td>n= 27</td>
<td>n= 16</td>
<td>n= 17</td>
<td>n= 14</td>
</tr>
<tr>
<td>Average alcohol consumption per week (mls)</td>
<td>2.9 (0.09)</td>
<td>5.4 (1.69)</td>
<td>4.0 (0.82)</td>
<td>12.9 (4.80)*</td>
<td>4.2 (1.63)</td>
<td>2.7 (0.62)</td>
</tr>
</tbody>
</table>

**MEN**

<table>
<thead>
<tr>
<th>Ethnic Group</th>
<th>Drinks on an average sitting</th>
<th>European (se)</th>
<th>Pacific (se)</th>
<th>Samoan (se)</th>
<th>Cooks (se)</th>
<th>Tongan (se)</th>
<th>Niue (se)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-54</td>
<td>4.9 (0.19)</td>
<td>8.7‡ (0.66)</td>
<td>8.7‡ (0.75)</td>
<td>8.9* (1.70)</td>
<td>8.4 (2.53)</td>
<td>9.3* (2.16)</td>
<td></td>
</tr>
<tr>
<td>55-74</td>
<td>3.2 (0.11)</td>
<td>6.2‡ (0.74)</td>
<td>6.5† (0.85)</td>
<td>8.3‡ (1.23)</td>
<td>3.8 (0.75)</td>
<td>9.0† (1.83)</td>
<td></td>
</tr>
</tbody>
</table>

Average consumption per week (mls)

<table>
<thead>
<tr>
<th>Ethnic Group</th>
<th>Drinks on an average sitting</th>
<th>European (se)</th>
<th>Pacific (se)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-54</td>
<td>161 (14.54)</td>
<td>110† (12.97)</td>
<td>93† (11.24)</td>
</tr>
<tr>
<td>55-74</td>
<td>153 (11.12)</td>
<td>96 (35.82)</td>
<td>61† (19.72)</td>
</tr>
</tbody>
</table>

**WOMEN**

<table>
<thead>
<tr>
<th>Ethnic Group</th>
<th>Drinks on an average sitting</th>
<th>European (se)</th>
<th>Pacific (se)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-54</td>
<td>3.1 (0.13)</td>
<td>5.8 (0.13)</td>
<td>57 (18.94)</td>
</tr>
<tr>
<td>55-74</td>
<td>2.5 (0.08)</td>
<td>2.9 (1.01)</td>
<td>51 (30.57)</td>
</tr>
</tbody>
</table>

Low numbers of women drinkers meant that age categorised analysis by Pacific ethnic group was very prone to random error

adjusted for age, *p<0.05; †p<0.01; ‡p<0.0001 compared to European
Figure 8 shows that Pacific drinkers consumed 2-5 more drinks than Europeans who experience similar levels of socioeconomic deprivation. For Europeans there was little difference in the number of drinks consumed on an average drinking occasion between the different NZDep2001 groups. However, the pattern was different for Pacific people. Pacific drinkers in the middle classes appeared to have a more hazardous drinking style (consuming more drinks per occasion) compared to those Pacific groups experiencing the most and least amount of financially deprivation as measured by NZDep2001.
4.3 Diabetes

**Pacific and European ethnicity**

The proportions of impaired fasting glucose (IFG), impaired glucose tolerance (IGT), newly diagnosed, previously diagnosed (known), and total diabetes are shown in Figure 9. Europeans had the lowest proportions whilst Pacific people had the highest prevalence of all abnormal glucose states. The prevalence of total diabetes mellitus was 4.1 times higher for Pacific people compared to Europeans.

**Figure 9** Prevalence of diabetes states by ethnicity adjusted for age and sex

<table>
<thead>
<tr>
<th>Diabetes by ethnicity (%)</th>
<th>European</th>
<th>Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td>IFG</td>
<td>2.2</td>
<td>4.1</td>
</tr>
<tr>
<td>IGT</td>
<td>6.7</td>
<td>6.7</td>
</tr>
<tr>
<td>New</td>
<td>1.8</td>
<td>4.0</td>
</tr>
<tr>
<td>Known</td>
<td>3.9</td>
<td>19.5</td>
</tr>
<tr>
<td>Total</td>
<td>5.7</td>
<td>23.5</td>
</tr>
</tbody>
</table>

Lifestyle, socioeconomic status and demographic characteristics by diabetes status are presented in Table 22. These proportions have been adjusted for age, sex, and ethnicity. Those with abnormal glucose tolerance generally had significantly higher BMI, were older and exercised less. Compared to those with new or known diabetes and IGT categories, the IFG subgroup was not as distinctly differentiated from the ‘normal’ group.
Table 22 Percentage or mean demographic characteristics by diabetes status; adjusted for age, sex, and ethnicity

<table>
<thead>
<tr>
<th>Diabetes status</th>
<th>Normal 80.9%</th>
<th>IFG 7.1%</th>
<th>IGT 2.7%</th>
<th>New 2.6%</th>
<th>Known 6.7%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male*</td>
<td>52.0 %</td>
<td>42.8 %</td>
<td>42.4 %*</td>
<td>49.3 %</td>
<td>54.0 %</td>
</tr>
<tr>
<td>Smoker</td>
<td>15.2 %</td>
<td>21.1 %</td>
<td>15.2 %</td>
<td>15.9 %</td>
<td>19.5 %</td>
</tr>
<tr>
<td>Mod-ex</td>
<td>68.3 %</td>
<td>65.8 %</td>
<td>62.0 %</td>
<td>47.8 %†</td>
<td>61.5 %</td>
</tr>
<tr>
<td>Vig–ex</td>
<td>27.5 %</td>
<td>22.3 %</td>
<td>10.9 %‡</td>
<td>10.9 %†</td>
<td>15.6 %†</td>
</tr>
<tr>
<td>Good† health</td>
<td>88.8 %</td>
<td>86.4 %</td>
<td>80.5 %†</td>
<td>79.5 %</td>
<td>75.7 %‡</td>
</tr>
<tr>
<td>Education</td>
<td>64.0 %</td>
<td>52.9 %</td>
<td>57.2 %</td>
<td>52.2 %</td>
<td>57.2 %</td>
</tr>
<tr>
<td>Age (years)♦</td>
<td>49.6</td>
<td>52.7†</td>
<td>56.5‡‡</td>
<td>54.1‡‡</td>
<td>57.3‡‡</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.6</td>
<td>29.8‡</td>
<td>30.5‡‡</td>
<td>30.4‡‡</td>
<td>30.2‡‡</td>
</tr>
</tbody>
</table>

*p<0.05; †p<0.01; ‡p<0.0001 compared to Normal group; ●Not adjusted for sex; ✔Not adjusted for age; IGT: impaired glucose tolerance; IFG: impaired fasting glucose; Mod-ex: Participated in moderate exercise at least 1× per week in past 3 months; Vig-ex: Participated in vigorous exercise at least 1× per week in past 3 months.; Good+ health: Rated personal health as good or better.

Risks of having newly diagnosed or known diabetes by ethnic group are shown in Table 23. In all age groups, Pacific people had significantly higher risks of known diabetes than Europeans, with the highest being in the 55–64 year age group (RR: 9.3).

Pacific participants in the <45, and 45–54 year age groups were also found to have a significantly higher risk of new diabetes status (RR: 11.6 and 4.2, respectively) compared to Europeans.
The highest proportion of new diabetes was observed in the Pacific 45-54 age group (6.9% for Pacific people compared to 2.2% for Europeans). The age/ethnic group with the largest proportion of previously diagnosed (known) diabetes was reported by the Pacific people, aged 55-64 of 38.2%. This is compared to the European proportion of 4.4%.

The only significant ethnic difference in IGT risk was observed in the 45-54 year age group (Table 24). For IFG, the only significant risks were observed in Pacific aged <45 and 45-54 years. Generally, a clear trend was observed where Pacific had the highest risk for both IGT and IFG compared to Europeans. However, one exception to this trend did exist. The over 65 years IFG and IGT Pacific groups had lower (but not significantly different) risks compared to Europeans.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Diabetes</th>
<th>European RR (%)</th>
<th>Pacific RR (95% CI) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;45 years</td>
<td>New</td>
<td>1.0 (0.2)</td>
<td>11.61 (1.43-82.28)* (2.5)</td>
</tr>
<tr>
<td></td>
<td>Known</td>
<td>1.0 (1.4)</td>
<td>5.88 (2.02-15.48) † (7.4)</td>
</tr>
<tr>
<td>45–54 years</td>
<td>New</td>
<td>1.0 (2.2)</td>
<td>4.16 (1.87-8.68) ‡ (6.9)</td>
</tr>
<tr>
<td></td>
<td>Known</td>
<td>1.0 (2.5)</td>
<td>7.01 (3.38-13.13) ‡ (14.8)</td>
</tr>
<tr>
<td>55–64 years</td>
<td>New</td>
<td>1.0 (2.7)</td>
<td>2.19 (0.90-5.07) (3.7)</td>
</tr>
<tr>
<td></td>
<td>Known</td>
<td>1.0 (4.4)</td>
<td>9.33 (5.73-13.41) ‡ (38.2)</td>
</tr>
<tr>
<td>65+ years</td>
<td>New</td>
<td>1.0 (3.5)</td>
<td>0.99 (0.34-2.75) (3.0)</td>
</tr>
<tr>
<td></td>
<td>Known</td>
<td>1.0 (12.5)</td>
<td>2.46 (1.18-4.26)* (32.4)</td>
</tr>
</tbody>
</table>

*p<0.05; †p<0.01; ‡p<0.0001 compared to Europeans
Table 24 Relative risk (RR) of impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) by age group and ethnicity, adjusted for sex

<table>
<thead>
<tr>
<th>Age group</th>
<th>European RR (%)</th>
<th>Pacific RR (95% CI) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;45 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IGT</td>
<td>1.0 (3.4)</td>
<td>1.49 (0.71-3.01) (4.5)</td>
</tr>
<tr>
<td>IFG</td>
<td>1.0 (1.0)</td>
<td>4.24 (1.16-14.32)* (3.7)</td>
</tr>
<tr>
<td>45–54 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IGT</td>
<td>1.0 (6.0)</td>
<td>2.27 (1.26-3.88) † (10.5)</td>
</tr>
<tr>
<td>IFG</td>
<td>1.0 (1.8)</td>
<td>4.31 (1.36-12.22)* (6.0)</td>
</tr>
<tr>
<td>55–64 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IGT</td>
<td>1.0 (7.5)</td>
<td>1.58 (0.83-2.86) (7.5)</td>
</tr>
<tr>
<td>IFG</td>
<td>1.0 (3.8)</td>
<td>1.56 (0.64-3.61) (3.6)</td>
</tr>
<tr>
<td>65+ years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IGT</td>
<td>1.0 (15.8)</td>
<td>0.76 (0.19-2.33) (9.6)</td>
</tr>
<tr>
<td>IFG</td>
<td>1.0 (3.4)</td>
<td>0.58 (0.18-1.81) (1.6)</td>
</tr>
</tbody>
</table>

*<p<0.05; †<p<0.01 compared to Europeans

The cumulative proportion of newly diagnosed diabetes mellitus by age group and ethnicity is shown in Figure 10. This graph shows that the Pacific ethnic group follow a different path to Europeans. For Pacific people, the same proportion of all newly diagnosed participants, were diagnosed approximately ten years earlier than for Europeans. For example 80% of newly diagnosed Pacific participants were diagnosed by age 54 years, but for Europeans less than 80% were diagnosed by age 64 years.
In Table 25 two multivariate models for newly diagnosed diabetes mellitus are presented. Model 1 shows that being Pacific significantly increases the odds of being newly diagnosed with diabetes mellitus compared with Europeans (OR = 2.98). After adjustment for Body Mass Index (BMI) in Model 2, the odds ratios for Pacific ethnicity attenuated, and was no longer statistically significant, although the point estimate suggested there was still a possible increase in risk.

Table 25 Multivariate odds ratios (95% CI) for ‘newly’ diagnosed diabetes mellitus

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.05 (1.03-1.07)</td>
<td>1.06 (1.03-1.08)</td>
</tr>
<tr>
<td>Male</td>
<td>1.53 (0.91-2.59)</td>
<td>1.67 (0.99-2.86)</td>
</tr>
<tr>
<td>Pacific</td>
<td>2.98 (1.78-4.97)</td>
<td>1.57 (0.85-2.90)</td>
</tr>
<tr>
<td>BMI</td>
<td>–</td>
<td>1.11 (1.06-1.15)</td>
</tr>
</tbody>
</table>

Model 1 includes age, male, Pacific; Model 2 includes Model 1 plus BMI.
Pacific ethnic groups

The following results look more closely at the diabetes characteristics of the Pacific ethnic groups. Table 26 shows the fasting and 2-hour fasting glucose levels and proportions of those with newly diagnosed diabetes, known diabetes, impaired glucose tolerance (IGT), and impaired fasting glucose (IFG) by ethnic group for men. Compared to European men, all Pacific groups had higher HbA\(_1c\) levels. Samoan men had the highest proportion of total diabetes. Some differences were not statistically significant due to low numbers. For example, the proportion of total diabetes of 20.8% in Cook Islands men compared with 6.3% in European men.

Table 27 shows the fasting and 2-hour fasting glucose levels and proportions of those with newly diagnosed diabetes, known diabetes, impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) by ethnic group for women. Compared to European women, all Pacific groups had higher levels of HbA\(_1c\) and higher prevalence of total diabetes mellitus.

These results show that Niuean women have a clearly distinct diabetes profile compared to other Pacific groups. Niuean women have the lowest plasma glucose levels (both fasting and 2 hour), the lowest percent of HbA\(_1c\), and had the lowest prevalence of total diabetes.

Samoan men, and Tongan women had the highest overall prevalence of total diabetes of Pacific men and women. Most ethnic groups showed little inter-gender diversity in diabetes prevalence except for Tongans where Tongan women had a prevalence greater than 2 times that of Tongan men (Tables 26-27).
Table 26 Comparison of diabetes factors among men aged 35–74 years (age adjusted). Values are mean (SE) or percent

<table>
<thead>
<tr>
<th>Variables</th>
<th>European (n=863)</th>
<th>Samoan (n=246)</th>
<th>Tongan (n=123)</th>
<th>Niuean (n=49)</th>
<th>Cook Islands (n=46)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma glucose (mmol/L)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fasting</td>
<td>5.35 (0.04)</td>
<td>6.19 (0.18)***</td>
<td>6.02 (0.30)*</td>
<td>5.81 (0.20)*</td>
<td>5.74 (0.23)</td>
</tr>
<tr>
<td>2 hour</td>
<td>5.64 (0.08)</td>
<td>6.43 (0.41)</td>
<td>6.00 (0.38)</td>
<td>6.20 (0.57)</td>
<td>6.46 (0.69)</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>5.6 % (0.02)</td>
<td>6.5 (0.12)***</td>
<td>6.3 (0.15)***</td>
<td>6.2 (0.14)***</td>
<td>6.3 (0.23)**</td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>6.3 % (0.01)</td>
<td>26.2 % (0.04)***</td>
<td>17.8 % (0.06)*</td>
<td>14.9 % (0.05)</td>
<td>20.8 % (0.08)</td>
</tr>
<tr>
<td>Impaired Glucose Tolerance</td>
<td>8.4 % (0.01)</td>
<td>4.8 % (0.01) *</td>
<td>7.6 % (0.05)</td>
<td>5.7 % (0.02)</td>
<td>6.2 % (0.04)</td>
</tr>
<tr>
<td>Impaired Fasting Glucose</td>
<td>2.9 % (0.01)</td>
<td>3.1 % (0.01)</td>
<td>4.2 % (0.02)</td>
<td>4.7 % (0.03)</td>
<td>2.7 % (0.02)</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01, ***p<0.0001 compared to European; †p<0.05 compared to Samoan.

