Dietary acculturation of Chinese in the Manawatu in association with risk factors for type 2 diabetes

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Abstract

Acculturation is known to affect migrants' dietary habits and eating patterns. To evaluate the influence on the diets of Chinese migrants who have settled in New Zealand and its relation to risk factors for type 2 diabetes mellitus, a total of 46 self-selected participants took part in this 2006 dietary acculturation study in the Manawatu region. The majority was from Mainland China, and more than 40% of the entire group had a family history of diabetes, which was possibly the underlying motivation for them to take part in this study. In addition, Chinese participants were less likely to visit their preferred General Practitioners regularly, unless they felt unwell, when compared to New Zealand population.

The participants' acculturation levels were evaluated by the Suinn-Lew Asian Self-identify scale, and most of the participants identified themselves as Asian. The entire group was divided into two acculturation groups (Low and High) by using a cut-off point (2.0) from the acculturation scores. Three demographic variables, arrival age, residency length, and current age, were investigated. It was significant that the residency length was negatively associated with the acculturation score ($P < 0.001$). Participants who had younger arrival ages gained higher acculturation scores; they had become more acculturated to Western culture.

Food frequency questionnaires and 24-hour dietary recalls were used to collect the participants' dietary information. The participants with high acculturation scores were more likely to consume Western-style foods more frequently, and to have sedentary lifestyles. In contrast, participants with low acculturation scores were more likely to have traditional eating patterns. In addition, participants with high acculturation scores consumed morning or afternoon tea more frequently than those people in the low acculturation group ($P < 0.05$); having morning or afternoon tea is popular in New Zealand. Breakfast was the first meal to be Westernised among the study participants. One of the significant findings was

that energy intakes from dietary fat were 36.4% (females) and 38.6% (males), and these were higher than the recommended less than 35% of total energy intake from fat. Also, low dietary intakes of vitamin D, calcium and folate, together with an extreme high sodium intake, were observed in the study group.

To provide additional data, body weight, height, waist and hip circumferences were measured in this study. The BMI values, waist circumference and W/H ratio were used as markers of risk factors for heart diseases and diabetes. Based on the Chinese Standards for BMI and waist circumference, more than 50 percent of male participants were considered as either overweight or obese. Furthermore, females with low acculturation scores had greater BMI values than those in the high acculturation group ($P < 0.05$). Three blood tests, fasting plasma glucose (FPG), HbA_{1c} and total cholesterol (TC) values were measured among 33 participants, and two of them were found to have abnormal FPG and HbA_{1c} accordingly were referred to their preferred General Practitioners.

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Table of Contents

Abstract i

Acknowledgements iii

Table of Contents iv

List of Figures vii

List of Tables ix

Chapter 1 INTRODUCTION 1

Chapter 2 LITERATURE REVIEW 5

2.1 Background 5

2.2 Acculturation 7

2.3 The relationship between acculturation and dietary changes 8

2.4 Dietary acculturation 14

2.5 Acculturation, dietary acculturation and health 18

2.6 Chinese traditional food habits 22

2.6.1 Meal composition 22

2.6.2 Different cuisine 23

2.6.3 Ingredients and commonly used foodstuffs 23

2.6.4 Cooking methods 23

2.7 Dietary changes of Asians after moving to Western countries 24

2.8 Nutrition transition 26

2.8.1 Dietary changes during nutrition transition 26

2.8.2 Other influences caused by nutrition transition 29

2.9 Prevalence of type 2 diabetes mellitus 30

2.9.1 Prevalence of type 2 diabetes mellitus in the world 30

2.9.2 Incidence of NIDDM in China 31

2.9.3 Prevalence of type 2 diabetes mellitus among Asians in Western countries 32

2.10 Risk factors for type 2 diabetes mellitus 33

2.10.1 General potential risk factors 33

2.10.2 Dietary factors 34

2.10.3 Lifestyles 39

2.11 Chinese immigrants in New Zealand 43

2.11.1 Chinese population in New Zealand 43

2.11.2 Health status of Chinese migrants in New Zealand 43

Chapter 3 METHODOLOGY 46

3.1 Human Ethics Application 46

3.2 Pilot study 47

3.3 Subjects' recruitment 47

3.4 Data collection 48

3.5 Dietary assessment 48
3.5.1 Food Frequency Questionnaire 49
3.5.2 24-hour dietary recalls 51

3.6 Primary Questionnaire 54
3.6.1 Acculturation scale 54
3.6.2 Physical activity levels 55
3.6.3 Demographic questions 55

3.7 Body Measurements 56

3.8 Blood tests 59

3.9 Data processing 60

Chapter 4 RESULTS 62

4.1 Sample descriptions 62
4.1.1 Demographic characteristics 62
4.1.2 Socioeconomic characteristics 68
4.1.3 General health 73

4.2 Acculturation levels 75

4.3 Food eating patterns 82
4.3.1 Meal eating patterns 82
4.3.2 Food items consumed by the participants based on the food frequency questionnaire 88

4.4 Physical activity levels 113

4.5 Body measurements 117

4.6 Blood test results 123

4.7 Dietary intake 129
4.7.1 Group dietary intakes 129
4.7.2 Dietary intakes in high and low acculturation groups 140
4.7.3 Summary 148

Chapter 5 DISCUSSION 149

5.1 Sample characteristics 149

5.2 Acculturation levels 149

5.3 Dietary acculturation and food eating patterns 151
5.3.1 Meal eating patterns 151
5.3.2 Food choices information from 24 hours dietary recalls 152
5.3.3 Food choices information from the food frequency questionnaire 152

5.4 Body measurements 159

5.5 Physical activity 161

5.6 Dietary intakes 162
5.6.1 Energy intake and distribution 162
5.6.2 Carbohydrates and dietary fibre intakes 165
5.6.3 Micronutrients and minerals intakes 166

5.7 Blood tests results 170

5.8 Integration with acculturation levels **170**
5.8.1 High acculturation group 170
5.8.2 Low acculturation group 171
5.8.3 High and low acculturation groups 171

5.9 Increased risk for diabetes **172**
5.9.1 Dietary fat intake 172
5.9.2 Carbohydrate and dietary fibre intake 173
5.9.3 Micronutrient and mineral intakes 173
5.9.4 Body measurements and blood test results 175
5.9.5 Physical activity levels 175

5.10 Limitations of the study **176**

Chapter 6 CONCLUSION and RECOMMENDATIONS **179**

Bibliography **184**

APPENDIX A **209**

Human Ethics Approval **209**

APPENDIX B **210**

Advertisements and fliers used in recruitment (English and Chinese) **210**

APPENDIX C **212**

Participants' consent form (English) **212**

APPENDIX D **214**

Participants' information sheet (English and Chinese) **214**

APPENDIX E **221**

Health checklist form **221**

APPENDIX F **224**

Subjects ID and Contact form (English and Chinese) **224**

APPENDIX G **228**

Primary questionnaire (English and Chinese) **228**

APPENDIX H **237**

Food Frequency Questionnaire (English and Chinese) **237**

APPENDIX I **244**

24-Hour Dietary Recalls Form **244**

APPENDIX J **246**

Photos used in Food Frequency Questionnaire and 24-Hour Dietary Recalls **246**

APPENDIX K **249**

Chinese food photos and Chinese Food Composition Table **249**

APPENDIX L **253**

Blood test report form (English and Chinese) **253**

List of Figures

Figure 2-1 Proposed Model of dietary acculturation 17
Figure 4.1.1 Acculturation scores between females (F) and males (M). 65
Figure 4.1.2 The correlation between acculturation scores and residency length. 66
Figure 4.1.3 The correlation between acculturation scores and age 66
Figure 4.1.4 The correlation between acculturation scores and arrival ages 66
Figure 4.1.5 Arrival ages between low and high acculturation levels 67
Figure 4.1.6 Residency length between low and high acculturation levels 67
Figure 4.1.7 Ages between low and high acculturation levels 67
Figure 4.2.1 Histogram of scores 76
Figure 4.2.2 Histogram of scores in males 77
Figure 4.2.3 Histogram of scores in females 77
Figure 4.2.4 PLS Std Coefficient Plot 78
Figure 4.2.5 PLS Loading Plot 78
Figure 4.3.1 Differences in oil consumption 83
Figure 4.3.2 Meat consumed by the participants 84
Figure 4.3.3 Meat consumed by both acculturation groups 85
Figure 4.5.1 Histogram of BMI vaues in Groups L and H 119
Figure 4.6.1 Total cholesterol levels in different PAL level groups 126
Figure 4.6.2 Total cholesterol levels in acculturation groups 126
Figure 4.6.3 Median cholesterol levels in different groups 127
Figure 4.6.4 Total cholesterol in income and education groups 128
Figure 4.7.1 Group energy intakes 129
Figure 4.7.2 Total energy intakes from fat 130
Figure 4.7.3 Cholesterol intakes in gender groups 130
Figure 4.7.4 Types of fat intakes in male and female groups 133
Figure 4.7.5 Energy intakes from types of fat in females 134
Figure 4.7.6 Energy intakes from types of fat in males 134
Figure 4.7.7 Protein and dietary fibre intakes in different age groups 135
Figure 4.7.8 Macronutrients intakes in females 140
Figure 4.7.9 Females' types of fatty acid and total fat intakes 142
Figure 4.7.10 Females' energy distribution 142
Figure 4.7.11 Males' macronutrient intakes 143

Figure 4.7.12 Males' energy distribution 144
Figure 4.7.13 Males' total fat and types of fat intakes 144
Figure J-1 Three sizes of solid food intakes used for portion sizes in the FFQ. 246
Figure J-2 Portion sizes of lipid food items (left side: 250ml, right side:180ml) in FFQ. 246
Figure J-3a Small, medium and large portion sizes of food in one standard plate 247
Figure J-3b Small, medium and large portion sizes of food in one standard ball 247
Figure J-4 Meat and vegetables models used in 24-hour dietary recalls. 247
Figure J-5 Nuts and dessert models 248
Figure J-6 Cooking measurements for estimating portion sizes during 24hour dietary recalls. 248

List of Tables

Table 4.1.1 Age characteristics of the participants 62
Table 4.1.2 Gender of the participants 63
Table 4.1.3 Original Countries of the participants 63
Table 4.1.4 Residency length of the participants in New Zealand 63
Table 4.1.5 Arrival ages of the participants 64
Table 4.1.6 Demographic characteristics of Group L and Group H 65
Table 4.1.8 Income levels 69
Table 4.1.9 Employment status 69
Table 4.1.11 Living arrangements 70
Table 4.1.12 Socio-economic status between both acculturation groups 71
Table 4.1.13 Differences in socioeconomic status (%) 72
Table 4.1.14 General health status 73
Table 4.1.15 Frequency of visiting GPs 74
Table 4.1.16 General health status in Group L and Group H 74
Table 4.2.1 Acculturation scores of the participants 76
Table 4.2.2 Different acculturation scores between genders 76
Table 4.2.3 Answers from Q 30 and Q 31 in the Primary Questionnaire 79
Table 4.2.4 Answers from Q 32 in the Primary Questionnaire 80
Table 4.2.5 Different acculturation scores by residency length in New Zealand 80
Table 4.2.6 Different acculturation scores by ages 81
Table 4.2.7 Different scores of participants' arrival ages 81
Table 4.3.1 Food eating patterns from 24-hour dietary recalls 82
Table 4.3.2 Cooking oil consumed by both acculturation groups (Low and High) 84
Table 4.3.3 Percentages of participants ate different servings of fruits 85
Table 4.3.4 Percentages of participants consumed types of vegetables 86
Table 4.3.5 Participants ate servings of fruits and types of vegetables in Groups L and H ... 86
Table 4.3.6 Food eating patterns between both acculturation groups 87
Table 4.3.2.1 Percentages of participants consumed dairy products (%) 89
Table 4.3.2.2 Dairy products consumption in acculturation and gender groups (%) 89
Table 4.3.2.3 Frequency in consuming bread in four groups (%) 90
Table 4.3.2.4 Frequency of consuming carbohydrate in different acculturation groups (%) . 91
Table 4.3.2.5 Percentages of people eating pasta, rice and porridge at least weekly (%) 92
Table 4.3.2.6 Percentages of people eating meats at least once a week (%) 93

Table 4.3.2.7 Meat intakes in acculturation and gender groups (%) 94
Table 4.3.2.8 Percentages of participants eating meat products at three frequencies 95
Table 4.3.2.9 Percentages of people eating meat products at least once a week (%) 95
Table 4.3.2.10 Fish intakes in different acculturation and gender groups 96
Table 4.3.2.11 Percentages of people consuming fish/shellfish at least once a week (%) 97
Table 4.3.2.12 Intakes of the most popular vegetables in NZ by four groups (%) 98
Table 4.3.2.13 Percentages of people consuming vegetables at least once/week (%) 98
Table 4.3.2.14 People consuming Chinese vegetables at least once/week (%) 98
Table 4.3.2.15 Participants ate Chinese vegetables in acculturation (Acc) groups (%) 101
Table 4.3.2.16 Percentages of participants eating stirfry vegetables/vegetables soups (%) 102
Table 4.3.2.17 Percentages of consumption of beverages at least three times a week (%) .. 103
Table 4.3.2.18 Percentages of females consuming beverages at varied frequencies (%) 105
Table 4.3.2.19 Percentages of males consuming beverages at varied frequencies (%) 106
Table 4.3.2.20 Frequency of cooking ingredients in different groups (%) 107
Table 4.3.2.21 Percentages of participants eating table spreads at least once a week (%) .. 108
Table 4.3.2.22 Percentages of people consuming fast foods at least once per week (%) 108
Table 4.3.2.23 Percentages of participants consuming fast food at varied frequencies (%) 109
Table 4.3.2.24 Participants in gender and acculturation (Acc) groups ate cooking oils (%). 110
Table4.4.1 Physical activity levels by gender 113
Table 4.4.2 total time spent in minutes on sedentary activities per day 113
Table 4.4.3 Time spent in different physical activities 114
Table 4.4.4 Time spent in physical activities 114
Table 4.4.5 Physical activity levels in different socioeconomic groups 115
Table 4.4.6 Physical activity time in different acculturation groups 116
Table 4.4.7 Percentages of participants in different degrees of activities 116
Table 4.5.1 BMI in the New Zealand standard and Chinese standard 117
Table 4.5.2 Female body measurements 118
Table 4.5.3 Male body measurements 118
Table 4.5.4 Body measurements in both acculturation groups 118
Table 4.5.5 (1) Body measurements in females between two acculturation groups 119
Table 4.5.5 (2) Body measurements in males between two acculturation groups 119
Table 4.5.6 Being overweight and obesity by using different standards of BMI levels 120
Table 4.5.7 BMI and being overweight and obesity by the Chinese standard 120
Table 4.5.8 Percentages of participants being overweight or obese in both groups 120
Table 4.5.9 Percentages of participants having "at risk" waist circumferences 121
Table 4.5.10 "At risk" waist circumferences in different acculturation groups 121
Table 4.5.11 Percentages of participants having "at risk" BMI, Waist and WHR values 122

Table 4.6.1 Blood test results in males and females 124
Table 4.6.2 Blood tests in Low and High acculturation groups 124
Table 4.6.3 Total cholesterol levels in different groups 125
Table 4.6.4 Blood tests results in different socioeconomic groups 127
Table 4.6.5 Total cholesterol results in different socioeconomic groups 127
Table 4.7.1.1 Group energy and macronutrients intakes (n=44) 130
Table 4.7.1.2 Female and male groups' energy and macronutrient intakes 131
Table 4.7.1.3 Female and male groups' fat and sugar intakes 133
Table 4.7.1.4 Percentages of energy from types of fat 133
Table 4.7.1.5 Different percentages of total energy intakes from types of fat 134
Table 4.7.1.6 (1) Protein and dietary fibre intakes in participants aged 30 to 50 years 135
Table 4.7.1.6 (2) Protein and dietary fibre intakes in participants aged 50 to 70 years 135
Table 4.7.1.7 Female and male groups' micronutrient intakes 136
Table 4.7.1.8 Micronutrient intakes in females and males 137
Table 4.7.1.9 Female and male groups' mineral intakes 138
Table 4.7.1.10 Comparisons of mineral intakes 138
Table 4.7.1.11(1) Micronutrient intakes in females and males aged 30-50 years 139
Table 4.7.1.11 (2) Micronutrient intakes in females and males aged 50-70 years 139
Table 4.7.2.1 Energy and macronutrient intakes among female acculturation groups 141
Table 4.7.2.2 Energy and macronutrient intakes of males in both acculturation groups 143
Table 4.7.2.3 Micronutrient intakes of females with low and high acculturation 145
Table 4.7.2.4 Micronutrient intakes of males with low and high acculturation 146
Table 4.7.2.5 Mineral intakes of females with low and high acculturation 147
Table 4.7.2.6 Mineral intakes of males with low and high acculturation 147

Chapter 1 INTRODUCTION

The dietary change among Chinese in the Manawatu area of New Zealand which occur as a result of acculturation is the focus of this study. The extent to which this increases risk factors for type 2 diabetes mellitus will be examined. Dietary acculturation levels were measured by two approaches: acculturation levels (a modified acculturation scale) and dietary assessment (food frequency questionnaires and 24-hour dietary recalls). Previous research located reveals few other studies measuring acculturation levels of Chinese migrants; however, a number of studies found were concerned with Asian groupings. An acculturation scale previously used with Asians in Australia was modified and used with the Chinese group sampled for this research.

New Zealand, a multicultural country, has attracted many migrants from both industrialised countries and developing countries. In particular, Asian people, who have distinctive cultures, are exposed to New Zealand culture after they move away from their original birthplace. A psychological term, acculturation, often is used to describe this phenomenon. The influences of migration will understandably alter migrants' eating patterns and food choices, which, in turn, may lead to changes in dietary intakes through the exposure to differing food culture and food supplies in New Zealand. The alteration of eating patterns and food choices often occurs at the later stage when cultural changes have taken place. Once the acculturation process is applied to dietary intake, "dietary acculturation" will be the new term for this situation. However, research has located few studies which have measured dietary acculturation levels among migrants.

Changes of dietary patterns and lifestyles recorded in other studies of Asian migrants are also seen in Chinese migrants in New Zealand. In China, people have a high intake of carbohydrates and a low intake of animal fat, mainly as a result of eating a wide range of vegetables and fruits. In New Zealand, more processed food and fewer varieties of vegetables are consumed than in China, which is indicative of the different choices made

due to the availability or non-availability of food. People resident in New Zealand tend to consume a diet with a high intake of animal and partially hydrated fat and low fibre intake. Subsequent to their arrival, it is possible that Chinese migrants adopt by preference both healthy and poor habits which lead to different individual health outcomes. For example, the study of Tan (2001) which investigated the dietary changes of mainland Chinese women living in Auckland, found that migrant Chinese had a very high intake of fat and low intake of carbohydrate; in addition, intake of calcium was low and intake of sodium was high. With nutrition transition, dietary patterns have changed gradually both in developing and developed countries. Since dietary changes are associated with changes in certain chronic disease patterns, risk factors have increased, together with the prevalence of chronic diseases.

Furthermore, it has been commonly accepted that high fat intake and a sedentary lifestyle play a significant role in the development of chronic diseases, such as obesity, diabetes and cardiovascular diseases. A large body of research has focused on the identifiable risk factors in developing chronic disease; particularly type 2 diabetes mellitus, because of its rapidly increasing prevalence around the world. In addition, Asian descent is identified as one of risk factors for developing type 2 diabetes mellitus, mainly due to genetic susceptibility. Chinese who move away from China and come to live in New Zealand meet a new cultural challenge, and, when they are trying to meld into the new society, simultaneously their dietary habits and lifestyles move towards the established New Zealand eating culture. The alteration in their eating patterns, dietary intakes and lifestyles, added to their genetic vulnerability, comprise major risk factors in developing type 2 diabetes mellitus. Specifically, migrants from China change their diets and lifestyles from traditional Chinese to "Western" habits. However, given that there are few previous research studies in this area, risk factors for type 2 diabetes mellitus among Chinese in New Zealand will be the main focus of this study.

With the implementation of New Zealand immigration open policies, a large number of Chinese have migrated to New Zealand due to a diverse number of reasons. The numbers of Chinese people in New Zealand has dramatically increased, and presently the Chinese have become one of the largest Asian migrant groups in New Zealand. Accordingly, their health

status must be of considerable concern. However, education initiatives and the provision of healthy service policies may not be culturally appropriate for this specific group, due to a lack of information with regard to their dietary intakes, food consumption and factors affecting food choices. Assessing the dietary intakes and gaining an understanding of the gradual process of acculturation among Chinese in New Zealand may assist future migrants of Chinese descent to establish healthy dietary habits and lifestyles which will prevent them from suffering certain types of chronic diseases, or at the very least, delay the onset of more serious complications.

Aim of the study

With the increase of the Chinese population in New Zealand, their health status also should be carefully considered alongside other ethnic groups. Chinese emigrate from China to New Zealand, a country like many others which has a distinctive culture, and the migrants gradually adapt to the new culture, which can be represented as being of a different acculturation level. With the development of the acculturation processes over time, the health of the ethnic minority group may be enhanced or suffer deterioration, depending on a wide range of social, cultural and economic circumstances, which may involve both the group itself, and the host population. In addition, different food supplies and food choices may alter Chinese migrants' eating habits, from mainly traditional Chinese diets. Dietary alteration and lifestyle changes are likely to contribute to the chronic disease patterns of Chinese living in New Zealand. In terms of recent studies as reported within the Asian Health Chart Book 2006 (Abbott et al, 2000; North et al, 2004, cited in Ministry of Health, 2006a), there is a potential for the Asian migrants' experience in New Zealand to negatively affect their health, at least in the short term.

The epidemic of chronic diseases, especially type 2 diabetes mellitus, has become a public health concern in both developing countries (China) and developed countries (New Zealand). It is well established that type 2 diabetes mellitus can be prevented or delayed by positive intervention in both diets and lifestyle. Studies have showed that healthy diets and active lifestyles can delay the development of complications from type 2 diabetes mellitus and prevent its onset at the beginning stage of impaired glucose tolerance / impaired fasting glucose. The rapid increase in the prevalence of type 2 diabetes mellitus cannot be

explained solely by genetics, because environmental factors play an important role in its development. In particular, people who change to "Western" lifestyles are more likely to gain weight, to be obese, and possibly go on to develop type 2 diabetes mellitus.

Chinese people are considered to have an inherited vulnerability to diabetes. There are a number of well-known risk factors leading to the development of type 2 diabetes mellitus, such as age, overweight, family medical history, high blood pressure, Asian ethnicity, and diagnosed impaired glucose tolerance.

The aims of this research are to identify acculturation levels of Chinese living in New Zealand and examine these in association with risk factors of type 2 diabetes mellitus.

In detail, these aims are threefold:

Firstly, to classify participants by their different acculturation levels by using a modified acculturation questionnaire scale for Asian people;

Secondly, to identify the risk factors for type 2 diabetes mellitus, (including BMI, waist-hip-ratio, waist circumference and physical activity levels), of Chinese living in the Manawatu region of New Zealand, through the use of a primary questionnaire and clinical examination findings;

Thirdly, to examine the association between acculturation levels (including dietary ascepts) and the presence of risk factors for type 2 diabetes mellitus.

Chapter 2 LITERATURE REVIEW

2.1 Background

New Zealand is viewed as a nation of migrants from different countries, but traditionally, people who are from Europe, Australia and the United Kingdom are welcomed because of their similar cultural backgrounds. More recently after the Gold Rush in the 1860s, many Chinese mine workers came to New Zealand (most them from Canton and Fujian), who were possibly the first generation of Chinese immigrants and the largest non-European non-Polynesian race in New Zealand. Subsequently, with the alteration of immigration policies in New Zealand in the 1980s, many young Chinese came to New Zealand to study or work.. Sang and Ward (2006) reported that China and India have occupied the largest migrant section of the growing population in New Zealand since the mid-1990s. At present, Chinese people have become the biggest proportion of Asian migrants in New Zealand. On the basis of the 2001 New Zealand census, 6.6% of the population are Asian and 2.8% are Chinese (Statistics New Zealand, 2002). According to the 2006 Census data (Statistics New Zealand, 2007), Asian ethnic groups in New Zealand increased from 238,176 in 2001 to reach 354,552 in 2006, which was almost an increase of 50% in just five years. With an increased number of Asian migrants settling in New Zealand, the health status of these minority groups has been of some concern due to the health impacts on New Zealand of migration both in the short and longer term.

Nevertheless, with the limitation of language and social status, Chinese in New Zealand may access less public health care and have fewer opportunities to see their own chosen General Practitioners. However, the question remains, do they have had any significant healthy difficulties including chronic diseases, such as hypertension, obesity, diabetes, heart disease. The argument centers on whether these disease patterns are the same as in their original countries. In some circumstances, the degree to which they adopt a new culture can affect migrants' health status. It is important to establish the relationship between the stages of cultural change and the prevalence of chronic diseases amongst migrants. Language

problems are the greatest barrier to the utilisation of health services, especially for new immigrants, even those who are high skilled. In addition, the majority of Chinese in New Zealand prefer use the Chinese medicines, herbalists and acupuncturists rather than Western medicines (Xie, 2003).

There are few research studies investigating the health status of this population in New Zealand. Overseas, a number of studies have indicated that Chinese Americans have a higher prevalence of chronic disease, such as diabetes, heart disease, and certain types of cancers, than Chinese in Asian countries (Campell, Parpia & Chen, 1998; Satia et al., 2000; LeMarchand, Wikens, Kolinel, Hankin, & Lyu, 1997; Yu, Harris, Gao, & Wynder, 1991). Based on several epidemiologic studies (Ziegler et al., 1993, and World Cancer Research Fund, 1997, cited in Neuhouser, Thompson, Coronado, & Solomon, 2004), it has been consistently reported that people who migrate from one country to another quickly adopt the chronic disease patterns of their new host countries. Currently, due to the lack of information about population food consumption and factors affecting food choices, educational initiatives may not be culturally appropriate for the specific minority groups (Satia et al., 2000), and such studies describe similar circumstances to those existing in New Zealand. Therefore, it is necessary to gain more information about eating patterns, the effect of changing diets and risk factors for chronic diseases among Asians in New Zealand. This study investigates the dietary changes following the acculturation and effects on risk factors for type 2 diabetes among Chinese in New Zealand, in particular, within the Manawatu area.

Today, people move from one country to another having a distinctive culture for a variety of reasons, from adventure to economic, education or social purposes, and the like. Often it is easy for some people over time to become absorbed by a new culture, but the majority of the immigrants find that it is not so easy to become involved with the new culture due to all types of reasons, such as education, economic status, language, and those with few years so far lived in the new country. New Zealand, as a developed country, is becoming a multicultural society because of many emigrants from both developing and developed countries.

2.2 Acculturation

A new concept has been used to define this complex phenomenon described above, acculturation. In their early studies, Redfield, Linton and Herskovits (1936, cited in Berry, Poortinga, Segall, & Dasen, 2002) described acculturation as a process of adapting to a new environment resulting from contact between one original culture and another new culture. As the classical definition states:

> "Acculturation comprehends those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact, with subsequent changes in the original culture patterns of either or both groups... under this definition acculturation is to be distinguished from culture change, of which is but one aspect, and assimilation, which is at times a phase of acculturation. (Redfield, Linton & Herskovits, 1936, cited in Berry, Poortinga, Segall, & Dasen, 2002, p.349)

In 2004, the International Organization for Migrants defined acculturation as a process of adopting the elements of a foreign culture by individuals and groups from their original culture, including ideas, words, values, norms, behaviours and institutions (Sam & Berry, 2006).

In addition, acculturation is considered to exist both at the micro and macro levels (Satia, 2003). At the micro level, acculturation is referred to as changes by individuals in attitudes, beliefs, behaviours, and values; at the macro level, it means the physical, biological, political, economic, and cultural alterations within the minority groups, or in society as a whole. Suinn, Khoo and Ahuna (1995) described acculturation as a linear process from one stage moving into another irreversibly, at the beginning having current ethnic identification and at the end being assimilated into the host culture, for example, merging into a racial and ethnic mix, which can be said was suitable for the European experiences, but it cannot be used to analyse the migrants who have physical and cultural distinction.

Berry (1997, 2001, cited in Berry, Poortinga, Segall, & Dasen, 2002) demonstrated four types of acculturation strategies of intercultural relations by using the bidirectional approach, which focuses on assimilation, integration, marginalization, and separation. This

model has been tested within several studies, such as, for example, examining Vietnamese-Americans' adaptation (Pham & Harris, 2001), which demonstrated that higher education was correlated to high self-esteem, but, in contrast, people who have lived in the USA for a short time, who are less educated and those who communicate less with American culture, showed low self-esteem.

Apart from these two types of models, the results from acculturation are different according to the make up of individual characteristics among the population. Suinn, Khoo and Ahuna (1995) referred to three possibilities for this result, which were assimilation with people turning away from their parent culture, resistance with the individual resisting the host culture and insisting on their parent culture, and biculturalism, with people adopting characteristics from both the host and the parent culture.

Due to the process of acculturation, it is not simple to abandon the entire cultural values of origin. Some immigrants who are interested in becoming bicultural may view a new culture as a complement to their own, rather than as competition. In particular, Chinese have their own traditional culture. Once the Chinese culture meets a Western culture, such as New Zealand's, the process will take a long time to move from one to the other and also some traditional beliefs still will be maintained by Chinese migrants, whatever may be the duration of their residence in New Zealand.

2.3 The relationship between acculturation and dietary changes

As described above, the definition of acculturation is a process that individuals undergo in response to a changing cultural context, and eating patterns and food habits (as one aspect of culture) have been considered to be associated with religious beliefs or ethnic behaviours. This may be likely to be similar to dressing in traditional clothes or to speaking in native languages. Kittler and Sucher (2004) proposed that eating as a daily activity can reconfirm a cultural identity, which is always the last part of tradition that people change through acculturation. The reason is that eating often happens at a private home and is hidden from observation by the majority of people in the host country.

A large number of dietary studies have focused on the dietary changes among Hispanics in America. Romero-Gwynn and Gwynn (1997) demonstrated that the diets of first and second generation Americans of Mexican descent have increasingly begun to resemble a more typical or mainstream American diet. Some dietary alterations are healthy while most of them are considered potentially deleterious. For example, increased consumption of milk, vegetables and fruits can be classified as healthy changes, but a large increase in fat intake including butter, vegetable oil, mayonnaise, and sour cream, and an increased consumption of sugars instead of using traditional fruit-based beverages and homemade teas, are both classified as unhealthy changes. Bermudez, Falcon and Tucker (2000) compared older Hispanic adults with non-Hispanic white people residing in Massachusetts, and reported that highly acculturated respondents consumed fewer ethnic foods and more food related to the eating patterns of the non-Hispanic white people. This resulted in a lower intake of complex carbohydrates and a higher intake of simple sugars, and less energy contributed by polyunsaturated fatty acids and more by saturated fatty acid.

A further study examined the association between diet and acculturation among Hispanic immigrants from twenty communities in Washington State (Neuhouser, Thompson, Coronado, & Solomon, 2004), and researchers observed that highly acculturated respondents consumed fewer servings of fruits and vegetables per day in comparison with the intake of less acculturated people; highly acculturated respondents had a higher fat intake because of adding fat at the table to bread and potato.

However, African Americans tend to improve their diets after they migrate to the United States. Ard, Skinner, Chen, Aickin, and Svetkey (2005) explored the relationship between acculturation and health-related behaviours in African Americans. The researchers confirmed that the level of acculturation was associated with dietary fat intake and the consumption of fruit and vegetables, alongside other factors, such as age, gender, socioeconomic status or availability of foods. According to the data analysis in this research, traditional African Americans had lower consumption of fruits/vegetables and milk/dairy products, and higher intakes of fats, meat, and nuts. Moreover, in contrast, the same study revealed that African Americans who were highly acculturated to American culture had

higher intakes of bread, fibre, dairy products, and vegetable protein as a percentage of energy intakes.

There are a number of other studies which have investigated diets and acculturation among other groups including Asian-Americans, Asian Indians in the USA and Canada, Thai Americans, Korean Americans, and Chinese immigrants in the USA. Unger et al. (2004) examined the relationships between acculturation, fast-food consumption, and physical activity among Asian Americans. The higher degree of acculturation after arriving in the US was significantly associated with less frequency of physical activity participation and high consumption of fast-food. These are both obesity-related behaviours, which often leads to the increased potential risk of overweight and obesity, even though the Asian-Americans had a low prevalence of overweight when compared to other ethnic groups in the USA. The constant relationship between acculturation and health behaviours is closely related to the dietary alteration after immigration. Wang et al. (1994, cited in Unger et al, 2004) described how Asian immigrants who moved to Western countries always adapted gradually to Western diets, and, as a consequence, they increased the consumption of fat, processed meat, snack food, between-meal snacks, and fast-food, while simultaneously decreasing their intake of fish, fresh vegetables, and whole grains.

Furthermore, studies of Indian migrants to America and Canada (Ritenbaugh, Szathmary, Goodby & Feldman, 1996; Szathmary, Ritenbaugh & Goodby, 1987) reported that there was a decrease in intake of non-traditional Western foods following the increase in ages of the different groups. Raj, Ganganna and Bowering (1999) carried out another Asian Indian study in the United States where they investigated the alteration of dietary habits in relation to the length of residence within the USA. They found that the consumption of traditional mixed dishes had decreased since Asian Indians migrated to the United States; eventually, traditional dishes and snacks were reserved for special occasions, such as family gatherings, festivals and religious ceremonies. Interestingly, long time residents in this study were reported as reducing the consumption of ghee, yoghurt, butter and milk partly because of the awareness of the unhealthy effect of saturated fats. Raj et al. concluded that Asian Indians incorporated American foods in their diets, they continued to eat many traditional foods on special occasions in order to maintain their original cultural identity, and such

choices likely were influenced by many factors, including the length of residence in the USA.

Similar alterations of dietary patterns were observed in a Thai group in the United States, where Sophitmanee and Brittin (2006) examined the relation between food practices, changes, preferences, and acculturation among Thai in the United States. They reported that 79% of respondents had changed their eating habits since moving there; all respondents consumed fewer meals each day and altered their snack foods from Thai dessert and tea to sweet and salty items and soft drinks. In addition, acculturation was found to be positively related to consuming some American food and negatively associated with some traditional Thai food.

Moreover, it has been observed that the extent of acculturation is related to dietary practices and nutrition intakes among groups of Korean immigrants. A study of Korean Americans (Lee, Sobal & Frongillo, 1999) examined the variation of eating patterns and dietary intakes based on different acculturation levels. This study found that American meals were more frequently consumed as breakfast and lunch once people were more acculturated; whereas Korean meals were favoured for dinner as an emotional attachment. In addition, respondents who were more acculturated to American culture consumed American food more frequently than people less acculturated. Lee, Sobal and Frongillo (1999) observed that the fruit groups, together with sweet and fat groups of food, were eaten more often by the acculturated Korean American respondents. However, the traditional participants ate the vegetable group of food more often in this research. In summary, the dietary patterns of Korean Americans had been influenced by the extent of acculturation, but dietary quality did not vary by acculturation status.

Later, Kim and Chan (2004) examined how food and nutrient intakes alter with the levels of acculturation of Korean Americans. They outlined that respondents with higher acculturation levels tended to increase their energy intake derived from fat, together with vitamin E and folate intake, alongside the consumption of sweets. Notwithstanding, the less acculturated participants had a greater intake of sodium, niacin and dietary fibre. All these differences were statistically significant in this research. Park, Murphy, Sharma and Kolonel (2005) discussed the health-related behaviour and food and nutrients intakes

between US-born and Korean-born Korean American women. They observed that US-born Korean women had higher total fat intakes and energy intakes from fat, whereas lower intakes of sodium, vitamin C, and energy intakes derived from carbohydrate were evident, when compared to Korean-born women respondents; US-born Korean women consumed more whole grains and red meat but less soy products, vegetables and fruits. The researchers identified that the acculturation of Korean immigrants influenced their dietary intake patterns, which have caused an increased exposure to the potential risks of several chronic diseases, possibly due to an increasing total fat intake and fat consumption as a percentage of energy intake.

Two Japanese migrants studies in 1978 and 1979 (cited in Huang et al., 1996) observed that the incidence of diabetes for Japanese migrants to Hawaii was twice as high as their counterparts in Japan. This phenomenon was believed to relate to the different dietary patterns, in particular, percentages of energy intake from fat, simple and complex carbohydrates. Huang et al. also found that for Japanese immigrants in Hawaii, the consumption of fat contributing to their energy intake was twice that consumed by Japanese people of similar ages living in Japan. Furthermore, Japanese immigrants in Hawaii consumed less than one third of complex carbohydrates and twice the amount of simple carbohydrates when compared to that of similar aged indigenous Japanese.

Since the increase in the number of Asians migrating to Western countries, their health status and resultant affecting factors have been studied, including migrants from India, Thailand, Japan and Korea. Western diets have affected the traditional diets which Asians had before they moved out of their native countries. The studies above have showed different dietary changes affected by acculturation among Asians in Western countries. Meanwhile, a large number of Chinese, which occupy a large proportion of Asian emigrants, have migrated to Western countries. Therefore, a considerable number of studies in Western countries have explored dietary changes and eating patterns related to acculturation.

Earlier, Hrboticky and Krondl (1985) investigated the change of dietary patterns in connection with the acculturation process among first and second generation Chinese adolescent immigrants in Canada. They reported that the second generation of Chinese

boys consumed more processed food, including processed meat, potato chips, cakes, cold breakfast cereals; and only four vegetables were commonly consumed, which were broccoli, corn, snow peas, and lettuce; and they also tended to consume most Canadian food items the same as Canadian boys, which was viewed as the influence of acculturation. In addition, the use of rice, pork, and soybean milk were found to be negatively correlated to language acculturation among this study group. The frequency of consuming dairy foods, processed cereals, meats, miscellaneous items (honey, beer, peanut butter, jams, margarine, coffee), and typical North American vegetables (potatoes, baked beans, carrots, and cucumber) were the most pronounced differences because of acculturation. These second generation Chinese boys incorporated "cold cereals" into their diets, but some foods, like Brussels-sprouts, were rejected. However, potatoes were considered by the researchers as a stabilising food in the participants' diets. Hrboticky and Krondl suggested that acculturation is a continuous progression within each generation in a host country, and that the alteration of dietary patterns among immigrants was not always desirable, since some nutritionally poor food then also was incorporated into their habitual diets.

Satia et al. (2000) observed that the first meal to be Westernised among Chinese-American women was breakfast, because preparing a Chinese traditional breakfast was time consuming. However, the majority of participants in this study consumed Chinese-style lunch, such as rice, noodles, or soup rather than Western-style food. Most of the participants consumed a Chinese-style dinner. Food quality, convenience, cost, and availability were considered as the important predictors of dietary change among the participants in this research. In addition, from the qualitative interviews, the major sources of fat in Chinese diets were cooking oil and meat. Conversely, in American cuisine, the main sources of fat were whole milk, cheese, salad dressing and fried chicken. Later, Nan and Cason (2004) reported that Chinese Americans increased their frequency of eating Western foods along with all seven food groups (grains, vegetables, fruits, meat/meat products, dairy products, fats/sweets and beverages), while simultaneously decreasing the frequency of eating traditional Chinese food. Furthermore, the increase of consumption of these food items was found to be significantly associated with respondents' educational levels and English proficiency. More than half of the respondents agreed that they had changed their diets since they emigrated to the United States, mainly because of the time

consuming method of preparing traditional Chinese food and the non-availability of certain food items. They observed that certain food items consumed were significantly increasing and decreasing. The increased food items included pizza, breakfast cereal, bread, pasta, French fries, hamburgers, hot dogs, ham, cheese, yoghurt, coffee and doughnuts. The decreased foods included steamed bun, dumpling, bean sprout, bamboo shoots, soybeans, tea, tofu and duck meat.

Recently, Demory-Luce, Morals and Nicklas (2005) investigated acculturation, eating habits, and weight status among Chinese-American children and their caregivers. They demonstrated that 43% of food consumed by children at home reflected the Chinese style, such as mixed dishes, meat and soup. The American food groups consumed by these Chinese immigrants consisted of desserts, sweetened beverages, enriched bread, candy, salty snacks, high fat meat, and ready to eat unsweetened and sweetened cereal. Furthermore, 53% of the caregivers were considered overweight or obese according to the WHO standard (BMI $\geq$ 23kg/m^2). A Chinese American study (Nan & Cason, 2004) demonstrated that Chinese immigrants in America increased their dietary variety and consumed more fats, sweets, and soft-drinks, while the consumption of traditional Chinese food decreased.

These studies from Chinese people in America showed the changing diet of the Chinese immigrant, such as increased dietary variety, processed food intake, and intakes of fats, sweets, and, in contrast, decreased consumption of traditional Chinese foods, in particular, soy bean products, green leaf vegetables. These changes were partly associated with different acculturation levels of respondents in these studies. The Chinese in New Zealand, as in other countries, experienced a culture gap and brought their own culture with them to a new environment. Different lifestyle, attitudes, beliefs, eating habits will inevitably gradually affect both the new Chinese migrants and older Chinese settlers in New Zealand.

2.4 Dietary acculturation

Many researchers have studied the relationship between acculturation and dietary patterns of minority groups in host countries. Acculturation, as a psychological term, describes a

process occurring when people emigrate to a new country and have been exposed to a new culture. Another terminology, "dietary acculturation", describes the alternations of eating patterns and food choices in their new environment following on from the process of acculturation. For example, dietary acculturation for the Chinese immigrant to New Zealand may be characterised by increased consumption of "Western" foods, such as fish and chips, burgers, pizzas, and decreased consumption of traditional Chinese dishes, such as pickled vegetables, fresh green vegetables, and soy products. However, dietary acculturation is not a unilateral process, which means the host country adopts some of foods and dietary practices of the minority groups, at the same time as the immigrant group adopts the traits of the host food culture. Accordingly, there are increases in the number of Chinese supermarkets and restaurants in New Zealand. Simultaneously, Western people have started to accept some traditional Chinese foods and dietary patterns.

In theory, dietary acculturation (Satia, Patterson, Kristal, Hislop, Yasui & Taylor, 2001) refers to a multidimensional and complex process of adopting the eating patterns/food choices in a new environment among a migrating group (Satia et al., 2001; Satia, Patterson, Neuhouser & Elder, 2002; Satia, 2003), describing the study of dietary changes after immigration. As a part of the process in acculturation, immigrants endeavor to maintain their traditional food, or find new ways to use traditional foods. For example, Asian immigrants keep rice as an important staple food, but cereal and bread may take the place of other traditional foods. Following the process of dietary acculturation, people might replace steamed buns by a meat pie or a sandwich. In addition, because of the non-availability of traditional foods and the time spent in preparing traditional dishes, immigrants may incorporate the available food from local markets in preparing traditional dishes.

The published studies of Szathmary, Ritenbaugh, and Goodby (1987) and Ritenbaugh, Szathmary, Goodby and Feldman (1996) illustrated that those with dietary acculturation would prefer to add new foods to a stable traditional diet rather than replace traditional foods and the effect of this was thought to result in an increase of energy intake. These dietary pattern alterations among Indians in America and Canada were believed to be associated with the appearance of hyperglycemia and diabetes. Another study by Wahlqvist

(2002), which focused on Asian migration to Australia, indicated that Asians in Australia tended to decrease energy expenditure and increase the intake of energy density food through the higher intake of fat and sugary drink, together with a decreased intake of protective food, such as soy, green leaves vegetables, and tea.

Satia, Patterson, Neuhouser and Elder (2002) proposed a model of dietary acculturation which shows a complex and dynamic relation of socioeconomic, demographic and cultural factors with exposure to the host culture. Fig 2-1 provides more details of these factors. A number of dietary studies (Lee, Sobal & Frongillo, 1999; Pan, Dixon, Himburg & Huffman, 1999; Raj, Ganganna & Bowering, 1999; Satia et al., 2001; Satia et al., 2000) showed that longer residence in the host country, higher education and income, younger age, high English proficiency, employment outside the home, and even being married and having young children, all result in greater dietary acculturation with the faster and broader acceptance of host food. Figure 2-1 also shows that changes in psychosocial factors and taste preferences and changes in environmental factors lead to changes in food procurement and preparation. The lesser availability of traditional foods and ingredients led to increased consumption of the food of the host country. Furthermore, given the high expense in purchasing traditional foods, or time spent in preparing such food, immigrants are more likely to choose convenient and affordable food from the host country. The alteration of dietary patterns will possibly show up as three choices: maintenance of tradition; adoption of host country food; and bicultural eating patterns.

Figure 2-1 Proposed Model of dietary acculturation

Figure 2-1 Source: Satia, Patterson, Neuhouser and Elder, (2002, p. 1107). Dietary acculturation: applications to nutrition research

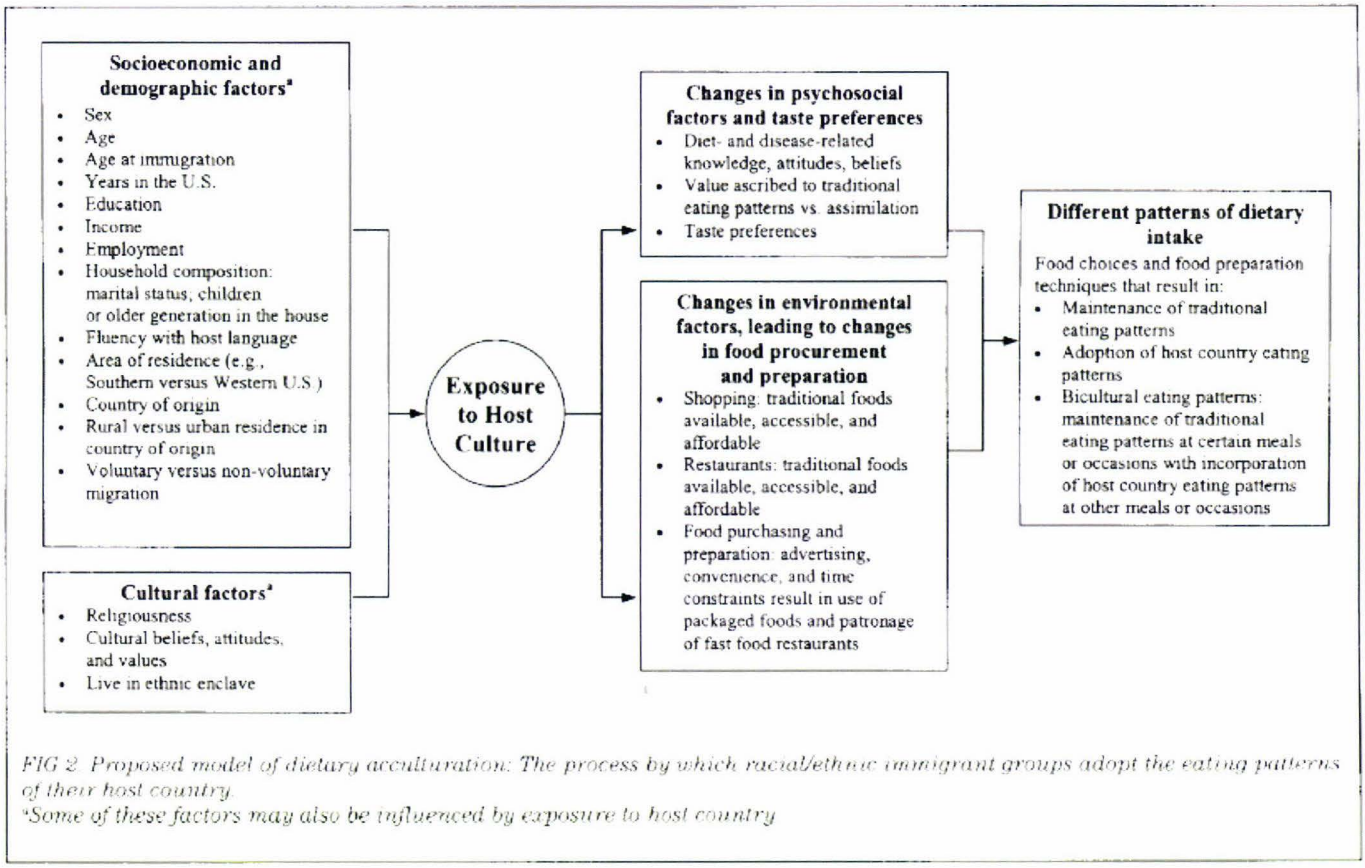

FIG 2. Proposed model of dietary acculturation. The process by which racial/ethnic immigrant groups adopt the eating patterns of their host country.
[a]Some of these factors may also be influenced by exposure to host country

Satia, Patterson, Neuhouser & Elder (2002) reviewed 18 studies examining associations of diet and acculturation in Asian (Koreans, Japanese, Vietnamese and Chinese) and Hispanic migrants settling in the United States and Canada. Even though most of these studies reported some statistically significant associations between acculturation levels and diets, the researchers commented that it was the lack of consistency in relation to dietary changes associated with acculturation. Satia et al. suggested that more studies should concentrate on examining the relative importance of various determinants in influencing acculturation-associated dietary changes and the impacts of such changes on health status.

Dietary changes can result from all sorts of reasons, including socioeconomic, demographic and cultural factors after migrants' exposure to their host culture. Peng (2005) investigated dietary acculturation of Chinese students in the United States, and the results showed that Chinese students experienced meaningful dietary acculturation changes while living in the United States, and female Chinese students were more likely to have Western acculturated food habits than males. Furthermore, there was no significant difference between the young and older student groups in the dietary acculturation scores.

After people migrate to a new environment, dietary acculturation is considered as one of the behavioural consequences. The new dietary patterns of immigrants comprise of the rejection of traditional foods and acceptance of culturally new foods, however, the impact of this process on health is interconnected with the balance of change between nutritionally sound and nutritionally questionable food, since there is a very close relationship between diet and health status.

2.5 Acculturation, dietary acculturation and health

Acculturation has been shown to influence the dietary patterns of immigrants by both maintaining the traditional eating habits and adapting to the new cultural way of eating. The correlation between diets and the prevalence of chronic diseases has been recognised. Studies of first and second generation immigrants to America showed that acculturation to a Western lifestyle seemed to result in an increase in morbidity and mortality from many degenerative diseases (Parker, Davis, Wingo, Ries & Health, 1998, cited in Kim & Chan,

2004). A possible reason for these diseases is dietary change as the process of acculturation occurred (Huang, Rodriguez, Burchfiel, Chyou, Curb & Yano, 1996). As immigrants move to a new host country with their rich cultural heritage, they might shift their lifestyle into mainstream culture, which may easily result in rapid modification of chronic diseases patterns. Ziegler et al. (1993) reported that Asian-American older female migrants had an 80% higher risk of breast cancer than recent immigrants. Marmot and Syme (1976), cited in Kaplan, Chang, Newsom and McFarland (2002), reported that traditional Japanese had a lower prevalence of chronic disease compared to their Westernised counterparts.

Sundquist and Winkleby (2000) investigated Mexican-American women and men from a third National Health and Nutrition Examination survey. The researchers found that about 68.7% of US-born women had high prevalence of abdominal obesity and were more likely to have high serum insulin, non-insulin dependent diabetes, high blood lipids, or hypertension, when compared to Mexican-born counterparts. These findings were consistent with the Hispanic HANES study which showed BMI were larger among second and third generation Mexican Americans than the first generation (Khan, Sobal & Martorell, 1997).

On the aspect of health-related characteristics, Park, Murphy, Sharma and Kolonel (2005) reported that US-born women had a higher body mass index level, and the proportion of overweight and obesity in US-born women was around three times higher than immigrants born in Korea. In addition, the average hours of sports and vigorous work were lower among the US-born Koreans, which might be considered to affect their body weight gain.

There are four studies which investigated health status, health-related behaviours, and acculturation among Hispanics or Latinos. Gordon, Harris, Ward and Popkin (2003) studied three subgroups of Hispanic migrants (Mexicans, Puerto Ricans and Cubans) in the United States, in order to examine how the acculturation process affects differences in overweight and its subsequent risk factors including diet, smoking, and physical activity. They found that longer residence in the US was associated with increased overweight and that US-born adolescents had rapid acculturation of overweight-related behaviours.

Hubert, Snider and Winkleby (2005) recently reported from a cross-sectional survey that a high acculturation level had the strongest correlation with obesity (measured by BMI), followed by physical inactivity and poor diet. The researchers identified a trend that respondents with higher BMI had greater levels of acculturation. In addition, they found that increased BMI was negatively related to the level of physical activity. Hubert et al. considered that low levels of moderate/vigorous physical activity were observed as an independent contributor to obesity. Meanwhile, Vaeth and Willett (2005) examined the level of acculturation and the prevalence of hypertension among Hispanics in Dallas County. They reported that participants who were lower acculturated were significantly less likely to have hypertension, when compared to those respondents having either medium or high acculturation levels.

Later, Fitzgerald et al. (2006) focused on the association of socioeconomic status and acculturation with the influence of risk factors for chronic diseases among low-income Puerto Rican women in the USA. They observed a positive relation between obesity and acculturation, which was supported by Himmelgreen et al. (2004, cited by Fitzgerald et al. 2006), who reported that BMI was positively associated with acculturation. The respondents in Fitzgerald's study, who were highly acculturated, had a higher consumption of alcohol and cigarette smoking.

In addition, the relationship between acculturation and diabetes has been discussed in an American study of Arab migrants in the United States (Jaber, Brown, Hammard, Zhu & Herman, 2003). They observed that both male and female participants with low acculturation levels consumed more Arabic food, and that less acculturated women only, were observed to have greater waist-to-hip ratio. Low acculturation was positively associated with the risk of diabetes among male respondents by adjusting for age and BMI. Generally, lower acculturation was associated with a higher incidence of diabetes among females. The researchers used a number of items to classify a low acculturation level, which included low education, unemployment, speaking Arabic with friends, and more frequent consumption of Arabic food. Lower acculturation levels, together with the alteration of healthy behaviours, are considered an essential risk factor for developing diabetes among Arab migrants in the United States. The results from this study is similar to

a study of an Hispanic group (Mainous et al., 2006) in the United States, which confirmed that individual Hispanic respondents with low acculturation measured by language, risked developing diabetes, but, however, there was no significant relation between acculturation and diabetes control.

In contrast, Huang et al (1996) argued that Japanese-American men in Hawaii, who were highly acculturated to American culture, had an increased prevalence of diabetes. Further, the study indicated that respondents who maintained a traditional Japanese lifestyle had higher physical activity levels. The researchers considered that physical activity was a confounding factor in studying the relationship between acculturation and diabetes.

Lee, Sobal and Frongillo (2000) showed that there was a linear relationship between acculturation and body mass index among male Korean American respondents, but not for females. They found that acculturation was positively related to light physical activity but not vigorous activity; this is opposite to the Japanese study described above (Huang et al., 1996). A few years later, Song et al. (2004) examined the relation between acculturation and health risk behaviours of Californians of Korean descent. All respondents in this study were divided into three subgroups, acculturated, bicultural, and traditional. The majority of people in the acculturated group were second generation Americans with fewer Korean friends. However, the first generation, which had predominately Korean friends and preferred Korean food and restaurants, mostly belong to the traditional group. The study found that both the acculturated men and women had a significantly higher prevalence of overweight than people in Korea. In particular, the BMI value of Korean-American men had a significantly positive relationship with their acculturation levels. Interestingly, those in the traditional group of Korean Americans were less physical active than their counterparts in Korea, and the acculturated and bicultural groups were more likely to exercise than their Korean counterparts.

Campbell, Parpia & Chen (1998) investigated the changes in eating habits and health-related behaviours among Chinese immigrants in the United States, and they found that Chinese migrants have a tendency to consume a more Western diet with increased fat and cholesterol intake, together with an increased vegetable intake and less intake of fibre. As a result, some of these changes were considered to be associated with a higher prevalence of

diet-related chronic diseases, such as coronary heart disease, strokes, and some cancers; and also to lead to an increased incidence of type 2 diabetes mellitus and certain types of cancers.

Immigrants who are becoming acculturated to Western culture and simultaneously changing their diets to Western style in a negative way, are more likely to develop chronic diseases, such as obesity, type 2 diabetes mellitus and cardiovascular diseases. Especially, Chinese people in China have completely distinctive and different eating habits and lifestyles when compared to Western people. Once Chinese move away from their own country to Western countries, for example, New Zealand, on the one hand, they wish to keep their traditional dietary style; however, on the other hand, they try their best to meld into a new environment. As a result, Chinese migrants may adopt both healthy and unhealthy lifestyle factors, which when added to different genetic backgrounds, may possibly cause them to develop diet-related chronic diseases.

2.6 Chinese traditional food habits

2.6.1 Meal composition

Chinese consume a wide variety of foods, including green vegetables, soy bean products, and meats. Normally traditional Chinese food is divided into five culinary regions based on the availability of foodstuff and different climates (Kittler & Sucher, 2004). Chinese mostly consume three meals per day often adding numerous snacks. Breakfast consists of the hot rice or congee with seasoning and small amounts of meat or fish, or hot steamed bread, dumplings, and even noodles. Lunch is composed of rice, soup, and several dishes, as a smaller version of dinner. Whatever may be the composition of a meal, the balance of ying and yang foods, which refers to "fan" and "ts'ai", is considered all the time. A primary element in a meal, "fan", includes cooked rice, porridge, noodles, eaten together with "ts'ai" containing cooked meats and vegetables, which are used to give more taste to the meal.

2.6.2 Different cuisine

There is a long history of cooking in China. People from different regions of China may use a wide variety of cuisine. For example, in Northern China, foods always are preserved and hot clear soup is favoured within a meal. However, in Southern China there are three culinary types, which are Sichuan, Yunnan, and Cantonese. One of the features in Sichuan dishes is using chilli, garlic, and the Szechwan pepper, and often smoked dishes and liberal use of sesame oil, together with its use of several cooking methods in making one dish (Simoons, 1991). The distinguishable factor in Yunnan cooking is its use of dairy products, such as yoghurt, fried milk curd, and cheese. Cantonese cooking is achieved without heavy use of chilli peppers and is characterised by stir-fried dishes, fresh, dried and salted seafood, and delicate thickened sauces. Therefore, by using a wide range of available food and a variety of cooking methods, Chinese dishes are very different from Western foods in both flavour and taste.

2.6.3 Ingredients and commonly used foodstuffs

The basis of the Chinese diet is boiled rice grains which provide most of the calories, and the most popular pulse crop in China is soybean which is able to develop into a varied range of soybean products, such as soy sauce, soy bean paste, and soy bean curd. The commonest non-leaf vegetables are the root crops, including white radish, green radish, bulbs, as well as the shoots of many plants, for example, bamboo shoots. The well-known green leaf vegetables mainly include bok choy, Peking cabbage, and mustard greens. Ginger, garlic, and spring onion are major ingredients in stir-fried dishes and dumpling fillings. In addition, seafood, fresh fishes, pork, and poultry are favoured by Chinese (Anderson, 1988).

2.6.4 Cooking methods

The primary Chinese cooking methods are boiling, steaming, and stir-frying; and cutting is a basic step in food preparation in order to produce bite-size or smaller chunks. Chinese prefer lightly cooked food, such as less cooked chicken, crispy vegetables, and succulent seafood. Moreover, cooking is done over high heat in order to cook and produce the meal quickly. The most distinctive factor about Chinese cooking when compared with other

Asian countries, is the flavouring mix, which includes a complex and subtle variety of foods and spices: onions, garlic, brown pepper, various fungi, sesame oil, rice vinegar, chilli peppers, sugar, five-spice, star anise, malt syrup, and the like (Anderson, 1988).

2.7 Dietary changes of Asians after moving to Western countries

Many studies have investigated the changes of dietary habits, eating patterns, and food preferences among different immigrant groups.

Reeves and Henry (2000) examined how Malaysia students in the United Kingdom modulated their food intake and energy balance in the six months after they arrived. The findings showed that students were able to cope with the alteration of eating habits by keeping their energy balance, even though they changed their food intake, and, for example, the consumption of breakfast cereals, meat products, coffee and tea had all increased. In addition, breakfast was the most likely meal to change from traditional Malaysian food to toast and cereal, whereas lunch and dinner were less likely to change.

Pan, Dixon, Himburg and Huffman (1999) revealed the alteration of eating patterns among Asian students in the United States. They reported similar traits as the above study in the UK, whereby an increased number of respondents skipped their breakfast and consumed more snack foods, including salty and sweet items. Once students ate away from home, they would choose American fast food. In summary, there were noticeable changes in increased consumption of fats/sweets, dairy products, and fruits and decreased intake of meat/meat alternatives and vegetables, once Asian students had emigrated to the United States.

There were three significant differences in the study of Yang and Read (1996) which investigated the dietary pattern changes of Asian immigrants to the United States. These were trimming fat from meat, adding butter/margarine to vegetables, and adding cheese to food. When comparing their previous home country diet to their current US diet, there was a significant increase in the intake of saturated fat and monounsaturated fat and cholesterol, and conversely, a decrease in the consumption of carbohydrate and fibre. However, in

accordance with the American dietary standard, the Asian immigrants' current intake was relatively low fat, high carbohydrates and high fibre, in comparison with their American counterparts.

A two generation Asian American study (Wu-Tso, Yeh & Tam, 1995) showed that young Asian Americans consumed food relatively high in fat and cholesterol but low in fibre, which was considered to be a more Americanised diet. Conversely, older Asian Americans were more likely to consume traditional Asian diets which were composed of foods low in fat, high in carbohydrate, particularly complex carbohydrates, and moderate in protein. Furthermore, the study found that young Chinese American respondents consumed 20% more cholesterol and gained more percentage of energy intakes from fat, when compared to the older Chinese Americans. Earlier, Whittemore et al. (1990, cited in Wu-Tso, Yeh & Tam, 1995) compared the diet between Mainland Chinese and Chinese Americans, and they observed that Mainland Chinese obtained 15 to 20 percent of energy intake from fat, whereas about 30 to 40 percent of energy intake was from fat among Chinese Americans.

Besides American studies, Australian Chinese have been questioned about food intakes after emigrating from China to Australia (Hsu-Hage, Ibiebele & Wahlqvist, 1995; Zhang, Hsu-Hage & Wahlqvist, 2002). The results of these two studies were opposite to the above American studies described above. Hsu-Hage, Ibiebele and Wahlqvist (1995) found that food consumed by Melbourne Chinese who had been in Australia for longer, and who had high education levelsand socioeconomic status, had gradually moved into Australia eating patterns. In contrast, Chinese of older age and lower education levels, tended to maintain their traditional eating habits even though they were limited by the food availability in Australia. Zhang et al's study identified longitudinal changes in nutrient intakes among a Melbourne Chinese sample. The study showed that the contribution of fat to the total energy intake in these people was less than that of their ethnic counterparts in their native country; and moreover, that the nutrient intakes had improved from 1989 to 1995, even though they still showed an insufficient intake of calcium and zinc.

The foregoing studies focused on the changing dietary patterns of Asians after they migrated to Western countries which had distinctively different cultures. As time passes for

people who settle in New Zealand, New Zealand culture gradually influences their dietary patterns, eating habits, and even chronic disease patterns, including both newly arrived and old migrants. Similar to the findings of the Asian studies in Western countries as described above, Chinese who live in New Zealand change their diets and eating habits for a variety of reasons, and these alterations in diet possibly affects their health status subsequently over time. Many factors, such as the different personal characteristics, educational levels, socioeconomic status, the length of time living in New Zealand, English proficiency and surrounding social environments, all affect food choices and the eating patterns of Chinese in New Zealand. Dietary changes have played an important role in the development of chronic diseases during nutrition transition

2.8 Nutrition transition

2.8.1 Dietary changes during nutrition transition

Transition initially was used to describe the epidemiological transition, but later it has been used by Popkin et al. (1993), Popkin (2001) and other researchers (Lieberman, 2003; Vorster, Venter, Wissing & Margetts, 2005) to describe trends connected to diet, food consumption and chronic diseases, particularly in developing countries. Over the past hundred years, there have been more than 170 million children who suffer from under-nutrition, and 3 million dying of diseases related to such under-nutrition. However, with nutrition transition, under-nutrition and over-nutrition now both exist as phenomena and it is estimated that about one billion adults are overweight, and more than 300 million are clinically obese (Caballero, 2006). In addition, Caballero reported that the disease patterns of most developing countries have changed from communicable to non-communicable, with diet-related chronic diseases mainly due to individual nutrition transition and lifestyle changes. With the processes of urbanisation and modernisation, a positive energy balance from increased dietary energy intakes and a high proportion of fats and refined sugars, (coupled with reduced labour energy demands) has been identified, and as a consequence, has led to excessive weight gain (Caballero, 2006). Therefore, dietary intake changes combined with changing physical activity levels is believed to be a major factor in

changing disease patterns, not only in developing countries, but also in developed countries.

Both nutrition transitions from one country to another, and from rural to urban areas in the same country, will affect the eating patterns and lifestyles of these populations, which may possibly increase the risk of developing chronic diseases. For example, a cross-sectional population-based survey in South Africa (Vorster, Venter, Wissing & Margetts, 2005) found gradually decreased consumption of carbohydrate as energy intakes among urban groups, and simultaneously, the total fat intakes contributing to energy intakes had a significant difference, ranging from 22.6% (men) and 23.6% (women) in rural groups to 30.6% and 31.8% respectively in the urban respondents. A significantly increased serum cholesterol level and low-density lipoprotein cholesterol value from rural to urban men and women also was observed. As a result, the risks of developing chronic diseases, in particular, obesity, cardiovascular diseases, hypertension, and diabetes, had increased among the urban population when compared to rural groups. The influence of urbanisation and modernisation with regard to economic shifts has been studied in China, India, and Latin America, and the existence of both under-nutrition and over-nutrition has been measured in these studies (Popkin, 1994). China, as one of developing countries facing nutrition transition, has, in particular, been the focus of such investigations.

In China, traditional eating patterns used to demonstrate high carbohydrate intakes including rice, noodles, and flours; be low in animal fats; and have high intakes of vegetables. However, with the open policies of the Chinese government, Westernisation and industrialisation have gradually changed Chinese eating habits, dietary intake patterns, and lifestyles. Lieberman (2003) described a typical pattern of nutrition transition which included an increased intake of animal fat, sugar, processed foods through the rapid globalisation of fast food franchises, and also less involvement in physical activity due to mechanised transportation and labour-saving household technologies. In consequence, this pattern of transitional eating habits is one of the major risk factors in the onset of overweight or obesity and degenerative diseases, because of the significant positive energy balance caused by increased food input and decreased energetic output. One of the earlier studies from Anderson (1988) noticed that an increase in using cheap ingredients, such as

sugar, salt, and monosodium glutamate, for cooking was occurring. Anderson reported that there was a tendency of Chinese to accept American coffee-shop and fast-food chain companies, while simultaneously abandoning traditional Chinese food restaurants. With the rise of income and urbanisation, diets high in complex carbohydrate have been replaced gradually by more energy-dense diets with a high intake of sugar and fats (Popkin, 2001). Moreover, the same study included data from a China Health and Nutrition Survey (CHNS) in 1993 where the proportion of upper-income respondents had increased from 22.8 in 1989 to 66.6% in 1993. This was mainly because of increased imported foods and food consumed away from home. In addition, a shift towards a diet higher in fat and meat, and lower in carbohydrates and fibre, had been observed. Meanwhile, an increased number of urban Chinese adults were involved in lower levels of physical activity at work, which possibly caused significant increases in their body mass index and obesity.

According to the research from Du, Lu, Zhai and Popkin (2002), five stages of nutrition transition in China are evident. The first two stages are less cereal consumption because of famine; the third and fourth stages are a recovery and reform period; and the fifth is a shift in energy requirements and the alteration of Chinese dietary patterns, due to the economic progress related to the liberalisation of food production and free food markets. During the fifth stage, cereal consumption, in particular coarse grain consumption, decreased and the total consumption of vegetables and fruits were less than before. The larger decrease was seen to occur among low income groups. However, increased consumption of animal foods was noticed in the whole population, partly due to income levels. Another rapid increase in food consumption arose from eating away-from-home sources. Furthermore, the prevalence of overweight and obesity increased fourfold from 1982 to 1997, mainly because of the increase of energy intakes and the decrease in energy expenditure.

Recently, Struchtemeyer (2006) reported the findings from the China Health and Nutrition survey which included eight provinces from different districts in China. The researcher found that the traditional Chinese diet was being lost in the eating pattern shifts, due to the economic revolution and globalisation. Upper-income respondents in the survey were more likely to obtain more than 30% of their energy from dietary fat. In addition, people were consuming more imported food and food away from home. As the use of human energy to

produce products and services is reduced by modernisation and industrialisation, people can experience less daily physical exertion.

Popkin and Du (2003) reported that in China between 1989 and 1997, energy intake shifted away from carbohydrate to fat: 68.7% carbohydrate in 1989 dropped to 59.8% in 1997; 19.3% fat in 1989 climbed to 27.3% in 1997. Over half of the respondents from the China Health and Nutrition survey consumed excessive energy from animal fat. This plays an important role in the dietary shift by increasing the saturated fat intake which is then linked to the alteration in disease patterns. From their perspective, the alteration of eating patterns, including increased energy intake, higher animal product intake, together with a high fat diet, tends to lead to the large shift in disease patterns from under-nutrition to chronic diseases, such as obesity, type 2 diabetes mellitus, and cardiovascular disease. The researchers announced that the linkage between the increased animal fat intake and the prevalence of chronic disease should not be ignored. A study based on the data from the 1989 China Health and Nutrition Survey (CHNS) (Popkin et al., 1993) showed that the diet of Chinese people was rapidly changing to the typical high-fat and high sugar diet due to the continuous increase of incomes, and the data in this study identified the tendency to increase the percentage of energy from fat with a high proportion of meat in the diet. However, a high fat diet existed dramatically among urban and higher income populations when compared to rural and lower income groups. In particular, middle- and higher-income groups consumed more high-fat red meat products in comparison with lower income adults. These people consumed much more wheat and cereal products. In addition, adults with a higher income had a higher rate of obesity.

2.8.2 Other influences caused by nutrition transition

With nutrition transition, dietary patterns have changed gradually both in developing and developed countries. Since dietary changes are associated with changes in certain chronic disease patterns, risk factors have increased, together with the prevalence of chronic diseases. Obesity is often concentrated in the cities where urbanised people adopt Western diets and sedentary lifestyles. Lieberman (2003) reported that more than 80% of new cases of type 2 diabetes mellitus were related to obesity, and women with a BMI $\geq 33 kg/m^2$ had

60 times greater risk than lean subjects of developing the disease. Men with a BMI $\geq$ 35kg/m^2 had a 40 times higher risk than lean subjects to develop diabetes. The researcher concluded that the development of type 2 diabetes mellitus correlated with the degree of adiposity, duration of obesity and body fat distribution. However, the estimation of the percent of adults overweight from the World Health Organization is 15% in China and since some Asian people, whose body weight stayed in the normal range were still associated with the onset of type 2 diabetes mellitus, the WHO suggested lower BMI risk levels should be the target goal for these populations.

Nutrition transition happens also among Chinese emigrants from China to New Zealand, due to large differences in eating habits, food choices and lifestyles. One of risk factors in the development of chronic disease can be linked to such dietary changes. Chinese immigrants in New Zealand gradually adopt Western lifestyles at different stages of their lives, at first keeping mostly traditional habits then moving to achieve completely Western ones. To an appreciable extent, dietary changes among Chinese in New Zealand may result in an increased incidence of chronic diseases, particularly type 2 diabetes mellitus, and this link will be able to be further established and measured through future research.

2.9 Prevalence of type 2 diabetes mellitus

2.9.1 Prevalence of type 2 diabetes mellitus in the world

Diabetes New Zealand (2006a) reported a number of key messages in 2006, including that diabetes is a worldwide health issue, and that about 3.2 million deaths are attributable to diabetes each year. In addition, at least 194 million people in the world have diabetes, a figure which might double by 2030. King, Aubert and Herman (1998) reported that the adult population (age $\geq$ 20) will increase by 64%; that prevalence of diabetes in adults will increase by 35%; and that the number of people with diabetes will increase by 122% from 135 million to 300 million between 1995 and 2025. The countries with the largest number of people with diabetes are India, China and the USA. In developing countries, there will be about a 170% increase in the number of people with diabetes from 84 million to 228

million. Moreover, the highest increase in prevalence of diabetes is expected to be for China (68%).

There are three kinds of diabetes: insulin dependent diabetes mellitus (type 1 diabetes); non-insulin dependent diabetes mellitus (type 2 diabetes known as NIDDM); and gestational diabetes. Type 2 diabetes mellitus is responsible most notified for cases of diabetes. Zimmet, McCarty and de Courten (1997) illustrated that non-insulin-dependent diabetes constituted about 85% of all cases of diabetes in developed countries, and that it had reached epidemic proportions in many developing nations, and also in disadvantaged groups in developed countries. The researchers found that the high prevalence population groups were Pacific Islanders, Native Americans, and migrant Asian Indians and Chinese, especially in populations where they moved away from a traditional towards a modern lifestyle.

2.9.2 Incidence of NIDDM in China

According to the epidemiological data of such studies identified above, type 2 diabetes mellitus has reached epidemic proportions in the world. Its pandemic and associated complications will continue to escalate both in developed countries and developing nations in the coming decades. The prevalence of type 2 diabetes mellitus is believed to relate to the impact of modernisation and urbanisation, and China is a specific example. Based on the data of National Diabetes Survey in 1980, Chen (1996) reported the prevalence of type 2 diabetes mellitus was about 1% among the Chinese adult population, until 1998 when the incidence in the middle-aged and elderly population rose to 5.7%. In the Capital city of China, Beijing, the prevalence of diabetes in 1989 was 1.2% of the population over 15 years old. However, a replicated study five years later showed the prevalence had reached 3.4%, almost triple (Chen, 1996).

From the 2002 China National Nutrition and Health Survey, Wang, Mi, Shan, Wang and Ge (2007) estimated that the prevalence of diabetes would rise to 7.7%. Recently, a population-based cross-sectional study from 2001 to 2002 (Dong et al., 2005) observed that around 9.5% of urban Qingdao residents were diagnosed as having diabetes, and undiagnosed diabetes was revealed to be high in young people. Furthermore, they reported

urban participants were significantly more obese, were more physically inactive, and had a higher prevalence of parental history of diabetes, than the rural subjects.

An epidemiologic study of type 2 diabetes mellitus in Taiwan (Chang et al., 2000) found, that between 1985 and 1996, the mortality rate from diabetes had almost doubled from 4.9% to 9.2%, and that the prevalence of Impaired Glucose Tolerance was about 15.5%. The 2002 National Study in China (Wang, Mi, Shan, Wang & Ge, 2007) examined the prevalent trends in obesity and chronic disease. The researchers revealed that the prevalence of diabetes in urban areas (4.5%) was much higher than in rural areas (1.8%) and even higher in larger cities (6.4%). They also found that the shift from traditional diets to high-fat and high-energy diets had contributed to the changes of prevalence in chronic diseases in China. Decreased physical activity due to advanced technology, transportation and communication, was considered to play another essential role in the chronic disease patterns in China.

An increased prevalence of chronic diseases, especially diabetes, has been observed in China at a time of fast economic and social development. The high household income allows people to afford high-fat and high-energy dense food, and to have more chances to be exposed to sedentary lifestyles. The significant rise in the prevalence of type 2 diabetes mellitus in China has taken place too quickly to be explained solely by genetics, though it has been established that Native American, Pacific Island and Asian populations have a high genetic susceptibility to type 2 diabetes mellitus. It has been argued that environmental causes, in particular Western lifestyles, may have unmasked the influences of pre-existing genes in an increased incidence of type 2 diabetes mellitus among Asian populations (McBean, Li, Gilbertson & Collins, 2004; McNeely & Boyko, 2004; Zimmet, Shaw, Murray & Sicree, 2003).

2.9.3 Prevalence of type 2 diabetes mellitus among Asians in Western countries

There are a number of studies which have concentrated on the incidence of type 2 diabetes mellitus among Chinese in China. However, with the popularity of migration, a large number of Asians, including many Chinese, are moving away from their native countries to

Western countries. Two matters of interest are: what is the prevalence of type 2 diabetes mellitus among Asians in Western countries; and do figures show a tendency for this to be different from Asians in their own countries. Traditionally, diabetes has been reported less commonly in Asia than in Western countries. However, the high rates among migrant Asians indicate that environmental factors, for example, "Westernisation", contribute to the increased prevalence of diabetes among Asians in Western countries; both urbanisation and migration are believed to play a major role in the increase of risk for developing diabetes (Fujimoto, 1996). A retrospective study (McBean, Li, Gilbertson & Collins, 2004) described the prevalence and newly diagnosed cases of diabetes among the elderly between four ethnic groups (Whites, Blacks, Hispanics and Asians). During the study period, the greatest increase in diabetes prevalence was among Asians (68%). Soderberg et al. (2005) used a population-based survey in the years 1987, 1992 and 1998, so as to examine the prevalence of different stages of glucose intolerance among Indians, Creole and Chinese from Mauritius. An increased prevalence of type 2 diabetes mellitus was observed in both women and men among all age groups, from 12.8% in 1987, to 15.2% in 1992 and 17.9% in 1998. The prevalence of the newly diagnosed diabetes increased dramatically when compared with the prevalence of known previous diabetes.

New Zealand is a multicultural and developed country, which has become a popular place for Chinese migrants. According to data from Ministry of Health obtained in 1999, there were about 115,000 people with known diabetes and a possible further 40,000 to 60,000 people undiagnosed among New Zealanders (Ministry of Health, 1999).

2.10 Risk factors for type 2 diabetes mellitus

2.10.1 General potential risk factors

With a dramatic increase in the prevalence of type 2 diabetes mellitus and its complications, both in developed and developing countries, the direct and indirect factors affecting the development of type 2 diabetes mellitus have been questioned. According to information from Diabetes New Zealand, risk factors increasing the potential of developing type 2 diabetes mellitus included:

1) Being European and over 40 years old;

2) being of Maori, Asian, Middle Eastern or Pacific Island descent and over 30 years old;

3) family history;

4) overweight;

5) high cholesterol or high blood pressure;

6) diagnosed as having Impaired Glucose Tolerance; for females whether they had a large baby weighing more than 4 kg or had diabetes during pregnancy

(Diabetes New Zealand, 2006b, para 4).

However, dietary factors and lifestyles (drinking alcohol, cigarette smoking and physical inactivity) are believed to play essential roles, not only in developing diabetes, but also in the subsequent progression of type 2 diabetes mellitus. Recently, Kagawa, Saito, Kerr, Uchida and Binns (2006) compared the nutrient intakes and physical activity levels within both Australian Caucasian and Japanese males living in Australia, with Japanese males in Japan. They found that the continuation of high energy-dense food intakes and physical inactivity was identified as being a potential risk for weight gain or increased abdominal fat accumulation, and also for the development of chronic diseases.

2.10.2 Dietary factors

2.10.2.1 Total diets

Dietary patterns are considered to demonstrate increased risk factors for diabetes, and a number of studies have focused on this aspect. Lako and Nguyen (2001) revealed a high prevalence of overweight and obesity among the indigenous urban Fiji women and a high contribution of total energy intake from fat. Main sources of fat intakes were observed to be butter, cooking oil, coconut cream, lamb chops and whole-cream milk. Moreover, a majority of respondents had low levels of activity (more sitting and sleeping/lying down rather than standing), which produces negative effects on insulin sensitivity. As a result of dietary excesses and physical inactivity, the study respondents had increased their risk factors of developing diabetes.

Baxter, Coyne and McClintock (2006) reported that diet patterns with high fruit and vegetable content were associated with a lower prevalence of metabolic syndrome, and that high meat intake was frequently related to impaired glucose tolerance. Ultimately, it was accepted that no individual dietary components could be considered entirely responsible for the relations between the diet and metabolic syndrome. Wahlqvist (2001) argued that Chinese and Malay populations were reaching diabetes prevalence of around 10% by the 1990s and an energy-dense (high saturated fat, high alcohol and low dietary fibre) diet predisposed towards obesity, and even to diabetes. Additionally, food varieties having either nutrients or non-nutrients (phytochemicals) would be associated with reduced overall glycaemic response and status. Another Da Qing study in China (The Diabetes Control and Complications Trial Research Group, 1993) reported that the combination of a healthy diet and more exercise approach could reduce the progression to type 2 diabetes mellitus in those Chinese who had developed Impaired Glucose Tolerance.

van Dam, Rimm, Willett, Sampfer and Hu (2002) lately identified and validated two major dietary patterns by studying dietary patterns and risks for type 2 diabetes mellitus among male health professionals in America. One dietary pattern ("prudent" diet in the study) was characterised by a higher consumption of vegetables, fruit, fish, poultry and whole grains, and the other ("Western") consisted of higher consumption of red meat, processed meat, French fries, high-fat dairy products, refined grains, sweets and desserts. These researchers found that a prudent diet was associated with a modestly lower risk for type 2 diabetes mellitus, whereas, the Western diet correlated to a substantially higher risk for the same condition. These relationships were independent of BMI, physical activity, age and family history of diabetes. In particular, combining a Western dietary pattern with physical inactivity formed an especially high potential risk for type 2 diabetes mellitus. These findings are similar to a further study in dietary patterns and the incidence of type 2 diabetes in Finland (Montonen et al., 2005).

Lindquist, Gower and Goran (2000) reported that insulin sensitivity was 40% lower and insulin secretion was 2-fold higher in African Americans than in white European children. In the same study, carbohydrate consumption had a positive effect on insulin sensitivity, especially a high carbohydrate and low fat diet which gives increased insulin sensitivity.

2.10.2.2 Dietary fat

The relationship between diet, insulin sensitivity and the development of type 2 diabetes mellitus was reexamined by Parillo and Riccardi (2004), particularly the influence on diabetes of the amount and type of dietary fat intake. This study reviewed a number of journal articles from 1971 to 2002, and reported that: 1) early epidemiological studies considered that total fat intake was positively associated with the risk of diabetes; further that increased animal fat intake had led to a higher prevalence of type 2 diabetes mellitus among Japanese living in Hawaii, compared to Japanese in Japan; 2) in a Health Professionals' Study, total and saturated fat intakes both were associated with a higher risk of type 2 diabetes mellitus; and 3) that a potentially adverse effect of animal fat and trans fatty acids on the risk of type 2 diabetes mellitus had been reported by Hu, van Dam and Liu (2001). In such a result, animal fat intake predominately affects the development of type 2 diabetes mellitus because dietary fat can influence insulin sensitivity independently of any change in body weight (Hu, van Dam & Liu, 2001). Overall, in this review article, they identified a consistently positive relationship between saturated fat intake and hyper-insulinaemia, independently of body fat.

Later, Steyn et al. (2004) reviewed epidemiological and experimental studies and summarised that high total fat intakes had been associated with higher fasting insulin concentrations and a lower insulin sensitivity index. The review reported that higher vegetable fat and polyunsaturated fat intakes had been well documented to lower the risk of type 2 diabetes mellitus, as well as decreasing fasting and two-hour glucose concentrations. A long-term trial study by Vessby et al (2001, cited by Steyn et al, 2004) confirmed a substitution of monounsaturated fat for saturated fat significantly improved insulin sensitivity in healthy participants after a three-month dietary period. Earlier, Hu, Dam and Liu (2001) reviewed epidemiologic investigations and suggested that a higher intake of polyunsaturated fat and increased long-chain n-3 fatty acids, instead of a high consumption of saturated fat and trans-fatty acid, had beneficial influences on glucose metabolism and insulin resistance. Increased total fat and saturated fat intake were associated with a higher risk of type 2 diabetes mellitus, which was confirmed by the Health Professionals Follow-up study in the United States (van Dam, Rimm, Willett, Stampfer & Hu, 2002). Moreover,

increased animal fat intake was observed to contribute to the presence of type 2 diabetes mellitus in a case-control study from the Mediterranean Group (Thanopoulou et al., 2003).

The consumption of red meat and processed meat is a major contribution to the dietary fat intakes of Western diets. A positive association between red meat or processed meat intakes and the development of type 2 diabetes mellitus has been observed by three Western cohort studies (van Dam, Willett, Rimm, Stampeer & Hu, 2002; Fung, Schulze, Manson, Willett & Hu, 2004; Schulze, Manson, Willett & Hu, 2003). The frequent consumption of processed meat, including bacon, sausage, hot dog and salami in Western diets, may contribute to the increased risk of type 2 diabetes mellitus.

As described above, the quality and quantity of dietary fat intakes are associated with the risk of developing type 2 diabetes mellitus. Reasonably, a current recommendation for preventing type 2 diabetes mellitus suggests to reduce saturated and trans-fatty acid intake, and to decrease total fat intake (World Health Organization, 2003). A systematic review of cohort studies (Murakami, Okubo & Sasaki, 2005) illustrated that no appreciable association between total fat and the risk of type 2 diabetes mellitus was observed in all 31 cohort studies, but specific types of dietary fat, saturated fat and trans-fatty acids, were considered to play an important role in the development of type 2 diabetes mellitus in this research. Murakami et al. confirmed that consuming a diet high in polyunsaturated fat but low in saturated fat and trans-fat, could have substantial benefits for reducing the risk of type 2 diabetes mellitus. However, another aspect of dietary intake with respect to the prevention of type 2 diabetes mellitus has been identified, namely the increased consumption of carbohydrate and fibre in the diet (World Health Organization, 2003).

2.10.2.3 Carbohydrate and fibre

Three review articles (Murakami, Okubo & Sasaki, 2005; Parillo & Riccardi, 2004; Steyn et al., 2004) agreed that there was no significant relationship between dietary carbohydrate intakes and the risk for type 2 diabetes, and that there was no specific minimum carbohydrate guideline for reducing the risk of type 2 diabetes mellitus, even though the World Health Organization (Steyn et al., 2004) recommends that carbohydrate in the diet should comprise at least 55% of total energy intakes. However, dietary fibre intake has

been questioned recently in relation to the process of developing type 2 diabetes mellitus, because it is one of the factors influencing post-prandial glucose and insulin responses. Steyn et al. (2004), Murakami, Okubo & Sasaki (2005) and Hu, Dam and Liu (2001) found dietary fibre had a reverse relationship with the risk of type 2 diabetes mellitus, and it provided protection against type 2 diabetes mellitus. Hu, Dam and Liu (2001) reviewed a number of prospective cohort studies and argued that a high dietary fibre intake improved glycaemic control and insulin response.

As an example, a prospective cohort study in the Nurses' Health Study II (Schulze et al., 2004) found that a higher consumption of sugar-sweetened beverages directly correlated to a greater magnitude of gaining weight and an increased risk for developing type 2 diabetes mellitus in women, partly due to amassing excessive calories from a large amount of rapidly absorbable sugars by drinking these beverages. Conversely, the Iowa Women's Health Study, which included a six-year follow-up (Janket, Manson, Sesso, Buring & Liu, 2003), reported that there was no definitive influence of sugar intakes on the potential risk of developing type 2 diabetes mellitus.

After previously discussing the two aspects, dietary fat and carbohydrate intake, separately, there are two dietary studies which examined a combination of a high fibre and low fat diet in relation to weight loss and risks for type 2 diabetes mellitus (Lindstrom et al, 2006; Schulz et al, 2005). These two studies found that low-fat and high-fibre intake maintained the participants' body weight, or at least prevented them from gaining excessive body weight. Lindstrom et al. observed that dietary fat and fibre intakes were significant predictors both for the sustained weight reduction and the progression of type 2 diabetes mellitus.

A Hawaii-Los Angeles-Hiroshima Study (Nakanishi, Okubo, Yoneda, Jitsuiki, Yamane & Kohno, 2004) compared Japanese-Americans with Native Japanese. These observations were that: 1) Japanese Americans had a higher fat consumption from animal origin, a lower ratio between Polyunsaturated and Saturated fatty acids, and a 1.5 to 2 fold higher intake of simple carbohydrates, when compared to Native Japanese; 2) with respect to the prevalence of type 2 diabetes, the result was 6.2% among Native Japanese, whereas in Japanese-Americans living in Hawaii and Los Angeles it was 18.9% and 13.7%, respectively; 3)

Japanese Americans had higher serum insulin, total cholesterol and triglyceride levels than those of Native Japanese. As a consequence, the researchers found that not only were there genetic reasons for the Native Japanese (lower initial insulin response and insufficiency of insulin secretion compared to Caucasians), but also the Westernised lifestyle had led to the higher prevalence of type 2 diabetes mellitus among Japanese-Americans.

2.10.3 Lifestyles

2.10.3.1 Cigarette smoking and drinking alcohol

Besides dietary factors being influential in developing diabetes, other lifestyle choices have been discussed, such as cigarette smoking, drinking alcohol and consumption of coffee. A large prospective cohort study based on the data collected from the Cancer Prevention Study in the United States (Will, Galuska, Ford, Mokdad & Calle, 2001) showed a positive relationship between the frequency of cigarette smoking and the incidence of diabetes. In detail, men who smoked over 2 packs of cigarette per day had a 40% increase in the rate of developing diabetes in all BMI categories. Women who had quit smoking more than 5 years, and men who had quit for more than 10 years, had the same incidence of diabetes as those who had never smoked. In addition, another cohort study among health professional men in the United States with a six-year follow-up (Rimm, Chan, Stampfer, Colditz & Willett, 1995) examined the ratio of cigarette smoking, alcohol consumption and the risk of diabetes. The findings showed a positive association between smoking and the subsequent risk for developing diabetes, both in current smokers and former smokers. These results indicated that smoking had a short term influence on insulin sensitivity and a long term effect on insulin secretion. By comparison, moderate alcohol consumption among healthy men may relate to increased insulin sensitivity and a reduced risk of diabetes.