Table 27 Comparison of diabetes factors among women aged 35–74 years (age adjusted). Values are mean (SE) or percent

<table>
<thead>
<tr>
<th>Variables</th>
<th>European (n=882)</th>
<th>Samoan (n=238)</th>
<th>Tongan (n=132)</th>
<th>Niuean (n=60)</th>
<th>Cook Islands (n=70)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma glucose (mmol/L)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fasting</td>
<td>5.02 (0.03)</td>
<td>6.00 (0.19)***</td>
<td>6.70 (0.69)*</td>
<td>5.53 (0.21)*</td>
<td>5.85 (0.25)**</td>
</tr>
<tr>
<td>2 hour</td>
<td>5.48 (0.07)</td>
<td>7.28 (0.49)***</td>
<td>9.03 (1.12)**</td>
<td>6.01 (0.47)</td>
<td>7.54 (0.50)**</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>5.5 % (0.02)</td>
<td>6.3 (0.12)***</td>
<td>6.6 (0.27)***</td>
<td>6.0 (0.10)***</td>
<td>6.2 (0.12)***</td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>5.5 % (0.01)</td>
<td>25.3 % (0.05)***</td>
<td>35.8 % (0.07)***</td>
<td>10.8 % (0.03)†</td>
<td>17.8 % (0.04)**</td>
</tr>
<tr>
<td>Impaired Glucose Tolerance</td>
<td>5.4 % (0.01)</td>
<td>12.1 % (0.02) **</td>
<td>6.4 % (0.03)</td>
<td>7.1 % (0.03)</td>
<td>13.9 % (0.04)</td>
</tr>
<tr>
<td>Impaired Fasting Glucose</td>
<td>1.6 % (0.01)</td>
<td>5.1 % (0.03)</td>
<td>1.4 % (0.01)</td>
<td>8.2 % (0.04)</td>
<td>2.3 % (0.02)</td>
</tr>
</tbody>
</table>

*p<0.05, **<0.01, ***p<0.0001 compared to European; †p<0.05 compared to Samoan.
Urinary albumin concentrations by diabetes status, sex and ethnic group are shown in Table 28. Concentrations of urinary albumin increased with increasing diabetes status, however for Pacific with previously diagnosed diabetes had a lower concentration than newly diagnosed subjects. For Europeans it was the opposite. Pacific participants generally had higher concentrations of urinary albumin across the board, however, only Pacific women who were non-diabetic, IGT or with newly diagnosed diabetes were significantly different to their European counterparts.

Table 28 – Mean Urinary albumin concentrations (sd) adjusted for age in participants classified as Non-diabetic, IFG, IGT, new or known cases of diabetes mellitus by ethnic group and gender.

<table>
<thead>
<tr>
<th></th>
<th>European</th>
<th>Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (mg/L)</td>
<td>n (mg/L)</td>
</tr>
<tr>
<td>Total (n)</td>
<td>1745</td>
<td>1011</td>
</tr>
<tr>
<td>Non-diabetic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>675</td>
<td>304</td>
</tr>
<tr>
<td>Women</td>
<td>732</td>
<td>299</td>
</tr>
<tr>
<td>IFG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>30</td>
<td>21</td>
</tr>
<tr>
<td>Women</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>IGT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>87</td>
<td>27</td>
</tr>
<tr>
<td>Women</td>
<td>64</td>
<td>55</td>
</tr>
<tr>
<td>New diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>24</td>
<td>32</td>
</tr>
<tr>
<td>Women</td>
<td>18</td>
<td>28</td>
</tr>
<tr>
<td>Known diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>47</td>
<td>103</td>
</tr>
<tr>
<td>Women</td>
<td>43</td>
<td>112</td>
</tr>
</tbody>
</table>

Data are geometric means with standard error. Significant differences between Europeans and Pacific subjects are indicated. †p<0.01

Figure 11 shows the proportion of total diabetes that were ‘newly’ diagnosed and ‘previously’ diagnosed by gender and ethnicity. Ratios of ‘previously’ to ‘newly’ diagnosed diabetes were 5:1 for Niueans, 4:1 for Samoans and Tongans, and 2:1 for Cook Islanders and 2:1 for European men and women combined.
Figure 11 Proportion of total diabetes that is known and new, by gender and ethnicity
4.4 Overweight and Obesity

Perceptions of Body Weight

Table 29 Correct estimation and underestimation of self-reported body weight

<table>
<thead>
<tr>
<th></th>
<th>Correct estimation of body weight (+/- 2 Kg)</th>
<th>Under-estimation of body weight (&gt;2kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total (%)</td>
<td>Men (%)</td>
</tr>
<tr>
<td>European</td>
<td>63.1</td>
<td>59.7</td>
</tr>
<tr>
<td>Pacific</td>
<td>57.9</td>
<td>50.6*</td>
</tr>
<tr>
<td>Samoan</td>
<td>55.3</td>
<td>49.9</td>
</tr>
<tr>
<td>Cook Island</td>
<td>70.9</td>
<td>72.3</td>
</tr>
<tr>
<td>Tongan</td>
<td>64.7</td>
<td>57.4</td>
</tr>
<tr>
<td>Niuean</td>
<td>57.3</td>
<td>41.3*</td>
</tr>
</tbody>
</table>

*p<0.05; ‡p<0.0001 compared to Europeans

Table 29 compares self-reported estimates of body weight to measured body weights (Table 29). Results show that women were generally more likely to know their actual weight than men. For women, there was very little ethnic difference in this knowledge (range 12.2%), however, for men the ethnic difference was more pronounced. Niuean men were least aware of their current weight (41.3%), compared to Cook Islands men (72.3%) who were most aware, encompassing a 31.1% range which was approximately three times greater than the range for women. With the exception of the Cook Island group, under-estimation of body weight between all other ethnic groups were quite similar. Men were more likely to under-estimate their body weight than women. Cook Islands men and women were significantly less likely to under-estimate their body weight than their European counterparts.

Table 30 Perceptions of weight

<table>
<thead>
<tr>
<th>Weight now v 1 year ago</th>
<th>European (%)</th>
<th>Pacific (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighter</td>
<td>13.5</td>
<td>17.3</td>
</tr>
<tr>
<td>Same</td>
<td>69.2</td>
<td>60.2†</td>
</tr>
<tr>
<td>Heavier</td>
<td>17.2</td>
<td>22.7*</td>
</tr>
</tbody>
</table>

Perception of your weight

<table>
<thead>
<tr>
<th></th>
<th>European (%)</th>
<th>Pacific (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under weight</td>
<td>5.2</td>
<td>7.6</td>
</tr>
<tr>
<td>Just right</td>
<td>30.1</td>
<td>36.2*</td>
</tr>
<tr>
<td>Overweight</td>
<td>64.9</td>
<td>55.6†</td>
</tr>
</tbody>
</table>

*p<0.05; †p<0.01 compared to Europeans, v = versus.
Perceptions of weight by ethnic group are presented in Table 30. Significantly more Europeans reported to maintain a stable weight, whilst significantly more Pacific people reported being heavier compared to one year ago. Significantly fewer Pacific people reported being overweight than Europeans.

Table 31 Percentage of participants overweight and obese in each perception of body weight category by ethnic group (age and sex adjusted)

<table>
<thead>
<tr>
<th>Self-perception</th>
<th>European</th>
<th>Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overweight (25&lt;30 kg/m²)</td>
<td>Obese (≥30 kg/m²)</td>
</tr>
<tr>
<td>'Under weight'</td>
<td>2.0 %</td>
<td>4.7 %</td>
</tr>
<tr>
<td>'Right weight'</td>
<td>24.1 %</td>
<td>2.5 %</td>
</tr>
<tr>
<td>'Over weight'</td>
<td>49.0 %</td>
<td>33.7 %</td>
</tr>
</tbody>
</table>

Note: rows add to 100% when normal group is included.

Table 31 compares self-perceptions of weight status (under weight, just right, over weight) with actual prevalence of overweight and obesity (categorised by BMI). Of those who self-reported being ‘Under weight’ 6.7 % and 63.5 % of European and Pacific people were actually ‘overweight or obese’, respectively. Of those who self-reported being the ‘Right weight’, 26.6 % of Europeans and 90.4 % of Pacific were ‘overweight or obese’. Of those who self-reported being ‘Over weight’, 82.7 % of Europeans and 100 % of the Pacific group, were ‘overweight or obese’.
Figures 12 & 13 show the proportions of overweight and obese by ethnic group for men and women using ethnic specific body mass index classification. For Europeans, men were more likely to be ‘overweight or obese’ than women, however, in contrast, Pacific women were more likely to be ‘overweight or obese’ than Pacific men. Cook Island men had a similar level of obesity to European men and were the only Pacific group that were more likely to be overweight than obese. For women, almost all Pacific ethnic groups were either overweight or obese compared to approximately 60% of European women.

The combined Pacific ethnic groups were significantly different to Europeans in all weight categories. Approximately 96% of all Pacific people were either ‘overweight or obese’ compared to 67.4% of Europeans (p < 0.0001). This relationship remained the same when assessing ‘overweight or obesity’ by age groups.
BMI levels

Figure 14 European men and women’s average BMI by age group

Figure 15 Pacific men and women’s average BMI by age group

Average BMI levels of European and Pacific people are plotted in Figures 14 and 15 by age and gender. For Europeans (Figure 14), males in the two younger age groups (<45 and 45-54 years) had higher BMI levels than their female counterparts with the opposite experienced in the older age groups (55-64 and 65+ years). In contrast, Pacific women had higher BMI levels at every age group than their male counterparts (Figure 15). Mean BMI increased up to age 55-64 years in European women and remained relatively static with age in European men. In contrast, BMI decreased with age in Pacific men, whereas it was relatively stable in Pacific women until age 55-64 years and then decreased.

Table 32 Relationship between BMI and participation in physical activity for Pacific only (adjusted for age and sex)

<table>
<thead>
<tr>
<th>Physical Activity</th>
<th>Average BMI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vigorous &amp; Moderate</td>
<td>33.3</td>
<td>(ref)</td>
</tr>
<tr>
<td>Vigorous</td>
<td>33.6</td>
<td>0.7821</td>
</tr>
<tr>
<td>Moderate</td>
<td>34.6</td>
<td>0.1152</td>
</tr>
<tr>
<td>Neither</td>
<td>34.8</td>
<td>0.0683</td>
</tr>
</tbody>
</table>

Table 32 shows that for Pacific participants increased participation in physical activity (PA) had no association with BMI levels.
### Table 33 Multivariate odds ratios (95% CI) for factors that may contribute to obesity

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.01 (1.00-1.03)*</td>
<td>1.01 (1.00-1.03)*</td>
<td>1.01 (1.00-1.02)</td>
</tr>
<tr>
<td>Male</td>
<td>1.33 (1.03-1.73)*</td>
<td>1.34 (1.03-1.75)*</td>
<td>1.36 (1.04-1.76)*</td>
</tr>
<tr>
<td>Pacific</td>
<td>16.78 (10.57-26.57)‡</td>
<td>12.92 (7.82-21.35)‡</td>
<td>17.73 (11.27-27.91)‡</td>
</tr>
<tr>
<td>NZDep2001</td>
<td>-</td>
<td>1.07 (1.02-1.13)†</td>
<td>-</td>
</tr>
<tr>
<td>Non-smokers</td>
<td>-</td>
<td>-</td>
<td>1.63 (1.09-2.43)*</td>
</tr>
<tr>
<td>Non-drinkers</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Exercise @ 30mins a day</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.01 (1.00-1.02)*</td>
<td>1.01 (1.00-1.02)*</td>
<td>1.01 (1.00-1.02)</td>
</tr>
<tr>
<td>Male</td>
<td>1.41 (1.08-1.84)*</td>
<td>1.37 (1.05-1.78)*</td>
<td>1.47 (1.12-1.93)†</td>
</tr>
<tr>
<td>Pacific</td>
<td>13.92 (8.54-22.69)‡</td>
<td>15.66 (9.77-25.11)‡</td>
<td>11.72 (6.91-19.86)‡</td>
</tr>
<tr>
<td>NZDep2001</td>
<td>-</td>
<td>-</td>
<td>1.07 (1.02-1.13)†</td>
</tr>
<tr>
<td>Non-smokers</td>
<td>-</td>
<td>-</td>
<td>1.96 (1.28-2.99)†</td>
</tr>
<tr>
<td>Non-drinkers</td>
<td>1.57 (1.14-2.16)†</td>
<td>-</td>
<td>1.32 (0.94-1.84)</td>
</tr>
<tr>
<td>Exercise @ 30mins a day</td>
<td>0.59 (0.44-0.78)†</td>
<td>-</td>
<td>0.59 (0.44-0.78)†</td>
</tr>
</tbody>
</table>

*p<0.05; †p<0.01; ‡p<0.0001

Six multivariate models for obesity are presented in Table 33 for the total sample. The comparison group are those participants with normal weight. In Model 1, Pacific ethnicity is associated with an increased odds of being obese of over sixteen fold compared with Europeans. Adjusting for deprivation (NZdep2001) impacts the greatest on the Pacific odds ratio lowering it to 12.92 (Model 2). The other models show that being male, having increased deprivation, non-smoking and non-drinking is associated with as increased odds of being obese and that participating in exercise is associated with a decreased odds of being obese. In the combined regression (Model 6) with the exception of non-drinking all other factors maintain their significance and Pacific people are over eleven times as likely to be obese than Europeans.

Table 34 presents the findings of 5 multivariate models for obesity in Europeans only. The comparison group were those European participants with normal weight. Of the
factors investigated only non-smoking did not have a significant association with being obese when tested independently, however, in the combined regression (Model 5) non-smoking became significant. This transition to significance of non-smokers was due to the inclusion of both NZDep2001 and Exercise time. Further investigation found that with the inclusion of NZDep2001 or Exercise time to Model 2, the odds ratio for Non-Smokers increased by 11% (from 1.49 to 1.66) and became statistically significant.