Cigarette smoking is a health issue not only in The West, but also in Asian countries. Two Japanese studies examined the relationship between cigarette smoking and the risk for diabetes. Nakanishi, Nakamura, Matsuo, Suzuki and Tatara (2000) found that, with the increase in the number of cigarettes smoked per day and the number of pack-years of exposure, the risk for impaired fasting glucose and type 2 diabetes mellitus increased among middle-aged Japanese men. Later, a large prospective study with more than 5 years

follow-up (Sairenchi et al., 2004) confirmed that smoking was independently associated with an increased risk of type 2 diabetes mellitus among both middle-aged and elderly men and women in Japan, but they failed to show the dose-response relationship between the number of cigarettes smoked per day and risk of diabetes. In addition, Ko, Chan, Tsang, Critchley and Cockram (2001) reported that smoking was independently associated with risk of diabetes in Hong Kong Chinese men after adjustments for age, body mass index, alcohol and family history of diabetes. However, there was no conclusive relationship observed between smoking and diabetes development among Hong Kong Chinese women, mainly due to a low prevalence of cigarette smoking.

2.10.3.2 Physical activity

With the rapid economic expansion, lifestyles have changed in all urban and rural areas in the world. Physical inactivity is implicated as an essential factor in the onset of type 2 diabetes mellitus, due to a failure to keep an appropriate energy balance. There is widespread agreement that regular moderate physical activity is beneficial to health and wellbeing. Moreover, physical inactivity is recognised as a major risk factor for developing non-communicable diseases, being ranked between the second and sixth most important risk in contributing to the population burden of disease in Westernised countries (Bauman & Craig, 2005). Pima Indians from Arizona and participants from Mauritius were examined in an epidemiological study (Kriska et al., 2001). They found participants who were more active had significantly lower mean insulin concentrations (average of the fasting and postload insulin) than those less active, after adjusting for age, BMI, waist-to-hip ratio. A six year follow-up study in a high-risk population (Kriska et al., 2003) reported that the total activity level was related to the incidence of diabetes in both men and women, but after the adjustment for their body mass index, the relationship tended to be weakened. However, this study still showed a physically active lifestyle was associated with a lower incidence of type 2 diabetes mellitus, therefore they suggested that adoption and maintenance of a physical active lifestyle may play a significant role in preventing the incidence of type 2 diabetes mellitus.

A series of cross-sectional surveys, which were carried out in 1982, 1987, 1992 and 1997 in Finland (Lahti-Koski, Pietinen, Heliovaara & Vartiainen, 2002), showed that participants

who were moderately or highly active at leisure time were less likely over time to be obese than others with a low level of activity in both males and females. The researchers found also that leisure-time physical activity was inversely related to mean BMI which strengthened over the 15-year period in both male and female participants. Later, another Finnish study with a 12 year follow-up (Hu, Li, Colditz, Willett & Manson, 2003) examined occupational, commuting, and leisure-time physical activity in relation to risk for type 2 diabetes mellitus in middle-aged men and women. The findings of this study state: 1) after the adjustment for age and study year, commuting and leisure-time physical activity were significantly inversely related to the mean value of BMI, blood pressure, the prevalence of obesity and the occurrence of smoking in men and women; 2) combining men and women, occupational activity was inversely associated with diabetes incidence, even adjusting for sex and multivariate risk factors; 3) participants with moderate to high physical activity, with either of three types of physical activity, experienced a 62% decrease in the risk for type 2 diabetes mellitus. Therefore, moderate and high occupational, commuting or leisure-time physical activity, independently and significantly reduced the risk for type 2 diabetes mellitus among middle-aged Finnish men and women.

In prospective studies, individuals with active lifestyle had fewer chances to develop impaired glucose tolerance and type 2 diabetes mellitus when compared to people with physical inactivity (Burchfiel et al., 1995; Hu et al., 1999; Manson et al., 1992; Manson et al., 1991).

Increasing the physical activity level has been used by public health campaigns as a strategy to reduce obesity and the development of type 2 diabetes mellitus (Bazzano, Serdula & Liu, 2005; Ramachandran, Snehalatha, Mary, Mukesh, Bhaskar & Vijay, 2006). However, there is little close attention given to the reduction of sedentary lifestyles. Hu, Li, Colditz, Willett and Manson (2003) examined the relationship between television watching or other sedentary behaviours and the risk of obesity and type 2 diabetes mellitus among women in the United States. Female respondents who spent more time watching TV were more likely to smoke cigarettes and drink alcohol, less likely to exercise, and had an elevated risk of being obese. Therefore, watching TV was strongly associated with an increased risk of type 2 diabetes mellitus in this research. Hu, Li, Colditz, Willett and

Manson (2003) suggested that about 30% of obesity and 43% of type 2 diabetic cases could be prevented by reducing prolonged TV watching and minimising other sedentary behaviours. In general, active individuals have better insulin and glucose profiles than other, inactive, counterparts.

Obesity and central fat distribution are believed to be major contributors to insulin resistance which is strongly involved in the pathogenesis of type 2 diabetes mellitus. At this point, physical activity may help reduce obesity and fat located in the central body, and subsequently, exercise might prevent or delay type 2 diabetes mellitus due to decreasing total fat and intra-abdominal fat. Nevertheless, a study in Shanghai, China, examined the relationship between types of physical activity (leisure-time exercise, daily living and occupational physical activity) and the incidence of type 2 diabetes mellitus (Villegas et al., 2006). The findings revealed that either leisure-time exercise or daily living physical activity were likely to reduce the risk for type 2 diabetes mellitus in participating women, whereas occupational physical activity was not associated with a reduction in risk of type 2 diabetes mellitus.

As a result of the rapid economic development in China, including increased food supply from national and international routes, wide-spread use of television, computers, private cars and public transport, physical activity levels have decreased in the recent past two decades. Meanwhile, a rapid increase in the development of overweight, obesity, and even diabetes, has become an essential public health issue in China (Wang, Mi, Shan, Wang & Ge, 2007). Once Chinese people emigrate to developed countries with an industrialised environment, their physical activity levels may be reduced. Lee et al. (1994) observed that Chinese with increasing years in North America were noticed to be progressively less active than those in China. However, Chinese people in China spent more time in vigorous activities and walking, and less time sitting, when compared with Chinese in North America.

After Chinese emigrate to New Zealand, a developed country, they become used to the new environment and are gradually affected by the new lifestyle. According to the 1996/97 New Zealand Health Survey (Russell, Parnell, Wilson et al., 1999), nearly four in ten (39.1%) adults were described as physically inactive, in particular, 15.3% adults were sedentary.

These data also are reflected in the incidence of type 2 diabetes mellitus (around 4.1% in men and 3.3% in women). The World Health Organization in 1994 (World Health Organization, 2003) reported that many of highest rates of type 2 diabetes mellitus were found in the populations with changing lifestyles from "traditional" to "Westernised/urbanised".

Negative dietary changes, physical inactivity, and other changes of lifestyles are important in an increased risk of developing type 2 diabetes mellitus, both in developing and developed countries.

2.11 Chinese immigrants in New Zealand

2.11.1 Chinese population in New Zealand

People of Asian ethnicity in New Zealand have more than doubled between 1991 and 2001, and almost one in fifteen people were identified as Asian (Statistics New Zealand, 2002). The Chinese population in New Zealand (New Zealand-born Chinese and overseas-born Chinese) is increasing, and comprised 100,680 (3%) of the total New Zealand population and 44% of the Asian population in 2001 census year. According to the 2001 census in New Zealand (Statistics New Zealand, 2002) from 1991 to 2001, New Zealand-born Chinese had increased by 10,209, and overseas-born Chinese had increased by 50,118. Between 1998 and 2001, the city of Palmerston North witnessed a 50% increase in overseas-born Chinese residents. Based on the latest information from the 2006 Census (Statistics New Zealand, 2007), the national wide total of Asian ethnic groups has increased from 238,176 in 2001 to reach 354,552 in 2006. This is almost a 50% increase, and it can be stated that Asian ethnic groups are the fastest growing group in the total population in New Zealand. In addition, in the Manawatu-Wanganui region, there are 8121 Asians, and about 5,409 Asian people are domiciled in Palmerston North city.

2.11.2 Health status of Chinese migrants in New Zealand

With the number of Asian migrants increasing in New Zealand, their health needs have been considered by various public health teams. A report from an Asian Public Health

Project (Asian Public Health Project report, 2003) attempted to provide a relatively comprehensive view of health care needs of the Asian population within the Auckland region. They reported that Chinese were the largest Asian group (about 45%) in the Auckland region, and that diabetes was one of the six top potentially avoidable deaths for such people. In addition, Asian people wish for better access to health services that meet their needs. Later, the report of Asian Health in Aotearoa based on the 2002/2003 New Zealand National Health Survey (Scragg & Maitra, 2005), examined the health status within Asian communities, and found that Asian people were more likely to have an advanced educational level, but were less likely to have a paid job, when compared to all New Zealanders. Moreover, Asian people are less likely to visit a health practitioner or access health services when they felt unwell, even when such people suffer from some chronic diseases. The conclusions from this Asian Health report confirmed that Asian people in New Zealand currently had lower prevalence of most chronic diseases apart from diabetes, and that the disease rates were likely to change over time with acculturation. Culturally-aware health services should be developed to meet the unique needs of Asian people due to their distinctive cultures.

In particular, a Chinese women's nutrition survey in the Auckland region (Tan, 2001) found that the high incidence of central obesity would be one of the potential risk factors to Chinese migrants' future health. The dietary intake difficulties found in this Chinese women migrants' sample included high intakes of fat and low intakes of carbohydrate distributed to total energy, together with a high consumption of cholesterol and sodium, and low intakes of fibre, vitamin A, calcium and selenium. The researcher concluded that the process of acculturation has led to considerable changes in both eating patterns and lifestyles among this Chinese group in the Auckland region. Moreover, the key findings from another final report of the research by DeSouza and Garrett (2005) confirmed that a lack of English proficiency leads to communication difficulties and knowledge gaps for Chinese people in New Zealand, both in knowing the details of available health services, and in understanding the important roles of primary health care providers and general practitioners, who should be contacted at the onset of health difficulties.

It appears that most of the nutrition studies so far involve Asian people in the Auckland region of New Zealand. This present research project concerns Chinese in the Manawatu region, especially those living in Palmerston North city.

Since Chinese people came to settle in the Manawatu region, an increasing number of Chinese markets, retail stores, and restaurants or takeaway shops have been established. Two "flea markets" are held on weekends, about four retail stores have opened, and eleven Chinese food takeaway shops and three Chinese restaurants are now available in the city of Palmerston North. In addition, 500 Chinese members have joined the Manawatu Branch of the New Zealand Chinese Association.

To sum up, these research studies have investigated immigrants' acculturation levels, the relationships between acculturation and dietary/lifestyles changes, and the associations with risks for the development of chronic diseases. Some studies from Chinese people in America showed the changing diet of the Chinese immigrant, such as increased dietary vietary, processed food intake, and intakes of fats, sweets, and decreased consumption of traditional Chinese foods. These changes were partly associated with different acculturation levels of respondents in these studies. In addition, studies have reported that physical activity and dietary factors are playing important role in developing type 2 diabetes mellitus. The World Health Organization in 1994 (World Health Organisation, 2003) reported that many of higher rates of type 2 diabetes mellitus were found in the populations with changing lifestyles from "traditional" to "Westernised/urbanized". With an increased number of Chinese in New Zealand, this study has focused on their acculturation levels, dietary factors, and lifestyles in relations to their health status, in particular, type 2 diabetes mellitus.

Chapter 3 METHODOLOGY

This research project was based on a mixed-methodological design (Creswell, 1994), which used a four-phase approach to collect both quantitative and qualitative data for analysis. The data which was collected by using questionnaires, dietary assessments and body measurements, shows how the degrees of acculturation levels among Chinese settling in New Zealand relates to the potential increased risk factors for developing type 2 diabetes mellitus. In addition, optional blood tests taken by willing participants provided additional data of their current health status.

3.1 Human Ethics Application

The methodology of this study consisted of four major phases: questionnaires, 24-hour diet recalls, body measurements and optional blood tests. All the documents used in the study were available as both Chinese and English versions, and participants could choose which one they preferred. The study was granted approval by the Massey University Human Ethics Committee: Southern A (see Appendix A). The experimental protocol and volunteers' rights were fully explained to all participants. After they understood and accepted the procedure of the study, the participants signed their preferred language version of the consent form. At any time before the data collecting was complete, participants were able to withdraw from the study without giving reasons. All the information gained from the participants was kept confidential in a locked cabinet at all times. All the participants were informed that, if they wished, they would receive a summary of the findings of the study once it was completed.

3.2 Pilot study

In order to test the appropriateness of the two questionnaires, a pilot study was carried out among Chinese international students at the Turitea campus at Massey University before the subjects were recruited. Twenty volunteers completed both the original primary questionnaire and food frequency questionnaire. Twenty-six acculturation questions, ten demographic questions, and fourteen physical activity questions were asked in the primary questionnaire. There were 250 food items in the original food frequency questionnaire. Both questionnaires were only in the English version. The difficulties found in the pilot study in relation to the primary questionnaire included that the questionnaire was too long to complete effectively, and some personal questions, such as age and income level, were left unanswered. In particular, the students reported that acculturation questions were too difficult to answer. In addition, the students found that the food frequency questionnaire was to long for adequate concentration and complete understanding. Some said that they were too tired to answer questions one by one, and they just ticked the same answer for each food. Also, portion sizes were difficult to standardise without the essential visual images. Subsequent to the pilot study, both questionnaires were made shorter and substantially adjusted before they were used in the major study. The pilot study, therefore, was extremely useful in avoiding future difficulties which otherwise would have arisen.

3.3 Subjects' recruitment

The criteria for inclusion in this study were: participants were required to be 30 years of age or over; have at least one parent who is entirely of Chinese descent; had never been diagnosed with either type 1 or type 2 diabetes mellitus; and were not holding a student visa while living in New Zealand. People, who qualified under the above criteria, were interested in taking part in the study, were then sent further detailed information from fliers either written in Chinese or English, which had been distributed to Chinese markets, restaurants, the Ethnic Council of Manawatu and local churches. In addition, to obtain the greatest exposure to the Chinese community, this research study was advertised through various social networks to enlist suitable participants. The advertisements were placed in local newspapers supported by an interview: Massey News, Manawatu Standard, and one

local Chinese newspaper (The Trolley), all of which are eaily available to Chinese people living in Palmerston North; also, informative posters were placed at Chinese churches and the central Chinese Association Hall in Palmerston North. Fliers were included in the newsletters for members belonging to the Manawatu Branch of the New Zealand Chinese Association. Lastly, advertisements were placed on respective notice boards of the waiting rooms where Chinese General Practitioners and acupuncturists work. When potential participants read the detailed information of the research, they could choose to contact with the researchers by telephone or via the postal mail.

3.4 Data collection

Upon participants arriving at the Human Nutrition Unit of the Food, Nutrition and Human Health Institute at Massey University, the researcher carefully informed them of the main aspects of the study, including describing to them the optional nature of the blood sampling component. Any questions participants had about the research were clearly answered. Subsequently, the researcher explained all the rights of participation in the study carefully to them before respondents signed the consent form. At the commencement of the collection of the data, a food frequency questionnaire was given to the participants followed by an interview requesting 24-hour diet recalls. Then, the participants were requested to fill out a self-explanatory primary questionnaire; finally, the researcher measured body weight, height, and waist and hip circumferences. If the participant was willing to have blood drawn, a referral slip was given to them along with instructions as to how to arrange their appointment with trained phlebotomists at the Med Lab, a local clinical laboratory (the blood to be measured for fasting blood glucose, glycosylated hemoglobin (HbA_1c) and total blood cholesterol levels). Later, another two 24-hour dietary recalls were conducted by telephone, by which time, after completion, they had completed the study.

3.5 Dietary assessment

Dietary assessment is one of the major methods to obtain details of individuals' dietary intakes, details of which are often used in epidemiological studies. Methods for measuring

the food consumption of individuals can be classified into two major groups – quantitative and qualitative (Gibson, 2005). An individual's diet is not exactly the same from one day to the next, so one survey result would not be completely replicated by the other. The selection of the dietary assessment methods for any study depends on the objectives of the study and the study population. Qualitative methods, like food frequency questionnaires, gain retrospective information on the patterns of food intake during a longer, less precisely defined, time period; and are always used to assess the habitual food intake; however, to some extent, these methods can be modified to gain the nutrient intake (Gibson, 2005). Quantitative methods including 24-hour dietary recalls and dietary records are used to assess the quantity of the individual foods consumed over a one day period. In addition, the quantitative estimates of an individual's usual intake may be obtained by increasing the number of measurement days (Gibson, 2005). Special modifications in the content of dietary assessment methods are recommended when the study population is composed of individuals with a distinctive ethnic identity, in particular, with the requirement of an interview. In order to communicate more effectively, it is preferred that the interviewers are the same ethnicity or cultural background as the interviewees. Furthermore, to ascertain the number of ethnic foods in the food composition data base is essential, since certain types of food eaten by ethnic groups of the population may not show up in the list of the food database (Thompson, Byers & Kohlmeier, 1994). As an example, in this research study of Chinese in New Zealand, the researcher is of the same ethnicity as the participants, and, for accuracy, all the questionnaires for collecting dietary information were available in both Chinese and English versions.

Acknowledging the above information, and in order to ensure relatively accurate data of the dietary intake of New Zealand Chinese participants in this study, a semi-quantitative food frequency questionnaire and multiple replicated 24-hour dietary recalls were used.

3.5.1 Food Frequency Questionnaire

In nutritional epidemiology, there are a variety of early methods used in examining the relationship between diet and occurrence of major diseases from modern civilisation, such as basic biochemistry, animal experimentation and metabolic studies in humans, which

only partly but not directly address such relationships. However, complex relationships between dietary factors and the development of diseases result in difficult challenges for researchers to choose a suitable methodology. Food frequency questionnaires are often used by epidemiologists studying associations between dietary habits and disease (Janket, Manson, Sesso, Buring & Liu, 2003; Kesse, Clavel-Chapelon, Slimani, van Liere & the E3N Group, 2001; Schulze, Manson, Willett & Hu, 2003; Willett, 1994; Woo et al., 2003). A Chinese study (Woo, Leung, Ho, Lam & Janus, 1997) reported that the food frequency questionnaire method had advantages over the 24-hour recall in taking into account day to day variation and examining the relationship between the frequency of consuming certain food items and individual clinical disease. Woo et al. found this method could provide a good estimation of energy, protein and potassium intake, but failed to report sodium intake because of the lack of standard portion size. A semi-qualitative food frequency questionnaire was chosen in this study to assess the frequency with which food items were consumed during the previous twelve months, coupled with the addition of portion-size estimates to obtain selected nutrient intakes and the derivation of energy intakes.

However, any kinds of dietary assessment method cannot completely obtain accurate details of foods consumed and nutrient intakes. Food frequency questionnaires also have advantages and limitations. The advantages of a food frequency questionnaire include the ability to rank individuals according to their usual consumption of foods and nutrient intakes, lower respondent burden and lower costs of data collection. The limitations of the food frequency questionnaire method are lack of details of dietary intake and accurate quantification of intake; and also errors arise from frequency estimation and the estimating of usual serving sizes. In particular, Chinese individuals' dietary intakes are difficult to measure because the Chinese diet is composed of many stir-fried mixed dishes using vegetable oils as ingredients during food preparation rather than an added fat on the table. The original Block questionnaires (2005) was designed to estimate usual and customary intake of a wide array of nutrients and food groups, which can be completed by either self- or interviewer-administration, and its food list was developed from NHANES 1999-2002 dietary recall data However, in order to test the questionnaire among Chinese communities in New Zealand, foods listed in the New Zealand Food Composition Table and typical Chinese food available in the local markets have been considered in developing the food

frequency questionnaire used in this study (Appendix H) . In addition, each row in the food frequency questionnaire only has one food item in order to avoid the misunderstanding from participants. All food frequency questionnaires were completed during the face-to-face interviews by simultaneously using examples of serving-size measurements in order to match the "small, medium and large" entries in the questionnaire (Appendix J).

3.5.2 24-hour dietary recalls

Another dietary assessment method used in this study was a 24-hour dietary recall which was based on foods and amounts actually consumed by an individual on one or more specific days. Some participants only had one 24-hour dietary recall if they choose not to furnish the blood test; others who did blood tests had two extra 24-hour dietary recalls which constituted one weekend and two weekdays so the relationship between blood test results and dietary intake could be analysed. Undertaking a 24-hour recall on 3 occisaions generates relatively accurate data (Buzzard, 1998).The first 24-hour dietary recall was conducted during a face-to-face interview with the respondent, and then the other two interviews were carried out by telephone calls at unscheduled intervals ranging from three weeks to three months. In general, the group dietary data was calculated based on the first 24-hour dietary recalls which were conducted during face-to-face interviews. When analysing blood test results, dietary data was based on to the three days of dietary recalls. The statements from face-to-face interviews were also used to describe the data.

Even though a face-to-face interview with the respondent is commonly used in investigating dietary intakes, recalls taken over the telephone have become increasingly popular. A number of dietary studies compared the use of 24-hour recalls both in-person face-to-face and through the telephone. One early study (Posner, Borman, Morgan, Borden & Ohls, 1982) investigated the feasibility and validity of a series of telephone-administrated 24-hour dietary recalls in obtaining mean nutrient intakes among elderly respondents in the United States. The researchers found the 24-hour dietary recalls over the telephone provided suitable acceptable data of energy and nutrient intakes among the respondent individuals. Recently, Godwin, Chambers and Cleveland (2004) and Tran, Johnson, Soultanakis and Matthews (2000) both compared two techniques of the multiple-

pass 24-hour recalls (in-person and telephone-administered), and reported there was no significant differences in the data collected by using the different techniques. In addition, three further dietary studies conducted by Casey, Goolsby, Lensing, Perloff and Bogle (1999), Tran, Johnson, Soultanakis and Matthews (2000) and Godwin, Chambers and Cleveland (2004) confirmed that the data collected by telephone-administrated 24-hour recalls were not significantly different from that gained from a face-to-face 24-hour recall interview. The researchers agreed that collecting 24-hour dietary recalls over the telephone was a practical, feasible and valid tool in nutritional surveys, which had lower costs and was less time consuming. However, these four studies also reported that both in-person and via telephone 24-hour dietary recall methodology had the same issue, which was related to underreporting. It is arguable, therefore, that each dietary assessment method has different advantages and weaknesses.

Multiple-pass 24-hour dietary recalls have been used widely in nutritional and epidemiological studies. As a quantitative method, its strengths (Buzzard, 1998) include less respondent burden, less likelihood of respondents altering eating behaviour, no requirement of literacy. In particular, this method is open-ended which makes it possible to accommodate any food items and to allow an unlimited specificity regarding types of food items, food source, food processing methods, food preparation and other details in describing foods and the amounts consumed. The last advantage is useful for estimating intakes in distinctively cultural diverse population groups to represent their wide range of foods and eating habits. Accordingly, three days of 24-hour recalls were chosen in this research to examine the dietary intakes of Chinese settling in New Zealand in order to discover the details of specific foods and cooking methods used by this particular group.

However, there are a number of inherent weaknesses in collecting dietary information from a 24-hour dietary recall method. Individuals may not report accurately the food items and the quantity of the food eaten, which can result in both under-reporting and over-reporting. This is mainly due to the twin problems of memory and the interview situation; hence it can be particularly unsatisfactory for the elderly and young children. In addition, a single 24-hour dietary recall cannot reflect the day-to-day variation in individuals' food intake, which is needed to estimate the mean nutrient intake of a group. So, multiple replicated 24-hour

dietary recalls are recommended for using in collecting the data of the usual intake of individuals. Zhao et al. (2004) collected the data by using standardised four-fold 24-hour dietary recalls in order to examine the relationship between blood pressure and dietary factors among Chinese. The methodology in an early cross-sectional Chinese study (Wang, Popkin & Zhai, 1998) was three consecutive days' 24-hour dietary recalls used to collect the data of individuals' dietary intakes. Understandably, how many days need to be repeated in 24-hour dietary recalls has been studied. Based on Buzzard's study (1998), the minimum number of days of most individuals' energy intake and macronutrients was thought to be three to ten days. In considering both the accuracy of the dietary data and respondents' burden, a three days 24-hour dietary recall method was selected for use in this study.

Another difficulty identified in conducting 24-hour dietary recalls is the ability to accurately estimate the portion size. Chinese usually cook mixed dishes and add a significant variety of ingredients, and most are not used to using standard cooking measurements, so all of these factors make it more difficult to estimate the quantity of food items consumed. Buzzard (1998) emphasised that it is important to quantify as accurately as possible the portion sizes while using a 24-hour dietary recall method. Gibson (2005) suggested two-dimensional and three-dimensional memory aids were required to be used to enhance the accuracy of the portion size estimations in dietary surveys. A study conducted by Bird and Elwood (1983, cited in Buzzard, 1998) reported that using photographs for estimating portion sizes was similar to using weighed-food records; also if more than one portion size option were offered, it would avoid the tendency of choosing whatever amount was presented. Therefore, in this study, a photographic atlas (Nelson, Atkinson & Meyer, 1997), together with photos of Chinese food items (Appendix K) and food models (Appendix J) was used to provide participants with more descriptive details of food and memory aids during the face-to-face interview.

A three-pass 24-hour dietary recall technique was used in this study. The first pass was to ask about all the food and drink which the participant had consumed during the previous 24 hours; the second pass was to ask the participant to describe the details of the quantity of food which they had consumed, including the type, brand, cooking method and amount; the

third-pass was to repeat to them all the food which the participant described in order to make sure the details taken were correct and that no food which was consumed was omitted.

3.6 Primary Questionnaire

The Primary Questionnaire (Appendix G) used in this research divided into three parts: estimation of the physical activity levels, modified acculturation questions and demographic questions.

3.6.1 Acculturation scale

Scales of measuring acculturation levels are different within the variety of population groups, and a significant number of studies have concentrated on Hispanics; however, the Suinn-Lew Asian Self-Identity acculturation scale has been commonly used with Asian migrant groups (Ownbey & Horridge, 1998; Suinn, Khoo & Ahuna, 1995; Suinn, Rickard-Figueroa, Lew & Vigil, 1987).

Which types of questions should be put into the measuring scale is often debated. Acculturation measures intend to capture three aspects, psychology, behaviour and attitude, all which may change when a continuous contact and interaction exists between individuals from different cultures (Cabassa, 2003). A short acculturation scale developed for Hispanics (de la Cruz, Padilla & Agustin, 2000) used 12 questions which contributed three dimensions: language use and preference at work, or at home, or with friends; language use in media; preferred ethnicity of individuals in social relations. The Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA) used in this current study (Suinn, Rickard-Figueroa, Lew & Vigil, 1987) is composed of 21 multiple choice questions, which cover six dimensions: language, identity, friendship choice, behaviours, generation and attitudes. This acculturation scale has been examined in Asian-American studies (Ownbey & Horridge, 1998; Suinn et al., 1987; Suinn, Khoo & Ahuna, 1995) including a Singapore-Asian study (Suinn, Khoo & Ahuna, 1995). Ponterotto, Baluch and Carielli (1998) also reviewed 16 empirical studies which used the SL-ASIA instrument, and which have been published in refereed national or international journals and 24 dissertations; the researchers

concluded that the SL-ASIA scale had a satisfactory level of accuracy for estimating the acculturation levels of Asian American college-age groups, even though some of studies modified the scale. Accordingly, the SL-ASIA scale was modified in this study in order to use in a Chinese group in New Zealand. In the questionnaire, the term "Asian" was replaced by "Chinese", and the term "New Zealander" was used instead of "American". The scoring of the SL-ASIA scale was based on the method developed by Suinn et al. (1987). For each of the 17 questions, scores ranging 1 to 5 were allocated against each answer given, and the totals obtained were then added together and finally divided by 17 to obtain the person's acculturation score. Therefore, individual scores will lie between 1 (low acculturation) and 5 (high acculturation).

3.6.2 Physical activity levels

The second part of the Primary Questionnaire in this project is a series of questions to measure physical activity levels. It has been established that reduced physical activity levels are associated with increased risks of developing type 2 diabetes (Kriska et al, 2003; The Diabetes Control and Complications Trial Research Group, 1993; Villegas et al., 2006). Measurement of physical activity levels is not currently part of the international agreed assessment technique (World Health Organization, 2003). In order to gain an appropriate, valid and reliable tool to measure physical activity levels at population levels, the World Health Organization (WHO, 2002) developed a Global Physical Activity Questionnaire (GPAQ), which was used in this current research. The information collected from the GPAQ related to three dimensions, which are: activity at work; travel to and from places; and recreational activities. The analysis and scoring of questions were based on the original GPAQ which describes how to clean and analyse the physical activity data (WHO, 2002).

3.6.3 Demographic questions

Demographic questions in this questionnaire aim to obtain basic information from participants, such as: age; sex; work status; educational levels; and family incomes.

The Primary Questionnaire and Food Frequency Questionnaire were pre-tested before they were provided to the participants in this study. Based on the answers and understanding of the questionnaire from 20 selected Chinese students at Massey, the questions in the questionnaire were proved to be able to be understood and answered.

3.7 Body Measurements

The relationship between the body fat distribution and body weight and risk factors of the development of chronic diseases, including obesity, type 2 diabetes mellitus and cardiovascular disease, has been well documented (Bei-Fan & the Cooperative Meta-analysis Group of Working Group on Obesity in China, 2002; Kriska et al., 2001; Li et al., 2002; Unwin et al., 1997), and anthropometric measurements are important aspects of assessing people's nutritional status.

The four measurements used in this study were body weight, height, and waist and hip circumferences. The International Standards for Anthropometric Assessment (Marfell-Jones, Olds, Stewart & Carter, 2006) was used to standardise the collection of physical measurements. Before the process of obtaining the measurements commenced, participants were asked to remove heavy jewellery, shoes, and jackets, also to empty their pockets of all items. All the subsequent measurements and records were made solely by the researcher.

Body weight was measured by a digital platform weight scale which was used on a level floor. After checking the scale was reading zero, the participant was asked to stand on the centre of the scale without support and to distribute the body weight evenly on both feet, with the arms loosely hanging by the side and the head facing forward. Two measurements were made; between these two measurements, the participant was asked to step away from the scale. If the two measurements were different more than 0.5kg, a third measurement was required.

Body height was measured by using a portable stadiometer. The participant was asked to remove shoes, and then stand with feet flat on the base plate with heels together and the heels, buttocks and upper part of the back touching the wall, and the head positioned when the line of vision was parallel to the floor. Finally the bar was brought down gently onto the

participant's head with adequate pressure to compress any hair. Two measurements were recorded, and if the differences between these were more than 0.1 cm, a third measurement was taken. Between each measurement, the participant was asked to step away from the stadiometer.

The waist circumference was defined as the narrowest part of the abdomen between the lower costal border and the top of the iliac crest (Marfell-Jones, Olds, Stewart & Carter, 2006), and the hip circumference was taken at the maximum circle around the buttocks when viewed from the side (Quigley, 1997). During the practical process of both measurements, the participant was requested to stand in a relaxed position facing to the researcher. The waist circumference was taken on bare skin where possible with a firm non-extended tape (Lufkin executive thinline 2m W608PM) in a horizontal position. All the measurements were taken twice; if they differed by 0.5 cm, a third measurement was required.

After all the measurements had been completed, the body mass index (BMI) and the waist/hip ratio were calculated. BMI equals the body weight (kg) divided by the power function of body height (m^2), which is used to classify obesity and overweight. The waist-hip ratio was considered to reflect the distribution of both subcutaneous and intra-abdominal adipose tissue (Gibson, 1993).

Gibson (2005) reported that the body mass index had been used both in international population studies to estimate risk factors of developing chronic diseases and epidemiological studies to classify overweight and obesity in adults. The World Health Organization (2000) recommended the classification of overweight and obesity in adults according to BMI levels: the participant with BMI $\geq$ 25 kg/m^2 is considered as overweight; a universal cutoff point of obesity is BMI $\geq$ 30 kg/m^2. However, a recent report from the WHO (WHO Expert Consultation, 2004) declared that the Asian population, which has a higher risk for type 2 diabetes mellitus and cardiovascular diseases, has relatively lower BMI levels. Accordingly, the WHO modified the classification in light of these ethnic differences and suggested the cutoff points of BMI values should be over 23.0 for overweight and over 32.5 for obese.

Wang et al. (1994) compared the body mass index and percent of body fat between the Caucasians (whites) and Asians in the United States. They reported that Asians who had a low body mass index had more body fat than the whites, and, particularly, that Asians had more upper-body subcutaneous fat, which was confirmed by another Chinese American study (Lauderdale & Rathouz, 2000). The relationship between body fat contribution and the risks for developing type 2 diabetes mellitus has been studied by Han, Feskens, Lean and Seidell (1998); the findings from this cross-sectional survey illustrated that the prevalence of type 2 diabetes was higher in the participants with shorter height, high body mass index, or high waist to hip ratio, and large waist circumference, and, in particular, the waist circumference was considered as a powerful independent predictor of diabetes.

A cross sectional study in the United Kingdom (Unwin et al., 1997) examined the values of BMI, waist circumference, and waist-to-hip ratio between Chinese and Europid adults, and they reported that Chinese with higher values of such body measurements were associated with glucose intolerance. A number of nutritional studies among Chinese (Hsu-Hage, Wahlqvist & Idema, 1995; Jia, Xiang, Chen, Lu & Wu, 2002; Lear, Chen, Frohlich & Birmingham, 2002; Li et al., 2002; Wang et al., 2004) used either BMI, waist and hip circumferences, or the waist-to-hip ratio as the predictors of body fatness, which in turn can be used to classify those who are obese or overweight. Later, a prospective Health Professional Follow-Up study suggested (Wang, Rimm, Stampfer, Willett & Hu, 2005) indicated that overall and abdominal adiposity predicts risk of type 2 diabetes mellitus independently, and that waist circumference was a better predictor value than BMI. In this current research, BMI, waist circumference and waist-to-hip ratio were selected to estimate risk factors for the potential development of type 2 diabetes mellitus.

In light of the different ethnic backgrounds, the cut-off points of anthropometric measurements may cause variety in the classification of obesity and overweight. Accordingly, it is important to identify the appropriate cut-off points of BMI, waist circumferences and waist-to-hip ratio in this Chinese study group. A cohort study from the Working Group on Obesity in China (Zhou & the Cooperative Meta-analysis Group of Working Group on Obesity in China, 2002) involved a study population from 21 provinces, municipalities and autonomous regions in mainland China as well as in Taiwan. Three

recommendations from the study are useful here: 1) a body mass index of 24 (kg/m2) is considered as the cut-off point of overweight for both male and female Chinese adults; 2) a body mass index of 28 (kg/m2) can be the cut-off point of "obesity" for both male and female Chinese adults; 3) a waist circumference of 85 (cm) is set as the cut-off point in men, while, it is set at 80 (cm) as the cut-off point in women. Therefore, these cut-off points were used in the current study to predict increased risk factors of type 2 diabetes mellitus of Chinese migrants in New Zealand.

3.8 Blood tests

An oral glucose tolerance test (OGTT) is normally required in the clinical diagnosis of diabetes, impaired fasting glucose and impaired glucose tolerance (Mann, 2007). However, since this test is labour-intensive and expensive for using in a large population, a fasting plasma glucose test (FPG) is preferred because it is simple and effective (Ko et al., 1998; Perry, Shankar, Fineberg, Gill, & Baron, 2001). Furthermore, a single FPG is not sufficient on its own to diagnose diabetes or to detect impaired glucose tolerance and impaired fasting glucose (The DECODE-study group, 1999). It is necessary to either add the OGTT test, or serum fructosamine level, or HbA_{1c}, or fasting proinsulin concentration (Cheng, Kushner & Falkner, 2006; Kasezawa et al., 1993; Perry, Shankar, Fineberg, McGill & Baron, 2001; The DECODE-study group, 1999; Wareham, Byrne, Williams, Day & Hales, 1999). HbA_{1c} is a measure of the mean blood glucose level over the previous two to three months. In light of two American and two Chinese diabetic studies (Ko, Chan, Tsang & Cockram, 2000; Ko et al., 1998; Perry, Shankar, Fineberg, McGill & Baron, 2001; Rohlfing et al., 2000) which shared the combination of FPG and HbA_{1c} in diabetes screening, a paired value of FPG and HbA_{1c} was chosen to detect diabetes among Chinese in New Zealand for this study. Rohlfing et al. (2000) and Perry, Shankar, Fineberg, McGill and Baron (2001) declared that the combination of using FPG and HbA_{1c} improved the sensitivity of screening diabetes in high-risk individuals. In addition, a Hong Kong Chinese study (Ko et al., 1998) compared the paired test of FPG and HbA_{1c} with a 75-g oral glucose tolerance test (OGTT). The results of this study showed that the paired test values could identify potential diabetes, the diagnosis of which was confirmed by the OGTT test. Two years later, a Chinese study (Ko

et al., 2000) supported the findings from the previous study and confirmed the use of paired FPG and HbA_{1c} values in the enhanced detection of diabetes. In addition, an elevated blood total cholesterol level is one of risk factors for estimating cardiovascular disease (He et al., 2004); also it is one of independent risk factors for coronary heart disease (Grundy, Pasternak, Greenland, Smith, & Fuster, 1999).

He et al. (2004) conducted a cross-sectional survey in a large representative Chinese sample and reported that 32.8% of the Chinese general population aged 35 to 74 had borderline high total cholesterol levels (≥ 5.18mmol/l) and an increased burden of high blood cholesterol was observed. A detailed lipoprotein profile, including LDL, HDL and triglycerides, is better used to estimate blood cholesterol status for individuals. However, due to financial constraints, serum lipoprotein levels could not be measured in the current study. Therefore, blood tests were conducted in the current study to measure: a fasting plasma glucose concentration (FPG); glycosylated hemoglobin (HbA_{1c}); and total cholesterol levels. Once the participants signed the consent form to agree to take blood samples, they visited the Med Lab in Palmerston North, and the blood sample was taken from a vein in their arms, following a 12-hour fasting period.

3.9 Data processing

Once the participant completed the interview in the Nutrition Lab at Massey University, the researcher checked that the questionnaires were filled in correctly and completely, except for the questions which the participant elected not to answer. All the questions in FFQ and Primary questionnaire were coded before entering into the statistical package (MiniTAB 14). The blood test results were sent back to the researcher directly, and the data entered into Microsoft Excel. The values from body measurements: body weight, body height, waist and hip circumferences, were also entered into the Microsoft Excel programme. In addition, the values of BMI and waist-hip ratio were calculated.

The dietary data obtained from the three 24-hour dietary recalls was entered into the Food Works Professional 2005. The New Zealand food database was used in the analysis of the dietary data; however, as some Chinese foods were not available in this database, a

database of Chinese food nutrients had to be added before starting the data entry. Approximately 40 entries of Chinese food items were added to the current food works database as new foods. The nutrients values of these new foods were adopted from either China Food Composition 2002 or China Food Composition 2004 published by the Institute of Nutrition and Food Safety, China CDC, because they are imported from China (Institute of Nutrition and Food Safety, 2002 & 2004). The nutrient values used in this study were the mean intakes of the three days of recalls. Once all the 24-hour dietary recall results were entered to the Food Works, they were exported to Microsoft Access, then entered on to the Microsoft Excel sheet; finally all the results in the Microsoft Excel sheet were entered into MiniTAB for further and final statistical analysis.

All the data from Food Frequency Questionnaire, Primary Questionnaire, dietary intakes, anthropometric measurements and blood test results were entered into MiniTAB 14 for subsequent statistical analysis.

Chapter 4 RESULTS

All the participants were recruited through pre-selected methods of publicity, including the advertisements and the fliers which were distributed in the Chinese markets and churches around Palmerston North. In total, 46 participants who had settled in Palmerston North during past years volunteered to be in this study sample. Of the participants, 34 completed the study, inclusive of blood tests, and the remaining twelve participants completed by choosing to decline the optional blood tests, but responding to all questionnaires and body measurements.

4.1 Sample descriptions

4.1.1 Demographic characteristics

The 46 study participants were from Mainland China, Hong Kong, Taiwan, and other countries (Malaysia, Vietnam, Indonesia and Thailand), including two participants who had been born in New Zealand of Chinese parents. All were aged between 30 and 79, and the sample consisted of 18 males and 28 females. Their residency length in New Zealand ranged from 2 to 58 years. The details of the demographic characteristics in this study are described within the seven tables below (Tables 4.1.1 to 4.1.7).

Table 4.1.1 Age characteristics of the participants

Age (years)	47.24 ± 13.33[1]
30 - 39	16 (34.8%)[2]
40 - 49	14 (30.4%)[2]
≥ 50	16 (34.7%)[2]

1. Figures are Mean ± SD

2. Figures are numbers (percentages)

This table shows that approximately equal numbers occur within each band when dividing the participants into age-related bands.

Table 4.1.2 Gender of the participants

Gender	Number	Percentage
Male	18	39.1%
Female	28	60.9%

This table describes the number and percentage of males and females in this study group. It is apparent that more females were prepared to participant in this study than males. Arguably, the reason for this might be that females are known to be more interested in their health and wellbeing.

Table 4.1.3 Original Countries of the participants

Original country	Number	Percentage
Mainland China	32	69.6%
Hong Kong	2	4.3%
Taiwan	4	8.7%
New Zealand	2	4.3%
Others	6	13.1%

This table illustrates the countries where the participants originally migrated. Participants were predominately from Mainland China (69.6%). One of the reasons for this phenomenon is that the fliers and the advertisements distributed in Chinese markets and Chinese restaurants might more easily reach people who were from Mainland China. Possibly, Mainland Chinese realised that some adverse health influences may arise from the distinct cultural environment in New Zealand where they had settled.

Table 4.1.4 Residency length of the participants in New Zealand

Residency length (years)	13.19 ± 13.72[1]
< 5	11 (23.9%)[2]
5 - 10	17 (37.0%)[2]
> 10	18 (39.2%)[2]

[1]Figures are Mean ± SD

[2]Figures are numbers (percentages)

Table 4.1.4 above describes the residency length in New Zealand of the participants. Eighteen participants had settled in New Zealand for more than 10 years, and seventeen participants had been here for 5 to 10 years. Overall, the majority (76.2%) of the participants in this study had been living in New Zealand for over 5 years.

Table 4.1.5 Arrival ages of the participants

Age (years) *	35.6 ± 11.97[1]
< 30	14 (31.8%)[2]
30 - 39	18 (40.9%)[2]
≥ 40	12 (27.3%)[2]

[1] Figures are Mean ± SD

[2] Figures are numbers (percentages)

* The total number is 44, which has excluded two participants who were born in New Zealand.

This table illustrates the ages at which the participants arrived in New Zealand. The arrival ages of the two participants who were born in New Zealand were zero, so they were not included in this table. Approximately 40.9% of the participants arrived in New Zealand when they were aged between 30 and 40 years. Relatively, people of this age are expected to be healthy and adaptable because they have already had work experience and certain advanced educational backgrounds. Furthermore, it was revealed in the interviews that most of the group of the participants who arrived in New Zealand after they were 40 years old, mainly emigrated because they wished to live with their sons or daughters who had already settled here.

The demographical characteristics of the participants in this study were divided into two groups by acculturation scores. The participants in group L who had individual acculturation scores less than two were less acculturated, and people in group H with acculturation scores of greater than 2 were more highly acculturated. However, the two participants with acculturation scores of 4.07 and 3.64 were excluded because they were both born in New Zealand.

Table 4.1.6 Demographic characteristics of Group L and Group H

	Group L (n = 19)	Group H (n = 25)	Total[3] (n = 44)
Acculturation score	1.65 ± 0.27[1]	2.34 ± 0.30[1]	2.04 ± 0.45[1]
Age (years)	48.26 ± 12.48[1]	46.96 ± 14.21[1]	47.52 ± 13.36[1]
Gender	Female 12 (63.2%)[2] Male 7 (36.8%)[2]	Female15(60%)[2] Male 10 (40%)[2]	Female 27 (61.4%)[2] Male 17 (38.6%)[2]
Residency length (years)	8.8 ± 5.64[1]	14.30 ± 15.42[1]	11.93 ±12.39[1]
Arrival age (years)	39.46 ± 13.83[1]	32.66 ± 9.62[1]	35.6 ± 11.97[1]

[1]Figures are Mean ± SD.