**Table 34 Multivariate odds ratios (95% CI) for factors that may contribute to obesity for European**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.01 (1.00-1.03)*</td>
<td>1.01 (1.00-1.02)</td>
<td>1.01 (1.00-1.03)*</td>
</tr>
<tr>
<td>Male</td>
<td>1.43 (1.09-1.87)†</td>
<td>1.44 (1.10-1.88)†</td>
<td>1.49 (1.13-1.96)†</td>
</tr>
<tr>
<td>NZDep2001</td>
<td>1.07 (1.02-1.13)*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Non-smokers</td>
<td>-</td>
<td>1.49 (0.98-2.26)</td>
<td>-</td>
</tr>
<tr>
<td>Non-drinkers</td>
<td>-</td>
<td>-</td>
<td>1.50 (1.07-2.09)*</td>
</tr>
<tr>
<td>Exercise @ 30mins a day</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.01 (1.00-1.03)</td>
<td>1.01 (1.00-1.02)</td>
</tr>
<tr>
<td>Male</td>
<td>1.46 (1.11-1.92)†</td>
<td>1.55 (1.17-2.05)†</td>
</tr>
<tr>
<td>NZDep2001</td>
<td>-</td>
<td>1.07 (1.01-1.13)*</td>
</tr>
<tr>
<td>Non-smokers</td>
<td>-</td>
<td>1.79 (1.15-2.80)*</td>
</tr>
<tr>
<td>Non-drinkers</td>
<td>-</td>
<td>1.25 (0.88-1.77)</td>
</tr>
<tr>
<td>Exercise @ 30mins a day</td>
<td>0.56 (0.42-0.76)†</td>
<td>0.56 (0.42-0.76)†</td>
</tr>
</tbody>
</table>

*p<0.05; †p<0.01

Five multivariate models for obesity in Pacific only are presented in Table 35. Due to small numbers of normal weight individuals (n=59) both normal weight and overweight participants were combined to form the reference group. Of the factors investigated in independent analyses: being female and being a non-smoker significantly increased the odds of being obese. In the combined regression, with the exception of age, all other variables (age, being female, Deprivation, non-smokers, and non-drinkers) reached significance. In contrast to Europeans, Pacific women were
more likely to be obese than Pacific men, and exercise (although showing some protection) did not significantly reduce the odds of obesity.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.98 (0.96-1.00)</td>
<td>0.98 (0.96-1.00)</td>
<td>0.98 (0.96-1.00)</td>
</tr>
<tr>
<td>Female</td>
<td>2.18 (1.48-3.22)‡</td>
<td>2.14 (1.47-3.11)‡</td>
<td>2.03 (1.36-3.04)†</td>
</tr>
<tr>
<td>NZDep2001</td>
<td>1.15 (1.02-1.29)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Non-smokers</td>
<td>-</td>
<td>1.81 (1.11-2.94)*</td>
<td>-</td>
</tr>
<tr>
<td>Non-drinkers</td>
<td>-</td>
<td>-</td>
<td>1.53 (0.97-2.42)</td>
</tr>
<tr>
<td>Exercise @ 30mins</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>a day</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.98 (0.96-1.01)</td>
<td>0.98 (0.96-0.99)*</td>
</tr>
<tr>
<td>Female</td>
<td>2.26 (1.54-3.32)‡</td>
<td>1.84 (1.24-2.73)†</td>
</tr>
<tr>
<td>NZDep2001</td>
<td>-</td>
<td>1.32 (1.03-1.68)*</td>
</tr>
<tr>
<td>Non-smokers</td>
<td>-</td>
<td>1.93 (1.23-3.02)†</td>
</tr>
<tr>
<td>Non-drinkers</td>
<td>-</td>
<td>1.28 (0.83-1.95)</td>
</tr>
<tr>
<td>Exercise @ 30mins</td>
<td>0.74 (0.48-1.14)</td>
<td>0.74 (0.49-1.11)</td>
</tr>
<tr>
<td>a day</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05; †p<0.01; ‡p<0.0001

Mean BMI, waist-hip ratios and waist measurements are presented in Table 36 for Europeans and the Pacific ethnic groups by sex. Pacific men and women had significantly greater mean BMI and waist measurements than their European counterparts. Tongan men and all Pacific women had significantly greater waist-hip ratios than Europeans.

Tables 37 presents mean BMI and waist measurements for Europeans and combined Pacific ethnic group by age group and sex. The older age groups in Pacific men had progressively lower BMI, whereas for European men, there was no change. For Pacific women a similar observation was made, that as age increased BMI tended to decrease. However, for European women the opposite was observed. With the exception of Pacific men, all groups had larger waist in the older age categories.
Table 36 Comparison of BMI and waist/hip measurements among men & women aged 35–74 years (age adjusted). Values are mean (SE) or percent.

<table>
<thead>
<tr>
<th>Variables</th>
<th>European (n=863)</th>
<th>Samoan (n=246)</th>
<th>Tongan (n=123)</th>
<th>Niuean (n=49)</th>
<th>Cook Islands (n=46)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.6 (0.16)</td>
<td>33.0 (0.47)***</td>
<td>34.4 (0.88)***</td>
<td>32.0 (0.75)***</td>
<td>30.8 (0.81)*** †</td>
</tr>
<tr>
<td>Waist-hip ratio</td>
<td>0.93 (0.002)</td>
<td>0.94 (0.01)</td>
<td>0.97 (0.01)***</td>
<td>0.93 (0.01)</td>
<td>0.93 (1.01)</td>
</tr>
<tr>
<td>Waist (cm)</td>
<td>97.8 (0.39)</td>
<td>105.9 (1.11)***</td>
<td>110.1 (2.05)***</td>
<td>102.1 (1.57)***</td>
<td>100.2 (2.93)†</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>176.7 (0.25)</td>
<td>173.5 (0.69)***</td>
<td>174.7 (0.85)*</td>
<td>173.0 (1.04)***</td>
<td>172.3 (1.78)*</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.3 (0.19)</td>
<td>36.3 (0.57)***</td>
<td>36.3 (1.05)***</td>
<td>35.3 (1.27)***</td>
<td>35.4 (0.78)***</td>
</tr>
<tr>
<td>Waist-hip ratio</td>
<td>0.81 (0.002)</td>
<td>0.87 (0.01)***</td>
<td>0.87 (0.01)***</td>
<td>0.85 (0.01)***</td>
<td>0.87 (0.01)***</td>
</tr>
<tr>
<td>Waist (cm)</td>
<td>87.1 (0.45)</td>
<td>105.1 (1.06)***</td>
<td>106.4 (1.73)***</td>
<td>101.0 (1.80)***</td>
<td>102.7 (2.00)***</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163.5 (0.23)</td>
<td>160.8 (0.51)***</td>
<td>165.1 (0.87)†† †</td>
<td>162.8 (0.76)†</td>
<td>160.3 (1.25)*</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01, ***p<0.0001 compared to European; †p<0.05, ††p<0.01, †††p<0.0001 compared to Samoan; ♦= geometric mean.

Table 37 Anthropometry by ethnicity, sex and age

<table>
<thead>
<tr>
<th>Age range</th>
<th>European</th>
<th>Pacific†</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Males</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI &lt; 45</td>
<td>27.4 (26.8-27.9)</td>
<td>33.7 (32.5-34.9)</td>
</tr>
<tr>
<td>45-54</td>
<td>27.9 (27.2-28.6)</td>
<td>33.2 (31.7-34.7)</td>
</tr>
<tr>
<td>55-64</td>
<td>27.5 (27.0-28.0)</td>
<td>32.8 (31.6-34.1)</td>
</tr>
<tr>
<td>65+</td>
<td>27.5 (26.9-28.1)</td>
<td>31.0 (29.3-32.7)</td>
</tr>
<tr>
<td>Waist (cm) &lt; 45</td>
<td>96.2 (94.7-97.6)</td>
<td>105.4 (102.8-108.8)</td>
</tr>
<tr>
<td>45-54</td>
<td>98.4 (96.8-99.9)</td>
<td>106.4 (103.0-109.8)</td>
</tr>
<tr>
<td>55-64</td>
<td>98.0 (96.7-99.3)</td>
<td>106.9 (103.7-110.1)</td>
</tr>
<tr>
<td>65+</td>
<td>99.5 (98.0-100.9)</td>
<td>105.8 (99.9-111.7)</td>
</tr>
<tr>
<td><strong>Females</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI &lt; 45</td>
<td>26.8 (26.0-27.6)</td>
<td>35.6 (34.5-36.6)</td>
</tr>
<tr>
<td>45-54</td>
<td>27.1 (26.4-27.8)</td>
<td>36.3 (34.5-38.0)</td>
</tr>
<tr>
<td>55-64</td>
<td>27.8 (27.1-28.5)</td>
<td>35.9 (33.5-38.3)</td>
</tr>
<tr>
<td>65+</td>
<td>27.8 (27.0-28.6)</td>
<td>33.7 (32.6-34.9)</td>
</tr>
<tr>
<td>Waist (cm) &lt; 45</td>
<td>85.0 (83.2-86.8)</td>
<td>101.7 (99.3-104.1)</td>
</tr>
<tr>
<td>45-54</td>
<td>86.2 (84.5-87.9)</td>
<td>105.2 (102.4-107.9)</td>
</tr>
<tr>
<td>55-64</td>
<td>89.1 (87.5-90.8)</td>
<td>105.1 (103.0-107.2)</td>
</tr>
<tr>
<td>65+</td>
<td>90.7 (88.8-92.6)</td>
<td>108.2 (101.8-114.5)</td>
</tr>
</tbody>
</table>

BMI: Body mass index = weight (kg) ÷ height (m²); †Mostly of Samoan, Tongan, Niuean or Cook Island ethnicity.
4.5 Cardiovascular risk factors of Pacific ethnic groups

The proportions and mean levels of CVD risk factors in men are shown in Table 38. As Samoan and Niuean men were significantly younger than European men and Tongan men were significantly older than Samoan men, subsequent analyses were adjusted for age. Compared to European men, Pacific men were significantly shorter, had higher NZDep2001 scores and higher predicted 5-year CVD risk. Compared to Samoan men, Tongan men had lower systolic blood pressure (BP), lower high-density lipoprotein (HDL) cholesterol, higher ratio of total to HDL cholesterol and low-density lipoprotein (LDL) cholesterol, and lower urinary albumin levels.

Proportions and mean levels of CVD risk factors in women are presented in Table 39. Pacific women were on average more than four years younger than European women. Therefore, all subsequent analyses were adjusted for age. Compared to European women, all Pacific groups had significantly higher NZDep2001 scores, higher diastolic blood pressure, and higher 5-year CVD risk. Pacific women also had significantly lower HDL-cholesterol than their European counterparts. There were no significant differences between Samoan and Cook Islands women.

In both men and women, 5-year CVD risks among the Pacific groups were all significantly higher than Europeans, with the exception of Niuean men (Tables 38 and 39). However, Niuean men were the only group to be significantly different to their Samoan counterparts. Five-year CVD risks, were higher for men compared to women for all ethnic groups.
Table 38 Comparison of CVD risk factors among men aged 35–74 years (age adjusted). Values are mean (SE) or percent

<table>
<thead>
<tr>
<th>Variables</th>
<th>European (n=863)</th>
<th>Samoan (n=246)</th>
<th>Tongan (n=123)</th>
<th>Niuean (n=49)</th>
<th>Cook Islands (n=46)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td>51.7 (0.18)</td>
<td>46.6 (0.77)***</td>
<td>53.8 (2.51)†</td>
<td>48.0 (1.52)*</td>
<td>50.0 (4.26)</td>
</tr>
<tr>
<td>Current smokers (%)</td>
<td>15.2 % (0.01)</td>
<td>34.2 % (0.05)***</td>
<td>36.3 % (0.08)**</td>
<td>18.4 % (0.07)</td>
<td>19.2 % (0.06)</td>
</tr>
<tr>
<td>Never smokers (%)</td>
<td>46.8 % (0.02)</td>
<td>30.4 % (0.05)***</td>
<td>25.5 % (0.08)*</td>
<td>41.6 % (0.08)</td>
<td>49.3 % (0.12)</td>
</tr>
<tr>
<td>Inactive leisure time (%)</td>
<td>24.3 % (0.02)</td>
<td>45.2 % (0.05)***</td>
<td>39.3 % (0.08)*</td>
<td>29.1 % (0.07)</td>
<td>47.2 % (0.10)*</td>
</tr>
<tr>
<td>Exercise (min/week) (tolerance)</td>
<td>66 (1.18)</td>
<td>26 (1.91)***</td>
<td>29 (2.67)</td>
<td>56 (2.22)</td>
<td>33 (2.36)</td>
</tr>
<tr>
<td>NZDep2001</td>
<td>4.4 (0.10)</td>
<td>7.9 (0.24)***</td>
<td>8.7 (0.30)***</td>
<td>7.9 (0.34)***</td>
<td>7.6 (0.45)***</td>
</tr>
<tr>
<td>Blood pressure (mmHg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>126 (0.62)</td>
<td>133 (2.44)**</td>
<td>125 (2.57)†</td>
<td>129 (2.55)</td>
<td>135 (3.24)**</td>
</tr>
<tr>
<td>Diastolic</td>
<td>78 (0.35)</td>
<td>83 (1.26)***</td>
<td>81 (1.55)</td>
<td>79 (1.67)</td>
<td>81 (1.81)</td>
</tr>
<tr>
<td>Serum lipids (mmol/L)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>5.61 (0.04)</td>
<td>5.28 (0.08)***</td>
<td>5.62 (0.19)</td>
<td>5.36 (0.17)</td>
<td>5.72 (0.23)</td>
</tr>
<tr>
<td>HDL-cholesterol</td>
<td>1.31 (0.01)</td>
<td>1.24 (0.03)*</td>
<td>1.12 (0.04)*** †</td>
<td>1.31 (0.05)</td>
<td>1.27 (0.05)</td>
</tr>
<tr>
<td>Ratio Tot/HDL</td>
<td>4.51 (0.05)</td>
<td>4.52 (0.14)</td>
<td>5.18 (0.24)*** †</td>
<td>4.26 (0.17)</td>
<td>4.63 (0.17)</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>1.65 (0.04)</td>
<td>1.68 (0.12)</td>
<td>1.67 (0.19)</td>
<td>1.51 (0.16)</td>
<td>1.56 (0.14)</td>
</tr>
<tr>
<td>LDL-cholesterol</td>
<td>3.57 (0.03)</td>
<td>3.31 (0.09)***</td>
<td>3.77 (0.17)†</td>
<td>3.38 (0.15)</td>
<td>3.74 (0.22)</td>
</tr>
<tr>
<td>Microalbuminuria (mg/L)♦</td>
<td>4.11 (1.06)</td>
<td>7.30 (1.22)***</td>
<td>4.45 (1.28)††</td>
<td>5.53 (1.46)</td>
<td>7.26 (1.78)</td>
</tr>
<tr>
<td>Diabetes (%) Total</td>
<td>6.3 % (0.01)</td>
<td>26.2 % (0.04)***</td>
<td>17.8 % (0.06)*</td>
<td>14.9 % (0.05)</td>
<td>20.8 % (0.08)</td>
</tr>
<tr>
<td>Five-year risk score of CVD</td>
<td>6.8 % (0.15)</td>
<td>9.4 % (0.70)***</td>
<td>10.8 % (1.13)***</td>
<td>7.1 % (0.37)††</td>
<td>9.1 % (0.54)***</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01, ***p<0.0001 compared to European; †p<0.05, ††p<0.01, †††p<0.0001 compared to Samoan, ♦ = geometric mean.