[2]Figures are numbers (percentages).

[3]Table excluded the two subjects who were born in New Zealand.

This table compares the low acculturation score group (L) and higher acculturation score group (H) in age, gender, residency length, and arrival age. The composition of gender and age in both groups are similarly distributed. The most interesting point in this table is the different mean residency length between group L (8.8 years) and group H (14.3 years), which relates to their acculturation scores. Participants in the higher acculturation group H tended to have a longer residency length in New Zealand than others in the lower acculturation score group L. In addition, the arrival age of participants in group H was younger than that in group L, which indicates that the arrival ages are negatively associated with the acculturation scores within both groups.

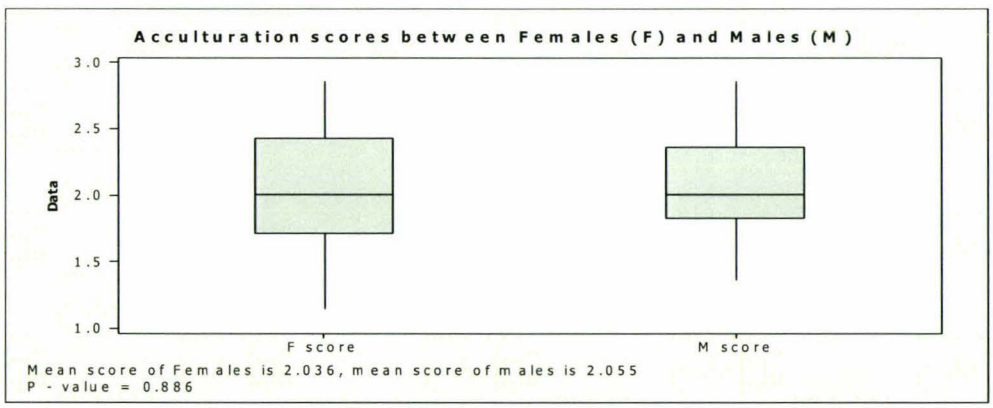

Figure 4.1.1 Acculturation scores between females (F) and males (M).

The difference of acculturation scores between male and female participants is not significant (P > 0.05).

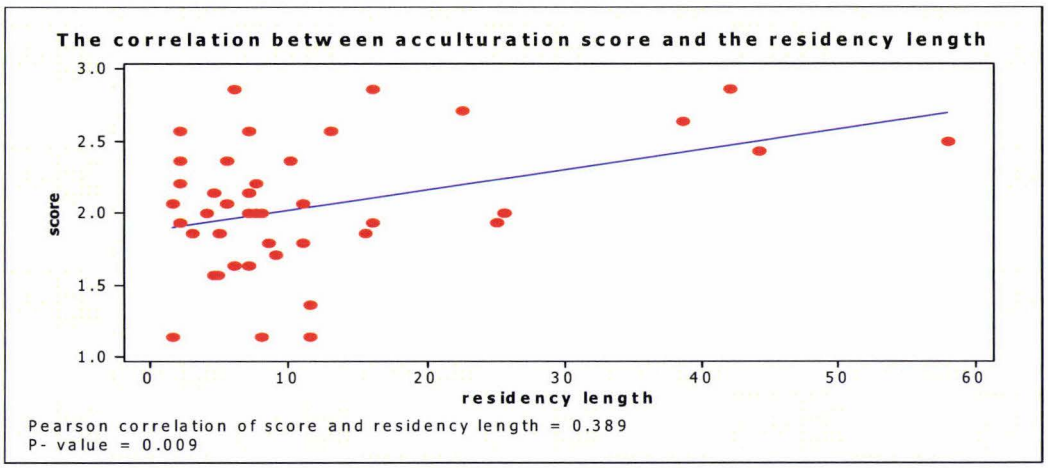

Figure 4.1.2 The correlation between acculturation scores and residency length.

The residency length in New Zealand is positively related to the acculturation score, which is statistically significant ($P < 0.05$).

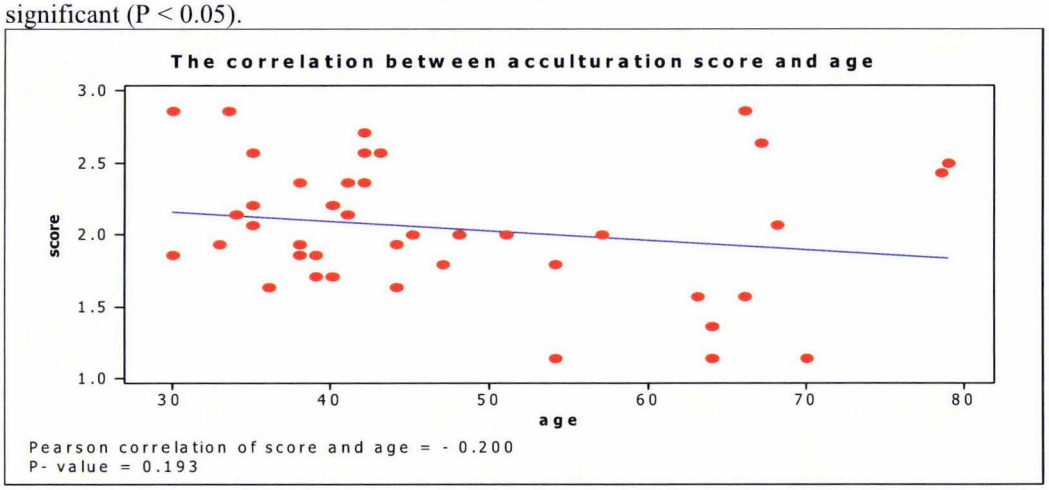

Figure 4.1.3 The correlation between acculturation scores and age

Age is negatively related to acculturation scores, which is not statistically significant ($P > 0.05$).

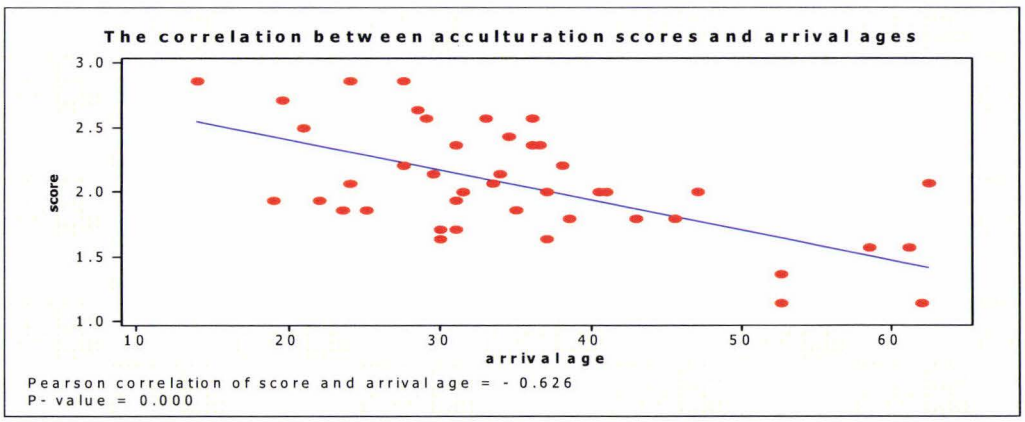

Figure 4.1.4 The correlation between acculturation scores and arrival ages

Negative correlation between the arrival ages and acculturation scores is statistically significant ($P < 0.001$).

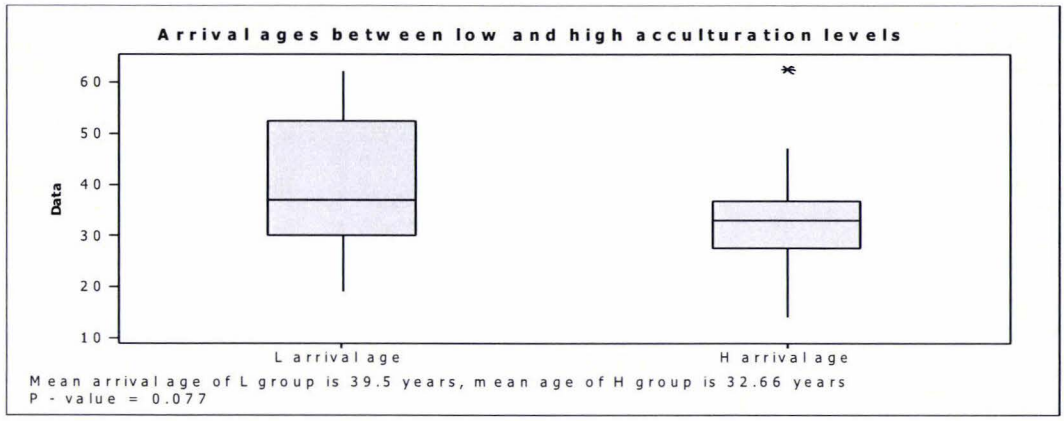

Figure 4.1.5 Arrival ages between low and high acculturation levels

Mean values of arrival ages in low and high acculturation groups are 39.5 and 32.66 years. The difference of arrival ages in L and H groups is not significant (P > 0.05). One outlier is in H group (arrival age 62.5 years).

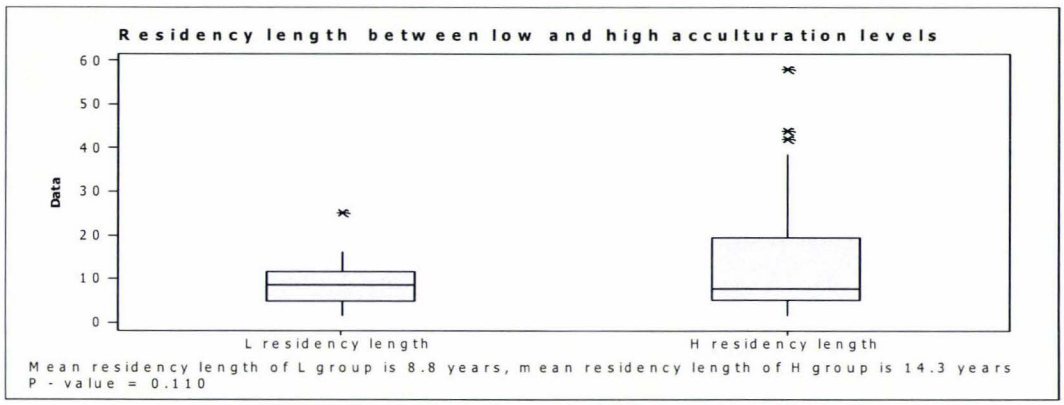

Figure 4.1.6 Residency length between low and high acculturation levels

The mean values of residency length in low and high acculturation groups are 8.8 and 14.3 years. There is no statistical significance (P > 0.05). One outlier is in the low acculturation group and three are in the high acculturation group.

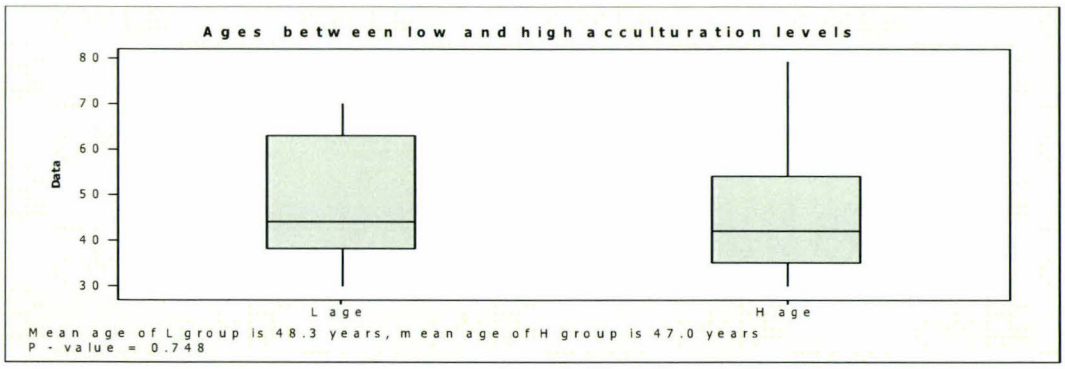

Figure 4.1.7 Ages between low and high acculturation levels

Mean ages of low and high acculturation groups are 48.3 and 47.0 years. There is no statistical significance (P > 0.05).

Table 4.1.7 Original Countries of the participants in Group L and Group H

	Group L(n = 19)	Group H(n = 25)	Total(n = 44)
China	16 (84.2%)	16 (64.0%)	32 (72.7%)
Hong Kong	0 (0)	2 (8.0%)	2 (4.6%)
Taiwan	2 (10.5%)	2 (8.0%)	4 (9.1%)
Others	1 (5.3%)	5 (20.0%)	6 (13.6%)

Note: 1.The total number is 44 which excluded the two subjects born in New Zealand.

2. Figures are displayed in numbers (percentages).

Table 4.1.7 above shows the difference in the percentages of participants who were from Mainland China between acculturation groups L and H. Relatively, the percentage of participants who were from Mainland China in Group L (84.2%) were higher than that in group H (64.0%), which indicates that more participants who had lower acculturation scores came from Mainland China.

In summary, the participants in this study pre-selected themselves as volunteers. More females volunteered than males, and the majority came from Mainland China rather than Hong Kong, Taiwan, and other countries. As mentioned, there were two participants who were born in New Zealand with Chinese parents. More than 70% of the participants had been in New Zealand for over five years, and almost 40% had lived in New Zealand more than ten years. Most of the participants in this study arrived in New Zealand when they were 30 to 40 years old. A longer residency is related to a higher acculturation score, and the arrival ages of the participants are negatively associated to the acculturation scores. Moreover, a higher percentage of the participants from Mainland China belong to the low acculturation group. The participants were volunteers; inevitably, all were most concerned to learn about how their present lifestyles affected their health.

4.1.2 Socioeconomic characteristics

In this study sample, socioeconomic characteristics were investigated, such as educational levels, income, employment status, and living arrangements. When recording their individual acculturation scores, all participants were divided into two groups, and the socioeconomic status of each group assessed individually. Furthermore, the socioeconomic information of the whole sample is compared with both the Palmerston North regional data

and that of the entire New Zealand population obtained from the Census 2006 statistics (Statistics New Zealand, 2007). The details of these socioeconomic data are displayed in the tables below (Tables 4.1.8 to 4.1.11).

Table 4.1.8 Income levels

Income	Number	Percentage
Not stated	4	8.7%
< $15,000	11	23.9%
$15,000 – $30,000	4	8.7%
$30,000 – $35,000	2	4.3%
$35,000 – $40,000	7	15.2%
≥$40,000	18	39.2%

This table shows the different income ranges of the participants in this study. Even though exact income was not requested, four of the participants did not state their income band. Median annual income in New Zealand from the Census 2006 data was $24,400 (Statistics New Zealand, 2007), whereas 58.7% of participants had their income over $30,000 in this study group. However, eleven participants stated their income as being below $ 15,000. Income levels will inevitably affect their food choice and lifestyle.

Table 4.1.9 Employment status

Employment	Number	Percentage
Full time employment	25	54.3%
Part time employment	3	6.5%
Not in employment (includes retired)	18	39.2%

This table shows the employment status of the participants. It reveasls that 54.3% of the participants had full time employment, which was close to that of the New Zealand resident population in 2006 of about 48.44% (Statistics New Zealand, 2007). This phenomenon correlates to the high education levels in this study group. However, the unemplyed rate was 39.2%, which was far higher than the New Zealand average unemployment rate in 2006 of about 3.37%. The reason for this may be the age distribution of participants (34.7% were over 50 years old), and perhaps indicates that those who were retired were not seeking employment.

Table 4.1.10 Education levels

Education levels	Number	Percentage
Lower than Diploma	9	19.6%
Diploma	10	21.7%
Bachelor's Degree	14	30.5%
Honours + Master's Degree	10	21.7%
Higher than Mater's Degree	3	6.5%

Note: Diploma refers to post-school qualification.

The table shows that the majority of participants in this study had reached the level of tertiary education, which correlates to the high employment rate and high personal annual income level. In addition, participants who were well educated may have better knowledge of good health and wellbeing, and they were more likely interested in being volunteers in this study.

Table 4.1.11 Living arrangements

Living arrangement	percentage	number
With family members	38	82.6%
With friends	5	10.9%
By yourself	3	6.5%

This table shows that more than 80% of the participants live with their family members. This may indicate most participants came to New Zealand together with their own family, and that they prefer to live with their family members because of economic and emotional reasons.

Table 4.1.12 summarises the differences in education levels, income, employment status, and living arrangements between group L and group H. Participants in group L were classified with lower acculturation scores (<2) and the others in group H had higher acculturation scores (>2). The acculturation scores in the current study group ranged from 1.0 to 3.0, so 2.0 was used to separate the group into two subgroups. The differences among the two groups in education and income levels were highly significant ($P< 0.005$), and the differences in employment status and living arrangements were also significant ($P < 0.5$). About 76% of the participants in group H had at least a Bachelor's degree, when compared to the percentage of participants in group L (36.8%). In addition, 56% of participants in

group H had annual income higher than $ 40,000, compared to only 10.5% of participants in group L.

Table 4.1.12 Socio-economic status between both acculturation groups

		Group L(n = 19)	Group H(n = 25)
Education	Lower than Diploma	6 (31.6%)	2 (8.0%)
	[1]Diploma	6 (31.6%)	4 (16.0%)
	Bachelor's	5 (26.3%)	9 (36.0%)
	Honours/Master's	2 (10.5%)	8 (32.0%)
	Higher than Master's	0 (0)	2 (8.0%)
[2]Income	< $15,000	8 (42.1%)	3 (12.0%)
	$15,000 – $30,000	2 (10.5%)	2 (8.0%)
	$30,000 – $35,000	0 (0)	2 (8.0%)
	$35,000 – $40,000	3(15.8%)	4 (16.0%)
	≥ $40,000	2 (10.5%)	14 (56.0%)
Employment	Full time	7 (36.8%)	16 (64.0%)
	Part time	2 (10.6%)	1 (4.0%)
	unemployment/retired	10 (52.6%)	8 (32.0%)
Living	With family	16 (84.2%)	21 (84.0%)
	With friends	3 (15.8%)	1 (4.0%)
	By yourself	0 (0)	3 (12.0%)

Note: 1. Diploma refers to post-school qualification.

2. Four participants (21.1%) in Group L did not record their income levels

According to the table 4.1.13 above, 30.4% of the total sample had obtained a Bachelor's Degree, and 21.7% had Honours or Master's Degrees. Also, there were 6.5% of the participants who had a higher qualification than Master's Degree. In comparison with New Zealand statistics (Statistics New Zealand, 2007), the percentage of education levels in Diploma, Bachelor's Degree, Honours and Master's Degree, and higher than a Master's Degree, were higher within the study sample. The data indicate that most were highly educated. Moreover, 54.3% of participants were in full-time employment, which were similar to New Zealand-wide data and the statistics relating to Palmerston North city. However, the unemployed rate, 39.2%, was much higher (Statistics New Zealand, 2007).

Furthermore, 39.1% of the participants stated their income as being over $40,000, which was higher than the average income of both the entire New Zealand population, and the smaller Palmerston North city population.

Table 4.1.13 Differences in socioeconomic status (%)

		The study sample	Palmerston North	New Zealand population
Education	Lower than Diploma	19.6	67.46	61.5
	[1]Diploma	21.7	8.14	8.49
	Bachelor's Degree	30.4	10.14	9.99
	Honours +Master's Degree	21.7	4.58	3.64
	Higher than Master's Degree	6.5	1.69	0.53
[2]Income	< $15,000	23.9	33.02	30.57
	$15,000 – $30,000	8.7	23.45	21.99
	$30,000 – $35,000	4.3	7.28	6.37
	$35,000 – $40,000	15.2	6.38	6.42
	≥ $40,000	39.1	22.38	24.49
Employment	Full time	54.3	49.18	48.44
	Part time	6.5	15.85	14.39
	Unemployed	39.2	3.65	3.37

Note: 1. Diploma refers to post-school qualification.

2. Four participants did not record their income levels.

Based on the figures shown in the foregoing tables, the socioeconomic status of this study group was relatively high when compared to New Zealand-wide and/or Palmerston North populations. The majority of the participants had been educated to at least tertiary level, and more than 50% of the whole group earned income over $30,000 per year. Over 50% of participants had full-time employment. Moreover, a great number of the participants preferred to live with their family members. The comparisons between the low and high acculturation groups in this study revealed that education and income levels were positively related to the acculturation scores. A large percentage of the participants with high

acculturation levels maintained full-time employment, which was twice as high as the participants in the low acculturation group. However, the participants continued living with their family members whether or not they had low or high acculturation scores. The participants with higher educational backgrounds and full-time employment were more likely to possess enough income to support both their family and themselves. Also, they would have more opportunities to get involved in the local environment, which possibly may lead to an increased acculturation score.

4.1.3 General health

According to the health checklist from the study, family history of diabetes, individual hypertension, high serum cholesterol level, frequency of seeing GPs, and smoking, were considered by the participants as indications of their general health status.

Table 4.1.14 General health status

	Number	Percentage
Having family history of diabetes	19	41.3%
With hypertension	7	15.2%
With high serum cholesterol	5	10.9%
Smoking	2	4.4%

Note: Percentages based on 46 participants.

It is apparent that 41.3% of the participants had a family history of diabetes, which may be a major reason why they were interested to participate in the study. In addition, this group of participants may pay more attention to what food they eat and their preferred lifestyle. In addition, 15.2% of the participants reported having been diagnosed with hypertension, and 10.9% of the participants confirmed having high serum cholesterol levels. Conceivably, people who had hypertension or high serum cholesterol were more likely to monitor their health and lifestyle. Finally, only 4.4% of the participants smoke.

Table 4.1.15 Frequency of visiting GPs

	Number	Percentage
Never	24	52.2%
Occasionally	5	10.9%
Once a year	3	6.5%
Every 6 months	8	17.4%
Every 3 months	6	13.0%

Table 4.1.15 shows the frequency of the participants having appointments with GPs. Significantly; more than 50% of the participants had never arranged to see a General Practitioner since they came to New Zealand. In addition, 10.9% saw GPs occasionally, and these participants stated that they only went to see GPs if they felt unwell. According to the report of Asian Health in Aotearoa (Scragg & Maitra, 2003), Asian people were less likely to visit a health practitioner than other New Zealanders, with the most common reason for visiting the GPs being for a short term illness or a routine check up.

Table 4.1.16 General health status in Group L and Group H

	Group L	Group H	P-value
Family history of diabetes	8 (42.1%)	11 (44.0%)	0.903
With hypertension	5 (26.3%)	2 (8.0%)	0.131
With high serum cholesterol	2 (10.5%)	3 (12.0%)	0.881
Smoking	1 (5.3%)	1 (4.0%)	0.850

This table illustrates the differences between acculturation groups L and H in their family history of diabetes, hypertension, high serum cholesterol, and smoking. In both groups, more than 40% of the participants had a family history of diabetes, which as discussed before, may be the main reason that they were interested in participating in the study. The differences between group L and group H listed in the table were not significant.

Table 4.1.17 illustrates the frequency of the participants visiting GPs in both groups L and H. Combining 6 (every six months) and 5 (every three months) together, eleven of the participants in group H visited their GPs at least every six months, but only two of the participants in group L visited their GPs as frequently. The difference between group L and

group H in the frequency of visiting GPs was highly significant. This may be that people who were highly acculturated were more likely to be familiar with the health care system in New Zealand, and of the importance of visiting their GPs regularly in protecting their own health, when compared to people who were less acculturated.

Table 4.1.17 Frequency of visiting GPs in both groups L and H

	Group L	Group H
Never	13 (68.4%)	10 (40.0%)
Occasionally	4 (21.1%)	1 (4.0%)
Once a year	0 (0)	3 (12.0%)
Every 6 months	1 (5.3%)	6 (24.0%)
Every 3 months	1 (5.3%)	5 (20.0%)

P-value < 0.05

The general health status of the study group was considered. Some participants reported that they had hypertension and/or high cholesterol levels. Family history and individual conditions may be possible reasons why many participants pay close attention to their diet and health. As a rule, they were less likely to visit their preferred General Practitioners regularly unless they felt unwell. However, the participants with high acculturation levels visited their GPs more often, which may indicate that highly acculturated participants are more aware of the health care system in New Zealand.

4.2 Acculturation levels

Acculturation levels were measured by different aspects within the questionnaire, determined by questions which included: language use, friends, movie and music preferences, eating habits and food choices.

Table 4.2.1 shows the percentage and number of participants with their acculturation scores. Over 40% of the participants had an acculturation score of less than 2.0, which was classified as being a less acculturated subgroup according to Suinn et al. (1995). Apart from the two people with the highest acculturation scores, twenty-five participants' acculturation scores ranged from 2.0 to 3.0, classified as more highly acculturated.

Table 4.2.1 Acculturation scores of the participants

Acculturation scores (method of Suinn et al., 1995)	Number (Percentage)[1]	Percentage[2]
1- 1.49	4 (8.7%)	9.1%
1.5 – 1.99	15 (32.6%)	34.1%
2.0- 2.49	16 (34.8%)	36.4%
2.5 – 2.99	9 (19.5%)	20.4%
Over 3.0	2 (4.4%)	0

[1] Percentage is calculated by using total 46 participants.

[2] Percentage is calculated by using 44 participants.

Note: 1. maximum score = 5.0

2. Based on the Suinn-Lew Asian self-identity acculturation scale (Suinn, Khoo & Ahuna, 1995).

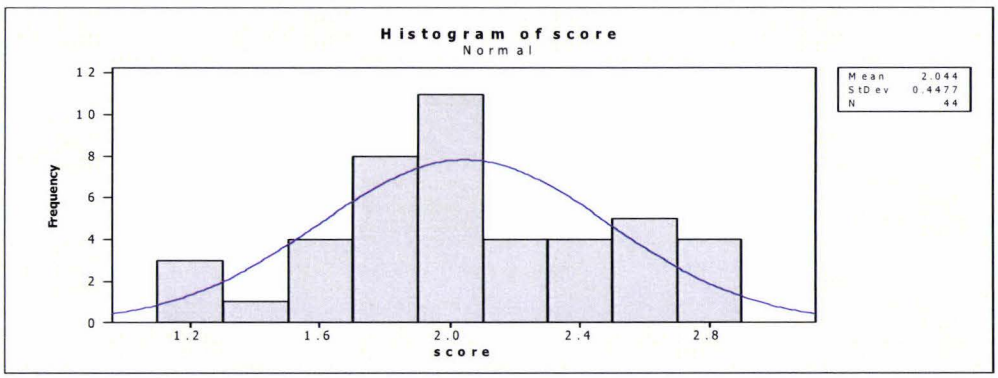

Figure 4.2.1 Histogram of scores

A normal distribution of acculturation scores in 44 participants, and the mean value is 2.044.

Table 4.2.2 Different acculturation scores between genders

	Males (n=17)	Females (n=27)
Low acculturation scores (less than 2.0)	7 (41.2%)	12 (44.4%)
High acculturation scores (2.0, 2.0 to 3.0)	10 (58.8%)	15 (55.6%)

P = 0.886

The table above shows that more than 50% of both male and female participants had high acculturation scores, however, the difference in acculturation scores between males and females was not significant (P >0.05).

The two histograms below show the distribution of the acculturation scores in both male and female participants.

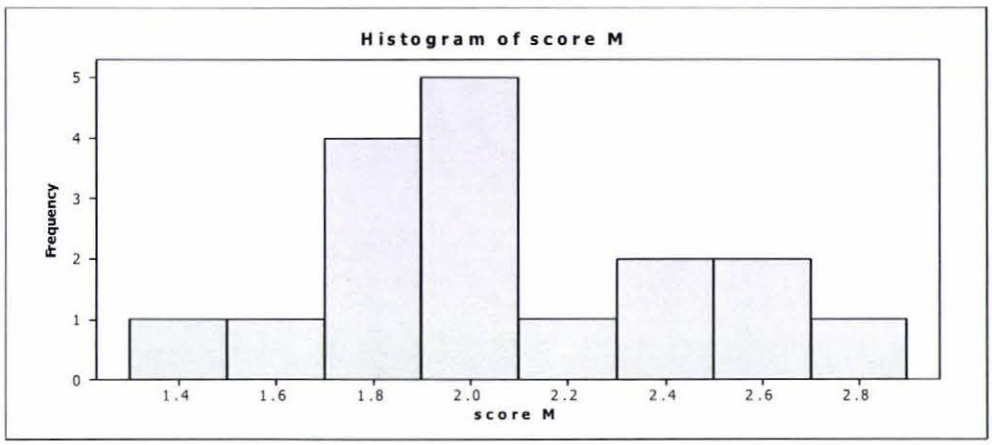

Figure 4.2.2 Histogram of scores in males

The high density scores were located between 1.7 and 2.1.

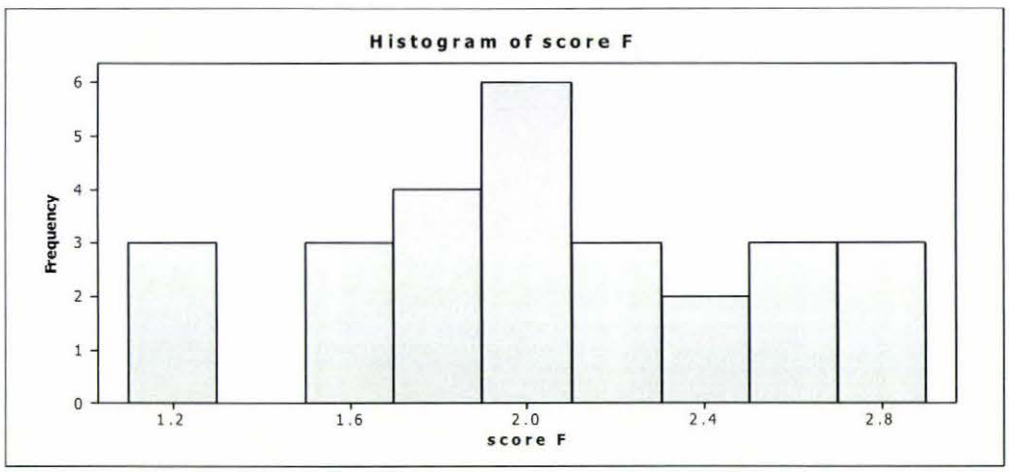

Figure 4.2.3 Histogram of scores in females

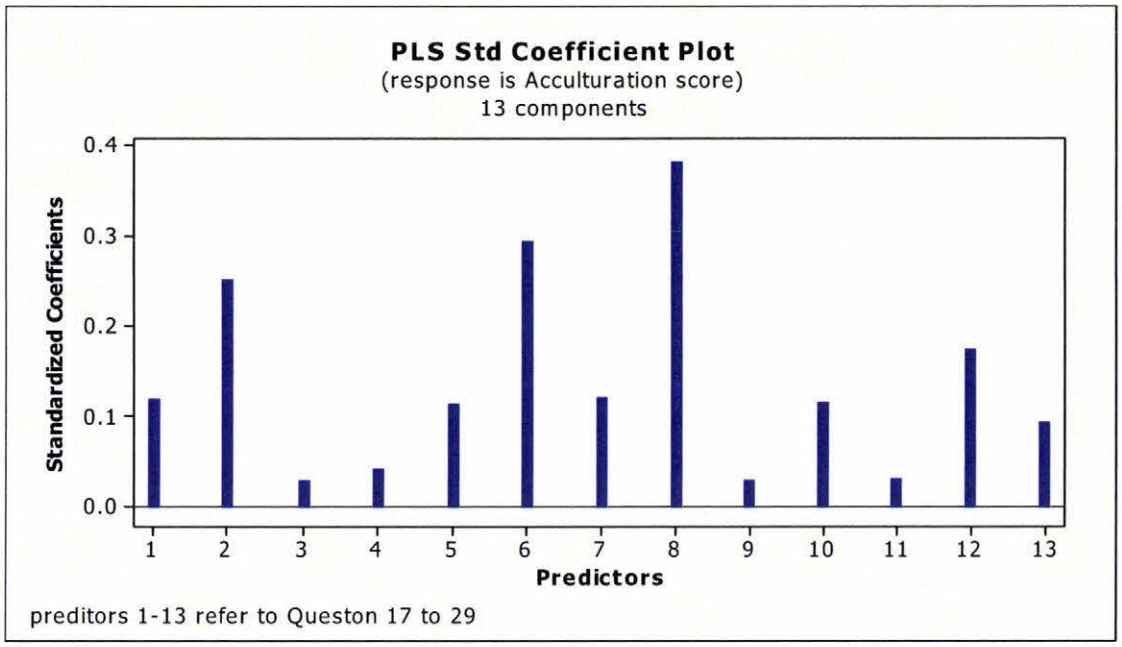

Figure 4.2.4 PLS Std Coefficient Plot

The standardized coefficients for the predictors (answers from Q17 to Q29), and the response is acculturation score. Predictors 2 (Q18), 6 (Q22), 8 (Q24), have the largest standardized coefficients and the biggest impact on acculturation scores. Question 18, 22, and 24 are related to language preference, preferred associate, and music preference, respectively.

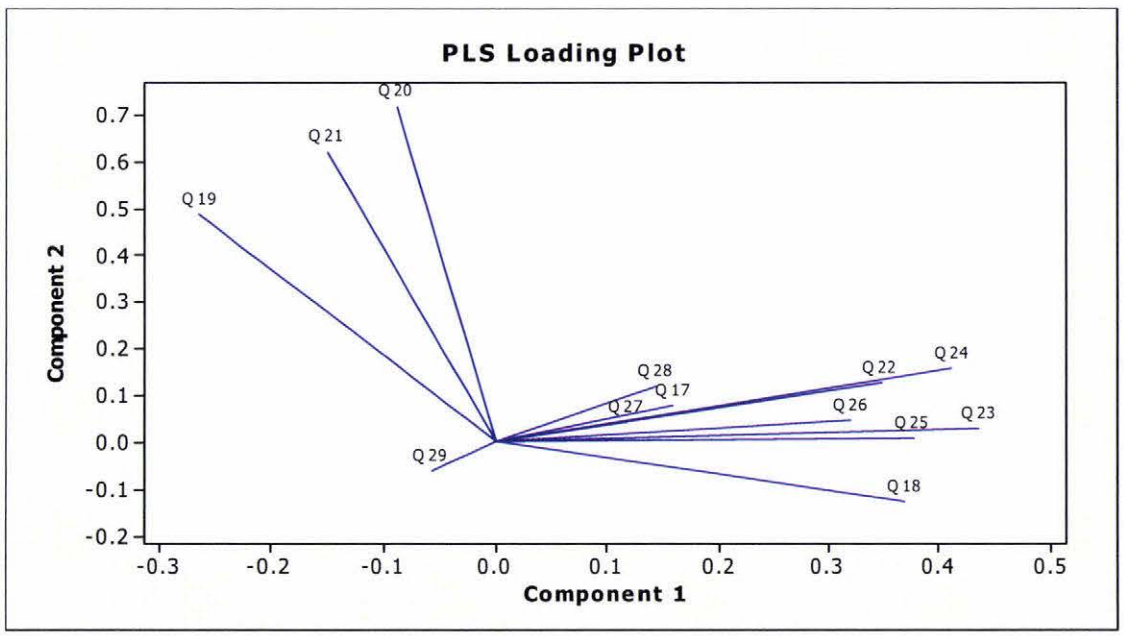

Figure 4.2.5 PLS Loading Plot

PLS Loading plot compares the relative influence of the predictors on the response. The shortest line, Q29 (generational level), is less related to the acculturation score. The longer lines, Q23 (movie preference), Q24 (music preference), and Q18 (language preference), are more related to the acculturation score. Other relative long lines, Q22 (preferred associate) and Q25 (food preference at home), also impact on the acculturation score.

Multiple variables impact on the acculturation scores, and a total of thirteen items were selected from the SL-ASIA questionnaire in this study. The two graphs above show the correlations between the acculturation scores and answers from questions 17, 18, 19, 20, 21, 22, 23a, 24, 25, 26, 27, 28, 29 (total 13 factors) in the primary questionnaire. Answers from language preference (Q18), music preference (Q24), and movie preference (Q23) are most closely associated with the participants' acculturation scores. People, with whom the participants preferred to associate in the community (question 22) and food preference at home (Q25), are relatively closely related to the acculturation scores of the participants. If the participants prefer to use English language, music, movies and eat Western foods, they gained a higher acculturation score. Conversely, if the participants are highly acculturated, they are more likely to use English in their speaking, reading and communicating with friends, and possibly to prefer eating Western foods. In contrast, some items in the SL-ASIA scale associated less with acculturation score in the present study are ethnic interaction (Q19, Q20, Q21), ethnic identity (Q17), participation in Chinese events (Q27), and generational level (Q29).

Table 4.2.3 Answers from Q 30 and Q 31 in the Primary Questionnaire

Q30 & Q31	Number	Percentage
Western	5	10.9%
Chinese	22	47.8%
Bicultural	17	36.9%
No answer	2	4.4%

Of the answers from Q30: "rate yourself on how much you believe in Chinese values (e.g. about marriage, families, education and work)." and Q31: "rate yourself on how much you believe in New Zealand (Western) values." in the primary questionnaire, the entire study group was divided into bicultural, Western, and Chinese according to Suinn et al. (1995).

Based on the answers being stated by the participants from Q30 and Q31, almost half of the participants regarded themselves as Chinese, and 36.9% of the participants were bicultural. Only five of the participants identified themselves as being Western. Conceivably, about

half of the participants still regarded themselves as Chinese, irrespective of how long they have been in New Zealand.

Table 4.2.4 Answers from Q 32 in the Primary Questionnaire

Q32	Number	Percentage
Western	4	8.7%
Chinese	33	71.7%
Bicultural	8	17.4%
No answer	1	2.2%

From the answers to Question 32: "there are many different ways in which people think of themselves. Which one of the following most closely describes how you view yourself", over 70% of the participants think of themselves as Chinese.

Comparing Q 30 and Q31 to Q32, the first two questions were enquiring of Chinese and Western values, which is different from Q32 asking about self-identification. People who think of themselves as Chinese may not agree with some Chinese values, because of the more recent influence from Western cultures.

Table 4.2.5 Different acculturation scores by residency length in New Zealand

Residency length in NZ (years)	Low acculturation scores (<2.0)	High acculturation scores (≥ 2.0)
< 10 (n=25)	13 (52.0%)	12 (48.0%)
≥ 10 (n=19)	6 (31.6%)	13 (68.4%)

P = 0.068

Table 4.2.5 illustrates that the percentage of participants that have low and high acculturation scores in two groups classified by residency length in New Zealand. Almost 70% of participants, who had been in NZ over 10 years, gained high acculturation scores, when compared to the participants who have been in NZ less than 10 years. This indicates that the longer time people have been in New Zealand, the higher acculturation scores they obtain.

Table 4.2.6 Different acculturation scores by ages

Age (years)	Low acculturation scores (<2.0)	High acculturation scores (≥ 2.0)
30 – 44 (n=25)	10 (40.0%)	15 (60.0%)
≥ 45 (n=19)	9 (47.4%)	10 (52.6%)

P = 0.047

This table above demonstrates different acculturation scores in two age groups of the participants (average age of the whole group was 47 years), and the difference between these two age groups is significant ($P < 0.05$). The interesting point in this table is that 60% of the participants aged 30 to 44 gained high acculturation scores (over 2.0), the reason for this was considered to be that relatively younger people are more likely to be acculturated based on their education and economic backgrounds.

Table 4.2.7 Different scores of participants' arrival ages

Arrival age (years)	Low acculturation scores (<2.0)	High acculturation scores (≥ 2.0)
30 – 34 (n=24)	8 (33.3%)	16 (66.7%)
≥ 35 (n=20)	11 (55.0%)	9 (45.0%)

P = 0.002

Table 4.2.7 shows the highly significant difference in acculturation scores between different arrival age groups of the participants ($P < 0.005$). Sixteen of the participants in the group that arrived in New Zealand under the age of 35 years old had high acculturation scores. Furthermore, a higher percentage whose arrival ages were over 35 years (55%) had low acculturation scores compared to the ratio of the participants (45%) who had high acculturation scores.

The acculturation levels were calculated through the acculturation questionnaire. Originally, the maximum score is 5.0, but the majority of the participants in this study had acculturation scores less than 3.0, except for the two participants who were born in New Zealand. The participants with a longer residency length, or younger age and/or arrival age, were more likely to be highly acculturated, mainly because they found it easier to adapt to a new environment.

4.3 Food eating patterns

4.3.1 Meal eating patterns

In this study, Western breakfast foods were characterised by the inclusion of several of the following food items: toast, jam, table spread, cold cereal, coffee; and, in addition, by rice, noodles, and steamed buns, which belonged to a Chinese breakfast. Also, sandwich, bread rolls, and chips were components of a typical Western lunch, while Chinese lunch usually included rice, noodles, and cooked dishes. Chinese dinner often had rice/noodles, together with several stir-fried/stewed dishes, and Western dinner referred to pizza, pasta, KFC, and burgers/potato chips in this study. Both morning and afternoon teas, which consist of Western tea/coffee together with biscuits, cakes and sweeties, are often offered in workplaces. Overall, 44 participants were questioned, excluding the two people who were born in New Zealand, based on their face-to-face 24-hour dietary recalls

Table 4.3.1 Food eating patterns from 24-hour dietary recalls

Day one	Western meals	Chinese meals	Skip meals
Breakfast	27 (61.4%)	17 (38.6%)	0 (0)
lunch	18 (40.9%)	23 (52.3%)	3 (6.8%)
Dinner	4 (9.1%)	40 (90.9%)	0 (0)
Morning tea	9 (20.5%)	0 (0)	35 (79.5%)
Afternoon tea	17 (38.6%)	0 (0)	27 (61.4%)

44 respondents were calculated in this table.

The table above shows certain kinds of meals eaten by the participants. Day one was the same day as the face-to-face interview, so all participants completed this part of the study. Twenty-seven of the participants had a Western style breakfast compared to those participants having Chinese breakfast, and nobody in this study group skipped their breakfast. The notable point in this table is that 90.9% of the participants had their Chinese style dinners and only 9.1% of them had a Western dinner. In addition, about 20% and 38% of the participants had morning and afternoon teas, considered Western style eating habits. The larger majority of the participants did not have any morning tea or afternoon tea. The dinner was considered as a main meal for this group of people, and most of them cooked several dishes to go with either rice or noodles, which is a traditional Chinese eating habit.

The main cooking methods for their dishes were mentioned as stir-fry and stew during the interviews.

Dinner was the main meal consumed in the traditional Chinese style of eating by the participants during both weekends and weekdays. This was the time for the participants to meet their family members or friends, and also it was possible to spend more time in preparing and cooking traditional Chinese dishes during dinner time. Dinner was the main meal consumed in the traditional Chinese style of eating by the participants during both weekends and weekdays. This was the time for the participants to meet their family members or friends, and also it was possible to spend more time in preparing and cooking traditional Chinese dishes during dinner time.

Dinner was the main meal consumed in the traditional Chinese style of eating by the participants during both weekends and weekdays. This was the time for the participants to meet their family members or friends, and also it was possible to spend more time in preparing and cooking traditional Chinese dishes during dinner time.Breakfast was the first meal to be changed into a Western style meal, so that more participants consumed their breakfast with toast, jams, table spreads and coffee instead of a Chinese traditional breakfast, such as, congee, noodles, and steam buns. Four participants prepared their lunch the previous night, and then took it to their workplaces. Also, some participants who were at home during lunch time cooked simple dishes with rice as their lunch.

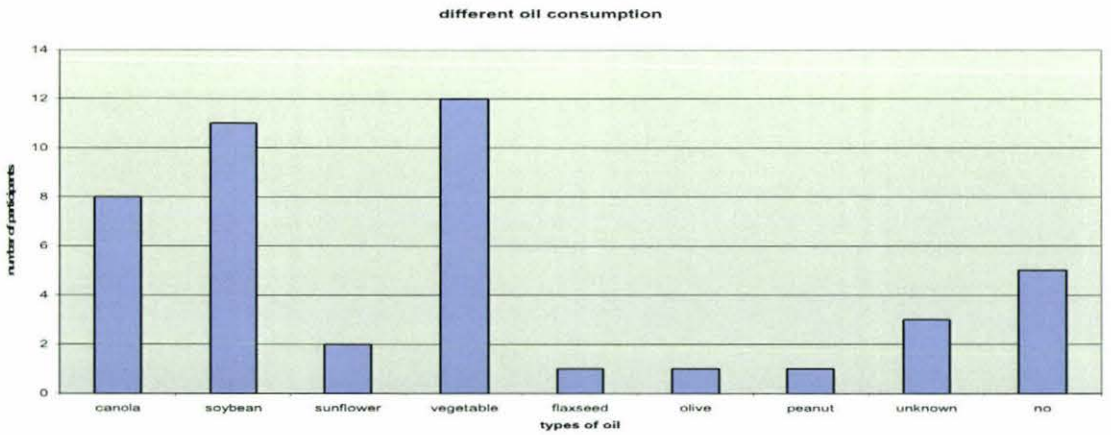

Figure 4.3.1 Differences in oil consumption

Percentages of the participants consumed different types of oil. Vegetable and soybean oil are the most popular two cooking oils used by this study group.