### Table 39 Comparison of CVD risk factors among women aged 35–74 years (age adjusted). Values are mean (SE) or percent

<table>
<thead>
<tr>
<th>Variable</th>
<th>European (n=882)</th>
<th>Samoan (n=238)</th>
<th>Tongan (n=132)</th>
<th>Niuean (n=60)</th>
<th>Cook Islands (n=70)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age in years</strong></td>
<td>52.1 (0.18)</td>
<td>46.9 (0.80)***</td>
<td>48.0 (1.67)*</td>
<td>46.2 (1.20)***</td>
<td>46.1 (1.02)***</td>
</tr>
<tr>
<td><strong>Current smokers (%)</strong></td>
<td>13.3 % (0.01)</td>
<td>18.0 % (0.04)</td>
<td>7.5 % (0.03) †</td>
<td>12.7 % (0.06)</td>
<td>30.5 % (0.09)</td>
</tr>
<tr>
<td><strong>Never smokers (%)</strong></td>
<td>53.9 % (0.02)</td>
<td>54.8 % (0.06)</td>
<td>84.0 % (0.05)***</td>
<td>49.6 % (0.11)</td>
<td>38.4 % (0.08)*</td>
</tr>
<tr>
<td><strong>Inactive leisure time (%)</strong></td>
<td>23.3 % (0.02)</td>
<td>37.7 % (0.05)**</td>
<td>47.0 % (0.07)**</td>
<td>36.6 % (0.09)</td>
<td>45.8 % (0.08)*</td>
</tr>
<tr>
<td><strong>Exercise (min/week)</strong></td>
<td>59 (1.16)</td>
<td>23 (1.57)***</td>
<td>15 (2.31)**</td>
<td>37 (2.33)</td>
<td>17 (2.41)*</td>
</tr>
<tr>
<td><strong>NZDep2001</strong></td>
<td>4.5 (0.11)</td>
<td>8.5 (0.27)***</td>
<td>9.0 (0.16)***</td>
<td>8.0 (0.38)***</td>
<td>7.9 (0.63)***</td>
</tr>
<tr>
<td><strong>Blood pressure (mmHg)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>116 (0.60)</td>
<td>128 (1.55)***</td>
<td>121 (3.85)</td>
<td>126 (2.64)***</td>
<td>128 (2.53)***</td>
</tr>
<tr>
<td>Diastolic</td>
<td>72 (0.34)</td>
<td>78 (1.00)***</td>
<td>78 (1.59)***</td>
<td>79 (1.57)***</td>
<td>(2.97)**</td>
</tr>
<tr>
<td><strong>Serum lipids (mmol/L)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>5.50 (0.03)</td>
<td>5.40 (0.12)</td>
<td>5.45 (0.13)</td>
<td>5.01 (0.09)*** †</td>
<td>5.88 (0.34)</td>
</tr>
<tr>
<td>HDL-cholesterol</td>
<td>1.62 (0.01)</td>
<td>1.36 (0.03)***</td>
<td>1.31 (0.05)***</td>
<td>1.39 (0.06)***</td>
<td>1.31 (0.04)***</td>
</tr>
<tr>
<td>Ratio Tot/HDL</td>
<td>3.57 (0.04)</td>
<td>4.07 (0.10)***</td>
<td>4.36 (0.21)***</td>
<td>3.77 (0.15)</td>
<td>4.72 (0.40)**</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>1.20 (0.02)</td>
<td>1.30 (0.06)</td>
<td>1.39 (0.08)*</td>
<td>1.34 (0.08)</td>
<td>1.78 (0.27)*</td>
</tr>
<tr>
<td>LDL-cholesterol</td>
<td>3.33 (0.03)</td>
<td>3.43 (0.10)</td>
<td>3.51 (0.11)</td>
<td>3.01 (0.08)*** †</td>
<td>3.76 (0.25)</td>
</tr>
<tr>
<td>Microalbuminuria (mg/L)♦</td>
<td>3.46 (1.06)</td>
<td>7.67 (1.51)**</td>
<td>5.20 (1.45)</td>
<td>3.53 (1.39) †</td>
<td>7.95 (1.40)***</td>
</tr>
<tr>
<td>Diabetes (%) Total</td>
<td>5.5 % (0.01)</td>
<td>25.3 % (0.05)***</td>
<td>35.8 % (0.07)***</td>
<td>10.8 % (0.03)†</td>
<td>17.8 % (0.04)***</td>
</tr>
<tr>
<td>Five-year risk score of CVD</td>
<td>3.0 % (0.10)</td>
<td>5.2 % (0.24)***</td>
<td>5.6 % (0.35)***</td>
<td>4.3 % (0.57)*</td>
<td>6.2 % (0.63)***</td>
</tr>
</tbody>
</table>

* p<0.05, ** p<0.01, *** p<0.0001 compared to European; † p<0.05, †† p<0.01, ††† p<0.0001 compared to Samoan. ♦ = geometric mean.

5 Discussion and conclusions

The following chapter will discuss the reported results. After firstly acknowledging various limitations of the study the discussion will follow an order similar to previous chapters. Although discussions will be centred on the 5 main topic areas i) health-related socioeconomic factors, ii) alcohol consumption patterns, iii) diabetes status, iv) overweight, obesity and body mass index, and finally v) cardiovascular risk. In place an account of limitations specific to topic areas may be included within topic sections. It is important to mention that to gain a more complete understanding of overall health among Pacific peoples, the reported health topics need to be considered holistically, rather than separately. To address this point a broader conclusion is presented at the end of the chapter.

Limitations

A limitation of this study is that using electoral roll based and cluster sampling frames did not allow for ethnic specific response rates to be determined. Although the overall response rate was not as high as in previous Auckland risk factor studies, it has been shown in the Atherosclerosis Risk in Communities Study\textsuperscript{75} that response rates lower than those in our study produced relatively small errors in the estimates of prevalence of common cardiovascular disease risk factors.

Caution should be taken when interpreting findings related to the smaller Pacific ethnic groups (Cook Islands, and Niuean) due to the higher proportion of participants that identified with more than one ethnic group. For the larger groups (Samoan and Tongan) approximately 5% reported affiliation to more than one ethnic group. However, for the Niuean and Cook Islands groups this was approximately 11%.
Comparisons made between the current study and the Auckland Pacific population (Table 10) suggest that the Pacific sample is a representative sample of the Pacific population in Auckland. Furthermore, comparisons between groups is probably reasonably valid as any responder bias is likely to be similar in all groups who took part.

The method of recruiting from a list of names identified as Pacific will undoubtedly exclude some Pacific people from selection; however, whether this group are different from those selected is not clear.

Although this is one of the two largest studies of Pacific adults in New Zealand to date that has been able to determine ethnic differences, in some circumstances, (i.e. alcohol) the sample size was too small to demonstrate any meaningful findings. This highlights the fact that future studies of Pacific people need to be larger.

5.1 Health-related socio-economic factors

This study showed that the majority of Pacific people living in New Zealand aged over 35 years were not born in New Zealand. Niueans and Cook Islanders generally had a more favourable socioeconomic profile compared to Samoans and Tongans. Cook Islanders and Samoans were in the best (and similar) financial positions, although Samoans reported greater financial stress. Samoans were more likely to report financial stress as they had the second highest number of occupants per household and also had the second highest number of children (Table 13). Significant differences in health-related socioeconomic characteristics existed between the Pacific ethnic groups and will be discussed in the following subsections.
**Ethnicity**

Seven percent of the total sample had mixed ethnicity. A strong sense of self identity has been found to be protective against adverse health outcomes, especially with regard to mental health, sexual health, and criminal behavior.\textsuperscript{76} In time, mixed ethnicity will be more common in New Zealand and in New Zealand’s Pacific population, increasing the potential risk associated with the loss of identity or change factors that may influence one’s identity.

**Migration**

Migrants tend to have more adverse risk factor profiles and generally have a higher prevalence of hypertension, chronic conditions (e.g. diabetes), obesity, and cardiovascular diseases (CVD).\textsuperscript{17} Birthplace and length of residence in New Zealand can be used as markers for immigration. Therefore, Cook Islanders and Niuean people should have better health profiles compared to Samoan and Tongan people (Tables 26-27, 36, 38-39), as, on average, they have lived longer in New Zealand (Table 11).

**Marital status**

Being married has a protective association with CVD. For both men and women, marriage decreases the risk of CVD and CVD mortality.\textsuperscript{77,78} Results showed that the more recently settled Pacific groups (Tongan and Samoan) were more likely to be married (Table 12) and therefore would be expected to gain the most protection. However, this may also reflect a strong cultural difference between traditional and more liberal Western social norms.
**Family size**

Family or household size can determine overcrowding and affects disposable household income. Most findings from this survey showed similar family trends to the Census 2001 (Table 13). One important difference was observed in the average size of Pacific families. Census 2001 reported Pacific family sizes ranged from 3.4 to 3.9 members. The DHAH estimated family or household size ranged of 6.0 to 6.9 members.

It is likely that this difference is the result of varied definitions of family or household size. This issue was addressed recently by Koloto et al, who in consultation with the Ministry of Social Development agreed that standard tools used to measure family size were inaccurate for Pacific people and that total household number was best used to quantify a Pacific household or family rather than family group, because a single Pacific household may encompass 3 to 4 family groups (extended family).

**Housing**

Housing has been directly linked to cardiovascular and all-cause mortality. Living in sub-standard housing has been shown to increase the risk of many infectious diseases and also to worsen the symptoms or ailments associated with chronic diseases. Pacific families were more likely to live in damp and cold housing than Māori and New Zealand Europeans, were also more dependent on rental accommodation and more likely to live in overcrowded circumstances in response to economic hardship and larger families. The above factors combined with having lower income increases the mobility of Pacific households, and can also be prompted by increasing property rents.
For these reasons it has been proposed that home ownership may be a positive indicator of prospective health status.\textsuperscript{18} Long-term residence can increase the quality of care received from a general practitioner as the general practitioner-client relationship can be developed over time and continuity of care established. It was surprising to find that the Cook Island ethnic group had a low level of home ownership (Table 14) considering their longer residence in New Zealand (Table 11), smaller household or family size (Table 13), and higher income levels (Figure 7) but approximately 10\% higher level of beneficiaries (Table 15). Contrary to our results (Table 14), Census 2001\textsuperscript{84} reported that Samoans had the highest level of home ownership (27\%), followed by Niueans (25\%), Cook Islanders (24\%) and Tongans (23\%).

**Income**

Income is reported to be the single most important determinant of health.\textsuperscript{16} Although Pacific people have been identified as having low-income levels, there is a paucity of published literature comparing the Pacific ethnic groups. Census 2001 reported that Niueans and Samoans had the highest median incomes.

The DHAH found Cook Islanders and Samoans had the highest and similar household income levels. However, Samoans reported greater financial pressure. This may result from the fact that Samoan families have larger households (Table 13) and that other financial pressures may contribute compared to the Cook Island community. These financial pressures include remittances to family in Samoa, donations of money to the Church, and a continual adherence to the cultural concept of *Fa’a Samoa*,\textsuperscript{85} which include requests from family elders, leaders, or *Matai* (village chief) for financial
contributions that will be used to finance projects, functions, or for gifting to prominent people, guests, and visitors.\textsuperscript{85}

**Employment**

The main factor determining income is employment.\textsuperscript{86} Employment has been shown to increase general health and wellbeing as it provides many opportunities for social interaction, community participation, the development of social status, and can increase levels of physical activity.\textsuperscript{86} Conversely, unemployment has been found to be detrimental to both physical and mental health.\textsuperscript{20} The low level of full time employment of Tongans was also observed in the Census 2001\textsuperscript{84} and may reflect larger family sizes and explain why more Tongans take part in ‘home duties’.\textsuperscript{84} Surprisingly, Tongans had the fewest beneficiaries and Cook Islanders had the most. This may reflect different levels of awareness for welfare entitlements, and how to access them. Many people who are entitled to a Community Services Card (which gives subsidised healthcare assistance to low income earners) do not have them, and this is more common in Māori and Pacific communities.\textsuperscript{87} Cook Islanders and Niueans hold New Zealand citizenship and are therefore entitled to welfare. This is not necessarily the case for all Tongan and Samoan resident in New Zealand, however, and may contribute to the lower numbers of beneficiaries.

**Education**

Education can affect many determinants of health indirectly by determining occupation and income,\textsuperscript{16} but also affects health directly by improving understanding of health information and confidence in seeking the aid of professionals. Mothers who were better educated were more likely to receive health services for their children
including postnatal care, immunisation, use of community nurses, and early dental care and childhood education.\footnote{88}

The more recent Pacific migrants (Samoan and Tongan) achieved higher-level qualifications (Table 16) compared to the longer-term New Zealand-resident Pacific groups (Niuean, Cook Islanders). Indeed, this trend was also observed in Census 2001.\footnote{84} An apparently stronger emphasis on education, may explain why these differences have occurred. This new opportunity of obtaining higher education is more likely to be appreciated, valued, and utilised. Furthering education is a primary reason for coming to New Zealand for many Pacific people, as there are few institutions that offer tertiary training in the Pacific. Current immigration policy gives preference to skilled/qualified applicants and may also contribute to the observed differences.\footnote{89}

**Summary**

This is one of the two largest surveys carried out on New Zealand’s Pacific community to date. The ethnic composition of this sample makes it a valuable dataset as it includes Auckland’s four largest Pacific ethnic groups aged 35–74 years (Samoan, Tongan, Cook Island, and Niuean), thus allowing comparisons to be made between them. It is recognised that the recruitment procedure used in sampling from the Electoral roll does have limitations as it would not capture Pacific people who have non-Pacific surnames (as explained previously). However it did allow for the targeted use of the Electoral Roll to sample the Pacific population.
Unlike previous surveys carried out on Pacific people, this is a population-based survey and therefore is more likely to be representative of the Pacific population as opposed to workforce surveys.

**Health Transition Theoretical Context**

From this assessment of the health-related socio-economic factors among the Cook Island, Niuean, Samoan and Tongan ethnic populations, it is clear that each community is at varied stages of transition into New Zealand society. An example that highlights this is the difference in family and household size. Tongan and Samoan groups have close to 4 children on average, whilst Niuean and Cook Island groups have close to 3 children each. Furthermore, participants from the Niuean and Cook Island groups were more than twice as likely to not have any children compared to both Tongans and Samoans. Lower levels of fertility were also reported for Niuean and Cook Islands ethnic groups in a report by Counties Manakau DHB.\(^9\)

**Conclusion**

In conclusion, a distinct pattern (continuum) emerged from the results. The Cook Island and Niuean ethnic groups generally had a similar and more favourable socioeconomic profile compared to the Samoan and Tongan ethnic groups (Table 11). These differences are most likely to be related to the length of residence in New Zealand. Longer residence in New Zealand appears to positively affect socioeconomic characteristics, and is most likely due to the health transition process.
Furthermore, to better determine and understand the health patterns of Pacific people, the findings of this study support the contention that each Pacific ethnic group should be investigated separately.

5.2 Alcohol

There is a dearth of research on alcohol consumption and drinking patterns of Pacific people. The Pacific Drugs and Alcohol Consumption Survey (PDACS) 2003, was the first major study developed to address this need. In the PDACS, 1103 Pacific participants aged 13-65 years provided a wealth of information on Pacific alcohol consumption and drinking patterns. In this study only 472 (42%) were adults aged 35 years and older. Our study, in contrast, only surveyed older Pacific adults and although not primarily focused on alcohol consumption, has provided an extensive amount of information on the use of alcohol of 1011 older Pacific adults. Arguably these findings could be regarded as the most reliable/extensive source of information on alcohol use of older Pacific adults in New Zealand.

Total alcohol consumption

In contrast to findings from the PDACS, a key finding of our study is that total alcohol consumption of Pacific adults is considerably lower than Europeans. The 2003 PDACS found that Pacific drinkers drank on average 21 litres of pure alcohol per year (men 28 litres, women 14 litres) compared to 11 litres per year (men 16 litres, women 7 litres) in European/Others. In contrast, the DHAH found that the Pacific drinkers drank on average 4.3 litres per year (men 5.6 litres, women 3.3 litres) compared to 6.6 litres per year for Europeans (men 8.2 litres, women 4.9 litres).
This point of difference may be explained in part by the differing age range of the two studies. The DHAH surveyed people from ages 35-74 years; whilst the PDACS surveyed from 13-65 years, suggesting higher consumption in Pacific youth than their non-Pacific counterparts. Some support for this suggestion is shown in Tables 17 and 21 where younger age groups were more likely to be drinkers, consumed more drinks on an average sitting resulting in greater quantities of pure alcohol consumed.

**Number of drinks**

In our study Pacific drinkers reported drinking 6.9 drinks on an average occasion. This was similar to the average of 8 drinks per occasion reported by the PDACS.\(^{27}\) The comparative average for European/Others was 4 drinks reported by PDACS and 5 drinks in the DHAHS for Europeans. Binge or risky alcohol use has been defined as consuming seven or more drinks on any one occasion.\(^{92}\) This underscores the fact that most Pacific drinkers tend to be high-risk drinkers.

**Drinking frequency**

The lower total level of alcohol consumption in Pacific people is due to their lower frequency of consumption. The majority (over \(2/3\)rd) of Pacific drinkers drank ‘\(\leq\) weekly’, whereas the majority of Europeans (approximately \(2/3\)rd) drank \(\geq 2-3\) days *per week*. This contrasts with results of the PDACS that found Pacific and European/Other drinking frequencies to be comparable. In the PDACS, Pacific people reported consuming alcohol 2-3 days per week compared to the national average of 3 days per week.
Non-drinkers

Non-drinking was much more common in the middle aged and older Pacific people. This may be due in part to alcohol playing less of a role in older Pacific people’s lives. It may also be that consumption of alcohol is socially frowned upon by Pacific communities and that older people are more likely to adhere to such social norms and expectations.

Reasons for stopping drinking

Social and family reasons were reported as the main cause for stopping drinking. It is possible that this may be a result of the importance placed on adhering to cultural/religious norms and familial expectations and a negative stigma that may surround alcohol consumption from within Pacific communities. The majority of Pacific people (83%) are members of a church, which may contribute to social reasons cited for stopping drinking and abstaining from drinking altogether. Pacific drinkers were twice as likely as Europeans to experience hazardous drinking, more likely to report violence and injury from other peoples drinking and problems from violence and serious arguments as a result of their own drinking. Our results confirm the binging nature of Pacific drinkers alcohol consumption patterns (Table 21) as reported elsewhere. Negative consequences of this binge drinking may act as a deterrent from drinking and explain why Pacific drinkers were approximately five times more likely to stop compared to Europeans.

Limitations

While the DHAH has many strengths (being one of the largest population based surveys of Pacific people allowing for intra-Pacific ethnic comparisons, gathering
physical measurements of risk factor status) it also has limitations. An important limitation of this study and indeed nearly all studies on alcohol consumption is the reliance on self-reported information concerning alcohol consumption and drinking patterns, which may be subject to recall and social desirability bias. Respondents may forget or report drinking behaviours that are more aligned to socially acceptable/appropriate norms rather than reality.

In addition, the low prevalence of drinking in this Pacific population has meant that the drinker sample is relatively small (n=299) compared to the whole Pacific sample (n=1011) making some analyses problematic. For this reason, findings need to be interpreted with caution especially when assessing the smaller Pacific ethnic groups and even more so when these groups are age or gender stratified.

Further research in this field could investigate in more detail the reasons why ex-drinkers stopped, and why many Pacific people abstained from alcohol consumption altogether. Research that aims to determine what environment can best facilitate the transformation of Pacific drinking patterns from the binging/hazardous style reported here and elsewhere to a more moderate/responsible style would also be useful.

**Conclusion**

Middle aged and older Pacific adults were less likely to consume alcohol than Europeans, however, those who do, consume more on an average occasion but drink less regularly, so that overall, they consume significantly lower amounts of pure alcohol. Drinking patterns in Pacific adults tend to show substantial diversity by age (older are less likely to drink), sex (women less likely to drink), and financial
deprivation (middle groups consume more than least and most financially deprived). For Europeans these differences were not so large and a more homogenous drinking style was observed. Pacific drinkers were approximately five times more likely have stopped drinking compared to Europeans, citing family and social reasons as their main motivation for stopping drinking.

For these reasons it is proposed that any possible beneficial effects that light/moderate alcohol consumption may offer in terms of lowering CVD risk are unlikely to be experienced by Pacific drinkers due to the binging consumption style.

**Health Transition Theoretical Context**

Because drinking is a common western lifestyle choice, it is interesting to note that non-drinking is more common in all Pacific communities than drinking. The gender differences also show that cultural norms have been carried over from home islands and are still strong within most Pacific cultures in New Zealand. Considering findings in the ‘Health Transition’ context, it is proposed that future drinking behaviours of Pacific people may change to more resemble that of the general New Zealand population which would mean an increased drinker population and a balance in consumption between the sexes. There are benefits associated with abstaining from alcohol consumption for Pacific people (especially considering the dominant drinking style), therefore health promotion campaigns that aim to maintain the high level of abstainers within Pacific communities could be worthwhile.
5.3 Diabetes

**Pacific and European ethnicity**

It has been frequently reported that between a third and a half of all diabetes in the community remains undiagnosed\(^{40}\) and that this may be experienced more by Pacific people.\(^8\) The common mantra that ‘for every known case of diabetes there is another undiagnosed in the community’, is not supported by our study and this finding has significant public health implications in estimating the projected burden of undiagnosed diabetes in New Zealand by ethnic group.

In the current study, the ratio of diagnosed:undiagnosed diabetes was approximately 2:1 or that for every two European people with previously diagnosed diabetes there was approximately one (0.92) person in the community undiagnosed.

For Pacific, the ratio of diagnosed:undiagnosed diabetes was approximately 5:1 suggesting that for every five Pacific people with previously diagnosed diabetes there was approximately one (1.05) person in the community undiagnosed.

In contrast, a study that measured new and known diabetes in adults aged 40–70 years in South Auckland during 1991-94, found that the proportion of new diabetes in Europeans was equal to 52% of those with known diabetes. For Pacific, the proportion was 81%.\(^{93}\) This finding suggests that diabetes screening for Pacific has improved considerably over the past decade.

Prevalences of previously diagnosed diabetes found in this study had similar ethnic patterns to those reported in the 2002/03 New Zealand Health Survey.\(^{37}\) However the
self-reported prevalences of previously diagnosed diabetes tended to be considerably lower in the New Zealand Health Survey. In absolute terms, the DHAH survey prevalences were higher than the New Zealand Health Survey data by approximately 1.4% for Europeans, and 9.5% for Pacific ethnic groups. These differences are in part due to the differing age structure of each survey. The New Zealand Health survey sampled from 15 years and above compared to 35 years for the DHAH. These surveys were both conducted during 2002/03. These findings emphasize the importance of presenting data on the prevalence of diabetes by age group as diabetes prevalence increases rapidly in increasing age.

In contrast to a cross-sectional survey carried out in South Auckland from 1991-1994 and the Workforce Survey in 1988-1990, diabetes prevalence appears to be increasing among Pacific people. The South Auckland study reported age adjusted rates of known diabetes of 5.2% for Europeans, and 6.0% for Pacific peoples compared to 3.9% and 19.5%, respectively, in the DHAH.

For those with previously diagnosed (known) diabetes, Pacific people aged 55-64 had the highest relative risk of diabetes (RR: 9.33) compared to Europeans. This is similar to the findings for Pacific people aged 50-54 (RR: 11.8) from the Workforce Survey. Prevalences of known diabetes by age group and ethnicity followed expected trends with Pacific people having the highest prevalence’s. Risk of new diabetes in Pacific people in different age and gender groups ranged from 0.99–11.61 compared to Europeans. The greatest increased risk for new diabetes was found in the Pacific age group of <45 years (RR: 11.61) which was similar to the Workforce Survey findings (RR: 9.5).
The Workforce Survey conducted during 1988-90\textsuperscript{6} reported newly diagnosed diabetes in 1.7% of Europeans and 7.7% Pacific people.\textsuperscript{75} However, these were likely to be lower than the general population as they were employees (healthy worker effect). Prevalences found in the DHAH were 1.8% for Europeans and 4.0% Pacific.

The marked decrease of newly diagnosed diabetes in Pacific is interesting and is likely to be the result of improved health and improved access to healthcare with the emergence of many new Pacific healthcare providers over the past two decades, resulting in earlier detection of diabetes. Measurement and classification of Pacific ethnicity could also have influenced this difference. This study used prioritisation of Pacific ethnicity similarly to that used in the 2001 Census which decreases the likelihood of under-reporting.\textsuperscript{63}

Participants with known diabetes were more likely to engage in moderate exercise when compared to those newly diagnosed. This suggests that once a diagnosis is made increased physical activity may have been recommended to these people.

Having received further tertiary education had a protective association with diabetes. Levels of tertiary education were lower for all categories of impaired glucose tolerance when compared to the ‘normal’ reference group. (Table 22) This may be due to education leading towards higher socio-economic status, and also an increased awareness of healthy lifestyles, diabetes risk factors and symptoms.
The difference observed in the cumulative proportions of new diabetes between Pacific and Europeans (Figure 10) showed that a larger proportion of Pacific people generally experience earlier onset of diabetes. This difference equates to Pacific people being diagnosed up to 10 years earlier than Europeans and suggests that Pacific people will live with diabetes and its complications significantly longer and/or have earlier mortality.

It is important to note that the age at diagnosis is not necessarily the age of development of diabetes, and that the time between development and diagnosis may vary between ethnic groups.

BMI and age were found to be the most significant factors associated with newly diagnosed diabetes, IGT, and IFG (Tables 22 and 24) which provides evidence of the universality of BMI as a risk factor independent of ethnicity. Furthermore, this finding supports the focus that many health campaigns have on prevention and control of obesity. Model 2 from Table 25 showed that adjusting for BMI alone substantially reduced ethnic differences in new diabetes prevalence.

Increasing and maintaining health promotion programmes centered on living healthy lifestyles (nutrition and activity) to keep a healthy BMI will continue to be the most appropriate method to prevent and manage diabetes in New Zealand.

**Diabetes and the Pacific ethnic groups**

Niueans had the healthiest diabetes profile of the Pacific ethnic groups. They had the lowest HbA$_{1c}$ levels, and prevalence of total and previously diagnosed diabetes.
Among women, Cook Islanders had the next lowest total diabetes prevalence, HbA$_{1c}$ levels, and fasting glucose levels followed by Samoan and Tongan women. These patterns by Pacific group were consistent with the socio-economic patterns highlighted previously.

Among men, however, the next lowest prevalence was observed in Tongans followed by Cook Islanders and Samoans.

Differences in diabetes prevalence between the sexes was most pronounced for the Tongan ethnic group, where Tongan women (35.8%) had more than double the prevalence of diabetes compared to Tongan men (17.8%). In all other Pacific ethnic groups men had higher prevalence of diabetes compared to their female counterparts. This observation may also explain why Tongan men have a life expectancy 4 years longer than women.$^{94}$ In all other Pacific nations, females have a greater life expectancy than males.

The only other studies that offer comparable data are the Workforce Diabetes Survey (WDS)$^{46}$ from 1988–1990 and the South Auckland Diabetes Project (SADP)$^{93}$ from 1991–1994. Workforce based surveys, however are not directly comparable to the DHAH due to a possible ‘healthy worker’ bias. Age groupings also differ between these studies which would compromise comparability, although all statistics are age adjusted. With these caveats, overall BMI levels in men were higher in the present study compared to the WDS survey.
Compared to the WDS, all ethnic groups in this study had higher proportions of diabetes. The prevalence for both Cook Islanders and Niueans doubled, Samoans tripled, whilst the Tongan prevalence was more than 6 times higher than those measured 13 years earlier.

Comparing measures of known diabetes (previously diagnosed) to the South Auckland Diabetes Project (SADP) carried out between 1991–94 demonstrated a similar pattern. Niueans reported the smallest difference (1.4 times higher in the current study), Cook Islanders were intermediate at about double the SADP prevalence, whilst the Tongan and Samoan groups reported prevalence was approximately 4 times higher.

As Samoan and Tongan communities have on average resided in New Zealand for a shorter period than the Niuean and Cook Islands communities, they may be more at risk of negative health consequences that come with migration.

Samoans, Tongans, and Niueans had similar ratios of known diabetes to undiagnosed diabetes (4:1; 4:1; 5:1; respectively). The Cook Islands group however had a smaller ratio (2:1) than the other Pacific groups as did Europeans. A larger ratio indicates better screening of diabetes as fewer cases are left undetected. The large ratios of the Samoan, Tongan, and Niuean groups could be due to aggressive screening for diabetes by Pacific health providers and the higher use of Pacific health providers by these groups.
The smaller ratio of the Cook Islands group, in spite of a relatively high prevalence of diabetes, may be due to lower utilisation of Pacific providers, and poorer screening of diabetes in Pacific people from mainstream health providers.

The Cook Islands community are more geographically spread throughout New Zealand than other Pacific ethnic groups. Of the four largest Pacific groups, the Cook Islands population had the smallest proportion (60%) living in the Auckland region. This geographic spread may also occur within the Auckland region and if so, could decrease the use of Pacific providers by Cook Islanders, as they maybe less likely to live in areas of high Pacific density (Table 10).

Thus, Cook Islanders may be more likely to access mainstream health providers. Higher levels of integration/acculturation into New Zealand society as a result of their lengthier stay, could also contribute to their lower use of Pacific providers. The same argument could be put forward for Niueans, however, they are most likely to live in the Auckland region (80%), and have the lowest prevalence of diabetes of the Pacific ethnic groups.

The high ratio of known to undiagnosed diabetes suggests that screening programmes in Samoan, Tongan, and Niuean communities have been successful. This could in part be due to ‘by Pacific for Pacific’ services provided by Pacific Primary Health Care Organisations (PHO) as well as more robust screening of Pacific people by mainstream healthcare services. However for Cook Islanders there is evidence that more aggressive screening for diabetes is needed.
Health Transition Theoretical Context

The lower prevalence of diabetes of Niueans indicates that this community could be at a more advanced stage of health transition compared to the other Pacific ethnic groups. As mentioned earlier, this is most likely to be related to their length of residence in New Zealand and political/historical ties to New Zealand. The higher prevalence of diabetes in Tongan women raises questions as to whether i) the prevalence in Tongan men will rise to a comparable level, or ii) if differences will remain, or iii) if the gap will be closed by lowering the female prevalence. Putting this in the Health Transition context, it may be that positive health characteristics of a traditional lifestyle experienced by the younger Tongan male group combined with an active labourers work life in New Zealand has offered temporary protection to them, however, for Tongan women, changes in lifestyle upon migration may have only worsened such differences. It is concerning to think that the diabetes rates of Tongan men may increase if they are to follow a path close to that of their female counterparts. Research into why Tongan men have comparatively lower levels of diabetes compared to women is therefore a priority.