The graph above illustrates the usage of cooking oil, and the most popular oils used were vegetable and soybean oil, and canola oil also was often used. Other oils used include sunflower oil, peanut oil, olive oil, and flaxseed oil. Three participants did not know which oil they used because they ate out, or bought takeaways. The frequency and quantity of using oils is directly related to the participants' habit of commonly consuming vegetable and soybean oil.

Table 4.3.2 Cooking oil consumed by both acculturation groups (Low and High)

Cooking oil	Group Low (n=19)	Group High (n=25)
Canola	3 (15.8%)	5 (20.0%)
Soybean	5 (26.3%)	6 (24.0%)
Sunflower	2 (10.5%)	0 (0)
Vegetable	4 (21.0%)	8 (32.0%)
flaxseed	0 (0)	1 (4.0%)
Olive	0 (0)	1 (4.0%)
Peanut	1 (5.3%)	0 (0)
Unknown	1 (5.3%)	2 (8.0%)
No oil	3 (15.8%)	2 (8.0%)

$P > 0.05$

Table 4.3.2 shows different cooking oils consumed by group L and H, the most frequently used cooking oils were vegetable and soybean oils in group L (47.4%) and group H (56.0%) (The difference was not significant, $P > 0.05$).

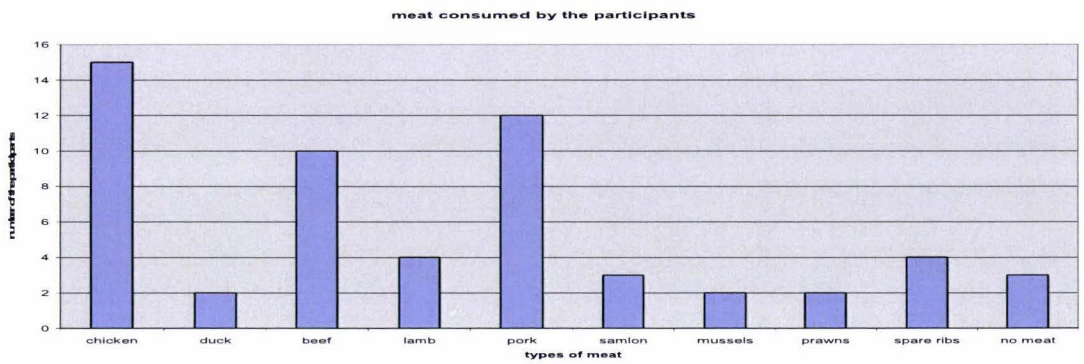

Figure 4.3.2 Meat consumed by the participants

Percentages of participants ate different types of meats, chicken being the most popular one, followed by pork and beef.

The meat consumption in the graph above is based on 44 participants, but some participants consumed more than one kind of meat during the day. This graph above illustrates the meats consumed by the participants. The first three kinds of meat consumed commonly are chicken, pork, and beef. Fish, shellfish and lamb were only occasionally consumed by the participants. Based on the conversations during the face-to-face interviews, they considered the taste and standard price of meat affected their purchase choices and consumption.

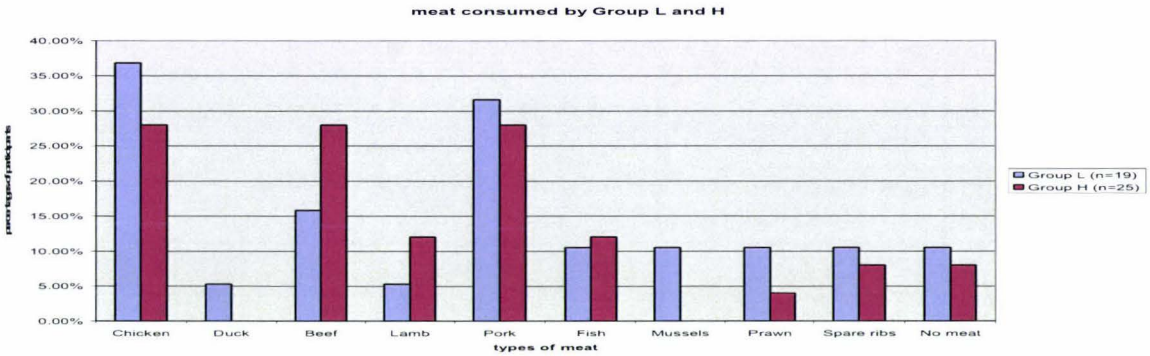

Figure 4.3.3 Meat consumed by both acculturation groups

Percentages of the participants in two acculturation groups (L and H) consumed different kinds of meats. In the L group, chicken and pork are the most popular two meats. However, beef, chicken and pork were consumed by participants in the H group regularly.

The graph above shows the difference of meat consumption of group L and H. The main kinds of meat consumed by group L were chicken and pork; however, group H consumed chicken and pork, but also beef. The frequency of consuming fish and shellfish in group L is significantly higher than that in group H ($P < 0.05$).

The table below shows how many servings of fruits were consumed by the participants during a single face-to-face interview day. The recommendation for healthy eating of New Zealand adults suggests at least two servings of fruit, and 56.8% participants in this group have not met this recommendation.

Table 4.3.3 Percentages of participants ate different servings of fruits

Servings	Number	Percentage
One	13	29.5%
Two	16	36.4%
Three	3	6.8%
No fruit	12	27.3%

Table 4.3.4 Percentages of participants consumed types of vegetables

Vegetables	Number	Percentage
No vegetables	1	2.3%
One	10	22.7%
Two	11	25.0%
Three	8	18.1%
Four	9	20.5%
Five	3	6.8%
Six	2	4.6%

Table 4.3.4 illustrates the types of vegetables consumed by the participants on one day. Almost 50% of the participants consumed less than two kinds of vegetables, and the vegetables listed include potato, carrots, pumpkin, cabbage, tomato, broccoli, spinach, and some Chinese vegetables. However, accurate serving sizes of vegetables intakes were not available here.

Table 4.3.5 Participants ate servings of fruits and types of vegetables in Groups L and H

	Group L(n=19)	Group H(n=25)	P value
One	5 (26.3%)	7 (28.0%)	
Two	5 (26.3%)	11 (44.0%)	
Three	2 (10.5%)	2 (8.0%)	
None	7 (36.8%)	5 (20.0%)	
Servings of fruits			0.284
One	6 (31.6%)	4 (16.0%)	
Two	5 (26.3%)	6 (24.0%)	
Three	2 (10.5%)	6 (24.0%)	
Four	2 (10.5%)	7 (28.0%)	
Five	2 (10.5%)	1 (4.0%)	
Six	2 (10.5%)	0 (0)	
No vegetables	0 (0)	1 (4.0%)	
Types of vegetables			0.906

The table above shows servings of fruits and kinds of vegetable consumed by the participants in group L and H. A higher percentage of the participants who were less

acculturated consumed no fruits (36.8%), whereas the high acculturation group recorded 20.0%. Fifty-two percent of the participants with higher acculturation scores (Group H) reached the New Zealand recommendation, whereas, in contrast, only 36.8% of the participants in Group L had at least two servings of fruits on the interview day. The majority of the participants in the high acculturation group consumed two to four types of vegetable during a single day. However, the difference of consuming servings of fruits and types of vegetables between two acculturation groups are not significant ($P > 0.05$).

Table 4.3.6 Food eating patterns between both acculturation groups

Group	Low acculturation (n = 19)	High acculturation (n = 25)	P - value
Western breakfast	9 (47.4%)	18 (72.0%)	0.107
Chinese breakfast	10 (52.6%)	7 (28.0%)	0.107
Western lunch	7 (36.8%)	11 (44.0%)	0.089
Chinese lunch	12 (63.2%)	11 (44.0%)	0.089
Skip lunch	0 (0)	3 (12.0%)	0.089
Morning tea	1 (5.3%)	8 (32.0%)	0.019*
Afternoon tea	6 (31.6%)	11 (44.0%)	0.410
Western dinner	1 (5.3%)	3 (12.0%)	0.431
Chinese dinner	18 (94.7%)	22 (88.0%)	0.431

The table above describes the different eating patterns between the high and low acculturation groups. There was a statistically significant difference in the consumption of morning tea between the two acculturation groups ($P < 0.05$). The large majority of the participants, irrespective of acculturation scores ($P > 0.05$), consumed a Chinese style dinner regularly.

From face-to-face interviews, over 60% of the participants stated that they often had a Western style breakfast, and more than 90% had a Chinese dinner as the main meal during each day. Furthermore, the participants with high acculturation scores had a Western breakfast and lunch often; in contrast, the participants in the low acculturation group consumed a Chinese breakfast and lunch frequently. However, dinner in both groups was

always Chinese style. It was significant that highly acculturated participants consumed morning tea and afternoon tea more regularly than the participants in the low acculturation group. Therefore, acculturation levels are related to the choices in meal eating patterns, and highly acculturated participants are more likely to adopt new eating habits.

The most popular oils were vegetable and soybean without statistically significant differences between low (L) and high (H) acculturation levels. Highly acculturated participants consumed more beef and lamb; in contrast, the participants with low acculturation scores consumed fish and/or shellfish more frequently than the others (the difference was not statistically significant). Moreover, twelve participants reported that they did not have any fruits on the interview day. There is no significantly different in vegetable consumption between low and high acculturation groups, although food choices have been affected among the high acculturation group.

4.3.2 Food items consumed by the participants based on the food frequency questionnaire

4.3.2.1 Milk products and rice

The table below shows the percentage of the participants who consumed certain kinds of dairy products and the comparison of these with the results from the 1997 New Zealand National Nutrition Survey. Interestingly, the percentages of the participants who chose the low fat milk in both male and female groups were about twice as high than recorded in the 1997 New Zealand National Nutrition Survey. Also, 48.2% of the female participants drank standard milk, and a slightly higher percentage of male participants consumed low fat milk at least once a week. For both the female and male groups, the ratios between the participants who consumed standard milk and those who consumed low fat milk (1:1 for females; and 4:5 for males) were significantly different from the results from the 1997 NZ National Nutrition Survey (2:1 for females; 3:1 for males). In addition, 48.2% of the females consumed yoghurt (standard or low fat), which was much higher than the consumption of the male group. A similar pattern appeared in the 1997 New Zealand National Nutrition Survey. It was a positive health phenomenon that the participants in the current study were more likely to have low fat milk instead of standard milk. Only 22.2% of the females and 17.7% of the males consumed cheese products, which was much lower

than the average New Zealand population intake of such food. Nobody in this study consumed any kinds of cream, which was significant in terms of this product. The reasons for this pattern of consuming dairy products were multiple, for instance, the taste of cream or cheese, how to use cream or cheese in their food, knowledge of healthy food, eating habits, promotions from supermarkets and the standard price of dairy food, which remains reasonably high.

Table 4.3.2.1 Percentages of participants consumed dairy products (%)

Gender	% Female	% Female	% Male	% Male
	Current study	1997 NZ NNS	Current study	1997 NZ NNS
Standard milk	48.2	54.0	41.2	66.0
Low fat milk	48.2	27.0	47.1	22.0
Yoghurt	48.2	42.0	17.7	27.0
Ice cream	11.1	32.0	17.7	43.0
Cheese	22.2	64.0	17.7	66.0
Cream	0	18.0	0	18.0

Figures in this table are percentages of the participants consuming foods at least once a week.

Table 4.3.2.2 Dairy products consumption in acculturation and gender groups (%)

	Females low acculturation			Female high acculturation			Males Low acculturation			Male high acculturation		
Frequency/wk	≥ 5	1-4	<1	≥ 5	1-4	<1	≥ 5	1-4	<1	≥ 5	1-4	<1
Standard milk	42	8	50	47	0	53	14	0	86	50	10	40
Low fat milk	33	8	58	47	7	47	57	0	43	40	0	60
Yoghurt	25	17	58	7	20	73	29	0	71	0	20	80
Lowfat/yoghurt	17	8	75	7	0	93	14	0	86	0	0	100
Ice cream	0	0	100	0	20	80	0	14	86	0	20	80
Cheese	8	8	83	0	27	73	14	0	86	0	20	80
Cream	0	0	100	0	0	100	0	0	100	0	0	100
Low fat cream	0	0	100	0	0	100	0	0	100	0	0	100

The table above reveals the consumption of varieties of dairy products in both female and male groups with different acculturation levels. It discloses that the greater percentage of the male participants in the high acculturation group (60%) consumed standard milk at least once per week compared with those featuring in the low acculturation male group (14.3%); in contrast, 40% of male participants with a high acculturation level consumed low fat milk, which was almost 20% lower than the percentage participants with a low acculturation level (57.1%). Male participants with high acculturation levels in this study were more likely to choose standard milk rather than low fat milk, which reflects the same trend in the 1997 National Nutrition Survey (where 66% of the males consumed standard milk and 22% consumed low fat milk). However, the differences in the percentage of female participants who consumed standard and low fat milk were not so significant than those in the male groups. Furthermore, a higher percentage of the females with low acculturation levels (41.7% and 26.7%) consumed regular yoghurt and low fat yoghurt at least once per week, when compared to the high acculturation group (26.7% and 6.7%). In addition, rarely did the participants in this current study consume cream or ice cream. The interesting detail in this table is that a larger percentage of the participants with a high acculturation level in both male and female groups (26.7% for females, and 20.0% for males) consumed cheese at least once per week, when compared to those in the low acculturation groups (16.7% for females and 14.3% for males). To a major extent, cheese and cream belong to the Western food group, which is less likely to be accepted by this Chinese group of participants. Also, milk products were less commonly consumed at least once a week by this group, as shown by approximately 50% in each group who consumed dairy products less than once per week.

Table 4.3.2.3 Frequency in consuming bread in four groups (%)

Groups	Females with low acculturation scores			Females with high acculturation scores			Males with low acculturation scores			Males with high acculturation scores		
Frequency/wk	≥ 5	1-4	<1	≥ 5	1-4	<1	≥ 5	1-4	<1	≥ 5	1-4	<1
Bread	58.3	16.7	25.0	33.3	40.0	26.7	14.3	57.1	28.6	60.0	20.0	20.0

Table 4.3.2.3 above demonstrates the frequency of consuming bread in four acculturation and gender categories. More than fifty percent of the females with a low acculturation level consumed bread over five times per week, but only 33.3% in the high acculturation group. In contrast, 60.0% of the males with a high acculturation level, which was over three times higher than those in the low acculturation group, consumed bread more than five times per week. However, there was no significant difference for low and high acculturation male or females groups in consuming bread at least once a week. Bread, as a major carbohydrate containing food in Western diets, has been accepted by Chinese because of its convenience in eating and preparation, and its availability in the supermarkets.

Table 4.3.2.4 Frequency of consuming carbohydrate in different acculturation groups (%)

Groups	Females with low acculturation scores			Females with high acculturation scores			Males with low acculturation scores			Males with high acculturation scores		
Frequency/wk	≥ 5	1-4	< 1	≥ 5	1-4	< 1	≥ 5	1-4	< 1	≥ 5	1-4	< 1
Weet-bix	17	8	75	13	7	80	0	14	86	0	0	100
Boiled rice	92	0	8	73	27	0	57	29	14	100	0	0
Boiled noodles	17	58	25	33	13	53	14	43	43	30	40	30
Pasta	8	0	92	0	27	73	0	0	100	0	10	90
Porridge	17	25	58	13	7	80	14	14	71	0	10	90
Muffin	8	0	92	0	13	87	0	29	71	10	20	70

The table above reveals the percentages of the participants with low and high acculturation levels in consuming different carbohydrate foods. Rice, as a dominant Chinese food, was still consumed popularly by this current study group, however, more female participants with a low acculturation level (97%) consumed rice more than five times per week, when compared to 73% of the high acculturated females. Conversely, all the male participants with a high acculturation level consumed rice over five times per week and about 57% of low acculturated males consumed rice with the same frequency. A higher percentage of the males in the high acculturation group consumed noodles more than five times per week, compared with those in the low acculturation male group. Possibly, the reason why males

had kept their habit of eating rice and/or noodles was that their partners still maintained traditional Chinese cooking and eating habits; in addition, the main meal was always served with rice and several dishes were eaten together with family members. Also, a lower percentage of the participants consumed weet-bix, pasta, and porridge as often as they ate rice or noodles. However, a higher percentage of the participants in the high acculturation groups (27% for females and 10% for males) consumed pasta at least once a week in contrast to those in the low acculturation groups (8% for females and 0 for males). This shows that some highly acculturated participants had started to accept pasta as a part of their diet, partly because of the similar taste to noodles and easy availability in the supermarkets.

Table 4.3.2.5 Percentages of people eating pasta, rice and porridge at least weekly (%)

	Current study	1997 NZ NNS	Current study	1997 NZ NNS
Gender	Female	Female	Male	Male
Pasta	18.5	57.0	5.9	52.0
Rice	96.3	49.0	94.1	46.0
Porridge	29.6	20.0	29.4	24.0

Table 4.3.2.5 compares the percentages of the participants who consumed pasta, rice and porridge at least once a week in the current study, compared with the 1997 New Zealand National Nutrition Survey. On the one hand, the percentages of the females and males (57.0% for females; 52.0% for males) in the 1997 National Nutrition Survey who consumed pasta at least once a week were much higher than those in the current study (18.5% for females; 5.9% for males). Separately, the percentages of participants (96.3% for females; 94.1% for males) who consumed rice in the current study were higher than those results from the 1997 National Nutrition Survey (49.0% for females; 46.0% for males). The traditional methods for cooking and eating rice are familiar to Chinese, whereas New Zealanders are used to cooking and tasting pasta. This result reflects that the majority of Chinese in this study were more likely to consume rice rather than pasta, however, with the increased degree of their acculturation levels, they may consume pasta more regularly, as a combination with their traditional meals.

4.3.2.3 Meat, fish and meat products

Table 4.3.2.6 Percentages of people eating meats at least once a week (%)

	Current study	1997 NZ NNS	Current study	1997 NZ NNS
Gender	Female	Female	Male	Male
Beef mince	18.5	43.0	17.7	47.0
Beef	22.2	51.0	17.7	57.0
Chicken	63.0	44.0	47.1	40.0
Lamb	3.7	19.0	0	22.0
Pork	44.4	9.0	47.1	12.0
Spare ribs	14.8	2.0	17.6	3.0

According to table 4.3.2.6, the meat consumed by the majority of the female and male participants (63.0% for females; 47.1% for males) was chicken, which was different from that in the 1997 New Zealand National Nutrition survey where beef was consumed by more than 50% of people. The second most popular meat was pork in the current study where 44.4% of the females and 47.1% of the males ate pork at least once per week. The percentages of people who consumed pork in the 1997 New Zealand National Nutrition Survey (9.0% for females; 12.0% for males) were much lower than those in the current study. This may result from Chinese people being unable to easily access their traditional sources of meat in New Zealand. Even a lower percentage of people (2.0% for females; 3.0% for males) consumed spare ribs, when compared to the current study (14.8% for females; 17.6% for males). The participants in the current study did consume beef and beef mince, but these results were not the same as in the New Zealand survey. Both male and female participants in the current study were more likely to have chicken and pork as their main meat options rather than beef, beef mince and lamb. Based on the face-to-face interviews with the participants, they stated that the taste of the meats, family preference, and prices of the meat products, would lead to different choices of meat.

Table 4.3.2.7 Meat intakes in acculturation and gender groups (%)

Groups	Females with low acculturation scores			Females with high acculturation scores			Males with low acculturation scores			Males with high acculturation scores		
Frequency (times/wk)	≥ 5	1-4	< 1	≥ 5	1-4	< 1	≥ 5	1-4	< 1	≥ 5	1-4	< 1
Beef mince	0	16.7	83.3	0	20.0	80.0	0	14.3	85.7	0	20.0	80.0
Beef	0	33.3	66.7	0	13.3	86.7	0	28.6	71.4	0	10.0	90.0
Chicken	8.3	66.7	25.0	0	53.3	46.7	14.3	57.1	28.6	20.0	10.0	70.0
Lamb	0	8.3	91.7	0	0	100.0	0	0	100.0	0	0	100.0
Pork	25.0	50.0	25.0	13.3	6.7	80.0	14.3	71.4	14.3	0	20.0	80.0
Spare ribs	16.7	8.3	75.0	0	6.7	93.3	0	28.6	71.4	0	10.0	90.0

The table above emphasises the different percentages of the female and male participants with low and high acculturation levels who consumed various kinds of meats. A far higher percentage of the females with low acculturation levels consumed chicken, pork and spare ribs at least once per week, when compared to the percentages of the females in the high acculturation group. Also, the females with low acculturation scores were more likely to consume meat than those in the high acculturation group. A similar trend occurred in the low and high acculturation male groups, the majority of the males with low acculturation levels preferring chicken, pork and spare ribs; moreover, a higher proportion of the males in the low acculturation group ate beef at least once a week in contrast to those in the high acculturation group. Totally, both the male and female participants with a low acculturation level preferred to consume meat, especially chicken and pork. In the current study, the participants in the high acculturation groups were less likely to consume either beef and beef mince or chicken and pork. More than 50 of the participants in both the low and high acculturation groups had not eaten beef and/or lamb at least once per week. The prices of beef or lamb may be one of the reasons for less consumption, but the taste of these meats may have significant effect also, due to the cultural preference of taste which remains with the Chinese participants.

Table 4.3.2.8 Percentages of participants eating meat products at three frequencies

Groups	Females with low acculturation scores			Females with high acculturation scores			Males with low acculturation scores			Males with high acculturation scores		
Frequency (times/wk)	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1
Bacon	0	16.7	83.3	6.7	13.3	80.0	0	0	100.0	0	0	100.0
Ham	0	25.0	75.0	13.3	33.3	53.3	0	0	100.0	10.0	30.0	60.0
Sausage	0	16.7	83.3	6.7	0	93.3	0	0	100.0	0	0	100.0

The table above shows the proportion in percentages of the participants in four acculturation subgroups who consumed meat products at different frequency levels. It is significant that the male participants with low and high acculturation levels had not eaten any bacon or sausage more often than once per week. A much higher percentage of the males in the high acculturation group consumed ham in contrast to zero in the low acculturation male group. Moreover, more females in the high acculturation group consumed bacon and ham than those in the female low acculturation group. About 40 percent each of the females and the males with high acculturation levels had accepted these convenient and easy to prepare meat products. Most meat products are readily available in the supermarkets and also there is a wide range of choices. However, most of the Chinese participants in this current study preferred fresh meat rather than processed meat products, perhaps because fresh meat is always available in the markets in China, and Chinese people are more familiar in using fresh meat with which to prepare their meals.

Table 4.3.2.9 Percentages of people eating meat products at least once a week (%)

	Current study	1997 NZ NNS	Current study	1997 NZ NNS
Gender	Female	Female	Male	Male
Bacon/ham	55.6	33.0	23.5	41.0
Sausage	11.1	26.0	0	36.0

According to table 4.3.2.9, generally, higher percentages of people in the 1997 NZ National Nutrition Survey consumed bacon/ham and sausage, when compared to those figures in the current study. However, a greater percentage of the female participants in this study (55.6%) ate bacon/ham at least once per week in contrast to 33.3% of the females in the 1997 NZ National Nutrition Survey. Meat products may provide females more choices in preparing the meals and also they were easier to prepare and/or cook which saves the cooking time. Separately, the taste, the cooking methods and the standard price of meat products are possible reasons for such food not being consumed by this group of Chinese migrants.

Table 4.3.2.10 Fish intakes in different acculturation and gender groups

Groups	Females with low acculturation scores			Females with high acculturation scores			Males with low acculturation scores			Males with high acculturation scores		
Frequency (times)/wk	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1
Baked/steamed fish	17	25	58	0	20	80	0	57	43	0	40	60
Canned fish	0	0	100	0	13	87	0	0	100	0	0	100
Deep fried fish	8	0	92	0	0	100	0	0	100	0	0	100
Prawn	0	33	67	7	20	73	0	29	71	0	20	80
Shellfish	0	17	83	0	13	87	0	14	86	0	0	100

Fish and shellfish are another group of food which is consumed regularly as a part of the Chinese diet. The availability and range of fresh fish is limited in the New Zealand markets, when compared to that in Chinese markets. Also higher prices in New Zealand of fish and shellfish are another barrier to eating fish or shellfish more often. Table 4.3.2.10 shows the percentages of the female and male participants with low and high acculturation levels who consumed fish and shellfish in three different frequency levels each week. Higher percentages of the participants with low acculturation levels (42% for females, and 57% for males) ate baked/steamed fish at least once a week in comparison to 20% of the females,

and 40% of the males, in the high acculturation groups. Further, the percentages of both the males and females in the low acculturation groups who consumed prawn and shellfish at least once per week were slightly higher than those with high acculturation levels. Only 13% of the females with high acculturation levels in the whole study group consumed canned fish at least once a week. These phenomena show that the participants with low acculturation levels were still trying to keep their traditional diet of eating fish and/shellfish, even though they may have difficulties in obtaining fresh fish/shellfish. Fewer participants from the high acculturation groups reported consuming fish/shellfish regularly.

Table 4.3.2.11 Percentages of people consuming fish/shellfish at least once a week (%)

	Current study	1997 NZ NNS	Current study	1997 NZ NNS
Gender	Female	Female	Male	Male
Baked/steamed fish	29.6	15.0	47.1	11.0
Canned fish	7.4	16.0	0	14.0
Deep fried fish	14.3	11.0	0	20.0
Prawn	29.6	2.0	23.5	2.0
Shellfish	14.8	5.0	5.9	7.0

The table above compares the percentages of the participants who consumed fish/shellfish at least once a week in the current study to the results from the 1997 New Zealand National Nutrition Survey. There were significantly higher percentages of both female and male participants who consumed baked/steamed fish, prawn and shellfish at least once a week, when compared to those from the 1997 NZ National Nutrition Survey. In contrast, higher percentages of the females (16%) and males (14%) consumed canned fish in the 1997 NZ NNS than those in the current study (7.41% for females; 0 for males). This reflects that the participants in this study prefer eating self-prepared fish, prawn and shellfish rather than canned fish, even though canned fish was both readily available and convenient. The reasons for these patterns in Table 4.3.2.11 are multiple, including the taste and price of canned fish, and the time taken to cook fish/shellfish.

4.3.2.4 Vegetables

Table 4.3.2.12 Intakes of the most popular vegetables in NZ by four groups (%)

Groups	Females with low acculturation scores			Females with high acculturation scores			Males with low acculturation scores			Males with high acculturation scores		
Frequency (times)/wk	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1
Carrots	33.3	50.0	16.7	26.7	20.0	53.3	28.6	28.6	42.9	0	70.0	30.0
Tomatoes	8.3	41.7	50.0	33.3	53.3	13.3	0	28.6	71.4	0	20.0	80.0
Lettuce	16.7	50.0	33.3	20.0	40.0	40.0	14.3	28.6	57.1	10.0	10.0	80.0
Onions	16.7	50.0	33.3	20.0	46.7	33.3	28.6	57.1	14.3	20.0	20.0	60.0
Pumpkins	0	0	100.0	0	6.67	93.33	0	0	100.0	0	0	100.0

Table 4.3.2.13 Percentages of people consuming vegetables at least once/week (%)

	Current study	1997NZ NNS	Current study	1997 NZ NNS
Gender	Female	Female	Male	Male
Carrots	63.0	86.0	64.7	81.0
Tomatoes	70.4	81.0	23.5	72.0
Lettuce	63.0	79.0	29.4	67.0
Onions	66.7	74.0	58.8	68.0
Pumpkin	3.7	55.0	0	49.0

Table 4.3.2.14 People consuming Chinese vegetables at least once/week (%)

	Current study	1997NZ NNS	Current study	1997NZ NNS
Gender	Female	Female	Male	Male
Mushroom	25.9	35.0	29.4	30.0
Capsicum	22.2	33.0	41.2	26.0
Sprouts	14.8	20.0	17.7	11.0
Soybeans/tofu	3.7	3.0	0	2.0

According to the report from the 1997 New Zealand National Nutrition Survey, potatoes, carrots, tomatoes, lettuce, onions/leeks and peas were the most common types of vegetables consumed at least once each week by New Zealanders. The extent of availability of certain vegetables always will result in different consumption choices being made. The vegetables listed in the table above are readily available in the supermarkets twelve months a year, and also the standard prices of such vegetables are relatively cheap.

In the table 4.3.2.12, to a large extent, more females in both low and high acculturation groups consumed carrots, tomatoes, lettuce, onions at least once a week, when compared to consumption by males. Moreover, fewer males with high acculturation levels had eaten tomatoes, lettuce and onions, than the low acculturated male participants. When comparing the results from the current study to the 1997 New Zealand National Nutrition Survey, lower percentages of both females and males consumed these five vegetables at least once a week. In particular, only 23.5% and 29.4% of the males in the current study consumed tomatoes and lettuce at least once a week, which was far less than 72% and 67% of the New Zealand population in the 1997 NZ NNS. The ways of cooking and eating vegetables for Chinese are different from Western people, and they like to mix several kinds of vegetables for each meal. Also, the large variety of common vegetables, together with seasonal fresh vegetables, are readily available in the markets in China, so that Chinese are used to picking up different kinds of vegetables from day to day. The taste and traditional Chinese eating preferences may lead to the less frequency of consuming the vegetables listed in table 4.3.2.13 than the New Zealand population.

Mushroom, capsicum, sprouts and soybean/tofu are four kinds of Chinese vegetables which are popular in China. From the figures in table 4.3.2.14, the percentages of the participants who consumed these vegetables at least once per week are lower than that in the 1997 New Zealand National Nutrition Survey. The variety and taste of these four vegetables may result in the less consumption frequency. For example, only three kinds of fresh mushroom (white button, Swiss brown and brown button), are readily available in the New Zealand markets, whereas there are many more types of mushroom frequently in the markets in China. Generally, Chinese would choose different flavours of mushrooms with various cooking methods. However, the choices for the Chinese participants in this study were

limited. When comparing the figures between the two tables 4.3.2.13 and 4.3.2.14, the proportion in percentages of people who consumed mushroom, capsicum, sprouts and soybean/tofu were much lower than those consuming carrots, lettuces, tomatoes and onions, the traditional food preferences showed in both Chinese and New Zealanders. The reduced availability and different taste of mushroom, capsicum, sprouts and soybean/tofu (which differ from the Chinese products in China), are a possible reason for the frequency of consumption. As a rule, local New Zealand people prefer their traditional foods rather than other food, because they lack the knowledge in the specific food flavours, and in preparation and cooking methods. Soybean products or tofu are typical examples. Chinese know how to prepare and cook them, but it is not easy to access these foods due to variety, availability and standard prices. In contrast, some local people in New Zealand occasionally try new soybean products, but they often do not know how to prepare and cook them effectively.

Table 4.3.2.15 shows the proportion in percentages of the participants within different acculturation and gender groups who consumed thirteen kinds of Chinese vegetables at three frequency levels. Higher percentages of the females with low acculturation scores consumed mushroom, capsicum, sprouts, seaweed and radish at least once a week, when compared to those in the high acculturated females. In the male groups, more males with low acculturation levels consumed sprouts, bok choi, eggplant, seaweed and radish than those in the high acculturation group. In total, both females and males who were in the low acculturation groups were trying to keep their traditional vegetable preferences, at the same time using some other readily available foods in the New Zealand markets. Relatively, the participants with high acculturation levels had started to alter some of their vegetable choices; meanwhile, they still purchase the traditional Chinese vegetables when they are available.

Table 4.3.2.15 Participants ate Chinese vegetables in acculturation (Acc) groups (%)

Groups	Females Low Acc			Females High Acc			Males Low Acc			Males High Acc		
Frequency (times/week)	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1
Mushroom	0	42	58	0	13	87	0	29	71	0	30	70
Capsicum	25	17	58	0	7	93	0	43	57	0	40	60
Sprouts	0	17	83	0	13	87	0	29	71	0	10	90
Soybean/tofu	0	0	100	0	7	93	0	0	100	0	0	100
Bok choi	8	58	33	7	60	33	0	100	0	0	60	40
Eggplant	0	0	100	0	7	93	0	29	71	0	0	100
Seaweed	0	25	75	0	7	93	0	29	71	0	10	90
Radish	0	25	75	0	7	93	0	14	86	0	10	90
Bamboo shoots	0	0	100	0	7	93	0	0	100	0	0	100
Ginger	97	0	8	27	27	47	86	14	0	30	50	20
Garlic	75	17	8	53	27	20	57	29	14	60	20	20
Spring onion	42	25	8	20	27	53	14	71	14	40	30	30
Pickled vegetables	8	17	75	7	13	80	0	14	86	10	20	70

Moreover, many vegetables are pickled or preserved in China before they are consumed, some of which are available in the Chinese markets locally in the Manawatu. Similar numbers of the participants with both low and high acculturation levels stated that they consumed pickled vegetables at least once per week. Ginger, garlic and spring onions are three types of ingredients commonly used on a regular basis in Chinese cuisine. The majority of the female participants with low acculturation levels consistently consumed ginger, garlic and spring onions at least five times per week, which was significantly different from the female participants in the high acculturation groups. Also, more males with low acculturation levels consumed ginger more than five times per week than those in the high acculturation group. This may result from the traditional food preferences and the

special flavour of ginger, garlic and spring onions, which are well established in Chinese eating habits. However, a higher percentage of the males in the high acculturation group consumed spring onions at five times per week, when compared to that of the low acculturation males.

Table 4.3.2.16 Percentages of participants eating stirfry vegetables/vegetables soups (%)

Groups	Females with low acculturation scores			Females with high acculturation scores			Males with low acculturation scores			Males with high acculturation scores		
Frequency (times/wk)	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1
Stir fried vegetable	83.3	6.7	6.7	66.7	26.7	6.7	71.4	14.3	14.3	90.0	10.0	0
Vegetable soup	25.0	33.3	41.7	13.3	40.0	46.7	28.6	57.1	14.3	10.0	50.0	40.0

Stir-fry is a major cooking method used in Chinese cuisine, which is also reflected in the results from the table above. The majority of the participants in this current study reported that they ate stir-fried vegetables more than five times per week. More than 50% of the participants stated they consumed vegetable soup frequently. The differences between the low and high acculturation groups are not significant. Using stir-fry or making soups are still preferable ways for Chinese people in maintaining their vegetable consumption.

The vegetable markets in New Zealand are very different from those in China, where a variety of fresh vegetables are available on a daily basis, in particular, green leafy vegetables and all types of beans. A Chinese traditional habit is that people buy their fresh vegetables each day for feeding the family, and they usually do not keep vegetables too long in the refrigerator. The limited variation and different tastes of fresh vegetables in New Zealand affected the food choices of participants in this current study. Based on the face-to-face interviews, the participants stated that they often went to the weekend flea

markets to buy some fresh Chinese vegetables. However, the participants were unable eat these fresh vegetables every day, because it is difficult for them to store such vegetables.

4.3.2.5 Beverages

Table 4.3.2.17 Percentages of consumption of beverages at least three times a week (%)

	Current study	1997 NZ NNS	Current study	1997 NZ NNS
Gender	Female	Female	Male	Male
Soft drink	11.1	18.0	17.7	30.0
Fruit juice	29.6	25.0	23.5	27.0
Western tea	29.6	65.0	41.2	58.0
Coffee	48.2	58.0	47.1	64.0
Herbal tea	11.1	11.0	0	4.0
Beer	3.7	10.0	5.9	51.0
Wine	7.4	36.0	11.8	27.0
Spirits	0	16.0	0	21.0

Tea and coffee are consumed by more than 50% of New Zealanders in the 1997 New Zealand National Nutrition Survey. Table 4.3.2.17 compares the proportions in percentages of the participants who consumed beverages at least three times per week in the current study with the 1997 New Zealand National Nutrition Survey. It was significant that fewer participants in the current study reported that they drank Western tea and coffee at least three times a week, however, coffee and tea also remained the main non-alcoholic beverages in the current study. Easy availability of coffee and tea results in the drinking frequency. In particular, it is a well established habit to offer morning tea and afternoon tea in the workplace or at gatherings in New Zealand. To a major extent, a far lower percentage of the participants drank alcohol, including beer, wine and spirits, when compared to the results for New Zealand population from the 1997 National Nutrition Survey. The availability and the taste of the alcoholic beverages are possible reasons for the lower frequency of consuming by the Chinese participants.

The two tables below display the percentages of the female and male participants who consumed nine types of non-alcoholic, and three alcoholic, beverages, at three different

frequency levels. The females in the high acculturation group who consumed Western tea and coffee more than five times per week had percentages five times higher than the participants with low acculturation levels. Also, there were a greater percentage of the females in the high acculturation group who consumed green tea more frequently than those in the low acculturation group. Among male participants, a similar pattern appeared in drinking Western tea and coffee. However, 71.4% and 80.0% respectively of the males in both low and high acculturation groups drank green tea more than five times per week, which reflects the Chinese traditional tea drinking habit. Green tea in this study includes tea bags and tea leaves. Traditionally, Chinese prefer making green tea from tea leaves rather than tea bags, and a variety of tea leaves and different storage times provide a variety of flavours and taste. The lower availability of green tea leaves may have affected the participants' choices. The taste of Western tea and caffeine contained in coffee are possible reasons why they do not drink such drinks frequently. Additionally, health benefits from green tea have been well accepted. In total, both female and male participants in this current study maintained their habit of drinking green tea, although more participants in the high acculturation groups consumed Western tea and coffee than those with low acculturation levels. In order to keep drinking good quality green tea, the participants, or their friends often carry it back from China. Being a part of cultural preferences, green tea is the main beverage consumed by the participants in this current study, however, Western tea and coffee has been accepted gradually by some Chinese participants.

Unsweetened juice, chocolate drink and soft drink were not popular drinks among the Chinese participants. However, a high percentage of the females drank juice at least once a week, but the males drank it significantly less often. Chinese in China do drink these non-alcoholic beverages occasionally, but not regularly. The majority of the participants in this study stated that they did not often consume alcoholic beverages. Only 28.6% of the males in the low acculturation group consumed wine at least once per week, because of understanding the health benefits of the wine. This comment is based on the statements from the participants.

Occasionally, Chinese drink alcohol, such as at family gatherings or Chinese festivals. In particular, Chinese alcoholic drinks are not usually made from grapes, but from grains,

fruits or rice. The limited availability in New Zealand of any known variety of Chinese alcohol may affect the frequency of consuming alcohol in this study.

Table 4.3.2.18 Percentages of females consuming beverages at varied frequencies (%)

	Females with low acculturation scores			Females with high acculturation scores		
Frequency (times/wk)	≥5	1-4	<1	≥5	1-4	<1
Green tea	16.7	16.7	66.7	46.7	13.3	40.0
Chinese herbal tea	16.7	8.3	75.0	6.7	0	93.3
Western tea	8.3	8.3	83.3	40.0	13.3	46.7
Coffee	8.3	33.3	58.3	40.0	26.7	33.3
Coffee (decaf)	0	0	100.0	0	6.7	93.3
Chocolate drink	0	16.7	83.3	6.7	6.7	86.7
Juice	8.3	25.0	66.7	6.7	40.0	53.3
Juice (unsweetened)	0	16.7	83.3	0	20.0	80.0
Soft drink	8.33	8.33	83.3	6.7	6.7	86.7
Beer	0	0	100.0	0	6.7	93.3
Wine	0	8.3	91.7	0	20.0	80.0
Spirits	0	8.3	91.7	0	0	100.0

Table 4.3.2.19 Percentages of males consuming beverages at varied frequencies (%)

Groups	Males with low acculturation scores			Males with high acculturation scores		
Frequency (times/wk)	≥5	1-4	<1	≥5	1-4	<1
Green tea	71.4	14.3	14.3	80.0	0	20.0
Chinese herbal tea	0	0	100.0	0	10.0	90.0
Western tea	28.6	0	71.4	40.0	10.0	50.0
Coffee	28.6	14.3	57.1	40.0	10.0	50.0
Coffee (decaf)	0	0	100.0	0	0	100.0
Chocolate drink	0	14.3	85.7	10.0	10.0	80.0
Juice	0	28.6	71.4	10.0	10.0	80.0
Juice (unsweetened)	14.3	0	85.7	0	10.0	90.0
Soft drink	0	28.6	71.4	0	20.0	80.0
Beer	0	0	100.0	10.0	10.0	80.0
Wine	14.3	14.3	71.4	0	10.0	90.0
Spirits	0	0	100.0	0	0	100.0

.4.3.2.6 Cooking condiments and fast foods

Due to traditional cooking methods, it is common for Chinese people to use the complex seasoning combinations in their dishes. Sesame oil, soy sauce and oyster sauce are some of the most popular ingredients in Chinese cuisine, which may be accessed from the local Asian markets. The majority of the participants continued to use traditional cooking ingredients in this study. However, a much smaller percentage of the males with high acculturation levels consumed oyster sauce more than five times per week, possibly linked to family preferences and the distinctive taste. Moreover, more males and female participants in the high acculturation groups consumed chilli sauce/powder, which arguably results from personal preference in the taste of food.

Tomato sauce and salad dressing are considered popular Western cooking ingredients. Chinese participants combined these with their traditional seasoning ingredients to create new flavours in their dishes. Tomato sauce was relatively easy to be accepted by the participants because they were used to the taste of tomato, but salad dressing was quite new to the Chinese participants. Usually, Chinese prefer cooked food rather than raw dishes based on the traditional Chinese health theories. Salad dressing is commonly put on salads for adding different flavours by New Zealanders, flavours which are not familiar to Chinese. Therefore, the participants, irrespective of whether placed in low or high acculturation groups, rarely consumed salad dressing in this study. In addition, a greater percentage of people consumed butter and peanut butter regularly in the 1997 NZ NNS than that in the current study, mainly because of Chinese cultural preferences.

Table 4.3.2.20 Frequency of cooking ingredients in different groups (%)

Groups	Females low acculturation scores			Females high acculturation scores			Males low acculturation scores			Males high acculturation scores		
Frequency (times/wk)	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1
Sesame oil	33	58	8	13	20	67	14	29	57	20	20	60
Soy sauce	92	8	0	87	13	0	86	14	0	80	20	0
Oyster sauce	17	17	67	20	7	73	29	29	43	10	0	90
Chick stock	33	25	42	27	0	73	29	0	71	20	20	60
Chilli sauce/powder	17	42	67	47	27	27	14	14	71	10	70	20
Tomato sauce	8	33	58	0	27	73	0	14	86	10	20	70
Salad dressing	8	0	92	0	13	87	0	0	100	0	0	100

The table below discloses the different percentages of females and males with low and high acculturation levels who consumed various table spreads at least once a week. More females and males with high acculturation levels consumed butter and peanut butter more regularly than the participants in the low acculturation groups. This may result from their

Chinese cultural influence. Highly acculturated participants gradually adapt to some Western food, meanwhile, they maintain their traditional preferences. A similar percentage of the females and males consumed jam and honey at least once per week, perhaps because a wide range of jam and honey are available in the local supermarkets. This possibly results in an increased sugar intake.

Table 4.3.2.21 Percentages of participants eating table spreads at least once a week (%)

Groups	Females with low acculturation scores	Females with high acculturation scores	Males with low acculturation scores	Males with high Acculturation scores
Butter	16.7	60.0	0	20.0
Peanut butter	16.7	33.3	14.3	57.1
Jam	41.7	46.7	57.1	60.0
Honey	50.0	46.7	42.9	60.0

Table 4.3.2.22 Percentages of people consuming fast foods at least once per week (%)

	Current study	1997 NZ NNS	Current study	1997 NZ NNS
Gender	Female	Female	Male	Male
Pizza	3.7	7.0	0	11.0
Meat pie	3.7	15.0	11.8	38.0
Burger	7.4	11.0	11.8	21.0
Pastries	14.8	7.0	17.7	14.0

Table 4.3.2.22 compares the different percentages of the participants in consuming four kinds of fast food in the current study to the results found in the 1997 NZ NNS. Generally, higher percentages of people consumed pizza, meat pie and burgers at least once per week in the 1997 NZ NNS when compared to those in the current study. In contrast, greater percentages of the participants in the current study consumed pastries (sweet and savory) more regularly than New Zealanders. Moreover, more males frequently consumed fast food than the females. Pizza, meat pies and burgers are consumed by a greater proportion of individual New Zealanders, as an essential component of Western convenience takeaway

food. However, such foods were not well accepted by Chinese participants in the current study in terms of the taste and traditional food choices. The table below reveals the details of the proportions of the participants with low and high acculturation levels who consumed fast foods at three different frequency ranges. More male participants in the high acculturation group stated that they had eaten French fries/wedges at least once per week, and relatively higher percentages of the females with high acculturation levels consumed meat pies and French fries/wedges. Easy availability of these fast foods leads to such consumption. However, the majority of the participants will not eat these foods frequently, because they appear to still maintain their traditional food preferences which were established during their childhood. Some alteration in choosing different types of food by Chinese participants may occur with increasing acculturation levels, but they cannot change to Western food patterns completely.