5.4 Overweight and Obesity

Prevalence of Overweight & Obesity

The 1988-90 Workforce Diabetes Survey found that 94% of Pacific men and 93% of Pacific women were ‘overweight or obese’. If the same BMI cut offs (overweight ≥ 25, obese ≥ 30) are used to analyse DHAH data, then 95% of men, and 100% of women were ‘overweight or obese’.
Within the Pacific population there has been a large shift into the obese category, the WDS reported 55% of men and 72% of women were obese whereas our study found that 73% of men and 83% of women were obese.

Although these studies are not directly comparable due to study design and differing age criterion, results may reflect a shift to higher levels of overweight and obesity in Pacific communities, similar to those reported for the national New Zealand population. Other support for this is found when comparing the 2002/03 and 2006/07 New Zealand Health Surveys (NZHS) where the proportion of Pacific participants who were obese increased from 38% to 64% for men, and from 47% to 66% for women.

Comparing mean BMI levels between the two studies (WDS and DHAH) also shows an increase over time. On average BMI levels of Pacific men increased by 1.8 kg/m² between these studies and for Pacific women an increase of 2.9 kg/m² was observed. This increasing trend of ‘overweight and obesity’ is in line with the total New Zealand population’s trend of increasing BMI over time.

Furthermore, more detailed ethnic comparisons show obesity is increasing in both Samoan and Tongan men and women. Comparing findings of the SADP/SOFP study conducted during 1991-96 to the DHAH, the proportion of obese Samoan men and women increased from 46 % to 58 %, and 60 % to 75 % respectively; and for
Tongan men and women obesity increased from 49 % to 60 %, and 59 % to 78 %, respectively.

These findings clearly illustrate how almost an entire community has been adversely affected by an obesogenic environment and the findings equally clearly demonstrate the need for public health interventions to be designed for the whole Pacific community. More effective strategies may require a structural shift in resources that foster more supportive environments, rather than supporting nutritional and activity initiatives that struggle to operate with observable success in an inhibitory / obesogenic environment.

**Perceptions of body weight**

It is apparent that Pacific people have similar awareness of their weight (in kg) as European New Zealanders. Despite a larger proportion of Pacific people reporting being heavier than 1 year ago and despite their much higher prevalence of overweight and obesity compared to Europeans, significantly fewer Pacific people regarded themselves as being overweight compared to Europeans.

Over 95% of the Pacific sample (men and women combined) were classified (using BMI) as ‘overweight or obese’ however only 56 % reported the perception that they were overweight – leaving a 40 % shortfall. Similar findings have been reported elsewhere, which found that Samoans residing in New Zealand and Samoa who were
above normal weight did not perceive themselves as being overweight and were happy with their body size, weight and health.\textsuperscript{96}

In contrast, 67\% of Europeans surveyed in the DHAHS were categorised as being ‘overweight or obese’ which was accurately reflected in their perceptions as 65\% reported the perception that they were overweight.

These findings are similar to those reported elsewhere\textsuperscript{97} and indicate that Pacific people have significantly different views on body image than Europeans with a preference for larger body size.\textsuperscript{98, 99}

Reasons identified have been that cultural preferences and established norms for a larger body size are partly responsible for these differences. The cultural preference for larger body sizes are reported to be symbolic of higher status, hierarchy and beauty.\textsuperscript{100-102}

While this study comprised older adults primarily born in the Pacific (95\%), research on the perceptions of young New Zealand born Pacific children have found a similar preference for a larger body size in Pacific youth as well.\textsuperscript{103}

**Physical activity & BMI / Obesity**

Tables 34 & 35 presented ethnic specific multivariate regression equations that model ‘obesity’, using ‘normal weight’ individuals for Europeans and ‘normal and
overweight’ individuals combined for Pacific participants as the reference group. For both Pacific and European non-drinking, non-smoking, and financial deprivation increased the likelihood of obesity and exercise decreased the likelihood of obesity.

For Europeans, men were also significantly more likely to be obese and ‘time exercised’ significantly lowered the likelihood of obesity. In contrast, Pacific women were more likely to be obese than Pacific men and ‘time exercised’ although protective did not significantly impact on the likelihood of being obese.

Further analyses that looked at any form of participation of exercise or physical activity (PA) in the past 3 months (vigorous or moderate) for Pacific people found no significant difference (although close p = 0.0683) in BMI levels when compared to sedentary individuals (Table 32). However, results showed that greater participation in PA did lower BMI. These findings indicate that for Pacific populations especially, there may be grounds to prioritise nutritional programs (over activity programs) that aim to impact on overweight and obesity in a more effective way.

Participation in Exercise may not have reached significance in the Pacific group due to interpretation bias. The PA measure has been validated for Europeans only, and it may be less sensitive for measuring PA in Pacific people. For example bias may occur if Pacific people did not perceive and therefore report some of their behaviours as PA. This could distort the sensitivity of the PA measure and diminish any possible effect detected by exercise on obesity levels.
In the combined multivariate model (Table 33, Model 6) and after adjusting for possible confounding factors, older Pacific adults were 11 times more likely to be obese than Europeans. This finding is similar to those found in a study that compared levels of extreme obesity in children aged 5-14 years, where Pacific children were 11 times more likely to be extremely obese than their European counterparts.51

**Health Transition Theoretical Context**

BMI levels for Pacific people tend to be lower in the older age groups (Table 15). Whether this is a true indication of reality is questionable. This point is raised due to differences observed in older and younger Pacific migrants. Older Pacific migrants are more likely to maintain aspects of a traditional diet104 (which is generally healthier, and lower in calories) and are therefore maybe more likely to have lower BMI values than their younger counterparts. Furthermore, the lower BMI levels may be influenced in part by survival bias if those who had higher BMI levels failed to reach older age, thus confounding the results. Internationally, BMI levels continue to rise across all ethnic groups and given their very high levels already, this issue is of particular concern for the health of Pacific people in New Zealand.

**Conclusion**

The continued increase in the prevalence of overweight and obesity in Pacific adults has resulted in almost 100% of men and women being defined as overweight or obese. It is also apparent that perceptions of an ideal body size for Pacific adults may contribute to the higher levels of overweight and obesity in this population. Observing BMI patterns by age and gender show that the Pacific population are different to the European population and these findings warrant further investigation. As almost the
entire adult Pacific population over 35 years of age in New Zealand is overweight or obese, any programme must address the whole community and focus on the environment in which they live. Programmes targeted at health education for overweight and obese individuals would be somewhat meaningless.

### 5.5 Cardiovascular health of Pacific ethnic groups

The findings of this study illustrate many of the causes of the substantial health disparities that exist between European and Pacific New Zealanders. Furthermore, they clearly show that there are important differences in the cardiovascular disease (CVD) risk profile between Pacific ethnic groups. Among Pacific people, Niuean men and women had the healthiest CVD risk profiles. They had the lowest inactivity levels, highest average exercise times, smallest waist to hip ratios, and the healthiest lipid profiles.

This finding may reflect the more favourable health-related socioeconomic profile that Niueans have compared to other Pacific ethnic groups as reported earlier and has implication on their better overall health outcomes. This finding is supported by other literature where area based measure (similar to the NZDep2001) of SES also found association with cardiovascular health. ¹⁰⁹

Among women, Samoans had the next best CVD risk profiles, followed by Tongans and Cook Islanders. Among men, Cook Islanders had the next best CVD risk profile to Niueans, then Samoans, and finally Tongans.
Unexpectedly, Cook Islands women had the poorest CVD profile despite their high SES and relatively long residence in New Zealand. This may be attributed to their higher level of smoking. However, they had the second lowest prevalence of diabetes after Niueans.

Within the gender groupings, more marked differences in CVD risk factors were observed in Pacific women. These differences do not appear to be moderated by differences in BMI, as BMI measures for Pacific in women were within 1 kg/m\(^2\) of each other as opposed to 3.6 kg/m\(^2\) in Pacific men. In men, all Pacific groups had lower smoking prevalence by more than 10% compared to the 1988-90 WDS study, and Tongans by 20% (although they remained the group most likely to smoke). Among women a rise in smoking prevalence of 10% was reported by Cook Islanders. However, all other groups reported similar levels to the WDS. Sex-specific prevalence mirrored those found in the Pacific where Tongan men were most likely to smoke and Niuean men least, and Cook Islands women were most likely to smoke and Tongan women least.\(^{105}\)

All groups reported higher exercise levels compared to the WDS. This is unexpected considering that the WDS was workforce-based. An altered social definition/perception of what constitutes ‘activity’ and the positive aspects that come with it, could in part be responsible for this difference considering the time-frames and settings.

Compared to the WDS, systolic blood pressure was higher in all groups with the exception of Tongans. Diastolic blood pressure was slightly higher in all groups
except for Cook Island men. These measures contrast with trends of the general New Zealand population previously reported, that showed a decrease in blood pressure in New Zealand over time. However, these trends were from a non-Polynesian sample. Niueans had the healthiest lipid profile for both men and women. All ethnic groups had a better profile compared to levels measured in 1988–90. This trend is similar to those of European New Zealanders and may be a result of national public health measures that have encouraged lower cholesterol and salt consumption through food regulation and health promotion. As in the WDS survey, Pacific women’s HDL cholesterol levels were significantly lower than European women’s. However, for men this trend was only observed for the Samoan and Tongan groups.

Pacific people’s levels of microalbuminuria were generally higher than Europeans. Samoan men and Samoan and Cook Island women had significantly higher levels of microalbuminuria than their European counterparts. Compared to levels from the 1988–90 WDS all groups had lower levels of microalbuminuria in the current study. Elevated microalbuminuria concentrations have been associated with obesity, high BP, and triglyceride concentrations. However, hyperglycemia is the key factor that explains higher levels of microalbuminuria. The lower levels of microalbuminuria measured in this study is reassuring and may indicate positive gains that are being made in the prevention of CVD in Pacific peoples.
Health Transition Theoretical Context

Positive health traits that traditional societies offer need to be firstly identified, valued and then nurtured in order to ensure best health outcomes for all. It seems that initial protection that these factors provide (healthy migrant effect) are overridden by financial constraints and consequential lifestyle changes (nutritional and activity) made on migration. Smoking is the leading modifiable CVD risk factor and is a good example of one such health trait. Tongan women were the least likely to smoke, however, Tongan men were most likely to smoke. This may be a cultural trait carried over from life in Tonga. These non-smoking values of Tongan women should be valued and encouraged rather than go unrecognised. This promotes a strengths-based approach to health research and health issues rather than focussing only on deficits. Each Pacific population is at varied stages of the ‘Health Transition’ in New Zealand. Using this theory to contextualise health and its outcomes can give insights into forecasting more accurate progressions in the future and/or developing effective health policies and interventions to promote better health in the present and the future.

From this study, it is apparent that although Pacific ethnic groups have many similar adverse health levels, there were Pacific ethnic differences that places them at different points of the Health Transition in the New Zealand context. Using the Health Transition as a construct to model future health forecasts of these different groups can allow greater understanding and aid policy/programme development in both prevention and provision of healthy services to Pacific communities in New Zealand.
**Conclusion**

These results illustrate the large health disparities that exist between European and Pacific New Zealanders and clearly show that there are important differences in the cardiovascular disease risk profile between Pacific ethnic groups.

For all Pacific communities, the high levels of CVD risk factors highlight the need for greater focus on both prevention and CVD risk assessment and management.

**5.6 Overall Conclusion**

The Pacific populations in New Zealand are socio-economically disadvantaged which undoubtedly impacts on their health. The length of residence in New Zealand tends to moderate this relationship, and is different for the various Pacific ethnic groups. Greater social mobility is needed and education may be the greatest enabler to ensure better health outcomes. A low proportion of the Pacific population consume alcohol and therefore any proposed CVD benefits are negligible. Furthermore, the adverse heavy consumption style of Pacific drinkers would counter any possible cardiovascular benefit to them. The prevalence of diabetes and CVD risk factors in Pacific populations continue to register at unacceptable levels. There have been considerable gains in screening for diabetes, high blood pressure and access to services for these conditions. These gains now need to be translated into better management and prevention. Like most westernised populations overweight and obesity in the Pacific population in New Zealand continues to increase, but for Pacific people it is much more prevalent than Europeans. This thesis has demonstrated that differences in BMI account for much of the ethnic differences in the diagnosis of new cases of diabetes. Given that overweight and obesity (and increasingly diabetes) is
almost ubiquitous among Pacific adults in New Zealand, it is clear that policy and regulation-based interventions aimed at the whole community are required if we are to address the observed ethnic disparities in health status.
References


74. Metcalf PA, Scott AJ. Using multiple frames in health surveys. Stats in Med 2009 [In press]


87. Parks C. A study of Community Service Cards in five primary health care practices in the Auckland region [MHSc thesis]. Auckland: University of Auckland; 1996.


Appendix A: Survey Methodology

Visiting cluster start points

Each start point consisted of a street name and street number. The recruiter went to the address of the start point to determine if it was a household. If so, information on all eligible adults (if any) was collected as described below and a further 19 subsequent households would form a cluster.

After visiting the start point, the recruiter then returned to the street. S/he then moved to the right, based on the direction when facing the household. The recruiter then continued from household to household in that fashion (i.e. to the left).

Town houses, flats, retirement villages and caravan parks were treated in the same way, except that the common drive was treated as the street.

A slight variation was required for apartment blocks and buildings that were arranged vertically. Here the recruiter moved through them in ascending order, based on their number or letter.

If the recruiter got to the start or end of a street, they simply continued around the corner staying on the same side of the road. The same rule applied if the recruiter arrived at the end of a dead end street.

In rare circumstances this process brought the recruiter back to a household that had already been visited. In this situation, the recruiter went to the household immediately behind him/herself, when facing the last household visited.
If the Start Point address were Flats, Townhouses or Apartments:

If the start point address was a block of flats, townhouses, or apartments, they were considered as separate households, and the middle number of the households was the start point. If there was an even number of households at a particular address, the recruiter began at the household numbered one greater than the middle. E.g. If there were 6 flats at a single address, the recruiter went to number 4. If there were two townhouses (7A & 7B), the recruiter went to 7B.

Start points in non-residential areas:

A small number of start points were in mostly non-residential areas e.g. Commercial, retail, Naval base, and industrial areas. These start points were rejected from the recruitment process after ensuring that there were no residential properties in the immediate area. To do this the recruiter first established that the property at the start point was non-residential. Then the recruiter proceeded from the start point in the manner described below (see selecting 19 subsequent households). Provided the next 20 addresses visited were also non-residential then the starting point was rejected. However, if even one property among the 20 visited was found to be residential, the starting point was used. Recruiters made an effort to include households that were attached to commercial premises. E.g. People who lived above shops.

Timing of visits:

The timing of the visits were designed to maximise efficiency, by visiting at times when people were most likely to be at home. It was also designed to reach people
who had a range of work and recreational routines. There were up to 3 visits made to one address, 1 of which was during the morning, 1 in the afternoon, and 1 in the early evening.