Table 4.3.2.23 Percentages of participants consuming fast food at varied frequencies (%)

Groups	Females low acculturation scores			Females high acculturation scores			Males low acculturation scores			Males high acculturation scores		
Frequency (times/wk)	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1
Pizza	0	8	92	0	0	100	0	0	100	0	0	100
Meat pie	0	0	100	0	7	93	0	14	86	0	10	90
French fries/wedges	8	0	92	0	13	87	0	0	100	0	20	80
Burger	0	8	92	0	7	93	0	14	86	0	10	90
Pastries	0	8	92	0	20	80	0	14	86	0	20	80

In terms of traditional Chinese cooking methods, particular cooking oils are often used by Chinese participants in this study. According to Table 4.3.2.24 below, canola and soybean oils were most commonly used by both the female and male participants in low and high acculturation groups. Significantly, a larger percentage of the females in the high acculturation group (40%) consumed olive oil more frequently than other groups. Moreover, about 50% of the males in the high acculturation group consumed vegetable oil at least once per week. The dramatic number of the females with high acculturation levels using olive oil possibly results from knowing the health benefits or personal preferences as to taste. It is hard not to accept that Chinese people frequently use olive oil, because they use a large amount of cooking oils in their dishes, even though there is a high proportion of monounsaturated fat contained in olive oils. The taste and standard expensive price of olive oil may possibly have affected the choices of some Chinese participants in the current study.

Table 4.3.2.24 Participants in gender and acculturation (Acc) groups ate cooking oils (%)

Groups	Females Low Acc			Females High Acc			Males Low Acc			Males High Acc		
Frequency (times/week)	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1	≥5	1-4	<1
Canola oil	42	17	42	47	7	47	43	0	57	60	20	20
Olive oil	0	0	100	33	7	60	0	0	100	0	10	90
Soybean oil	25	17	58	27	13	60	43	0	57	40	20	40
Sunflower oil	8	17	75	0	0	100	0	14	86	0	20	80
Vegetable oil	8	0	92	13	0	87	0	0	100	40	10	50

Section 4.3 revealed the data collected from the Food Frequency Questionnaire. In the first instance, the data from the current study and the results found in the 1997 New Zealand National Nutrition Survey were compared, mainly because the latter was the latest overview of food and nutrition information at the national level in New Zealand.

Separately, a comparison was made of the percentages of the participants who consumed various foods at different frequency levels of participants both having high and low acculturation scores in relation to gender differences.

4.3.2.7 Summary of food items ate by the participants

According to the data from the current study and the results found in the 1997 New Zealand National Nutrition Survey, more female and male participants in this study regularly consumed low fat milk rather than standard milk, and much lower percentages of the Chinese participants ate cheese products and/or cream regularly than do New Zealanders. The majority of the participants consumed rice frequently, conversely, more New Zealanders ate pasta than rice. Rice was still the major carbohydrate in the Chinese participants' diets. The participants in this study preferred to eat chicken and pork as their main meat consumption, mainly because of their cultural preference and the taste of the meat. A lower percentage of the participants ate beef, beef mince and lamb than New Zealanders. These meat consuming patterns were similar to the data collected from three-day 24-hour dietary recalls. Furthermore, fewer participants consumed meat products, including bacon/ham and sausages, frequently, all of which are regularly consumed by New Zealanders. There was a significant difference in the consumption of fish/shellfish between the Chinese participants and New Zealanders. A larger number of both male and female participants in this study ate baked/steamed fish and shellfish more frequently than New Zealanders.

Disclosed in the aforementioned tables are the differences in the percentages of people who consumed New Zealand popular and Chinese vegetables at different frequency bands. Five popular vegetables eaten by New Zealanders were carrots, tomatoes, lettuces, onions and pumpkins, which were eaten less frequently by the participants in the current study, possibly because of the taste and family preferences. However, a greater percentage of the participants consumed New Zealand popular vegetables than Chinese traditional vegetables, including mushroom, capsicum, sprouts and soybean/tofu. This is mainly because New Zealand popular vegetables are readily available twelve months a year and Chinese traditional vegetables in local markets in Manawatu are less varied, are less available, and taste differently from those found in China. However, some Chinese

vegetables consumed by the participants in this study were not included in the data from the 1997 New Zealand National Nutrition Survey.

Fewer participants drank both non-alcoholic and alcoholic beverages as frequently as New Zealanders, in particular, Western tea and coffee. New Zealanders commonly use tomato sauce, salad dressing, butter and peanut butter in their preparing and cooking of meals, and these were less frequently consumed by the participants in this study. Chinese participants preferred to use complex seasoning combinations in their dishes, such as sesame oil, oyster sauce, soy sauce. In addition, fewer participants consumed pizza, meat pies and burgers as regularly as New Zealanders, which are popular fast takeaway foods in New Zealand. In total, the participants in this study still retain their cultural preferences; meanwhile, some of them gradually have started to accept more Western-type food. The frequency of consuming certain kinds of food was different between low and high acculturated participants in this study.

Among dairy products, male participants with high acculturation levels preferred to drink standard milk rather than low fat milk, when compared to the low acculturated males. Both male and female participants in the low acculturation group preferred to eat spare ribs. Highly acculturated participants consumed meat products more frequently than the participants in the low acculturation group. Low acculturated participants also consumed baked/steamed fish, prawn and shellfish more regularly than the participants with high acculturation levels. Traditional Chinese food preferences were particularly present among the participants with low acculturation levels. Highly acculturated participants started to adopt Western food choices, while at the same time; they still retained some of their Chinese food eating habits.

A similar trend occurred in the frequency of consuming New Zealand local and Chinese vegetables. Generally, low acculturated participants consumed vegetables more frequently than the participants in the high acculturation groups, in particular, ginger, garlic and spring onion. Western tea and coffee are frequently drunk by high acculturated participants; however, green tea was popular among both low and high acculturation participants. Due to traditional Chinese cooking methods, the participants in this study continued to use complex seasoning combinations in their dishes, including soy sauce, oyster sauce, sesame

oil and chilli sauce/powder, rather than salad dressing and/or tomato sauce. Pizza, meat pies, French fries are the most popular fast takeaway foods in New Zealand, which were more frequently consumed by highly acculturated participants than by the participants in However, according to the analysis of the food frequency data, it is difficult to accurately summarise the eating and food patterns of participants either in the low acculturation group or in the high acculturation group, possibly because of not enough subjects.

4.4 Physical activity levels

Based on the Global physical activity level (PAL) score system, all participants were divided into two groups by low and medium levels. PAL levels were calculated by using the Global Physical Activity Questionnaire (GPAQ), which collected the information on physical activities in three settings, including activity at work, travel to and from places and recreational activities, and sedentary behaviours (World Health Organisation, 2002). There were no significant differences related to their age, the residency length in NZ, education levels, income and jobs.

Table4.4.1 Physical activity levels by gender

	Female	Female	Male	Male
PAL	Medium	Low	Medium	Low
Number	17	11	11	7
%Medium/%Low	60.7	39.3	61.1	38.9
%Total	37.0	23.9	23.9	15.2

In simple terms, from the table above, approximate 60% of both male and female participants had medium PAL levels.

Table 4.4.2 total time spent in minutes on sedentary activities per day

	Male	Female	Total
Mean	300.6	405	364.1
Median	240	360	360
Minimum	120	60	60
Maximum	640	900	900

Table 4.4.2 shows the total time that the participants spent in sedentary activities per day, which included sitting at a desk; sitting with friends; traveling in a car, bus, train; reading; playing cards; watching television, but did not include the time spent sleeping. The mean and median value show that females spent more time on their sedentary activities per day than was spent by male participants.

Table 4.4.3 Time spent in different physical activities

Time (minutes)	Male	Female	P value
Transport/week	146.1 ± 292.0	99.9 ± 152.0	0.542
Work/week	233.0 ± 506.0	139.8 ± 414.0	0.521
Recreation/week	135.3 ± 156.0	126.9 ± 174.0	0.866
Sedentary time/week	301.0 ± 162.0	405.0 ± 221.0	0.072

The difference in time spent in transport, work, recreation, and sedentary time per week between male and female participants was not significant ($P > 0.05$).

Table 4.4.4 Time spent in physical activities

Time (minutes)	Mean	SD	Q1	Median	Q3
Male total activity time/week	514.0	557.0	138.0	338.0	728.0
Male total activity time/day	73.4	79.5	19.6	48.2	103.9
Female total activity time/week	366.3	418.4	131.3	290.0	435.0
Female total activity time/day	52.3	59.8	18.8	41.4	62.1
Total activity time/week	424.0	476.9	143.8	300.0	543.8
Total activity time/day	60.6	68.1	20.5	42.9	77.7

Table 4.4.4 shows the total time spent in physical activities per week and per day by the male and female participants. The mean value of the total time that females spent on physical activities was 366.3mins, which was only about 70% of the time spent by the male participants. The average time spent in physical activities by all participants was 424 minutes per week, about one hour per day.

Table 4.4.5 Physical activity levels in different socioeconomic groups

	Low PAL levels	Medium PAL levels
Total (n=44)	17 (38.6%)	27 (61.4%)
Female(n=27)	10 (37.0%)	17 (63.0%)
Male(n=17)	7 (41.2%)	10 (58.8%)
The residency length (< 10 years) (n=28)	11 (39.3%)	17 (60.7%)
The residency length (≥ 10 years) (n=16)	6 (37.5%)	10 (62.5%)
Age (30-45 years) (n = 25)	12 (48.0%)	13 (52.0%)
Age (≥ 45 years) (n = 19)	5 (26.3%)	14 (73.7%)
High income (≥ $35,000) (n=23)	10 (43.5%)	13 (56.5%)
Low income (< $35,000) (n=21)	7 (33.3%)	14 (66.7%)
High education (n=26)	10 (38.5%)	16 (61.5%)
Low education (n=18)	7 (38.9%)	11 (61.1%)

The table above illustrates physical activity levels in different gender, age, and socioeconomic groups. About 50% of the participants with their ages between 30 and 45 years old had medium PAL levels, which was a lower percentage than the levels of the other age group (over 45 years old); also a higher proportion of the participants who were 30 to 45 years old belong to the low PAL level category than the participants with ages over 45. It is thought that younger participants maybe more sedentary than the older. Almost an equal percentage of the participants in the high income group belonged to low or medium PAL levels, while the percentage of the participants with a medium PAL level in the low income group was twice as high than the participants with a low PAL level.

Table 4.4.6 Physical activity time in different acculturation groups

Time (minutes)	Low acculturation (n=19)	High acculturation (n=25)	P value
Total time/week	568.0 ± 639.0	306.0 ± 292.0	0.110
Average time/day	81.1 ± 91.3	43.7 ± 41.8	0.110
Work time/week	281 ± 658.0	106.0 ± 197.0	0.112
Transport time/week	188.0 ± 302.0	68.0 ± 107.0	0.274
Recreation time/week	98.0 ± 128.0	133.0 ± 178.0	0.465
Sedentary time	295.3 ± 174.7	404.8 ± 219.9	0.073

Based on the figures in table 4.4.6, the total and average physical activity time per week between the low and high acculturation groups was not statistically significant ($P > 0.05$). The mean work, transport, recreation and sedentary time spent per week among two acculturation groups are not significant ($P > 0.05$).

Table 4.4.7 Percentages of participants in different degrees of activities

Types of activity	Degree of activity	Number (percentage)	Times/week (minutes)
Work	Vigorous	4 (9.1%)	656.25
	Medium	13 (29.6%)	409.62
	Both	1 (2.3%)	135.0
	None	26 (59.1%)	0
Transport	With	23 (52.3%)	244.35
	Without	21 (47.7%)	0
Recreation	Vigorous	17 (38.6%)	122.28
	Medium	22 (50.0%)	170
	Both	14 (31.8%)	291.43
	None	19 (43.2%)	0

This table above shows different degrees of three types of physical activities. Approximately 60% of the participants were not involved any physical activities during working time. About half of the participants did not walk or cycle when they travelled even a short distance from one place to another, they mostly drove everywhere.

Few participants in this study cycled or walked, but they mostly drove a car. About 50% of the participants did not undertake any physical activity at work. However, 60% of both female and male participants gained medium PAL levels. Relatively, more people within the over 45 age group recorded medium PAL levels than the younger age group, mainly because they spent more time on physical than sedentary activities. Significantly, low acculturated participants spent much longer on physical activities at work and/or travel from one place to the other, and less time in recreational activities; highly acculturated participants had a reverse pattern. Rarely did participantswithin this study group regularly take part in recreational activities.

4.5 Body measurements

Due to ethnic differences, there are two standards of BMI cut-off points. The New Zealand Standard (Russell, Parnell, Wilson et al., 1999) which was used in 1997 National Nutrition Survey, was the same as the standard of the WHO (2000). This classified people with BMI $\geq$ 25 kg/m^2 and < 30 kg/m^2 as overweight, and people with BMI $\geq$ 30 kg/m^2 as obese. However, based on the ethnic difference in body sizes, the Chinese standard (Zhou & the Cooperative Meta-analysis Group of Working Group on Obesity in China, 2002) defines those with BMI $\geq$ 24 kg/m^2 and < 28 kg/m^2 as overweight, and BMI $\geq$ 28kg/m^2 are classed as obese (see Table 4.5.1).

Table 4.5.1 BMI in the New Zealand standard and Chinese standard

	Overweight (kg/m^2)	Obesity (kg/m^2)	Overweight and obesity (kg/m^2)
WHO standard (New Zealand)	25≤BMI<30	BMI≥30	BMI≥25
Chinese standard	24≤BMI<28	BMI≥28	BMI≥24

The two tables below describe the body measurements in male and female participants. Mean weight of all females was 57.2 kg, and the mean BMI of the females was 22.8. Both values were in the normal range of BMI according to both the Chinese standard and the WHO standard. However, the mean BMI value of the males was 25.0, which belonged to the overweight range based on the Chinese standard. The mean and median waist

circumferences for female participants were under the risk lines but not for males (female ≤ 80 cm, and male ≤ 85 cm) according to the Chinese standard (Zhou & the Cooperative Meta-analysis Group of Working Group on Obesity in China, 2002).

Table 4.5.2 Female body measurements

Female	Mean	SD	Min	Q1	Median	Q3	Max
Weight (kg)	57.2	7.3	44.6	50.2	56.3	61.5	75.8
Height (m)	1.6	0.1	1.5	1.5	1.6	1.6	1.7
BMI (kg/m^2)	22.8	3.2	16.2	20.7	22.3	24.7	30.5
Waist (cm)	73.8	7.6	61.4	68.0	74.2	80.5	89.4
Hip (cm)	94.6	6.1	85.0	89.5	94.7	99.0	109.3
WHR	0.8	0.0	0.7	0.7	0.8	0.8	0.9

Table 4.5.3 Male body measurements

Male	Mean	SD	Min	Q1	Median	Q3	Max
Weight (kg)	73.9	7.9	53.9	68.6	74.3	80.9	86.2
Height (m)	1.7	0.1	1.6	1.7	1.7	1.8	1.8
BMI (kg/m^2)	25.0	2.5	19.4	22.9	25.5	26.8	28.5
Waist (cm)	87.0	6.9	69.9	82.6	88.8	92.2	95.9
Hip (cm)	98.9	4.3	90.5	96.7	99.1	101.0	107.5
WHR	0.9	0.0	0.8	0.8	0.9	0.9	1.0

Table 4.5.4 Body measurements in both acculturation groups

	Low acculturation (n =19)	High acculturation (n = 25)	P - value
Weight (kg)	64.0 ± 10.1	63.4 ± 12.1	0.850
Height (m)	1.6 ± 0.1	1.6 ± 0.1	0.239
BMI (kg/m^2)	24.6 ± 3.3	23.0 ± 2.8	0.099

Table 4.5.4above shows body weight, height and BMI in the low and high acculturation groups. The differences between the two groups in body weight and height were not significant ($P > 0.05$). Even though the difference in BMI values of the two groups was not significant, the mean BMI value in the low acculturation group was over 24 which is considered to be overweight.

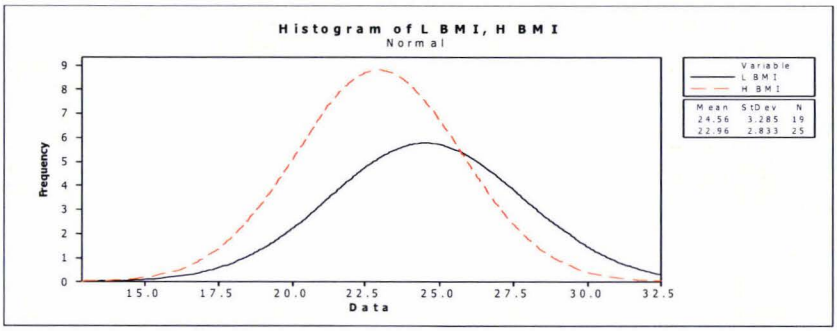

Figure 4.5.1 Histogram of BMI vaues in Groups L and H

The mean BMI value in group L is 24.56, which is higher than that in group H (22.96). The difference of BMI values between groups L and H is not significant (P>0.05).

The two tables below show BMI, waist and hip circumferences, and WHR in females and males between the two acculturation groups. The difference in the BMI value of female participants between two different acculturation groups is highly significant ($P < 0.05$), but it does not appear to be so in the male participants ($P > 0.05$). The mean and median BMI values of females in the low acculturation group were higher than those in the high acculturation group.

Table 4.5.5 (1) Body measurements in females between two acculturation groups

	Low acculturation (n = 19)		High acculturation (n = 25)		P - value
	Mean ± SD	Median	Mean ± SD	Median	
BMI (kg/m^2)	24.9 ± 3.4	24.7	21.5 ± 2.3	22.1	0.011*
Waist (cm)	77.0 ± 9.2	78.5	71.8 ± 5.9	71.8	0.121
Hip(cm)	97.4 ± 7.0	96.7	92.9 ± 4.6	93.4	0.083
WHR	0.8 ± 0.1	0.8	0.8 ± 0.1	0.8	0.420

Table 4.5.5 (2) Body measurements in males between two acculturation groups

	Low acculturation(n = 19)		High acculturation(n = 25)		P - value
	Mean ± SD	Median	Mean ± SD	Median	
BMI (kg/m^2)	24.7 ± 3.2	26.1	25.2 ± 2.0	25.4	0.705
Waist (cm)	85.3 ± 9.4	87.7	88.2 ± 4.6	88.8	0.474
Hip (cm)	96.5 ± 4.1	97.1	100.6 ± 3.7	99.2	0.065
WHR	0.9 ± 0.1	0.9	0.9 ± 0.0	0.9	0.853

Table 4.5.6 Being overweight and obesity by using different standards of BMI levels

	Number of Overweight (%)	Number of Obese (%)	Number of Overweight or obese (%)	Number of being not overweight or obese (%)
New Zealand BMI standard	14 (31.8%)	1 (2.3%)	15 (33.1%)	29 (69.9%)
Chinese BMI standard	15 (34.1%)	4 (9.1%)	19 (43.2%)	25 (56.8%)

The table above shows the percentage and numbers of the participants who were overweight or obese by using the New Zealand and Chinese standard cut-off points of BMI values. The proportion having obesity by using the Chinese standard was much higher than that in the New Zealand standard. In this study group, more than 40% of the participants were considered as overweight or obese.

Table 4.5.7 BMI and being overweight and obesity by the Chinese standard

	BMI*	Overweight	Obese	Overweight or obese	Not overweight or obese
Female (n=27)	22.8±3.2	6 (22.2%)	2 (7.4%)	8 (29.6%)	19 (70.4%)
Male (n=17)	24.8±2.5	9 (52.9%)	2 (10.5%)	11 (63.5%)	6 (36.5%)

* P value =0.017

Table 4.5.7 shows the significant difference in BMI values between female and male participants, and the males appeared to have higher BMI values than the females. By using the Chinese standard to classify overweight and obesity, the ratio of 63.5% of the male participants who were considered as either overweight or obese was more than three times higher than the ratio in females.

Table 4.5.8 Percentages of participants being overweight or obese in both groups

Acculturation	Overweight	Obese	Overweight or obese	Not overweight or obese
High (n=25)	8 (32.0%)	1 (4.0%)	9 (36.0%)	16 (64.0%)
Low (n=19)	7 (36.8%)	3 (15.8%)	10 (52.6%)	9 (47.4%)

The table above simply shows the percentage and number of the participants being overweight or obese in low and high acculturation groups, and there was a much higher percentage of the participants who were obese in the low acculturation group than those in the high acculturation group, however, this result may be effected by other factors, such as gender and age differences.

Table 4.5.9 Percentages of participants having "at risk" waist circumferences

Waist circumferences(cm)	Chinese standard	WHO standard
Female (n = 27)	7 (15.9%)	1 (2.3%)
Male (n = 17)	11 (25.0%)	0 (0)

In the Chinese standard (Zhou & the Cooperative Meta-analysis Group of Working Group on Obesity in China, 2002), people with the waist circumference > 80 cm for females and > 85 cm for males have increased risks associated with excess abdominal fat in adults. In the WHO standard, the cut-off for females is 88 cm and 102 cm for males. There is a significant difference between Chinese and WHO standards in estimating risks by waist circumference. According to the Chinese standard, 15.9% of female participants and 25% of males had increased risks being overweight or obese, while only one female and no males had risks related to extra internal body fat when using the WHO standard.

Table 4.5.10 "At risk" waist circumferences in different acculturation groups

Acculturation	Chinese standard	
High (n=25)	Female: 2 (13.3%)	Male: 7 (70.0%)
Low (n=19)	Female: 5 (41.7%)	Male: 4 (28.6%)

Note: The figures in this table display as numbers (percentages).

Table 4.5.10 illustrates the proportion and number of the females and males with high waist circumferences in both low and high acculturation groups. One of the interesting figures in this table is that a higher percentage of the female participants with low acculturation scores (41.7%) had their waist circumferences over 80 cm, when compared to females in the high acculturation group (13.3%). In contrast, more male pariticipants with high acculturation scores had waist circumferences over 85 cm than the other groups.

In the New Zealand National Nutrition Survey (Russell et al., 1999), the cutoff points for WHR were 1.0 for men and 0.85 for women. Based on this, only three females in this study group, two of whom had high acculturation scores, were over 0.85 and no males were over 1.0 in Waist and Hip ratios.

Table 4.5.11 Percentages of participants having "at risk" BMI, Waist and WHR values

	Females with low acculturation scores		Females with high Acculturation scores		Males with low acculturation scores		Males with high acculturation scores	
Ages	≥ 50	< 50	≥ 50	< 50	≥ 50	< 50	≥ 50	< 50
BMI (kg/m^2)	6 (100%)	0 (0)	1 (25.0%)	1 (9%)	2 (67%)	2 (50%)	3 (100%)	^ 4 (57%)
Waist (cm)	5 (83%)	0 (0)	0 (0)	2 (18%)	2 (67%)	2 (50%)	3 (100%)	4 (57%)
WHR	0 (0)	1 (17%)	0 (0)	2 (18%)	0 (0)	0 (0)	0 (0)	0 (0)

^ One person in this group has a BMI value over 28.

Note: 1.The figures in this table display as numbers (percentages). 2. BMI ≥ 24 kg/m^2

3. Waist circumference: female > 80 cm; male > 90 cm 4. WHR: female > 0.85; male > 1.0

Based on Table 4.5.11, six out of six (100%) female participants with ages over 50 years in the low acculturation group had their BMI value over 24 kg/m^2, which was much higher than that in the high acculturation group (25%). In addition, the percentage of the female participants whose waist circumference was over 80 cm in the low acculturation group was 83.3%, which was much higher than that in the high acculturation group. The differences in BMI values between females with ages less than 50 and those over 50 years old in the low acculturation group were significant (P=0.001), and the mean BMI value of elder females (27.3) was higher than younger females (21.7). Female participants with ages over 50 years and low acculturation scores had significantly higher BMI value than females with high acculturation scores in the same age group (P value = 0.01). However, differences in BMI values did not occur among male participants.

These figures shown in the foregoing tables revealed body weight, BMI, waist and hip circumferences, and WHR. Due to the ethnic difference in body measurement cut-off points, the Chinese standard was used to classify overweight and/or obese in this current study. The mean BMI of the female participants was 22.8, which was located in the normal range; however, the mean BMI value of the male was 25.0, which was inside the range of being overweight. Based on BMI levels, 35% of the participants were overweight and about 10% were obese among the entire study group. Particularly, more than 50% of the males were overweight and another 10% of them were obese. The comparisons between low and high acculturation groups showed that more participants with low acculturation levels were overweight or obese based on the BMI values. When taking into account age and gender differences, a greater percentage of the female participants with ages over 50 years in the low acculturation group (100%) had their BMI values over 24 kg/m^2 than those having high acculturation levels, but this pattern was not apparent in the male participants.

Waist circumference is another reference to estimate the risks associated with excess abdominal fat in adults. It is significant that more females in the low acculturation group had waist circumferences over 80 cm than highly acculturated females. After adjusting for age and gender, the differences between low and high acculturation females with age over 50 were significant ($P = 0.001$). In particular, the mean value of females with low acculturation scores was 83.4cm, which was higher than the recommended cut-off point (80cm for females). The male participants with ages over 50 in the high acculturation group had a greater mean value of waist circumference (91cm) than the recommended cut-off point (85cm for males).

4.6 Blood test results

In total, there were 33 participants in this study who completed blood tests. Two participants out of 33, one female and one male, had abnormal fasting glucose and HbA_{1c} levels, which is 6.06%.

Table 4.6.1 Blood test results in males and females

	Female (n = 20)	Male (n = 13)	P- value
Fasting glucose	4.8 ± 0.4	5.2 ± 0.6	0.082
HbA_{1c}	5.7 ± 0.4	5.5 ± 0.5	0.365
Total cholesterol (mmol/l)	4.8 ± 0.8	4.9 ± 1.0	0.751

Note: figures in table 7.1 display as Mean ± SD

The table above shows the blood test results for females and males. The mean fasting glucose for females was 4.8 and 5.2 for males, both of which were less than 6.0 (normal range). There were similar mean values of HbA_{1c} in female and male participants, 5.7 and 5.5 respectively. The mean values of serum total cholesterol were 4.8 in females and 4.9 in males, which were both less than the safe level, 5.0mmol/l, recommended by the New Zealand Heart Foundation. The differences between female and male participants in fasting glucose, HbA_{1c}, and serum total cholesterol are not significant ($P > 0.05$).

Table 4.6.2 Blood tests in Low and High acculturation groups

	Low acculturation	High acculturation	P- value
Fasting glucose	4.9 ± 0.5	5.0 ± 0.6	0.440
HbA_{1c}	5.6 ± 0.5	5.6 ± 0.4	0.941
Total cholesterol (mmol/l)	4.9 ± 0.8	4.8 ± 0.9	0.708

Note: figures are displayed as Mean ± SD.

Table 4.6.2 shows the blood test results for different acculturation groups. The mean fasting glucose values were 4.9 and 5.0 in low and high acculturation groups, the differences not being significant. The mean serum total cholesterol values were 4.9 in the low acculturation group and 4.8 in the high acculturation group, both of which were lower than the recommended level by the New Zealand Heart Foundation (< 5.0mmol/l).

Table 4.6.3 Total cholesterol levels in different groups

	Number (%) Total serum cholesterol 3.0 – 4.9 mmol/l	Number (%) Total serum cholesterol 5.0 – 5.6 mmol/l	Number (%) Total serum cholesterol 5.7 – 6.5 mmol/l	Total serum cholesterol Median (mmol/l)
Total (33)	17 (51.5%)	11 (33.3%)	5 (15.2%)	4.9
Female (n=20)	11 (55.0%)	7 (35.0%)	2 (10.0%)	4.8
Male (n=13)	6 (46.2%)	4 (30.8%)	3 (23.1%)	5.4
Low acculturation (n=16)	7 (43.8%)	7 (43.8%)	2 (12.5%)	5.2
High acculturation (n=17)	10 (58.8%)	4 (23.5%)	3 (17.7%)	4.8
Low PAL (n=13)	7 (53.9%)	3 (23.1%)	3 (23.1%)	4.8
Median PAL (n=20)	10 (50.0%)	8 (40.0%)	2 (10.0%)	5.0

Note: 1. 3.0- 5.0mmol/l is recommended as a safe level by New Zealand Heart Foundation.

2. 5.7mmol/l is the mean value of total serum cholesterol in 1997 NZ National Nutrition Survey.

Table 4.6.3 and three graphs below illustrate the serum total cholesterol levels in different groups. According to the values from the National Nutrition Survey in 1997, 5.7mmol/l was the mean serum total cholesterol of New Zealanders without difference in gender, and 6.5mmol/l was used as a cut-off point. In this current study, no participant had a serum total cholesterol value over 6.5mmol/l. The recommended cut-off point of total cholesterol level considered by the New Zealand Heart Foundation as the lower border of "high" risk is 5.0mmol/l, but the majority of the participants had the values of serum total cholesterol less than 5.0mmol/l, irrespective of gender, acculturation and PAL levels. In addition, the percentage of the male participants (23.1) with their total cholesterol value over 5.7mmol/l was about twice as larger than that of the females. In total, about 15% of the participants had a higher total cholesterol level than the mean value of New Zealanders. Also, the larger percentage of the participants in the low PAL group was located in the range between 5.7 to 6.5mmol/l, when compared to those participants who were in the medium PAL group. When comparing the low to the high acculturation group, a higher percentage of people with low acculturation scores had their serum cholesterol levels between 5.0 to 5.7mmol/l,

but fewer were in the range from 5.7 to 6.5mmol/l. The median values of serum cholesterol levels are displayed in the fourth graph below, showing that the values of male participants in the low acculturation group were higher than the safety value (5.0mmol/l), but they were less than the mean value of New Zealanders. Males are more likely to have higher total cholesterol levels than females. The participants with low acculturation scores had higher serum cholesterol levels than people in the high acculturation group. However, similar median values appear in medium and low PAL groups.

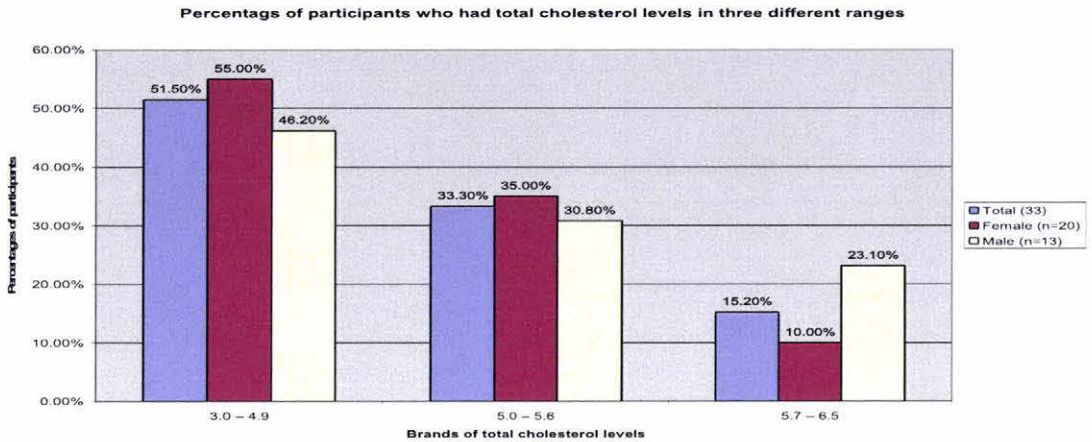

Figure 4.6.1 Total cholesterol levels in different PAL level groups

46.2% and 50.0% of participants with low and median PAL levels had higher TC levels than 5.0mmol/l.

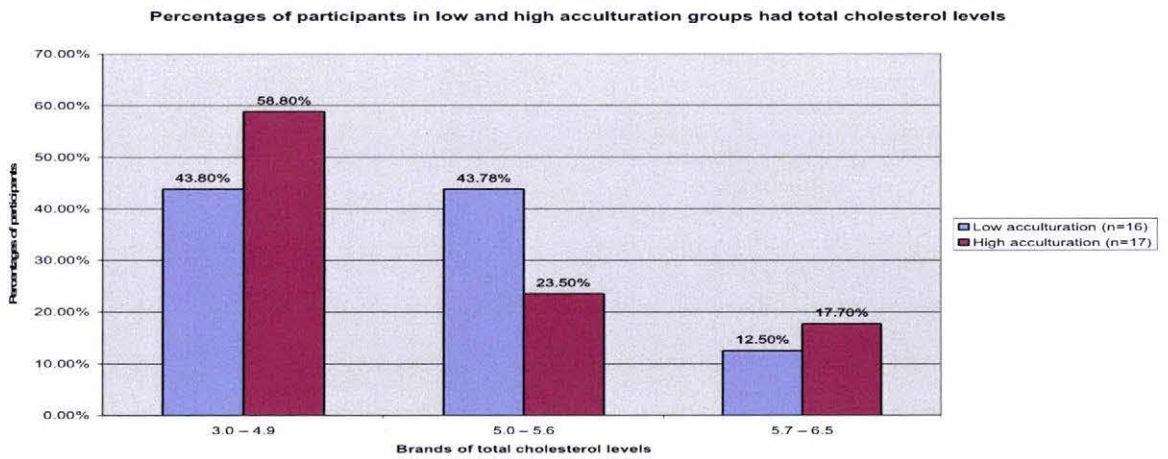

Figure 4.6.2 Total cholesterol levels in acculturation groups

56.3% and 41.2% of participants with low and high acculturation scores had higher TC levels than 5.0mmol/l.

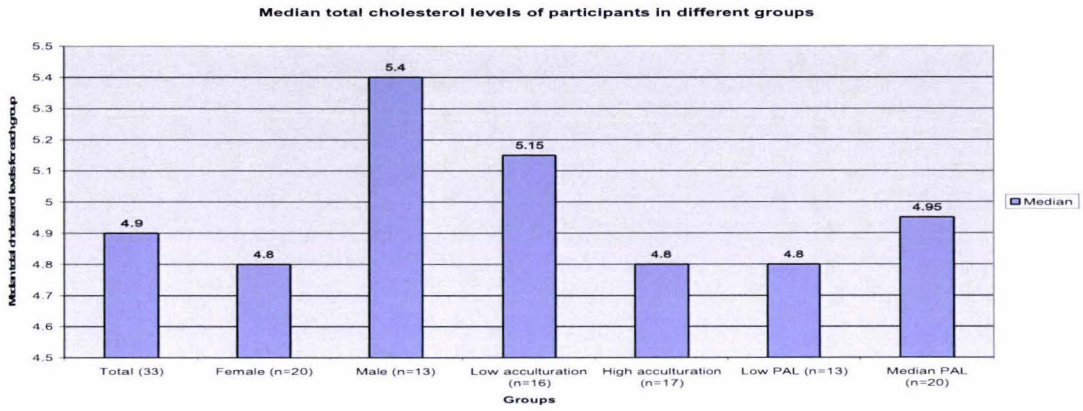

Figure 4.6.3 Median cholesterol levels in different groups

Median levels of males and the group with low acculturation scores had higher total cholesterol levels than 5.0mmol/.

Table 4.6.4 Blood tests results in different socioeconomic groups

	High income (≥ $35,000)	Low income (< $35,000)	High education	Low education
Fasting glucose	5.0 ± 0.5	5.0 ± 0.6	5.0 ± 0.5	4.9 ± 0.5
HbA_{1c}	5.6 ± 0.4	5.6 ± 0.5	5.5 ± 0.3	5.7 ± 0.6
Total cholesterol (mmol/l)	4.8 ± 0.9	4.9 ± 0.9	4.5 ± 0.9*	5.2 ± 0.7*

* The difference between high and low education groups in total cholesterol is significant ($P < 0.05$).

The table above describes the different values between high and low income and high and low education levels in respect of total cholesterol, fasting glucose, and HbA1c. The important figures in this table were the values of total cholesterol levels in high and low education groups. The total cholesterol levels in the low education group were higher than those in the high education group, and the difference between these two groups was significant ($P < 0.05$).

Table 4.6.5 Total cholesterol results in different socioeconomic groups

Total cholesterol	High income (n=17)	Low income (n=16)	High education (n=19)	Low education (n=14)
3.0-5.0 mmol/l	10 (58.8%)	7 (43.8%)	12 (63.2%)	5 (35.7%)
5.0-6.5 mmol/l	7 (41.2%)	9 (56.3%)	7 (36.8%)	9 (64.3%)
P - value	0.403	0.403	0.128	0.128

Note: the figures in this table are displayed in (numbers) percentages.

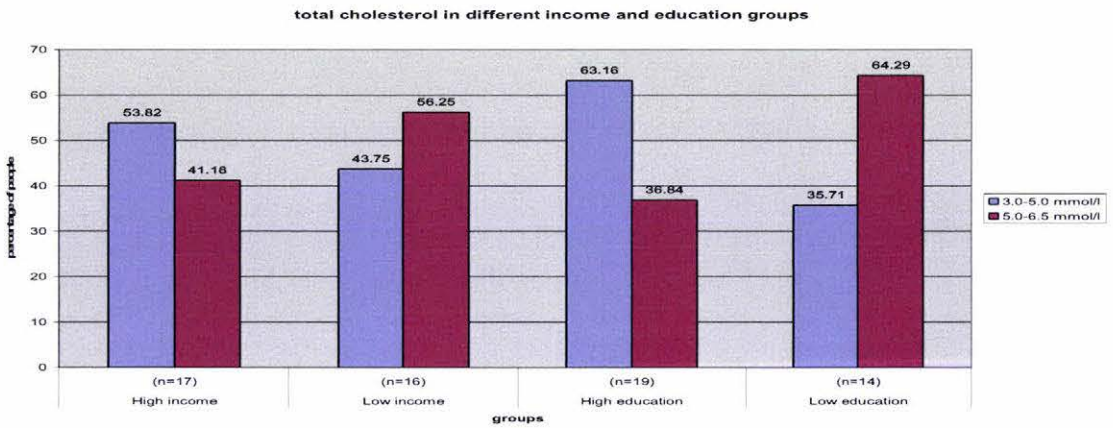

Figure 4.6.4 Total cholesterol in income and education groups

Percentages of the participants in different income and education groups had total cholesterol levels located in two ranges. Higher percentages of the participants in the low income group, than those in the high income group, located their total cholesterol levels between 5.0 and 6.5 mmol/l. Higher percentages of the participants in the low education group, than those in the high education group, located their total cholesterol levels between 5.0 and 6.5 mmol/l.

Table 4.6.5 and the above graph demonstrate the total cholesterol levels in different income and education groups. For the 60% of participants with high incomes, their cholesterol levels were less than 5.0mmol/l, but, in contrast, the higher percentage of people in the low income group had total cholesterol over this cut-off level. Approximate 65% of the participants in the low education group had cholesterol levels over 5.0mmol/l, however, a similar percentage of people who had high education levels had cholesterol values between 3.0 to 5.0mmol/l. Even though the differences between low and high income participants, and between the low and high education groups were not significant ($P > 0.05$), a higher percentage of the participants who had low income or low education levels had total cholesterol levels over 5.0mmol/l.

In summary, two participants were referred to their preferred GPs because of the elevated fasting serum glucose and HbA1c, and the rest of the participants had their fasting glucose and HbA_{1c} in the normal range. The mean values of total cholesterol among the males and low acculturated participants were over 5.0mmol/l, which was the recommended cut-off point confirmed as the lower border of "high" risk by New Zealand Heart Foundation. In the current study, more than 50% of the males and 45% of the females had their total cholesterol levels over 5.0mmol/l, and more participants with low acculturation levels had higher cholesterol values than those with high acculturation scores. Moreover, the

participants with high education levels had lower total cholesterol values than the other participants.

4.7 Dietary intake

4.7.1 Group dietary intakes

Dietary intakes were gained from 24-hour dietary recalls and calculated by using the Food Works Professions software application. In this study, 36 participants completed the three-day 24-hour dietary recalls, and 10 participants had only one day 24-hour dietary recall, as a result of either their preference of not having blood tests, or withdrawal from the study. The data of the group dietary intake collected dietary details from the face-to-face interviews using 24-hour recall, but excluded the two participants who were born in New Zealand.

4.7.1.1 Energy and macronutrients intakes

Table 4.7.1.1 shows the energy and macronutrients intakes for the entire group (44 participants). The mean energy intake is 8203 kJ, about 36% of energy from fat, and carbohydrate provided approximately 42% of total energy intake, with the rest of energy intake being gained from protein (21.4%) and alcohol (0.3%). The major type of fat is monounsaturated fat (MUFA), which made up about 42% of total fat intake.

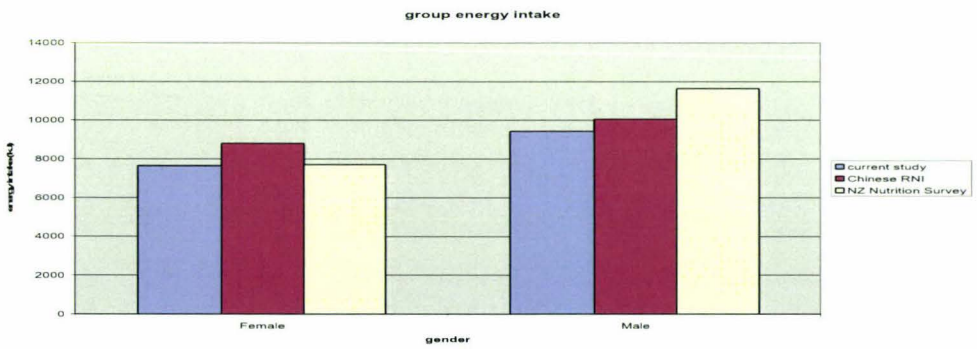

Figure 4.7.1 Group energy intakes

The mean group total energy intakes in the current study, the Chinese RNI value and in the 1997 New Zealand National Nutrition Survey between the females and males.

Table 4.7.1.1 Group energy and macronutrients intakes (n=44)

	Mean	SD	Min	Q1	Median	Q3	Max
Energy (kJ)	8203.0	1882.0	4207.0	7265.0	8052.0	9498.0	12755.0
Protein (g)	106.4	46.2	39.7	69.5	94.0	140.7	213.8
Total fat (g)	82.0	25.3	33.3	60.4	82.3	98.4	135.8
Cholesterol (mg)	332.1	177.0	89.9	177.5	318.8	408.8	788.9
Carbohydrate (g)	202.5	52.3	84.2	170.0	191.2	242.3	367.1
Alcohol (g)	1.0	3.9	0.0	0.0	0.0	0.2	23.8
Fibre (g)	23.9	11.4	2.4	17.5	21.4	27.8	66.2
kJ from protein (%)	21.4	7.1	11.8	15.5	20.8	26.4	43.0
kJ from fat (%)	36.3	6.4	21.0	31.6	37.1	41.6	48.0
kJ from carbohydrate (%)	42.0	7.9	24.8	36.5	41.6	48.3	56.9
kJ from alcohol (%)	0.3	1.3	0.0	0.0	0.0	0.1	8.2

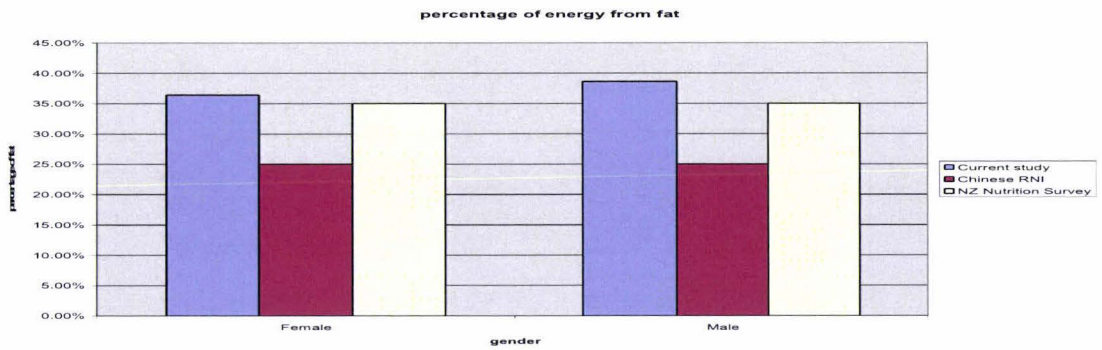

Figure 4.7.2 Total energy intakes from fat

Percentages of total energy intakes from fat for females and males in the current study were higher than those in, the Chinese RNI values, and in the 1997 New Zealand National Nutrition Survey.