One visit to each starting point occurred on a Saturday between 9.00 am and 6.00 pm or on a Sunday between 1.00 pm and 6.00 pm (to avoid church time).

Another visit occurred during the early evening, Monday through Friday between 5.00 pm and 7.00 pm. The last visit occurred on any day different from the previous two visits. If the third visit was on a Monday through Friday, it was at a different time of day (morning, afternoon or early evening) to the previous mid-week visit. E.g. If the previous weekday visit was in the morning, the next weekday visit was in the afternoon or early evening, and on a different day.

**Making return visits:**

Households where there was no access (because of a dog or for other reason) or no one home were all visited again. This step was essential to avoid selecting a sample of adults who spend more time than average at home. Up to two subsequent visits were carried out for each of those households before the attempt was abandoned. All visits were on different days and different times of the day than the initial visit. Households where all adults currently living in the household were not present were also visited again. Ideally, the timing for the return visit was arranged with someone else in the household.
**Documentation of household visits:**

Two types of documents were used that consisted of ‘Time & Travel’ Log and a ‘Call sheet’.

The ‘Time & Travel’ Log was a sheet used by the recruiter to keep a record of the time and distance spent travelling to and from the cluster for each of the 3 required visits.

If more than one cluster was visited on the same trip before going home, the time record began from when the recruiter left the first cluster and travelled to the second cluster; and it stopped as soon as the recruiter returned home, or left to visit the next cluster.

The ‘Call Sheet’ was used by the recruiter to record the details of all residences in the cluster. For any excluded property, the reason for its exclusion – non-residential or short-term residential – was recorded in the Comments box for that property.

The sequence of visiting households was recorded on the 1st visit. For each property, details were recorded in the columns (from left to right; by writing or ticking as appropriate) on the:

- Sequence number (A, B, C, etc to V – omitting I and O)
- Street name and number, with flat or apartment number if relevant
- Date and time of visit using the format dd-mm-yy for date and hhmm for time (24 hour clock)
- If the property was residential or not (Y or N)
- If there was no access because of a dog or for other reason
- If no one was at home
- If the person refused to discuss or talk with the recruiter
- The number of adults ineligible because this was not their usual address or they were aged under 35 years
- The number of adults aged 35-74 years who lived at this address
- The number of other adults aged 75 years and over who lived at that address
- If a translator was required before these details could be completed. This was noted in the language column of the ‘Comments’ box.
- Details about how this information was used to make decisions are described below.

**Usual address/eligibility:**

Adults were ineligible to be selected at a residence if: they were an overseas diplomat; a visitor, or an immigrant resident for less than 12 months.

If the recruiter was unsure about an adult’s eligibility for the survey, the recruiter continued to enrol the adult and complete the HOUSEHOLD ENUMERATION SHEET so that the Research manager could decide later. All relevant information was written in the Comments section beside the number for that person.

**Recruiting adults:**

This section describes how information collected from the CALL SHEET and the HOUSEHOLD ENUMERATION SHEET was used to recruit adults into the study.
For each of the residences in the cluster, one or more of the following outcomes had to be established:

- The number of adults resident in household over 35 years of age was recorded
- If none there was no need to return
- If one or more an attempt was made to recruit them as potential subjects
- If one or more adults were out when visited an appointment was made for a return visit
- If an adult was present the study was discussed with them
- If an individual agreed to participate this was recorded, as were details about the adult
- If they declined this was also recorded, and there was no need to return
- If English was not spoken by people in the household when visited this was recorded, along with their spoken language and then it was treated as if they were out and returned with a person who speaks their language, they could also be treated as a decline if they were clearly not interested.

No opportunity to discuss with householder

The following strategies were used when there was no opportunity to discuss the survey with the householder, because:

- No access to property. The reason was recorded, and a return visit was made later
- because of a refusal to communicate
- because of a dog
- because of another reason this was then recorded in the comments field
- Nobody home. A return visit was made later
- No one home at one address, so information obtained from people at a neighbouring
address
- If no adults aged 35 and over at preceding address this was recorded and a return visit was made later
- If there were adults age 35 and over at preceding address this was recorded and a return visit was made later

Recruiters did not take the word of neighbours regarding the question of whether an eligible adult resided at a particular address. However, if no one was home during a visit, then the next house visited was asked if there are adults aged 35 years and over living at the previous house. The house in question still received return visits regardless of the answer to this question. This information was used to assess whether any potentially eligible adults were being missed by the recruitment process because they were not home.

**NON – PARTICIPANTS**

It was wished to gather as much information as possible about the adults who were non – participants in the survey. This information would be used to help understand if the processes that were used to recruit adults were acceptable. The information gathered helped to guide changes necessary to improve the process.

It was very important to respect people’s privacy. Therefore, if a person was adamant that they did not wish to give any details about:
- the number of adults in the house,
- their age, sex or ethnicity,
- or reasons why they did not wish to participate,
then, they were thanked and the recruiter moved on to the next house.

For properties excluded for these reasons the property was recorded but was not included in the count or sequence lettering of households visited:

i) Short-term residential properties – hotels, motels, boarding houses & schools

ii) Non-residential properties – commercial, retail, hospital & industrial

**Safety issues**

Recruiters were asked to go to homes of persons they did not know to collect information for the survey. (Training of recruiters and interviewers included advice about personal safety)

Specific measures to protect recruiters included:

- Recruitment was to occur during daylight hours as much as possible
- Mobile telephones were provided for staff to carry while recruiting
- Recruiters did not approach a house where there was a dog that was not restrained

*If an accident / incident occurred the following procedure was followed:*

All accidents / incidents, whether causing injury or not, (e.g. Needle stick, sprained ankle, back injury) to any person on campus or involved in university work off campus were to be reported.

Accident forms were required to be filled in. Copies of these were given to staff. Failure to complete this form may have meant that they were not covered by ACC. Accident forms were to be sent to the Research Manager as soon as possible,
accompanied by relevant medical certificates or ACC documentation. These were forwarded for processing.
Appendix B: Letter of confirmation of booking

Auckland Diabetes, Heart and Health Survey
Division of Community Health

Date:………………………

The Auckland Diabetes, Heart and Health Survey

Dear ……………………….

We are pleased to confirm that your health check and survey booking for the Diabetes, Heart and Health Study is for …… a.m. on the …… of                   , at the Mangere Community Board Room, Citizens Advice Bureau entrance on Orly Avenue, Mangere Town Centre.

Please find a diagram showing how to find the venue, a Food Intake Questionnaire, and a container for your urine sample in this envelope. Some notes over the page tell you more about some of the tests we will be doing.

Some notes over the page will tell you more about some of the tests we will be doing.

1. Remember to bring the food intake questionnaire and urine sample with you.
2. Would you please bring any medications you are presently taking regularly with you, or else a list of their names. If you use asthma medication please bring them with you.
3. You may like to bring something to read or do while waiting, since the test for diabetes will take 2 hours.
4. Please wear a shirt or other garment with loose sleeves, to provide easy access to your upper arm, so your blood test and blood pressure can be measured without having to undress.
5. Please bring your spectacles if you need them to read.

You should not smoke during the booking, as it may influence the diabetes test results.

If you have any questions or concerns about the survey that you would like to discuss, or if you are unable to attend for any reason, please phone a member of the Diabetes, Heart and Health team at the Division of Community Health. Their phone number is 373 7599 extn. 82375.

We look forward to meeting you.

Yours sincerely,

Dr Patricia Metcalf
Senior Research Fellow and
Principal Investigator, DHAH Survey
## Appendix C: The General Questionnaire

### Diabetes, Heart and Health Survey

<table>
<thead>
<tr>
<th>Consent form</th>
<th>Full name (first) (middle) (last)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>English</strong></td>
<td>I wish to have an interpreter.</td>
</tr>
<tr>
<td><strong>Maori</strong></td>
<td>E hiahia ana ahau ki tetahi kaiwhakamaori/kaiwhaka pakeha koreoro.</td>
</tr>
<tr>
<td><strong>Samoan</strong></td>
<td>Oute mana’o ia iai se fa’amatafa upu.</td>
</tr>
<tr>
<td><strong>Tongan</strong></td>
<td>Oku ou fiemato ha fakatuneloa.</td>
</tr>
<tr>
<td><strong>Cook Island</strong></td>
<td>Ka inangaro ai i tetai tangata uri reo.</td>
</tr>
<tr>
<td><strong>Nueian</strong></td>
<td>Fia manaku au ke fakaaoga e taha tagata fakahohokoko kupu.</td>
</tr>
</tbody>
</table>

- I have read and I understand the information sheet dated 9/11/2001 for volunteers taking part in this survey.
- I have had the opportunity to discuss this survey. I am satisfied with the answers that I have been given.
- I understand that taking part in this survey is voluntary (my choice) and that I may withdraw from the survey at any time and this will in no way affect my future health care.
- I understand that my participation in this survey is confidential and that no material which could identify me will be used in any reports on this survey.
- I have had time to consider whether to take part.
- I also understand that my answers in this questionnaire will be linked with information collected routinely by health authorities on important hospital admissions or other medical attention.

I consent to the researchers storing a specimen of my blood and urine for its later use relevant to this research. **Yes / No**

I wish to receive a copy of my results. **Yes / No**

I hereby consent to take part in this survey. **Yes / No**

Signature:______________________________

In my opinion consent was given freely and with understanding.

Witness name (please print)______________________________ Witness signature______________________________ Date______________________________

**Principal Investigator:** Dr Patricia Metcalf, Division of Community Health, Auckland Medical School. Phone: 3737-599 Ext 88856.

Contact page

Full name  (first)  (middle)  (last)

Please list any other names that you are known by:

________________________________________________________________________

Address

________________________________________________________________________

Telephone Number (home or contact)  _________________________________________

In the future we may wish to contact you to repeat all or part of this survey. Would you be happy for us to contact you in the future?  Yes  No

To make our follow-up easier, please give the name and address of your family doctor, and also of your church if you attend one.

Family Doctor  _____________________________________________________________

Doctor's Address (Street or Suburb)  _________________________________________

Church  _________________________________________________________________

Church address (Street or Suburb)  _________________________________________

Who could help us contact you, if you change address?

Name:  ______________________  Relationship:  ________________________________

Address:  ________________________________________________________________

________________________________________________________________________

Phone:  ___________________ home  _______________ ext  __ work

Who else?

Name:  ______________________  Relationship:  ________________________________

Address:  ________________________________________________________________

________________________________________________________________________

Phone:  ___________________ home  _______________ ext  __ work
Section A. Sociodemographic

1. What is your date of birth? day / month / year

2. What is your sex? 1. Male 2. Female

3. What ethnic group(s) do you belong to?
   1. European
   2. Maori
   3. Samoan
   4. Tongan
   5. Niuean
   6. Cook Islander
   7. Tokelauan
   8. Other Pacific Islander (specify)
   9. Indian
   10. Chinese
   11. Other (specify)

4. What country were you born in? ____________________________

   If NOT NZ, how long have you lived in New Zealand? ________ years

5. What is your current marital status? (Circle ONE only)
   1. Married
   2. Defacto relationship
   3. Never married
   4. Separated, divorced, or widowed

6. Which of the following refers to your dwelling place? (Circle ONE only)
   1. Rented
   2. Own home with mortgage
   3. Own home without mortgage
   4. Living with friends or family
   5. Retirement village or similar
   6. Rest home
   7. Private Hospital
   8. Boarding house
   9. Other (specify)

7. How many adults (18 years and over) usually live there, including yourself? ____________

8. How many children did you have? ____________
Section B. Leisure time activities in the last 3 months

1. At least once a week in the last 3 months did you engage in any vigorous leisure time activity long enough to make you breathe hard or sweat?
   1. Yes        2. No

2. At least once per week in the last 3 months did you engage in any other physical leisure time activity (that did not make you breathe hard or sweat, such as brisk walking)?
   1. Yes        2. No

If YES to Question 1 or 2 above, below is a list of vigorous and moderate activities which you may do in your leisure time. Read carefully though this list and circle each activity that you have done for most weeks.

<table>
<thead>
<tr>
<th>Ball Games</th>
<th>Water Sports</th>
<th>Other leisure time activities</th>
</tr>
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<tbody>
<tr>
<td>1. Tennis</td>
<td>16. Swimming or snorkelling</td>
<td>21. Running or jogging</td>
</tr>
<tr>
<td>2. Squash</td>
<td>17. Scuba diving</td>
<td>22. Brisk walking or tramping</td>
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<td>4. Rugby (Union, touch or league)</td>
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<td>24. Home exercises</td>
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<td>5. Soccer</td>
<td>19. Rowing or canoeing</td>
<td>25. Martial arts</td>
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<td>7. Netball</td>
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<td>27. Snowskiing</td>
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<td>8. Softball or baseball</td>
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<td>28. Aerobics</td>
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<td>9. Golf</td>
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<td>29. Cycling (includes cycling to work)</td>
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<td>10. Cricket - English or Pacific Island</td>
<td></td>
<td>30. Hunting</td>
</tr>
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<td>11. Hockey</td>
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<td>31. Fishing - waders or surfcasting</td>
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<td>12. Lawn bowls</td>
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<td>32. Fishing - from boat, rocks or riverbanks</td>
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<td>13. Ten-pin bowls</td>
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<td>33. Horse riding</td>
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<td>14. Volleyball - indoor or outdoor</td>
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<tr>
<td>15. Table Tennis</td>
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</table>

3. Do you do any other vigorous or moderate activities in your leisure time? 1. Yes 2. No

If YES, describe ____________________________________________________________________________

<table>
<thead>
<tr>
<th>Office Use</th>
<th>Activity</th>
<th>V/M</th>
<th>Time/week</th>
<th>Min/time</th>
<th>Years</th>
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Section C. Alcohol consumption

These questions are about your usual alcohol consumption during the last 3 months.