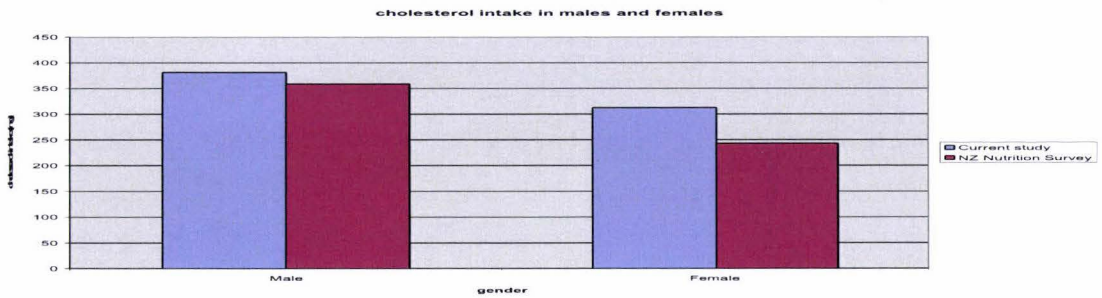

Figure 4.7.3 Cholesterol intakes in gender groups

Total cholesterol intakes in the male and females participants were slightly higher than the results from the 1997 New Zealand National Nutrition Survey.

Table 4.7.1.2 Female and male groups' energy and macronutrient intakes

Group intakes	Female (Mean ± SD)	Female (Median)	Male (Mean ± SD)	Male (Median)
Energy (kJ)	7561.0 ± 1748.0	7642.0	9224.0 ± 1659.0	9409.0
Protein (g)	94.8 ± 42.7	73.9	124.7 ± 46.8	134.0
Total fat (g)	72.7 ± 21.1	73.5	96.8 ± 24.9	96.8
Cholesterol (mg)	307.0 ± 147.5	312.1	371.8 ± 214.7	381.2
Carbohydrate (g)	159.9 ± 58.0	182.3	213.0 ± 41.3	202.5
Alcohol (g)	0.1 ± 0.2	0.0	2.4 ± 6.0	0.2
Fibre (g)	21.5 ± 8.8	20.1	27.5 ± 14.0	25.9
kJ from protein (%)	21.0 ± 7.7	18.8	22.1 ± 6.1	21.3
kJ from fat (%)	35.3 ± 6.8	36.4	37.8 ± 5.5	38.6
kJ from carbohydrate (%)	43.7 ± 7.4	45.3	39.3 ± 8.2	39.5
kJ from alcohol (%)	0.0 ± 0.1	0.0	0.8 ± 2.0	0.1

Based on the Chinese Dietary Reference Intakes (Yang, He & Pan, 2004), the Recommended Nutrient Intakes (RNI) of energy are 2400 (10041kJ) and 2100kcal (8786.4kJ) in males and females aged over 18 years old; the RNI of protein intakes are 80 and 70 grams in males and females; the Adequate Intakes of fat for both genders over 18 years old is 20 to 30% of the total energy intakes. The table above shows the median values of energy and macronutrients intakes in male and female participants. The median values of energy intakes in males and females are lower than the Chinese RNI and the daily median energy intakes from the 1997 New Zealand National Nutrition Survey (11631kJ for males; 7701 kJ for females). However, the group median protein intakes are higher than the values of the Chinese RNI, in particular, the male group (40.3% higher than RNI value). The median energy intakes from fat are 36.4 and 38.6% in females and males, which are both higher than Chinese RNI (20% to 30%), and even higher than 35% (the 1997 New Zealand National Nutrition Survey). The mean and median values of the energy intakes from fat in both male and female participants did not meet the New Zealand Nutrition Taskforce (1991) guideline for less than 33% of fat intakes contributing to the total energy intakes (Department of Health, 1991). In addition, the median dietary fibre intakes are 20.1 and

25.9 grams in females and males, which are both higher than the usual daily dietary fibre intakes (23g in males; 18g in females) from the 1997 NZ National Nutrition Survey, but only males reach the recommendation of New Zealand Nutrition Taskforce 1991 (25 to 30 grams/day). Furthermore, the percentage energy intake from carbohydrate in both groups did not meet the New Zealand recommendation (≥ 50%). It should be noted from Table 4.7.1.2 that the median total cholesterol intakes are 312.2 and 381.2 mg in females and males, which are both higher than the usual daily median cholesterol intakes found in the 1997 New Zealand National Nutrition Survey (243mg for females, and 359mg for males).

Table 4.7.1.3 illustrates the types of fat intakes and sugar in female and male groups. The predominant fat which contributed to the energy intakes in both female and male groups is mono-unsaturated fat. The results from the 1997 NZ National Nutrition Survey showed 15% of energy from saturated fat in both males and females; also 12% and 11% energy from monounsaturated fat in males and females; and only 5% of energy from polyunsaturated fat in both sexes. When compared to the current study group, the female and male participants consumed the higher percentage of energy from mono- or poly-unsaturated fat rather than saturated fat. In total, with three types of fat, polyunsaturated, monounsaturated and saturated, the consumption for males is higher than for females, which were 23.9g against 3.9g, 37.1g against 28.6g, and 25.1g against 10.5g, respectively. This reflects that males consumed higher dietary fat than females in this study group. In comparison with the New Zealand National Nutrition Survey (99g females, and 131g males), in respect of the daily median sugar intake, the current study group have lower values in both sexes (75.5g females, and 61.5g males).

Table 4.7.1.3 Female and male groups' fat and sugar intakes

	Female (Mean ± SD)	Female (Median)	Male (Mean ± SD)	Male (Median)
PUFA (g)	16.4 ± 8.2	3.9	21.3 ± 9.9	23.9
MUFA (g)	28.1 ± 9.5	28.6	35.8 ± 13.3	37.1
SFA (g)	21.0 ± 7.3	10.5	27.9 ± 11.2	25.1
Sugar (g)	76.0 ± 31.3	75.5	70.1 ± 39.8	61.5
Fat as PUFA (%)	24.3 ± 8.7	23.3	26.0 ± 10.4	25.4
Fat as MUFA (%)	42.9 ± 6.1	43.0	41.2 ± 5.4	41.9
Fat as SFA (%)	32.8 ± 8.2	31.8	32.8 ± 7.7	31.0

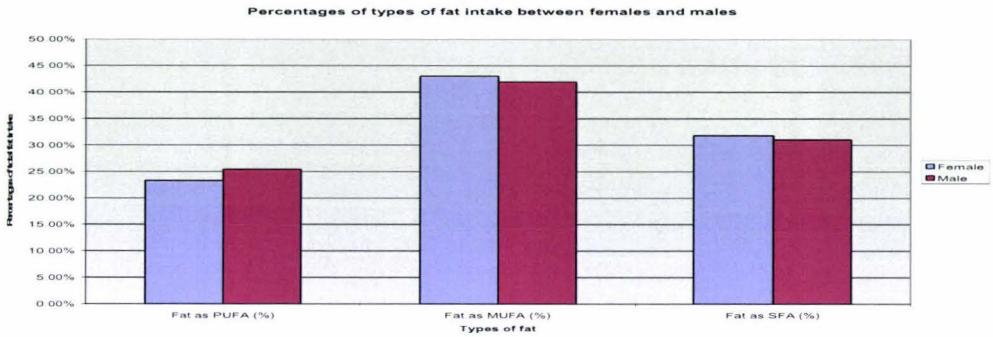

Figure 4.7.4 Types of fat intakes in male and female groups

Mono-unsaturated fat intakes in both females and males occupied the highest percentages.

Table 4.7.1.4 Percentages of energy from types of fat

Mean	Female	Male
%energy from PUFA	8.5	9.8
% energy from MUFA	15.7	16.2
%energy from SFA	11.6	12.0

The table above reveals the percentage energy from three types of fat in both male and female groups. In both gender groups, PUFA (poly-unsaturated fat) provided the highest percentage of energy intakes (about 16%), followed by the group SFA (saturated fat), which had approximately 12% of the energy intakes. When compared to the results from the 1997 New Zealand National Nutrition Survey, the current study group had a better composition of fat intakes. The predominant type of fat providing the energy intakes is

MUFA in the current study, but it was SFA in the 1997 Nutrition Survey, and similar trends appeared in both male and female groups. The two graphs below show the comparisons of the percentage of energy intakes from types of fat in both male and female groups between the current study and the results from the 1997 National Nutrition Survey.

Table 4.7.1.5 Different percentages of total energy intakes from types of fat

	Females in the current study	Females in NZ survey	Males in the current study	Males in NZ survey
%energy from PUFA	8.5%	5.0%	9.8%	5.0%
% energy from MUFA	15.7%	11.0%	16.2%	12.0%
%energy from SFA	11.6%	15.0%	12.0%	15.0%

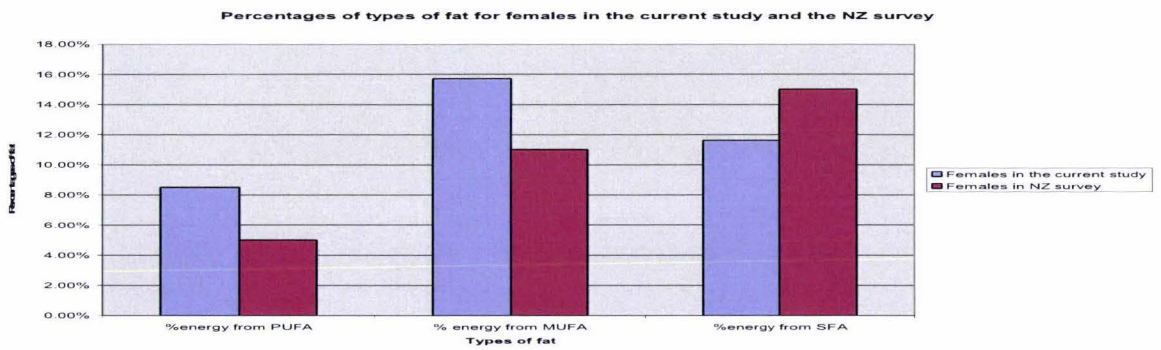

Figure 4.7.5 Energy intakes from types of fat in females

The major fat contributed to total energy intakes was MUFA in the current study, while it was SFA in the 1997 New Zealand National Nutrition Survey (Ministry of Health, 2006b).

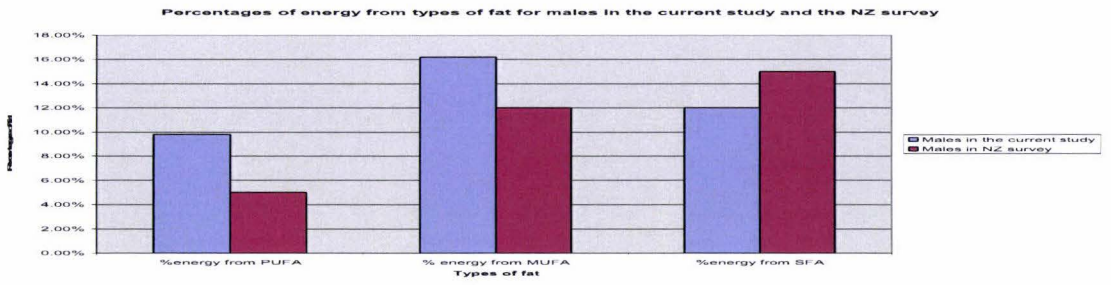

Figure 4.7.6 Energy intakes from types of fat in males

Energy intakes distribution from three types of fat in the male participants in the current study, compared to the results from the 1997 New Zealand National Nutrition Survey. The major fat contributed to total energy intakes was MUFA in the current study, while it was SFA in the 1997 New Zealand National Nutrition Survey.

Table 4.7.1.6 (1) Protein and dietary fibre intakes in participants aged 30 to 50 years

	Current study Male	RDI/AI Male	% RDI/AI	Current study Female	RDI/AI Female	% RDI/AI
Protein (g)	101.3	64.0	158.3	78.3	46.0	170.2
Dietary fibre (g)	24.2	30.0	80.7	22.1	25.0	88.4

Table 4.7.1.6 (2) Protein and dietary fibre intakes in participants aged 50 to 70 years

	Current study Male	RDI/AI Male	% RDI/AI	Current study Female	RDI/AI Female	% RDI/AI
Protein (g)	140.6	64.0	219.7	192.4	46.0	418.3
Dietary fibre (g)	34.0	30.0	113.3	48.5	25.0	194.0

Table 4.7.1.6 (1) and (2) show protein and dietary fibre intakes for two different age groups. The protein intake of all the participants is more than the RDI levels of both males and females. However, the dietary fibre intakes of the participants with ages from 30 to 50 years did not reach the RDI level, with 80.7% and 88.5% of RDIs for male and female participants. Other participants who were over 50 years consumed more dietary fibre than the RDI.

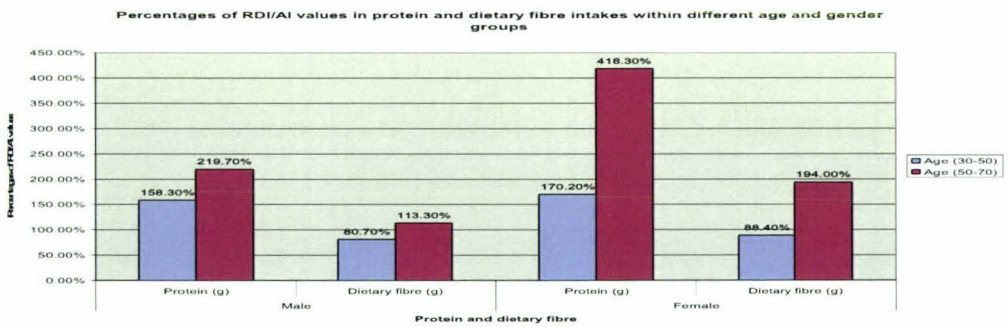

Figure 4.7.7 Protein and dietary fibre intakes in different age groups

Participants with ages between 30 and 50 years had lower intakes of dietary fibre than the RDI/AI levels from the Nutrient Reference Values for Australia and New Zealand.

4.7.1.2 Micronutrient intakes

Table 4.7.1.7 below shows the mean and median values of micronutrients intakes in female and male participants. The daily median vitamin A equivalent in males (1439.0) is almost twice that of the females. The higher values for males appear in vitamin C, vitamin E, riboflavin, Niacin equivalent, vitamin B12 and vitamin B6 intakes. In particular, the difference in vitamin E intake is significant between the female and male participants.

Table 4.7.1.7 Female and male groups' micronutrient intakes

	Female (Mean ± SD)	Female (Median)	Male (Mean ± SD)	Male (Median)
Vitamin A equal (μg)	1417.0 ± 1534.0	893.0	3413.0 ± 4548.0	1439.0
Vitamin C(mg)	163.1 ± 159.7	133.1	205.7 ± 195.8	158.8
Vitamin E (mg)	11.5 ± 4.6	12.3*	19.3 ± 9.5	17.5*
Thiamin (mg)	1.3 ± 1.2	1.0	1.2 ± 0.5	1.2
Riboflavin (mg)	1.46 ± 0.6	1.4	1.7 ± 0.8	1.7
Niacin equal (mg)	38.6 ± 18.4	36.3	49.4±20.6	44.5
Vitamin B6 (mg)	1.8 ± 1.6	1.5	1.9 ± 1.0	1.7
Vitamin B12 (mg)	5.7 ± 12.0	3.4	9.4 ± 19.9	5.1
Folate (ug)	324.8 ± 192.8	289.2	330.6 ± 138.8	285.4

* The difference in vitamin E intakes between the female and the male groups is significant ($p < 0.01$).

Table 4.7.1.8 below compares the daily median intakes of micronutrients in the current study, to the values from Chinese Recommended Nutrient Intake (RNIs) or Adequate Intake (AIs), and to the values from the Reference Nutrient Values for Australia and New Zealand (RDIs). When comparing to the Chinese RNIs or AIs, for females, only folate intake in the study group is lower and other micronutrient intakes in this table have reached the recommendations for males, the same pattern appears. Moreover, the folate intake for both male and female groups was about 72% of the reference value for Australia and New Zealand.

Table 4.7.1.8 Micronutrient intakes in females and males

	Current study Female	Chinese RNIS or AIs	RDI	RDI%	Current study Male	Chinese RNIS or AIs	RDI	RDI%
Vitamin A equal (μg)	893.0	700.0	700.0	127.6	1439.0	800.0	900.0	159.9
Vitamin C(mg)	133.1	100	45	295.8	158.8	100	45	352.9
Vitamin E (mg)	12.3	14	7	175.1	17.5	14	10	175.2
Thiamin (mg)	1.0	No value	1.1	93.6^	1.2	No value	1.2	101.7
Riboflavin (mg)	1.4	No value	1.1	124.6	1.7	No value	1.3	133.9
Niacin equal (mg)	36.3	13	14	258.9	44.5	14	16	278.4
Vitamin B12 (μg)	3.4	2.4	2.4	140.8	5.05	2.4	2.4	210.4
Folate (μg)	289.2^	400	400	72.3^	285.4^	400	400	71.4^

4.7.1.3 Mineral intakes

The table below shows the mineral intakes for the female and the male participants. Overall, the mineral intakes for the male group are higher than the females. The highly significant difference appears in the copper intake between the female and male participants. In addition, the phosphorus, iron and zinc intakes vary slightly between the females and males.

Table 4.7.1.9 Female and male groups' mineral intakes

	Female (Mean ± SD)	Female (Median)	Male (Mean ± SD)	Male (Median)
Calcium (mg)	741.2 ± 346.9	799.0	892.7 ± 376.8	901.70
Phosphorus (mg)	1364.0 ± 536.0	1239.0[1]	1723.0 ± 618.0	1573.0[1]
Magnesium (mg)	362.1 ± 129.1	354.8	441.2 ± 164.5	441.8
Iron (mg)	17.3 ± 8.4	15.8[2]	25.1 ± 15.7	23.2[2]
Zinc (mg)	12.8 ± 6.8	11.2[3]	16.7 ± 7.2	16.27[3]
Potassium (mg)	3379.0 ± 1364.0	3134.0	4043.0 ± 1417.0	4053.0
Selenium (μg)	69.5 ± 63.7	45.6	91.3 ± 80.5	75.2
Copper (mg)	1.6 ± 0.6	1.5*	2.1 ± 0.8	2.1*
Sodium (mg)	4900.0 ± 2617.0	4527.0	6054.0 ± 4165.0	4421.0

* a significant difference ($p < 0.05$).

[1]. P value is 0.058. [2]. P value is 0.073.[3]. P value is 0.076.

Table 4.7.1.10 Comparisons of mineral intakes

	Current study Female	Chinese RNIs or AIs	RDI	RDI%	Current study Male	Chinese RNIs or AIs	RDI	RDI%
Phosphorus (mg)	1239.0	700	1000	123.9	1573.0	700	1000	157.3
Magnesium (mg)	354.8	350	320	110.9	441.8	350	420	105.2
Zinc (mg)	11.2	11.5	8	139.4	16.3	15	14	116
Potassium (mg)	3134.0	2000	2800	111.9	4053.0	2000	3800	106.7
Selenium (μg)	45.6	50	60	76^	75.2	50	70	107.4
Copper (mg)	1.5	2.0	1.2	128.3	2.1	2.0	1.7	125.3
Sodium (mg)	4527.0	2200	460-920	492.1	4421.0	2200	460-920	480.5

Table 4.7.1.10 shows the values of minerals intake in the current study, compared to the Chinese RNIs or AIs and the Nutrient Reference Values for Australia and New Zealand. By comparing these to the Chinese RNIs, the intakes of selenium and copper for females were lower than the recommendation. When comparing to the Nutrient reference values for Australia and New Zealand, only the female selenium intakes reached 76% of RDI value. In addition, median sodium intakes for the female and male participants were higher than the Upper Level of intake value (2300mg) from the Nutrient Reference Values for Australia and New Zealand.

Table 4.7.1.11(1) Micronutrient intakes in females and males aged 30-50 years

	Current study Female	Chinese RNIs or AIs	RDIs	RDI%	Current study Male	Chinese RNIs or AIs	RDIs	RDI%
Vitamin B6(mg)	1.8	1.2	1.3	140.9	1.9	1.2	1.3	148.5
Vitamin D(μg)	2.7	5	5	54.3	2.3	5	5	45.6
Calcium(mg)	645.8	800	1000	64.6	786	800	1000	78.6
Iron(mg)	16.5	20	18	91.8	26.2	15	8	328.0

Table 4.7.1.11 (2) Micronutrient intakes in females and males aged 50-70 years

	Current study Female	Chinese RNIs or AIs	RDIs	RDI%	Current study Male	Chinese RNIs or AIs	RDIs	RDI%
Vitamin B6(mg)	1.6	1.5	1.5	108.5	1.9	1.5	1.7	174.7
Vitamin D(μg)	2.1	10	10	20.5	2.9	10	10	29.4
Calcium(mg)	934.0	1000	1300	71.9	1064.0	1000	1000	106.4
Iron(mg)	18.4	15	8	230.3	23.0	15	8	288.0

The two tables above show the micronutrients and minerals intake for different age and gender groups. For the participants aged between 30 and 50 years old, vitamin D and calcium intakes in both the male and female groups did not reach the recommendations from either the Chinese RNIs or the Nutrient reference values for Australia and New Zealand. In addition, female participants only gained 91.8% of the RDI value for iron. The other participants aged 50 to 70 years old in both male and female groups have obtained adequate intakes of vitamin B6 and iron. However, the vitamin D intakes in both gender groups are far less than the Chinese and Australia recommended values (20.5% of the RDI for females and 29.4% of the RDI for males). The female participants who are 50 to 70 years old had a lower level of calcium intakes, which is 71.9% of the RDI value.

4.7.2 Dietary intakes in high and low acculturation groups

4.7.2.1 Energy intake and macronutrients intakes

Table 4.7.2.1 below demonstrates the statistic difference in female macronutrients intakes for two different acculturation groups. The significant difference appeared in sugar intakes between the low and high acculturation female groups ($P < 0.05$). There are no statistical differences in the intakes of the energy and macronutrients from the table above.

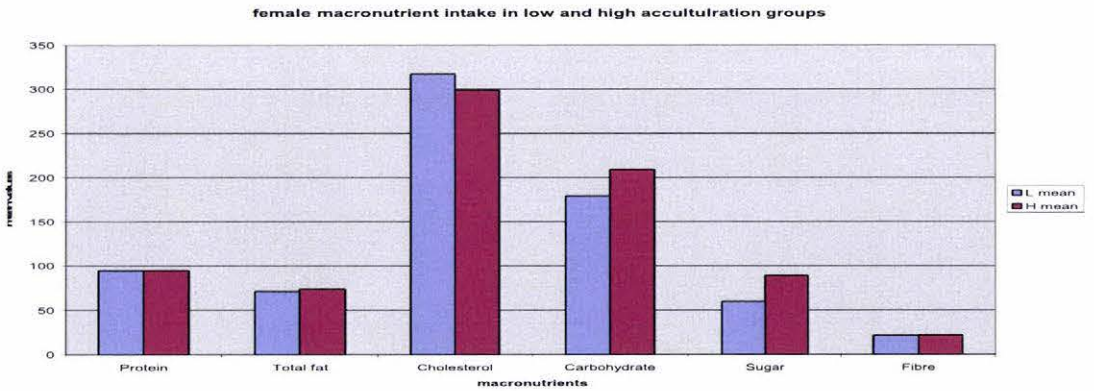

Figure 4.7.8 Macronutrients intakes in females

Sugar intake of females in the high acculturation group was higher than others in the low acculturation group.

Table 4.7.2.1 Energy and macronutrient intakes among female acculturation groups

	Low acculturation		High acculturation		
	Mean	Median	Mean	Median	P-value
Energy (kJ)	7253.0	7500.0	7807.0	7745.0	0.411
Protein (g)	95.0	85.3	94.7	73.9	0.984
Total fat (g)	71.4	71.8	73.7	77.2	0.779
Cholesterol (mg)	317.1	328.2	299.0	312.0	0.768
Carbohydrate (g)	179.4	178.6	209.2	186.5	0.184
Sugar (g)	59.7	58.8	89.1	94.2	0.013*
SFA (g)	21.6	20.2	20.5	20.5	0.710
PUFA (g)	16.0	18.1	16.7	15.2	0.835
MUFA (g)	26.9	26.5	29.0	31.0	0.551
Alcohol (g)	0.1	0.0	0.1	0.0	0.843
Fibre (g)	21.4	19.6	21.6	20.1	0.950
kJ from protein (%)	21.9	22.7	20.3	17.1	0.595
kJ from fat (%)	36.6	37.8	34.3	36.1	0.407
kJ from carbohydrate (%)	41.5	43.4	45.4	46.9	0.182
kJ from alcohol (%)	0.0	0.0	0.0	0.0	0.794
Fat as PUFA (%)	24.0	24.9	24.5	22.6	0.906
Fat as MUFA (%)	42.1	42.7	43.6	43.2	0.507
Fat as SFA (%)	33.9	32.4	32.0	31.2	0.560

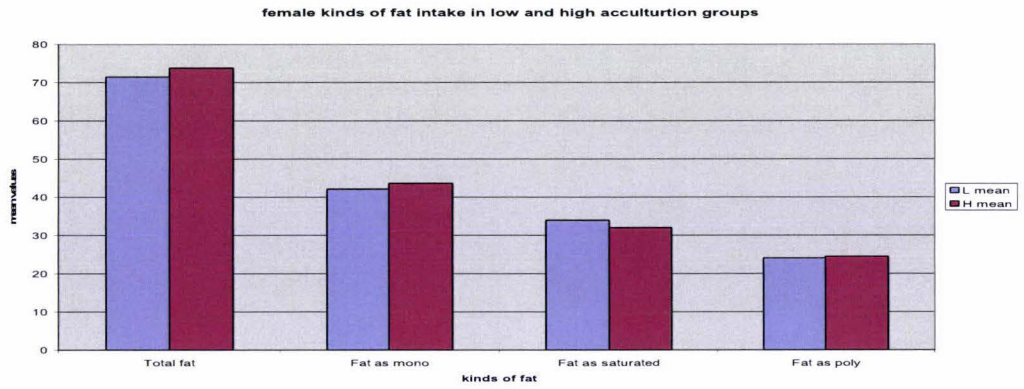

Figure 4.7.9 Females' types of fatty acid and total fat intakes

Mean intakes of different types of fatty acids among females within the low and high acculturation groups.

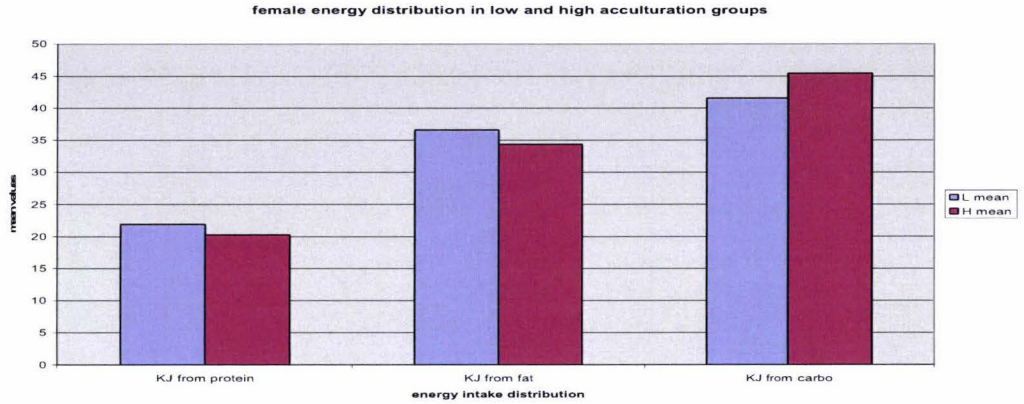

Figure 4.7.10 Females' energy distribution

The mean values of energy intakes from protein, fat and carbohydrate among female participants in the low and high acculturation groups.

The table below shows the statistical difference in intakes of energy and macronutrients by males comparing low and high acculturation groups. Even though there are some differences, they are not significant. The interesting point in this table is the sugar intake of the male participants in the low and high acculturation groups, which is a reverse of the result of to the intakes of the female participants in the low and high acculturation groups. Female participants with high acculturation levels had significantly higher sugar intake than those within the low acculturation group; however, conversely, the males with high acculturation levels had relatively lower sugar intakes than the low acculturation male group.

Table 4.7.2.2 Energy and macronutrient intakes of males in both acculturation groups

	Low acculturation		High acculturation		
	Mean	Median	Mean	Median	P - value
Energy (kJ)	9607.0	9876.0	8955.0	8167.0	0.40
Protein (g)	133.4	158.7	118.6	124.1	0.537
Total fat (g)	99.2	103.1	95.1	92.2	0.731
Cholesterol (mg)	377.5	370.2	367.8	387.4	0.932
Carbohydrate (g)	219.8	218.4	208.2	201.5	0.618
Sugar (g)	84.1	61.5	60.2	62.4	0.279
SFA (g)	26.0	24.6	29.3	30.4	0.530
PUFA (g)	23.9	29.0	20.2	21.0	0.461
MUFA (g)	35.1	36.9	36.3	37.3	0.851
Alcohol (g)	1.6	0.4	2.9	0.0	0.630
Fibre (g)	25.1	19.2	29.2	28.3	0.618
kJ from protein (%)	23.2	25.9	21.4	21.2	0.584
kJ from fat (%)	37.8	40.8	37.9	37.7	0.978
kJ from carbohydrate (%)	38.5	39.5	39.8	39.4	0.764
kJ from alcohol (%)	0.5	0.1	1.0	0.0	0.581
Fat as poly (%)	28.1	30.3	24.5	21.2	0.504
Fat as mono (%)	40.7	41.9	41.6	42.0	0.723
Fat as saturated (%)	31.2	28.7	33.8	34.4	0.540

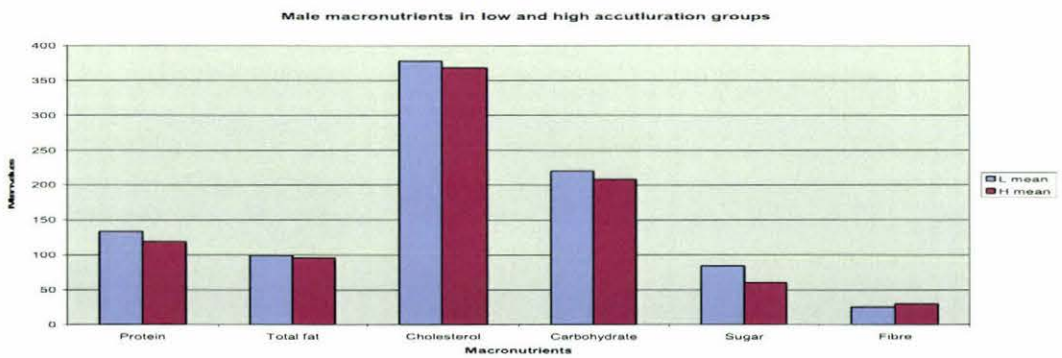

Figure 4.7.11 Males' macronutrient intakes

Mean values of macronutrient intakes among the male participants in low and high acculturation groups.

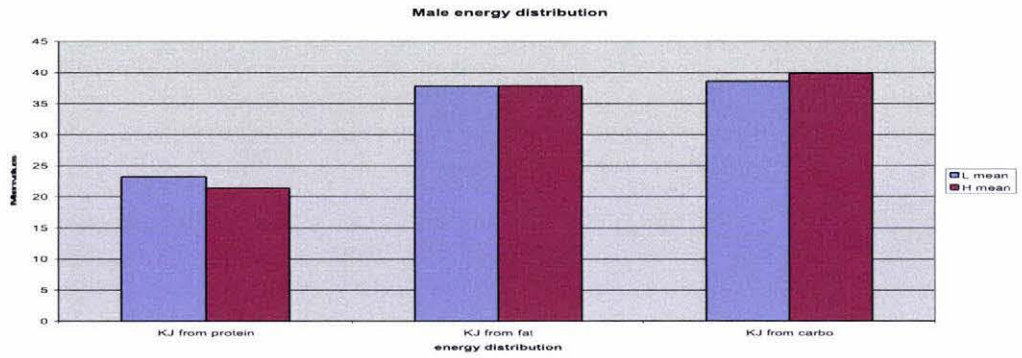

Figure 4.7.12 Males' energy distribution

Mean values of total energy intakes from protein, fat and carbohydrates in two male acculturation groups.

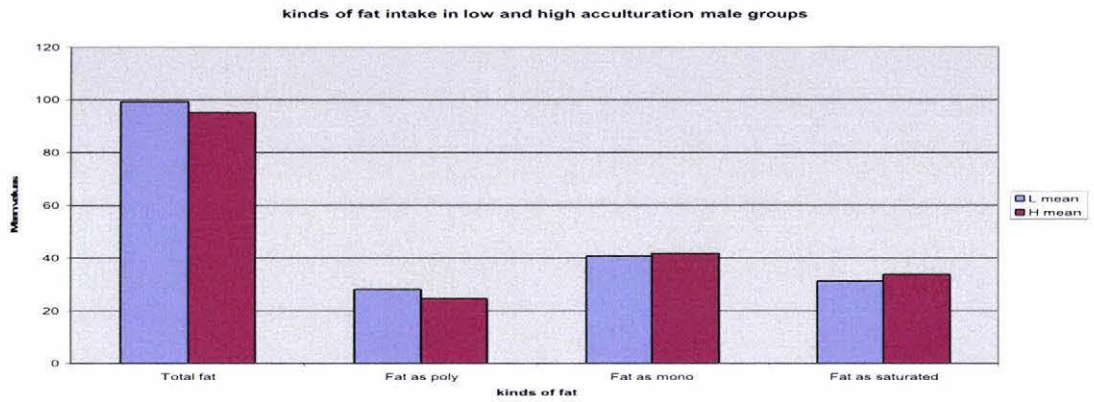

Figure 4.7.13 Males' total fat and types of fat intakes

Total fat and types of fatty acids intakes among males in low and high acculturation groups

4.7.2.2 Micronutrients intake

Table 4.7.2.3 shows the P values of these micronutrients, none of which are significantly different. The differences between two female acculturation groups in vitamin D and E are the nearest to 0.05. Those values may become statistically significant with an increased number of participants. The participants in the high acculturation group had higher intakes of vitamin D and E, when compared to the low acculturation group.

Table 4.7.2.3 Micronutrient intakes of females with low and high acculturation

Groups	Low acculturation		High acculturation		
	Mean	Median	Mean	Median	P - value
Thiamin (mg)	1.1	1.1	1.5	1.0	0.442
Riboflavin (mg)	1.5	1.5	1.4	1.1	0.700
Niacin (mg)	16.7	14.1	20.9	20.0	0.324
Niacin equal (mg)	36.7	35.1	40.0	36.3	0.654
Vitamin C (mg)	151.3	75.9	172.5	143.7	0.749
Vitamin D (μg)	1.4	1.1	3.4	2.2	0.082
Vitamin E (mg)	9.8	10.5	12.9	12.9	0.074
Vitamin B_6 (mg)	1.6	1.4	2.0	1.6	0.478
Vitamin B_{12} (μg)	8.3	3.8	3.5	3.3	0.373
Folate (μg)	387.7	353.9	274.5	231.9	0.152
Vitamin A equal (μg)	1609.0	780.0	1264.0	1071.0	0.608
Retinol (μg)	408.0	293.0	297.0	184.0	0.472
Bcarotene equal (μg)	4834.0	3977.0	5291.0	4667.0	0.805

For male participants, table 4.7.2.4 shows the statistical values of micronutrient intakes. The daily median intake of vitamin D in the high acculturation group is twice than that of the low acculturation group, even though the difference is not significantly different. In addition, the mean value of folate intakes is the same for both low and high acculturation groups; however, the daily median intake in the high acculturation group is much higher than that in the low acculturation group. Most micronutrients intakes in male acculturation groups are similar, not showing any significant differences.

Table 4.7.2.4 Micronutrient intakes of males with low and high acculturation

Groups	Low acculturation		High acculturation		
	Mean	Median	Mean	Median	P - value
Thiamin (mg)	1.1	1.1	1.2	1.4	0.510
Riboflavin (mg)	1.5	1.3	1.8	1.8	0.397
Niacin (mg)	25.8	27.0	22.8	21.5	0.569
Niacin equal (mg)	53.8	58.3	46.3	42.6	0.475
Vitamin C (mg)	216.4	156.0	198.1	170.1	0.870
Vitamin D (μg)	2.2	1.3	3.0	2.6	0.544
Vitamin E (mg)	18.9	15.6	19.5	18.2	0.897
Vitamin B6 (mg)	1.8	1.7	2.0	1.7	0.798
Vitamin B12 (μg)	16.3	5.43	4.51	4.27	0.353
Folate (μg)	330.6	239.6	330.6	312.5	1.000
Vitamin A equal (μg)	4097.0	995.0	2934.0	1614.0	0.661
Retinol (μg)	362.0	259.0	513.0	336.0	0.452
Bcarotene equal (μg)	19079.0	3576.0	6904.0	5759.0	0.409

4.7.2.3 Mineral intakes

The two tables below illustrate mineral intakes by males and females in different acculturation groups. Statistically, the differences in sodium, potassium, magnesium, calcium, phosphorus, iron, zinc, copper and selenium are not significant. However, the daily median intake of sodium in the high acculturation group is about 5% higher than that in the low acculturation group. The daily median calcium intakes in the high acculturation group are lower than the low acculturation group. Table 4.7.2.14 shows that the differences in these mineral intakes for males are not significantly different in the statistical values.

Table 4.7.2.5 Mineral intakes of females with low and high acculturation

Groups	Low acculturation		High acculturation		
	Mean	Median	Mean	Median	P - value
Sodium (mg)	5227.0	4305.0	4639.0	4527.0	0.581
Potassium (mg)	3452.0	3151.0	3321.0	2772.0	0.809
Magnesium(mg)	376.2	360.9	350.8	345.4	0.626
Calcium (mg)	837.0	803.0	664.4	633.1	0.216
Phosphorus (mg)	1392.0	1230	1342.0	1239.0	0.817
Iron (mg)	17.0	15.6	17.6	15.8	0.853
Zinc (mg)	11.9	12.6	13.4	10.8	0.561
Copper (mg)	1.5	1.4	1.80	1.8	0.156
Selenium (µg)	71.8	50.6	67.8	45.6	0.881

Table 4.7.2.6 Mineral intakes of males with low and high acculturation

Groups	Low acculturation		High acculturation		
	Mean	Median	Mean	Median	P - value
Sodium (mg)	6209.0	3842.0	5946.0	4817.0	0.900
Potassium (mg)	4533.0	4322.0	3700.0	3989.0	0.288
Magnesium (mg)	446.9	390.2	437.2	470.1	0.913
Calcium (mg)	861.0	562.0	915.3	933.2	0.799
Phosphorus (mg)	1895.0	1784.0	1603.0	1524.0	0.359
Iron (mg)	25.0	20.3	25.2	26.1	0.971
Zinc (mg)	16.7	16.6	16.8	15.7	0.990
Copper (mg)	2.1	2.1	2.1	2.3	0.970
Selenium (µg)	118.5	75.2	72.3	71.1	0.352

4.7.3 Summary

Energy intakes and distribution, macronutrient and micronutrient intakes among Chinese participants are revealed in the aforementioned tables. The daily median energy intakes of both male and female participants are lower than either the Chinese RNI or the results from the 1997 New Zealand National Nutrition Survey. However, the energy intakes from fat (36.4% for females, and 38.6% for males) are higher than the Chinese RNIs, and noticeably higher than 35% of New Zealanders in 1997. The main type of fat in the daily intakes of the participants is monounsaturated fat, which is related to the usage of cooking oils. Based on the nutrient reference values for Australia and New Zealand, the folate intakes for both males and females only reached 72% of the recommended values. Lower selenium intakes appeared in both the male and female participants, and the daily medium sodium intakes for both the male and female participants are twice as high as the Nutrient reference values for Australia and New Zealand. Additionally, both the male and female participants with ages between 30 to 50 years did not reach the recommended vitamin D and calcium intakes for either the Chinese RNIs or the Nutrient reference values for Australia and New Zealand. The females with ages over 50 years had lower calcium intakes than the standard Nutrient reference values for Australia and New Zealand value.

The female participants in the high acculturation group had higher sugar intake than those participants with low acculturation levels ($P < 0.05$). In contrast, males in the high acculturation group consumed less energy, fat and sugar than low acculturated participants, but these were not statistically significant. Lower intakes of vitamin D and E occurred among low acculturated females in comparison with highly acculturated participants ($P < 0.1$). The differences in other micronutrients and mineral intakes between male and female participants were not statistically significant ($P > 0.05$).

Chapter 5 DISCUSSION

5.1 Sample characteristics

A total of 46 qualified participants took part in this study, 60% of whom were females. The majority of the study group was from Mainland China, but two participants were born in New Zealand of Chinese parents and therefore had distinctively different eating patterns and lifestyles. These two participants were excluded from the analysis of the data. The most common age range was from 40 to 50 years old, and most of this group had been in New Zealand for over ten years. Relatively, this group had a high socioeconomic status, when compared to either the New Zealand or Palmerston North populations. Most of the participants had gained at least a tertiary qualification, and more than 50% had full-time employment and had household income over $30,000 annually.

The health status of all of participants was investigated through face-to-face interviews. More than 40% of the participants had a family history of diabetes, and about 15% and 11% of the participants reported having hypertension and high cholesterol levels, respectively. Moreover, the study participants were less likely to visit their preferred General Practitioners regularly unless they felt unwell, compared to the New Zealand population.

5.2 Acculturation levels

According to the classification of the Suinn-Lew Asian Self-identify Acculturation scale (Suinn et al., 1987), a score of 5 is given to those who identify as Western, a score of 1 is given to those identified as Asian, and the middle score of 3 represents bicultural. The mean acculturation score of the 44 migrants was 2.04. The two participants who were born in New Zealand gained the highest scores, 4.07 and 3.64 out of 5; these two participants were excluded from further analysis. The 44 participants were divided into low and high

acculturation groups by the acculturation score (2.0), and the mean values of the low and high acculturation groups were 1.65 and 2.34, respectively. Suinn et al. (1995) compared an Asian-American sample and an Asian sample from Singapore, both of which used the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA). The actual SL-ASIA scale mean scores for Singaporean Asians was 2.17 and 3.38 for Asian Americans, so that Singapore Asians identified themselves as Asian, while Asian Americans were defined as having bicultural levels of acculturation. In total, all participants in the current study may be defined as having Asian identity, according to this classification system. However, participants within the low acculturation group maintain a stronger Asian identity than those with high acculturation scores. The correlation between the acculturation score and the arrival age was similar to a Asian American study (Ownbey & Horridge, 1998), which stated that there was a moderately strong negative relationship between SL-ASIA scores and the age upon arrival in the USA.

Multiple variables impact on the acculturation scores, and a total of thirteen items were selected from the SL-ASIA questionnaire for calculating the acculturation score in this study. Based on the partial least squares analysis, answers from language preference (Q18), music preference (Q24), and movie preference (Q23) contributed most to participants' acculturation scores. People with whom the participants preferred to associate in the community (question 22) and food preference at home (Q25), were relatively closely related to the acculturation scores of the participants. In contrast, some items in the SL-ASIA scale associated less with acculturation score in the present study are ethnic interaction (Q19, Q20, Q21), ethnic identity (Q17), participation in Chinese events (Q27), and generational level (Q29). If the participants prefer to use English language, music, movies and eat Western foods, they gained higher acculturation scores. Conversely, if the participants are highly acculturated, they are more likely to use English in their speaking, reading and communicating with friends, and eat Western foods more often.

Three demographic variables, arrival age, residency length and age, were investigated. It is significant that the residency length was negatively associated with the acculturation score ($P < 0.001$). Moreover, age at arrival in New Zealand was correlated to the acculturation scores. Participants who were younger when they arrived in New Zealand gained high

acculturation scores, in other words, they were more acculturated. In contrast, participants who had longer residency length were more likely to have higher acculturation scores, and to be acculturated to Western culture ($P < 0.05$).

Food choices and eating patterns are both considered indicators of cultural changes and consequences resulting from a process of acculturation in the host country. Dietary acculturation has been used to investigate the process by which the immigrant groups adopt the eating patterns of their host country. However, many different factors may affect food choices, eating patterns and lifestyles of immigrants.