1. About how frequently would you say you drank any type of alcohol?
   1. 4 or more times a day  9. Once a fortnight
   2. 2 or 3 times a day   10. Once a month
   3. Once a day
   4. Every 2 days
   5. Every 3 or 4 days
   6. Every 5 or 6 days
   7. Once a week
   8. Every 10 days
   11. Lifetime nondrinker Go to Section D
   12. Occasional drinker, not monthly
   13. Used to drink at least once per month Go to Question C6

2. Thinking about the most common or usual drinking occasion, what type of alcohol do you usually drink?
   1. Beer
   2. Spirits / liqueurs
   3. Table wine or similar
   4. Fortified wine
   5. Other, specify

3. How much do you drink on an average occasion?

   SEE SHOWCARD C3

4. In the last 3 months, what is the most that you had to drink on any one day?

   SEE SHOWCARD C3

5. About how often would you drink this much? _______ times per month
   (0 = less than once a month)

   For ex-drinkers only: others go to Section D

6. If you used to drink, but now don’t drink at least once per month:
   How many years ago did you stop drinking more than once a month? _______ years
7. Which of the following best describes your reasons for giving up? (Circle ONE only)

1. Social or family reasons
2. Concerns about heart disease
3. Other health reasons
4. Other reasons (specify)

8. How frequently did you use to drink? (Circle ONE only)

1. 4 or more times a day
2. 2 or 3 times a day
3. Once a day
4. Every 2 days
5. Every 3 or 4 days
6. Every 5 or 6 days
7. Once a week
8. Every 10 days
9. Once a fortnight
10. Once a month

Section D. Sun exposure

1. In the last 3 months, how many hours each day, on average did you usually spend outdoors in the sun? (Circle ONE only)

a) On an average week day
   0  1  2-3  4-5  6 or more

b) On an average weekend day
   0  1  2-3  4-5  6 or more

Section E. Family History of Diabetes

1. Have any of the following members of your family had diabetes? (Circle ONE number for each)
   a) your mother?  1. yes  2. no  3. don’t know
   b) your father?  1. yes  2. no  3. don’t know
   c) your brothers or sisters?  1. yes  2. no  3. don’t know  4. don’t have any
   d) your spouse or partner?  1. yes  2. no  3. don’t know  4. single
Section F. Tobacco Smoking

1. Have you ever smoked cigars, or cigarillos or pipe more than once per day for as long as one year? (Circle ONE only)
   1. Yes
   2. No

2. Have you ever smoked cigarettes (ready made or roll your own) more than once per day for as long as one year? (Circle ONE only)
   1. Yes
   2. No

3. Does your husband, wife or partner smoke tobacco? (Circle ONE only)
   1. Yes
   2. No
   3. Single

4. How many hours each week do you usually spend near someone who is smoking? (Include exposure at work, home and all other places. Put '0' if none) ________ hours per week

5. Which of these best describes you? (Circle ONE only)
   1. Never smoker
   2. Ex-smoker
   3. Current smoker

   If NEVER SMOKER, go to Section G

6. What is / was the average daily number of cigarettes you smoke(d) since you started?  _____

7. At what age did you start smoking cigarettes regularly? ________ years

8. If EX-SMOKER, at what age did you stop smoking cigarettes? ________ years
   If EX-SMOKER, go to Section G

9. If CURRENT SMOKER, on how many days of the week do you usually smoke cigarettes? (Circle ONE only)
   1. Usually on 1 day or less
   2. Usually on 2 to 4 days
   3. Almost every day
   4. Every day

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## Section G: Health

1. Compared to other people your age, would you say that your health is: (Circle ONE only)

2. Please choose the answer that best describes how **TRUE or FALSE** each of the following statements is for you

<table>
<thead>
<tr>
<th>Definitely true</th>
<th>Mostly true</th>
<th>Don't know</th>
<th>Mostly false</th>
<th>Definitely false</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) I seem to get sick a little easier than other people</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b) I am as healthy as anybody I know</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c) I expect my health to get worse</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d) My health is excellent</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

3. The following items are about activities you might do during a typical day. Does your health **now** limit you in these activities? If so, how much? (Circle ONE number on each line)

<table>
<thead>
<tr>
<th>Yes, limited a lot</th>
<th>Yes, limited a little</th>
<th>No, not limited at all</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>b) Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>c) Lifting or carrying groceries</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>d) Climbing several flights of stairs</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>e) Climbing one flight of stairs</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>f) Bending, kneeling or stooping</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>g) Walking more than a kilometre</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>h) Walking half a kilometre</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>i) Walking 100 metres</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>j) Bathing or dressing yourself</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Have you been told by a doctor that you have any of the following medical conditions?

1. Cancer

   If YES, how old were you when first told? _____ years
   What type of cancer is it?

2. Diabetes (sugar in the blood)

   If YES, a) how old were you when first told? _____ years
   b) what is your current treatment?
   1. Insulin (injections)
   2. Capsules or tablets
   3. Special diet

3. High blood pressure or hypertension

   If YES, how old were you when first told? _____ years
   Are you currently on pills or medicines for high blood pressure?

   What pills are they?

4. Stroke

   If YES, how old were you when first told? _____ years

5. Heart attack, angioplasty, angina or bypass

   If YES, how old were you when first told? _____ years
6. Chronic bronchitis, emphysema or COPD 1. Yes 2. No

If YES, how long have you been breathless? _______ years

7. Asthma 1. Yes 2. No

If YES, how old were you when first told? _______ years

8. Do you use any inhaled medicines? 1. Yes 2. No

If YES, are they: (Circle those that you take)

1. Reliever (blue or grey) eg: Ventolin, Bricanyl, Combivent, Atrovent 1. Yes 2. No

2. Preventer (red, brown, orange) eg: Flixotide, Becotide, Becloforte, Pulmicort 1. Yes 2. No

3. Other (green) eg: Serevent, Oxis, Foradil 1. Yes 2. No

Do you take these medicines almost every day? 1. Yes 2. No


If YES, how old were you when first told? _______ years 66
### Section J. Current Health

1. What is your height? _____ cm  OR  _____ feet  _____ inches
2. What is your weight now? (without shoes or heavy clothing)
   _____ kg  OR  _____ stone  _____ pounds
3. Compared to 1 year ago, are you heavier, lighter or about the same weight? (Circle ONE only)
   1. Heavier  2. About the same  3. Lighter
4. How would you describe your present weight?
   1. Underweight  2. Just the right weight  3. Slightly overweight
   4. Moderately overweight  5. Excessively overweight
5. Do you get breathless:
   a) Walking slowly on flat ground? 1. Yes  2. No
   b) Walking briskly on flat ground? 1. Yes  2. No
   c) Walking uphill or upstairs? 1. Yes  2. No
6. When did you last see your General Practitioner (doctor)? (Circle ONE)
   1. Within the last month  2. Within the last 6 months
   3. Within the last year  4. Longer than 1 year
7. During the last 3 months, have you been taking regularly (ie at least once a week) any tablets or other medication prescribed by your doctor, non-prescribed aspirin or other self-prescribed medications, Homeopathic, Tribal or Drug Trials, etc? 1. Yes  2. No
   If YES, please describe ______________________________________________________________
   ______________________________________________________________
8. Compared to 12 months ago, are you less active, more active, or the same? (Circle ONE only)
9. In the next 3 months, do you intend doing less exercise, more exercise, or the same amount of exercise as you do now? (Circle ONE only)

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Section K. Chest pain

1. In the past 6 months, have you had any pain or discomfort in your chest? (Circle ONE only)
   
   1. Yes  
   2. No  
   
   If NO, go to Section L  
   
   If YES,  
   a. Where do you get this pain or discomfort?  
      (Circle the number in the area(s) where you get the pain)
      
      Right  
      
      1  
      
      2  3  4  5  6  
      
      2  3  4  7  6  
      
      Left  
      
      b. Do you get this pain or discomfort when you walk uphill or hurry? (Circle ONE only)
         
         1. Yes  
         2. No  
         3. Sometimes  
         
         c. If you get pain or discomfort in your chest when walking, what do you do? (Circle ONE only)
            
            1. Stop  
            2. Slow down  
            3. Continue at the same pace  
            
            d. Does it go away when you stand still? (Circle ONE only)
               
               1. Yes  
               2. No  
               
               If YES, how soon? (Circle ONE only)
               
               1. In 10 minutes or less  
               2. More than 10 minutes
**Section L. For those aged 65 years and over**

1. Do you have any of the following medical conditions at the present time?

   Read the list. If YES, circle the number(s).

   1. Arthritis or rheumatism
   2. Circulation trouble in arms or legs
   3. Stomach ulcers, other stomach, bowel or gallbladder problems
   4. Foot problem, bunions, corns or other foot pain
   5. Back pain
   6. Kidney, prostate, incontinence or other urinary problems
   7. Poor memory
   8. Feeling sad, depressed or low mood
   9. Blindness or vision problem
   10. Deafness or hearing problem
   11. Eating or chewing difficulty

**Section M. Women only**

1. Have you ever used oestrogen or had hormone replacement therapy (not including contraceptives)? (Circle ONE only)
   1. Yes
   2. No
   If NO, go to question 6.

2. Were they pills, patches, creams or injections? _____ 1. Yes 2. No

3. For how long did you use them altogether? (Circle ONE only)
   1. More than 10 years
   2. 5 - 10 years
   3. More than 1 year, but under 5 years
   4. Under 12 months

4. Have you used them in the last 12 months? _____ 1. Yes 2. No

5. What brand and what dose is that? __________________________

6. Have you had a menstrual period in the last 12 months? (Circle ONE only)
   1. Yes
   2. No
   If NO, how old were you when you had your last one? _____ years

7. Have you had a hysterectomy? _____ 1. Yes 2. No

8. Have you had both ovaries removed? _____ 1. Yes 2. No
### Section N. Socioeconomic

1. Which of the following best describes your occupation? (Circle ONE only)
   - 1. Full time paid work
   - 2. Part time paid work
   - 3. Retired
   - 4. Unemployed/redundant
   - 5. Beneficiary
   - 6. Home duties
   - 7. Other

2. Thinking of your money situation **right now,** would you say:
   - 1. I cannot make ends meet
   - 2. I have just enough to get along
   - 3. I am comfortable
   - 4. Don't know

3. What is / was your main lifetime occupation? (Specify type of work and industry/organisation)

4. Are (were) you the main source of income in your family/household? (Circle ONE only)
   - 1. Yes
   - 2. No
   - 3. Equal shares
   
   If **NO,** what is (was) the occupation of the main (other) income earner in the family/household? (Specify type of work & industry/organisation)

5. When you were 5 years old, what was the occupation of the main provider in your household? (Specify type of work & industry/organisation)

6. At what age did you leave school? _______ years

7. After leaving school, did you get any further education? 1. Yes 2. No
   
   If **YES,** what was that? (Circle ONE only)
   - 1. Degree eg: MA, PhD, BA, BSc, Medicine
   - 2. Diploma eg: Teaching, Nursing, Business Management
   - 3. Certificate eg: Trade or Technicians, apprenticeship, typing
   - 4. Other (specify)

8. What was your first ‘real’ job after leaving school? (Specify type of work and industry/organisation)
   
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9. Which of the following describes the gross combined yearly income of all of your household members, including your partner? (Circle ONE number)
   1. Less than $20,000  5. $50,001 - $60,000
   2. $20,001 - $30,000  6. $60,001 - $70,000
   3. $30,001 - $40,000  7. $70,001 - $80,000
   4. $40,001 - $50,000  8. Greater than $80,000

10. Are you on an electoral roll? (Circle ONE only)
   1. Yes  2. No

   If YES, which electoral roll are you on? (Circle ONE only)
   1. General  2. Maori

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Section P: Serving sizes

1. How does your usual serving size of the following foods compare with the life size photos, or glass? (Circle ONE number for each food)

   a) Chicken
      1. Less  2. Same  3. More
      4. Don't eat it

   b) Fish
      1. Less  2. Same  3. More
      4. Don't eat it

   c) Red meat
      (eg: steak or roasts)
      1. Less  2. Same  3. More
      4. Don't eat it

   d) Cheese
      1. Less  2. Same  3. More
      4. Don't eat it

   e) Potato, kumara or taro
      1. Less  2. Same  3. More
      4. Don't eat it

   f) Other vegetables
      1. Less  2. Same  3. More
      4. Don't eat it

   g) Cakes or desserts
      1. Less  2. Same  3. More
      4. Don't eat it

   h) Glass of milk, cordial, fruit juice or fizzy drink
      1. 100 ml  3. 200 ml
      2. 150 ml  4. 250 ml
Section Q. Measurements

1. When did you last have something to eat or drink? __________
   Polycal given __________  Urine sample received □

2. Blood samples

3. Blood pressure  systolic (mmHg)  diastolic (mmHg)  pulse (bpm)
   __________  __________  __________
   __________  __________  __________
   Average BP __________  __________
   c) Measurer: ________________________

4. Body mass
   a) Weight (kg) ________________________
   b) Height (cm) ________________________
   c) Waist (cm) ________________________
   d) Hip girth (cm) ________________________
   e) Measurer: ________________________

5. Lung function
   a) FEV1 __________  __________  __________  __________
   b) FVC __________  __________  __________  __________
   Measurer: ________________________

Office Use
Card G

Date of interview ________________________
Proxy □  Reason □
Appendix D: SHOWCARD C3
Questions on Alcohol Consumption

How much do you have on an average occasion?
Choose from this list, the type of alcohol you usually drink, and choose the size of glass or bottle you usually use. Write that code into the questionnaire. (Write in how many you usually drink.)

Draught or Lager Beer
Small glasses ...........................................5 fl. oz. / 140 mls 99
Standard beer glass ..................................7 fl. oz. / 200 mls 98
Large glasses ...........................................12 fl. oz. / 340 mls 97
Small handles ..........................................½ pint / 300 mls 96
Large handles ..........................................1 pint / 550 mls 95
340 ml cans ...........................................12 fl. oz. / 340 mls 94
460 ml cans ...........................................16 fl. oz. / 460 mls 93
375 ml (Australian) cans ...........................13 fl. oz. / 375 mls 92
Small bottles (stubbies)..............................12 fl. oz. / 335 mls 91
Standard bottles .....................................26 fl. oz. / 750 mls 90
Small jugs .............................................18 fl. oz. / 1/2 litre 89
Standard jugs ..........................................36 fl. oz. / 1 litre 88
Flagons ...................................................½ gal. / 2 litres 87
Others (please specify) .................................. 86

Low Alcohol Beer e.g. Swan light, Isenbeck
Standard beer glass ..................................7 fl. oz. / 200 mls 85
340 ml cans e.g. Isenbeck ...........................12 fl. oz. / 340 mls 84
375 ml cans e.g. Swan Light ..........................13 fl. oz. / 375 ml 83

Spirits or Liqueurs
Glasses (single nip) ................................... 79
Glasses (double nip) ................................. 78
Glasses (triple nip) ................................... 77
Small bottles (half bottles) ..........................13 fl. oz. / 375 mls 76
Standard bottles ......................................26 fl. oz. / 750 mls 75
1.125 litre bottles .....................................40 fl. oz. / 1125 mls 74
Other (please specify) .................................. 73

Mixed Cocktails glasses ................................69

Fortified Wines e.g. Sherry, Port
Very small glasses (sherry or port) .................2 fl oz / 56 mls 59
Small "wine" glasses ..................................3 fl. oz. / 90 mls 58
Standard "wine" glasses ..............................5 fl. oz. / 140 mls 57
Standard "beer" glasses ..............................7 fl. oz. / 200 mls 56
Small bottles 1/2 bottles ............................13 fl. oz. / 375 mls 55
Standard bottles ......................................26 fl. oz. / 750 mls 54
Flagons ................................................... ½ gal / 2.25 L 53
Others (please specify) .................................. 52
Large Wine Glass ..................................... 260 mls 51

Ordinary Wines e.g. Red, White or Rose
Small "wine" glasses ..................................3 fl. oz. / 90 mls 49
Standard "wine" glasses ..............................5 fl. oz. / 140 mls 48
Standard "beer" glasses ..............................7 fl. oz. / 200 mls 47
Small bottles (1/2 bottle) ...........................13 fl. oz. / 375 mls 46
Standard bottles ......................................26 fl. oz. / 750 mls 45
Large bottles or large carafe ...........................2.5 pints / 1.5 L 44
Flagons or very large bottles ......................½ gal / 2.25 L 43
Others (please specify) .................................. 42
Large Wine Glass ..................................... 260 mls 41

Other Alcoholic drinks (please specify) .............39
Half-pint beer glass
285 mls

Large handle
550 mls

Pint beer glass
550 mls

Small sherry glass
56 ml

Standard wine glass
140 mls

Large wine glass
260 ml