5.3 Dietary acculturation and food eating patterns

5.3.1 Meal eating patterns

In the current study, the majority of the participants consumed a Western style breakfast, including toast, jam, table spread, cold cereal, coffee. A Chinese style breakfast, which typically included rice, noodles, or steamed buns, was consumed by some participants. The participants who were more acculturated to New Zealand culture were more likely to eat a Western breakfast and lunch. However, dinner, as an important time shared with family members, was usually Chinese style for all participants, whether they had high or low acculturation levels. Two acculturation studies found a similar trend in immigrant groups. One study of Korean Americans (Lee, Sobal & Frongillo, 1999) found that American meals were frequently consumed as breakfast or lunch when people were more acculturated, whereas Korean meals were favoured for dinner as an emotional attachment. Also, Satia et al. (2000) observed that the first meal to be Westernised was breakfast among Chinese-American women, but the majority of the respondents consumed a Chinese-style lunch and also a Chinese dinner. Time consuming cooking methods in preparing a Chinese traditional breakfast may be one of reasons that the participants change their habit in the morning, especially people with full-time employment. Having morning tea and/or afternoon tea is popular in New Zealand, and there was a significant difference in these meals between low and high acculturation participants in this study. The participants with high acculturation levels consumed morning tea more frequently than low acculturated participants ($P < 0.05$).

One of the reasons given by high acculturated participants for having morning tea was that they have tea time in their working places or with their Western friends. Therefore, their living and working environments may gradually affect the participants' choices.

5.3.2 Food choices information from 24 hours dietary recalls

The major sources of fat in Chinese diets are from cooking oil and/or meat (Satia et al., 2000), and the most popular oils that were consumed by the participants in the current study were vegetable and soybean. Generally, the participants ate chicken and pork more frequently than beef and/or lamb. In addition, low acculturated participants more favoured fish or shellfish which are both relatively expensive. Surprisingly, about twice the number of the participants in the high acculturation group consumed no fruits on the first 24 hour dietary recall, when compared to low acculturated participants. A similar finding from a study of Hispanic immigrants (Neuhouser et al., 2004) is that highly acculturated respondents consumed fewer servings of fruits and vegetables per day in comparison with the intake of less acculturated people. Arguably, these responses may not entirely represent the individuals' usual eating patterns because of the nature of 24 hour dietary recalls.

5.3.3 Food choices information from the food frequency questionnaire

Food choices are affected by both psychosocial factors, taste preferences and environmental factors (Satia, Patterson, Neuhouser & Elder, 2002). Chinese people traditionally consume a wide variety of foods, including green vegetables, soy bean products, meats and poultry. Once a Chinese person moves to a Western country, both the availability of food and a distinctive cultural background may affect their food choices and eating patterns. The alteration of meal eating patterns has been discussed above, and foods listed in the food frequency questionnaire for this current study covered 16 categories: bakery, beverages, cereals, dairy, eggs, fast foods, oils, fish, fruit, meat, meat products, sauces and condiments, shellfish, snacks and vegetables. The traditional Chinese eating pattern consists of a high intake of carbohydrate, including rice, noodles and flours, and a low consumption of animal fats, alongside with a high intake of vegetables. However, changes to this eating pattern have occurred among Chinese, both in China and in other countries.

5.3.3.1 Dairy products

In relation to the data from the current study, compared to the 1997 New Zealand National Nutrition Survey (Russell, Parnell, Wilson et al., 1999), more female and male participants regularly drank low fat milk rather than standard milk, and the difference between males and females was not significant. More females consumed yoghurt (standard and low fat) at least once per week than the male participants; however, fewer participants ate cream and/or cheese, in this current study, when compared to the New Zealand population. Cheaper prices, easy availability, and a wide variety of dairy products in New Zealand are the more important reasons that the participants drank milk more frequently than they were in China. A relatively higher consumption of milk and dairy products was observed in the participants with high acculturation levels; in particular, two participants who were born in New Zealand consumed low fat milk seven days per week. Milk and dairy products have not been part of the Chinese traditional diet, and Chinese people traditionally had the lowest levels of the consumption in dairy products in the world (Fuller, Beghin & Rozelle, 2004). More recently, the consumption of dairy products has been affected by the exposure of the Chinese market to the international and economic trade influences. Urban Chinese people who have experiences of travelling abroad have increased their fresh dairy products consumption (Fuller, Beghin & Rozelle, 2004). Even though lactose intolerance is common among the Chinese, Wang et al. (1994) reported that Chinese Americans had a higher mean consumption of dairy products. Over 70% of Chinese subjects drank milk in a Mainland Chinese study on the elderly in Auckland (Xie, 2003). Xie suggested that Chinese increased their consumption of dairy products as part of the process of acculturation, otherwise it was a lesser possibility for Chinese to adopt dairy products as a part of their regular diet.

5.3.3.2 Rice, bread, pasta

Rice, as a dominant Chinese food, is still consumed regularly by this current study group, however, bread, as a major carbohydrate food in Western diets, has been accepted by Chinese because of its convenience in preparation and consumption, and its availability in the local markets. The consumption of rice and bread contribute to the total carbohydrate intake as well as affecting the intake of dietary fibre. A diet high in simple carbohydrate intake is associated with increasing risk of type 2 diabetes mellitus, and was reported in a

Japanese American study (Nakanishi et al., 2004). In addition, dietary fibre intake has been reported to have a reverse relationship with the risk of type 2 diabetes mellitus. Details relating to which types of rice and bread were mostly consumed were not investigated in the food frequency questionnaire; however, the 24-hour dietary intake analyses provided some information about carbohydrate and dietary fibre intake. The mean dietary fibre intake of the study participants with ages between 30 to 50 years was lower than the RDI values from the Reference Nutrient Values for Australia and New Zealand. In contrast, the mean values of both males and females aged over 50 years old was higher than the RDI values from the Reference Nutrient Values for Australia and New Zealand, which are also much higher than the mean values from a Chinese study group of the elderly in Auckland (Xie, 2003). Possibly, younger participants consumed more highly processed rice, bread and/or cereals than their elders. The median daily dietary fibre intake of this current study group was 21.35g, which was similar to the value (20g) for New Zealanders found in the 1997 National Nutrition Survey. However, the male participants in both studies consumed more dietary fibre daily than the females.

5.3.3.3 Meat and meat products

The main meats consumed by the participants were chicken and pork due to their cultural preferences, and the taste. Lower percentages of the participants ate red meat at least once a week, when compared to New Zealanders (57% for males and 51% for females) in the 1997 National Nutrition Survey. Relatively, more participants with high acculturation scores than those in the low acculturation groups ate beef or beef mince more than once a week. The consumption of beef and/beef products are less than the poultry meats in China. Reasons for this include the strong smell, a traditional view of beef being a "hot" and "winter" food, the meat is hard to digest, variable quality, cooking time being very time consuming, and not being a versatile cooking ingredient (van Gelder, van Gelder & Dinghuan, 1998). With the modernisation and the improvement of food technology, processed foods nowadays are popular in the supermarkets. The easy availability of processed meats and the convenience of preparing and cooking may result in increased consumption. The results from the current study showed that highly acculturated females consumed bacon or ham more frequently than those in the low acculturation group. Both low and high acculturated males consumed

bacon or ham and sausage less than once a week. The intake of red meat and processed meat is a major contribution to the dietary fat intake of Western diets. Three studies have revealed a positive correlation between red meat/processed meat intake and the development of type 2 diabetes mellitus (Schulze et al., 2003; Fung, Schulze, Manson, Willett & Hu, 2004; van Dam, Rimm, Willett, Stampfer & Hu, 2002). A trend of increasing the consumption of red meat and/or bacon/ham and sausage among highly acculturated female participants was observed in the current study. The Chinese participants did not entirely stop eating Chinese foods but they gradually overlaid Western foods onto their stable Chinese food patterns during the process of the acculturation.

5.3.3.4 Fish and Seafood

The consumption of meat and meat products may affect the intake of fish and/or shellfish. Chinese participants reported consuming baked or steamed fish more frequently than the New Zealand population because of their traditional food preference of eating fresh fish. A report of seafood consumption in China stated that Chinese consumers traditionally prefer live fish or seafood rather than frozen or chilled products and China produces about 35% of the total global seafood production (Glitnir Seafood Team, 2006). Culturally, Chinese are in favour of eating fish or seafood which is a part of their diet, even if they move to a Western country. Low acculturated participants were likely to consume fish or seafood more regularly than highly acculturated people in this study. Participants stated that the lesser availability of live or fresh fish and/or seafood in the Manawatu area, together with different tastes of fish or seafood in the markets, possibly limited the participants' food choices. However, many of the participants continue to attempt to consume fish/seafood in their diets. A Chinese prospective study reported (Yuan, Ross, Gao & Yu, 2001) that eating fish and shellfish weekly reduced the risk from myocardial infarction among men from Shanghai, China, aged 45 to 64 years.

5.3.3.5 Local and Chinese vegetables

A large variety of vegetables available in the markets in China, and traditional eating habits, leads to a high consumption of vegetables for the Chinese population. Typical Chinese traditional eating patterns include a high carbohydrate intake, low consumption of animal fats and a high intake of vegetables. However, both the nutrition transition in China

and Chinese migration to Western countries result in Chinese moving away from their traditional diets. In the current study, the five most popular eaten vegetables by New Zealanders were investigated (carrots, tomatoes, lettuces, onions and pumpkins). Chinese participants ate these vegetables less frequently than New Zealanders because they prefer to have a wide range of choices for daily meals. The participants in this study always buy the most available Chinese types of vegetables from "the flea markets" in Palmerston North, such as Chinese cabbage, mustard greens, lettuce stem, water spinach and so forth. As an example, only three kinds of mushroom are available in the markets in New Zealand, and there are twenty seven kinds of Chinese mushroom in the 2002 Chinese food composition list.

A large variety of common vegetables, together with seasonal fresh vegetables, are readily available in the markets in China, so that Chinese people are used to purchasing different kinds of vegetables from day to day. The 2002 Chinese food composition list itemises root vegetables, leguminous vegetables and sprouts, cucurbitaceous and solanaceous vegetables, allium vegetables, stems, leafy and flowering vegetables, aquatic vegetables and wild vegetables (Yang, Wang & Pan, 2002). A lower consumption of soybean products was observed among this local Chinese group, mainly because of lesser availability. Fresh soybean products are difficult to purchase in Palmerston North, however, some dried products, such as soybean milk film, wheat gluten and soybean curd sheet, are available in the Asian retail shops. According to the results from this current study, more low acculturated females consumed mushroom, capsicum, sprouts, seaweed and radish at least once a week, compared to those in the high acculturation group. More males with low acculturation levels consumed sprouts, pak choi, eggplant, seaweed and radish than those in the high acculturation group. Both low and high acculturated participants regularly consumed pickled vegetables, and more participants within the low acculturation groups regularly ate ginger and garlic than those with high acculturation levels. Stir-frying or making soups are still preferable cooking methods for many Chinese people in retaining their traditional vegetable consumption.

Vegetables are not only rich sources of micronutrients and dietary fibre, but also contain a variety of biologically active secondary metabolites (phytochemicals), such as phytosterols,

carotenoids, and glucosinolates.The health benefits from eating certain types of Chinese vegetables, mainly brassica vegetables (Chinese cabbage, kale, mustard and pak choi), have been discussed in different studies (Goldberg, 2003; Seow et al., 2002; Mithen, Dekker, Verkerk, Rabot & Johnson, 2000). A Singapore Chinese Health study investigated the diets of middle-aged men and women from 1993 to 1998 and reported that a high dietary intake of Brassica vegetables had an inverse relationship to the colorectal cancer risk because of the high content of glucosinolate degradation products from vegetables (Seow et al., 2002). Also, Goldberg (2003) summarised that the health benefits from a high consumption of Brassica vegetables were related to the metabolic effects of glucosinolated breakdown products, such as, isothiocyanates which induce phase II conjugating enzymens to detoxify carcinogenic substances.

5.3.3.6 Non-alcoholic and alcoholic drinks

Compared with 50% of the New Zealand population who drink Western tea and coffee at least three times per week, fewer participants in this current study drank coffee and tea as often. However, Western tea and coffee were major non-alcoholic drinks consumed regularly by the participants. Meanwhile, more participants frequently drank green tea than Western tea and coffee, and green tea remains one of the preferred drinks for Chinese. More male than female participants drank green tea more than five times a week. Occasionally, Chinese do drink alcohol, such as at family gatherings or Chinese festivals. Notably, Chinese alcoholic drinks are not usually made from grapes, but from grains, fruits or rice. Less availability of known varieties of Chinese alcohol may have limited the frequency of consuming alcohol in this study.

The majority of participants in this study maintained the habit of drinking green tea, a traditional Chinese non-alcoholic drink. The benefits of drinking green tea, such as helping to prevent cancer, cardiovascular disease, diabetes mellitus, and other lifestyle-related diseases, have been discussed in experimental and epidemiological studies (Basu & Lucas, 2007; Sueoka et al., 2001; Zhu, Huang & Tu, 2006). Cathechins constitute approximately 30% of the dry weight green tea and 9% of the dry weight of black tea (Harbowy & Balentine, 1997, cited in Arts, Hollman, Feskens, de Mesquita & Kromhout, 2001). Based on the Zutphen Elderly study, Arts, Hollman, Feskens, de Mesquita and Kromhout (2001)

reported catechin intake could be one of reasons for an inverse relationship between tea consumption and ischemic heart disease mortality. Zhu, Huang and Tu (2006) reviewed Chinese research papers related to tea and health from 1982 to 2002, and they reported that there were more than thirteen active compounds contained in tea; the most important functions among various bioactivities of tea were scavenging of free radicals and antioxidants. A recent review article (Basu & Lucas, 2007) summarized the evidence that green tea has unique cardiovascular health benefits because of its high content of polyphenolic flavonoids (mainly catechins). Two Japanese studies (Imai & Nakachi, 1995; Kuriyamaa et al., 2006) have reported an inverse association between habitual green tea consumption (especially more than ten cups a day) and mortality due to inflammatory diseases, cardiovascular disease, and cancers.

Besides drinking tea, participants increased their desire to drink coffee. A Finnish study (Tuomilehto, Hu, Bidel, Lindström & Jousilahti, 2004), a Dutch study (van Dam, 2002), and a Health Professionals' study (Salazar-Martinez et al., 2004) focused on the relation between coffee consumption and risk for type 2 diabetes mellitus, and they reported that either long-term or short-term coffee consumption was associated with a lower risk for this condition. However, the reasons for the relationship were not clear. Campos and Baylin (2007) reported that coffee consumption had shown a strong protective effect against type 2 diabetes mellitus based on epidemiological studies, but, the unclear biological components of coffee and its long-term influences on health modified by genetic backgrounds, made the specific recommendation of coffee consumption difficult to support.

5.3.3.7 Other foods

Due to traditional Chinese cooking methods, the participants in this study continue to use complex seasoning combinations in their dishes, including soy sauce, oyster sauce, sesame oil and chilli sauce/powder, rather than salad dressing and/or tomato sauce. Pizza, meat pies, French fries are the most popular fast takeaway foods in New Zealand, and these are more frequently consumed by highly acculturated participants than by the participants in the low acculturation group.

5.3.3.8 Factors related to dietary change

In terms of the relatively high socioeconomic status of participants in this study group, cultural and taste preferences and environment factors are possible reasons in altering their eating habits. Once they are exposed to New Zealand culture, their diet- and disease-related knowledge might change because of the new environment. However, this current study did not investigate the health knowledge of the participants. Separately, changes in the environmental factors, together with the psychosocial factors, affect the formulation of different eating patterns and food choices. Most participants maintained their traditional eating patterns, and some with high acculturation levels partly adopt Western eating

To sum up, due to the small number of subjects in this study, no obvious differences in eating and food pattens can be observed between participants with low acculturation scores and those with high acculturation scores.

5.4 Body measurements

Body weight, height, and waist and hip circumferences were measured in this study. The BMI values, waist circumferences and waist and hip ratios were used as markers of risk factors for heart disease and diabetes. Due to the ethnic difference in body measurement cut-off points, the Chinese standard was used to classify overweight and/or obese in this current study. Overall, the mean BMI values of female and male participants were 22.8 and 25.0, respectively. The differences of BMI values between females and males with ages less than 50 years old in this study are significant ($P < 0.01$), but among participants over 50 years old, the difference between females and males in BMI values is not significant ($P > 0.05$).

Distinctively, the mean values of BMI for male participants in the two age groups was over 24, which is the cut-off point for predicting overweight based on the Chinese standard. By using the Chinese standard to classify overweight and obesity, 63.5% of the male participants were considered as either overweight or obese which is more than three times higher than females. A similar trend occurred among the New Zealand population. In the 1997 New Zealand National Nutrition Survey, 39.2% of males and 25.7% of females with

ages from 25 to 44 were overweight, and 48.2% males and 36.6% females with ages from 45 to 64 were overweight, in accordance with BMI values ranging from 25 to 30 kg/m^2 for NZ European and others. The highest proportion of the population who were obese was 23% of males and 26.5% of females with ages from 45 to 64 (Russell, Parnell & Wilson et al., 1999). The report from the Chinese Nutritional Survey 2002 (Li et al., 2005) showed that 22.8% of adults aged 18^+ older were overweight and 7.1% were obese based on the same criteria, and the proportion of the population who were classified as overweight and/or obese was rapidly increasing.

Waist circumference is another marker used to estimate the risks associated with excess abdominal fat in adults. It is statistically significant that more females in the low acculturation group had waist circumferences over 80cm than females with high acculturation scores. When taking age into account, the differences between low and high acculturated females with ages over 50 were significant ($P = 0.001$). In particular, the mean value of females with low acculturation scores was 83.4cm, which is higher than the recommended cut-off point (80cm for females). The male participants with ages over 50 in the high acculturation group had a greater mean value of waist circumference (91.0cm) than the recommended cut-off point of 90cm. In the New Zealand National Nutrition Survey, the cutoff points for waist and hip (WHR) were 1.0 for men and 0.85 for women. Based on this cutoff, only three females in this study group, two of whom had high acculturation scores, had WHR above 0.85 and no males had WHR ratios above 1.0. The differences in WHR values of participants with high and low acculturation scores were not significant ($P > 0.05$).

In total, 22.2% of the female and 29.4% of the male participants in this study had both higher BMI and waist circumference, and therefore, were identified to have increased risks for diabetes, impaired glucose regulation (IGR) and metabolic syndrome. Li et al. (2002) reported that there was a linear relationship between the increased waist circumference and elevated metabolic risk factors, in parallel with increasing BMI values from a baseline value of 21.0 among Chinese adults. Other studies also showed that either overall or abdominal adiposity, assessed by measuring BMI values and waist circumferences, were associated with the development of type 2 diabetes in both males and females (Meisinger,

Döring, Thorand, Heier & Löwel, 2006; Rosenthal et al., 2004; Jia, Xiang, Chen, Lu & Wu, 2002). Rosenthal et al. (2004) suggested that the waist hip ratio might be a better indicator of risk of diabetes than BMI for Chinese women.

In addition, females in the current study with low acculturation scores had greater BMI values than those in the high acculturation group, and the difference was significant ($P < 0.05$). The medium waist circumference value of females with low acculturation scores was much higher than that in the high acculturation group. However, the differences in BMI and waist circumference between low and high acculturated male participants were not significant ($P > 0.05$).

5.5 Physical activity

Low physical activity level is another risk factor for developing type 2 diabetes mellitus. On the other hand, increasing the physical activity level can prevent the development of type 2 diabetes mellitus, even for people who are already overweight or obese. A cross-section health and nutrition survey conducted in Greece (Kavouras et al., 2006) found overweight or obese volunteers who were physically active had similar levels of glucose and insulin sensitivity, and lower insulin levels than lean inactive individuals. Also, the results suggested increased physical activity levels may reduce the detrimental effects of overweight or obesity on insulin sensitivity. Data from the Puerto Rico Heart Health Programme (Crespo et al., 2002) suggested that overweight or obese Puerto Rican men who were physically active experienced significant reductions in mortality, when compared to their equal weight counterparts who were sedentary.

By collecting the information from activities involved at workplaces, from one place to the other, or at recreation centres, the participants with median physical activity levels spent more time in workplaces (but rarely in the recreation centre) and travelling, even though traditionally the daily activity of travelling between the workplace and home is one of the major types of physical activity (Weng & Caballero, 2007). Weng and Caballero (2007) reported that the activity level load in workplaces for urban Chinese had decreased because of the shift in economic activity toward services and improved technology. Private cars

and/or public transport reduced the opportunity of using bicycles or walking from one place to the other, and fewer participants spent their time in undertaking vigorous activities at leisure time.

Approximate 60% of the participants were not involved in any physical activities during work time, and about half of the participants did not walk or cycle when they travelled a short distance from one place to another. Lee et al. (1994) observed that Chinese with increasing years in North America were likely to be progressively less active than those in China. In addition, younger participants were less likely to gain medium physical activity levels than those with age over 45 years. A study with elderly Mainland Chinese in Auckland (Xie, 2003) reported that subjects increased physical activity because of a lack of transportation and increased house work. Similarly, people in China, especially in rural areas, are physically active. According to the data from the International Collaborative Study of Cardiovascular Disease in Asia (Muntner et al., 2005), 78.1% (rural) and 21.8% (urban) residents in China were found to be physical active (participating in at least 30 minutes of moderate or vigorous activity daily), and most residents participated more in work-related activities, and less in leisure-time activities, in both rural and urban settings. By comparison, the data from the New Zealand Health Survey 1996-1997 indicated that almost four in ten adults were described as physical inactive, and men were more likely than women to be sedentary (Russell, Parnell & Wilson et al., 1999). Also, the results from the subsequent 1997/98 New Zealand Health Survey showed that 40% of New Zealand adults were sufficiently active when considering the regularity of physical activity (Ministry of Health and the University of Auckland, 2003).

5.6 Dietary intakes

5.6.1 Energy intake and distribution

The data of the dietary intakes were collected from the face-to-face interviews using 24 hour recall, but the data excluded the two participants who were born in New Zealand. The bases for determination of adequate intakes were the Nutrient Reference Values for

Australia and New Zealand (NRVs) (Ministry of Health, 2006b) and the Chinese Dietary Reference Intakes (Yang, He & Pan, 2004).

The usual daily median energy intakes were 7642 kJ for females and 9409 kJ for male participants, which were lower than those values for the New Zealand population (7701kJ for females; 11631kJ for males) in the 1997 New Zealand National Nutrition Survey. In comparison, the average total energy intake was 9420.69kJ for Chinese reported in the Chinese National Nutrition and Health Survey in 2002 (Li et al., 2005). It is commonly known that under- or over- reporting of the dietary intake will understandably introduce bias to the dietary data in the study. In order to measure the relative validity of dietary intake data, the Goldberg cut-off method was used to calculate the number of participants who were under-reporters (Gibson, 2005). Only one female participant aged over 60 was classified as an under-reporter, while ten out of seventeen male participants were under-reporters. However, data from these participants were not excluded from the analysis because under-reporters might be people whose health should be most of concern.

In the current study, 36.4% and 38.6% of total energy intakes were from fat in the diet of females and males, which are higher than both the New Zealand population (35.0%) reported in the 1997 New Zealand National Nutrition Survey and Chinese in urban (35.0%) and rural areas (27.5%) in the 2002 National Nutrition Survey. However, according to the 1997 New Zealand National Nutrition Survey, the predominant type of dietary fat which contributed to the total energy intake was saturated fat, which is distinct from mono-unsaturated fat which was present in the current study group. The New Zealand Nutrition Taskforce (Department of Health, 1991) guideline recommends less than 33% of the total energy intakes from fat, approximately 6 to 10% of polyunsaturated fatty acid, up to 20% of monounsaturated fatty acid, and no more than 20% of fat from saturated and/or trans fatty acid. The median proportion of total energy intakes from fat in the current study was located in the range recommended in New Zealand. In total, the study group had high energy intakes from fat, even though the main type of fat was monounsaturated. An increase in unsaturated fatty acids and decreased saturated fat intakes has been shown to have some protective benefits in the metabolic syndrome and cardiovascular health (Wahrburg, 2004; Riccardi, Giacco & Rivellese, 2004; Ros & Mataix, 2006). Wahrburg

(2004) reported that monounsaturated fatty acids had been shown to lower total and LDL cholesterol, not to affect the protective HDL cholesterol, and to protect against LDL oxidation. However, dietary monounsaturated fatty acids should be mainly obtained from plant oils and not from foods which are simultaneously rich in saturated fatty acids. Meanwhile, polyunsaturated fatty acids have been proved to have anti-atherosclerotic effects. Ros and Mataix (2006) suggested that, replacing fatty foods in the diet with nuts that contained both mono- and poly-unsaturated fatty acids, could provide health benefits by giving increased protection against the development of cardiovascular diseases.

The results from the current study are similar to a comparison study between Chinese in North America and China, and Lee (1994) reported that dietary fat provided 35% of total energy intakes for Chinese in North America and only 22% for Chinese in China. The mean percentage of energy intakes from fat was 35% in urban China, reported in the Chinese National Nutrition and Health Survey 2002 (Li et al., 2005). In contrast, a previous early study of Chinese immigrants in America between 1981 and 1983 (Choi et al., 1990) reported that Chinese participants in America were physically active and consumed 57% of energy intakes from carbohydrate and 24% energy from fat intake. Traditionally, the Chinese diet was lower in fat compared to the Western diet, and only 28.4% of energy intake was from fat, in the 1992 study (Li et al., 2005). With the nutrition transition, Chinese have increased their fat intake contribution to the total energy intake within the most recent twenty year period (Li et al., 2005). Although the participants in this study had a higher energy intake from fat, the patterns of fat distribution clearly showed the quantity of their dietary fat intake. Studies reported that both the quality and quantity of dietary fat intakes are associated with the risk of developing type 2 diabetes mellitus (Steyn et al., 2004; Hu, Dam & Liu, 2001; van Dam, Rimm, Willett, Stampfer, & Hu, 2002). Separately, a cross-sectional study of urban Chinese adults (Yao et al., 2003) reported that dietary fat could not play a significant role in predicting body fatness, though dietary variety had an important influence on Chinese adult body composition.

Dietary fat intakes are mainly from cooking oil in China because of the most popular cooking method, stir frying (Pan, Wang, Chang & Chen, 1993). It was a similar phenomenon in the current study group. Pan et al. reported that a wide range exists in using

the amount and type of cooking oil, and, based on family preference, shapes of vegetables or meats which are used in the cooking process, cooking time, and heating conditions would affect the amount of oil absorbed. Therefore, it is extremely difficult to estimate how much oil which contributed to dietary fat intakes was eaten by the participants. However, frequently using cooking oil and rarely trimming meats were main contributors to dietary fat intakes, based on the comments from the participants during the interviews.

5.6.2 Carbohydrates and dietary fibre intakes

Chinese traditional diets used to have a high proportion of carbohydrate intake to total energy intakes. At least 55% of total energy should be derived from various kinds of food containing carbohydrate, as suggested by the FAO/WHO Expert Consultation in 1998 (Cummings & Mann, 2007). In the current study, the median energy intakes from carbohydrate were 45.3% and 39.5% for females and males, respectively, which is slightly lower than the New Zealand population (47% for females; 45% for males) as evidenced from the 1997 New Zealand National Nutrition Survey (Russell, Parnell & Wilson et al., 1999). As a type of carbohydrate, dietary fibre intake has been discussed as being vital, but there is no agreement in the recommendation. Lack of dietary fibre has been considered as one of the important risk factors for type 2 diabetes mellitus (Steyn et al., 2004; Murakami et al., 2005; Hu, Dam & Liu, 2001), because it is one of the factors influencing post-prandial glucose and insulin responses. High dietary fibre intakes make a significant contributor to promote or protect against weight gain or obesity (World Health Organization, 2003). The study participants aged 30 to 50 had significantly lower intakes of dietary fibre than the agreed established value from the Nutrient Reference Values for Australia and New Zealand (RNIs). Separately, both male and female participants with ages over 50 had higher dietary intakes than the RNIs values. Younger participants in this study consumed less fruit, vegetables and wholegrain cereals than the elderly. However, a Chinese study with the elderly in Auckland (Xie, 2003) reported that the mean dietary fibre intake for males was 19.2g and 18.2g for females. Non-starch polysaccharide is one of major components of dietary fibre, so that food rich in non-starch polysaccharides, as an important source of dietary fibre intake, can reduce the risk of developing type 2 diabetes mellitus (Mann, 2007). In order to reach daily intakes of 20g in dietary fibre, wholegrain

cereals, legumes, fruits and vegetables should be consumed regularly by the participants who had low intakes of dietary fibre.

5.6.3 Micronutrients and minerals intakes

Most of the micronutrients intakes reached or exceeded the Chinese RNIs and the EARs/AIs from the Nutrient Reference Values for Australia and New Zealand. However, both male and female participants had a lower level of folate intakes than the updated EAR values (Minstry of Health, 2006). It is possible that Chinese participants consumed less breakfast cereals, most of which have been fortified with folic acid in New Zealand. Both dietary folate intake and folate supplements have been investigated and found to be related to cardiovascular disease by observational studies (Rimm et al., 1998; He et al., 2004; Voutilainen, Rissanen, Virtanen, Lakka & Salonen, 2001). After 14 years, with a follow-up cohort study, Rimm et al. (1998) found that women who had higher intakes of folate either from food or supplement sources had lower risks of coronary heart disease. Also, the results from the Kuopio Ischemic Heart Disease Risk Factor study showed an inverse association between moderate-to-high daily folate intakes and a reduced incidence of acute coronary events among middle-aged men in Finland.

The intakes of another two nutrients, selenium and thiamin, for female participants were lower than the RDIs. One of the reasons for a low intake of selenium is that New Zealand has a naturally low selenium status within soil. In particular, noticeable high intake of sodium was observed in both female and male participants, which is about 490% of the RDIs.

High sodium intakes are generally related to an elevated blood pressure. Unfortunately, there were no data recorded of blood pressure in this current study. However, a previous study of elderly Chinese in Auckland revealed a relatively low mean sodium intake (2165mg for men; 2146mg for women) because of possible underestimation, and the non-quantifiable use of salted seasonings (Xie, 2003). Another Chinese study (Zhao et al., 2004) observed the different prevalence of high blood pressure between Northern and Southern China. They found that the differences in the dietary sodium and sodium potassium ratios

were varying regional blood pressure in China. According to 2003/04 New Zealand total diet survey (Vanhoort & Thomson, 2005), higher sodium concentrations were found in processed than unprocessed food items, and bread and processed meats contributed to the single greatest sodium intake. There are no sodium intake data in the 1997 New Zealand National Nutrition Survey; however, the two largest surveys of urinary sodium excretion in New Zealand were conducted in 1975 and 1981. The results from the 1981 survey showed the equivalent salt intake (10.1 g/day for males; 7.8 g/day for females). Another local study in Dunedin, Waikato and Taranaki from 1993 to 1998 showed a slightly lower sodium intake (9.8 g/day for males; 7.1 g/day for females). In total, manufactured foods provided about 7 g/day of salt and only 1.5 g/day from salt added at the table in the New Zealand diet (Ministry of Health & the University of Auckland, 2003). The high sodium intakes observed in the current study were related to the consumption of salted/preserved vegetables and processed meat, even though the data from the food frequency questionnaire did not confirm a high frequency of eating preserved food.

Furthermore, from this study, both males and females with ages ranging from 30 to 50 had low intakes of vitamin D and Calcium. In addition, low iron intakes occurred among the females. Females aged 50 to 70 years also had low intakes of vitamin D and calcium. When compared to the results to the study of the elderly Chinese in Auckland (Xie, 2003), calcium, zinc, vitamin A and vitamin D insufficiencies were observed. The low intakes of both calcium and vitamin D are considered to be associated with bone health (Hu, Zhao, Jia, Parpia & Campbell, 1993; Walker et al., 2007) and increased risks for type 2 diabetes/metabolic syndrome (Flores, 2005; Ortlepp, Lauscher, Hoffmann, Hanrath & Joost, 2001; Palomer, González-Clemente, Blanco-Vaca & Mauricio, 2007; Pittas, Lau, Hu & Dawson-Hughes, 2007), and cardiovascular disease (Zittermann, 2006; Zittermann, Schleithofff & Koerfer, 2005; Zittermann, Schleithoff, Tenderich, Berthold, Körfer & Stehle, 2003).

Calcium intake is associated with bone health, hypertension, and metabolic syndrome. Hu, Zhao, Jia, Parpia and Campbell (1993) reported dietary calcium from dairy products increased bone mass in both middle-aged and elderly Chinese women. Vegetable and soy bean products provided 41% of the calcium intake and the calcium absorption from these

vegetables was higher than that from milk (Weaver, 1998). According to case studies and the Nurses' health study, calcium intake was inversely associated with prevalence of type 2 diabetes after adjustment for vitamin D intake (Pittas, Dawson-Hughes, Li, Van dam, Willett, Manson & Hu, 2006). The low consumption of dairy products is prevalent in China because of a high incidence of lactase deficiency (Pun, Chan, Chung & Wong, 1991). In the current study, the cheap price, easy availability, and a wide range of dairy products may increase the dietary calcium intakes, but low consumption of other vegetables and soy bean products possibly have led to the low calcium intakes for the participants. As milk supplies up to two-thirds of the total daily calcium intakes in Western countries, increasing milk intake should be recommended for these participants. Other good dietary calcium sources include cheese, yoghurt, soy milk, leafy vegetables, which may provide more calcium for the needs of the participants. Goulding (2007) listed some subgroups with special nutritional needs in dietary calcium, including people with high intakes of common salt, elderly people and people with food allergies or lactose mal-absorption.

Besides dietary calcium intakes, both male and female participants had low intakes of dietary vitamin D. The biological form of vitamin D in the blood, $1,25(OH)_2D_3$, is synthesised a first hydroxylation process taking place in the liver and a second hydroxylation occuring in the kidney. About 30% of vitamin D is usually obtained from the diet, with the remaining vitamin D requirements being met from the conversion of 7-dehydrocholesteriol in the skin to previtamin D_3 through the ultraviolet rays of the sun (Palomer, González-Clemente, Blanco-Vaca & Mauricio, 2007). The major function of vitamin D is to maintain calcium and phosphorus homeostasis and promote bone mineralization. The results from a study of 126 healthy subjects in California (Chiu, Chu, Go & Saad, 2004) showed a positive relation between 25-hydroxyvitamin D concentration and insulin sensitivity and a negative effect of hypovitaminosis D on β cell function. A cross-sectional survey conducted in New Zealand found (Scragg, Holdaway, Singh, Metcalf, Baker & Dryson, 1995) that newly diagnosed patients with type 2 diabetes mellitus or impaired glucose tolerance had lower 25-hydroxyvitamin D than the matched control group. A recent cohort study among the MiniFinland Health Survey study population (Mattila et al., 2007) found a significant inverse relationship between serum 25-

hydroxyvitamin D and risk for type 2 diabetes mellitus, but the association was attenuated after the adjustments for BMI, leisure-time exercise, and education. Also, the Nurses' Health study (Pittas et al., 2006) found that women who consumed 800 IU or more vitamin D per day had a 23% lower risk for developing diabetes when compared to those who consumed less than 200 IU per day after adjusting for age, BMI, and non-dietary covariates; and women who took more than 400 IU per day vitamin D from supplements had a 13% lower risk of diabetes than women who consumed less than 100 IU vitamin D supplement per day.

Even though vitamin D deficiency should be diagnosed by a blood test, the participants had low dietary intakes of vitamin D. Oily fish, meat, milk and eggs are relatively good dietary sources of vitamin D, which could be helpful in increasing dietary vitamin D intakes for the participants. In addition, environmental UVB exposure is another important natural source of vitamin D. Outdoor physical activities were not investigated in this current study group, but they should be encouraged to expose themselves to sunlight, especially during the winter time.

Low iron intakes were found in the females with ages 30 to 50 years, whereas the mean iron intakes of males were above the Chinese RNIs and the EARs from the Nutrient Reference Values for Australia and New Zealand. Iron deficiency is a global public health issue, in particular, in developing countries (China), because of the low bioavailability of dietary iron in the plant-based diets (Chen, 2003). Based on the Chinese National Nutrition and Health Survey in 2002, 15.2% of the general population was anaemic, and the prevalence of anaemia in young women was significantly higher than men (Li et al., 2005). In order to reduce the incidence of iron deficiency, iron fortified soy sauce has been developed in China (Chen, 2003). Dark red meat, organ meat, soybeans are good sources of dietary iron. However, the participants consumed less red meat even than the New Zealand population, even though these meats are readily available in the New Zealand markets.

5.7 Blood tests results

Fasting plasma glucose (FPG), HbA_{1c} and total cholesterol (TC) levels were measured in some subjects in this current study. The detailed serum lipid levels were not tested due to economic restrictions. Otherwise, a further analysis of risks for type 2 diabetes and cardiovascular diseases would have been conducted. Two participants had abnormal FPG and HbA_{1c}, and were referred on to their preferred general practitioners. The result from a study of Chinese elderly in Auckland (Xie, 2003) showed only one person who had an elevated fasting glucose level, based on the finger-prick test. More male participants than females in this group had total cholesterol levels above 5.0mmol/l, which is the recommended cut-off point considered by the New Zealand Heart Foundation as the lower border of 'high' risk. Moreover, more participants with low physical activity levels had elevated cholesterol levels (5.7-6.5 mmol/l) than those with high physical activity levels. Participants who had a higher level of total cholesterol may be advised to do further blood lipid tests in order to estimate their risk factors for chronic diseases.

5.8 Integration with acculturation levels

5.8.1 High acculturation group

In the current study, meal eating patterns, food choices, physical activity, body measurements and blood test results were compared in the participants in the low and high acculturation subgroups. The participants with high acculturation scores were more likely to consume Western breakfasts, lunches and morning teas, when compared to the participants with low acculturation scores. A higher consumption of milk and/or dairy products was observed in the participants with high acculturation scores. A significantly higher percentage of males with high acculturation scores in the current study reported consuming bread more frequently. Relatively higher percentages of the participants from the high acculturation groups ate beef or beef mince more frequently than those from the low acculturation groups. An increased consumption of processed meat was observed among female participants with high acculturation scores.

A higher percentage of males with high acculturation scores had elevated BMI, waist circumference and WHR, when compared to the percentages of those in the low acculturation group. It was significant that the participants with high acculturation scores had a greater sugar intake than those in the low acculturation groups. Total fat and dietary cholesterol intakes were higher in the high acculturation group than that in the low acculturation group. The participants with high acculturation scores had higher intakes of vitamin D and E than those in the low acculturation group. Female participants in the high acculturation group had higher sodium intakes than those with low acculturation scores.

5.8.2 Low acculturation group

The participants with low acculturation scores were likely to consume fish or seafood more frequently than those from the high acculturation groups. Also, they were likely to consume certain vegetables, mushroom, capsicum, sprouts, seaweed and radish, more often than other participants with high acculturation scores. According to the results from body measurements, females within the low acculturation group had greater BMI values and waist circumferences than those in the high acculturation group. Based on the physical activity result, low acculturated participants spent much longer on physical activities at work and/or travel from one place to the other, and less time in recreational activities; participants in the high acculturation group had a reverse pattern. Totally, thirty-three participants had their blood tested for fasting plasma glucose, HbA_{1c} and total cholesterol. There were two participants who had elevated fasting plasma glucose and HbA_{1c} levels. Both of them had low acculturation scores. The participants with low acculturation scores had a higher median total cholesterol level than those in high acculturation groups. In addition, a higher percentage of total energy intakes from fat was observed in the low acculturation group.

5.8.3 High and low acculturation groups

The participants in both low and high acculturation groups preferred to consume pickled vegetables regularly. Chinese dinners were consumed by the majority of the participants, whether or not they had low and high acculturation scores. Rice was still the predominant

carbohydrate containing food for most of the participants, and chicken and pork were the preferred meats of the majority of the participants.

To summarise, the acculturation process did affect dietary habits and lifestyles of these participants, but only gradually over time. They did not alter their traditional food preferences or lifestyles completely, but some with high acculturation scores started to adopt new foods, eating habits and lifestyles, as well as maintain their traditional preferences. Other Chinese studies in America (Nan & Cason, 2004; Demory-Luce, Morals & Nicklas, 2005) also found that Chinese immigrants increased their intakes of processed food, fats, and sweets, and simultaneously decreased their consumption of traditional Chinese foods. The changes they made, or they did not make, may have positive or negative influences on their general health and wellbeing, possibly increasing risk factors for type 2 diabetes mellitus.

5.9 Increased risk for diabetes

Increased risk factors for type 2 diabetes mellitus include overweight, obesity, abdominal obesity and physical inactivity, supported by convincing evidence (World Health Organization, 2003). With nutrition transition, dietary patterns change gradually in a way which is associated with increased prevalence of chronic disease (Popkin et al., 1993; Lieberman, 2003). Some dietary factors, such as high intakes of total fat and saturated fat, or trans-fatty acids, or low intakes of dietary fibre, are known to be associated with the development of type 2 diabetes mellitus.

5.9.1 Dietary fat intake

In the current study, the participants had higher total fat intakes contributing to total energy intake than even the upper end of the recommended intakes range (less than 35% of energy) from the Acceptable Macronutrient Distribution Ranges (AMDR). In particular, saturated and trans fats together should be limited to no more than 10% of total energy intake, to avoid the risks for obesity and cardiovascular disease (Ministry of Health, 2006b). However, female and male participants had 11.6% and 12.0% saturated fatty acids intakes

of energy, respectively, which were both higher than the recommendation (less than 10%). High total fat or saturated fatty acid intakes have been shown to affect insulin sensitivity independently of any change in body weight (Parillo & Riccardi, 2004). High saturated fatty acid or trans-fatty acid intakes have been considered to be associated with increased risk for type 2 diabetes mellitus (Steyn et al., 2004). The results from the KANWU study conducted by Vessby et al. (2001) found that replacing saturated fat by mono-unsaturated fat significantly improved insulin sensitivity in healthy subjects. On the positive side, the predominant fat intakes of the participants were mono-unsaturated fatty acid. However, high total fat intakes and relatively high saturated fat intakes will increase the risks for type 2 diabetes mellitus.

5.9.2 Carbohydrate and dietary fibre intake

Participants did not reach the target recommendation of 45 to 65% of energy intake from carbohydrate, as detailed in AMDR. Meanwhile, carbohydrate intakes should arise predominantly from low energy density or /and low glycaemic index foods (Ministry of Health, 2006b). In addition, a lower dietary fibre intake (21.5g) was observed in the female participants, but not in males. Dietary fibre intake has been discussed in relation to the process of developing type 2 diabetes mellitus (Hu et al., 2001; Lindstrom et al., 2006). Hu et al. (2001) reported that high intakes of dietary fibre were observed to improve glycaemic control and insulin response.

5.9.3 Micronutrient and mineral intakes

Female participants in this study had lower median intakes of folate, vitamin D, calcium, and selenium, when compared to the EAR/AI values from the Nutrient Reference Values for Australia and New Zealand. Fifteen out of twenty-seven female participants (55.6%) had their folate intakes less than 320 μg (the EAR value). Twenty out of twenty-seven female participants (74.1%) and seven out of seventeen male participants (41.2%) had lower intakes of calcium than the EAR value. Low vitamin D intakes were observed in both female and male participants, and the percentages of participants who had less vitamin D intakes than the EAR value were 88.9% for females and 88.2% for males. Finally, 51.9% of female and 41.2% of male participants had lower intakes of selenium than the EAR values.

Among these low intakes of micronutrients and minerals for the participants, much lower intakes of vitamin D and calcium were observed among the entire group of the participants. Vitamin D status has been discussed to be associated with insulin synthesis and secretion, even related to the development of type 2 diabetes mellitus or metabolic syndrome (Ortlepp, Lauscher, Hoffmann, Hanrath & Joost, 2001; Palomer, González-Clemente, Blanco-Vaca & Mauricio, 2007; Pittas, Lau, Hu & Dawaon-Hughes, 2007; Zittermann, 2006). Pittas, Lau, Hu and Dawaon-Hughes (2007) reviewed observational studies and clinical trials in adults and suggested vitamin D had a potential effect on the pancreatic b-cell function, insulin resistance and inflammation. In the Nurses Health Study, women with the highest calcium and vitamin D intakes had a lower risk of type 2 diabetes mellitus compared with women who had the lowest calcium and vitamin D intakes, after adjusting for multivariates (Pittas, Lau, Hu & Dawaon-Hughes, 2007). Another experimental study in the United Kingdom (Zittermann, 2006) found that a prevalence of diabetes is much higher, and that serum 25-hydroxyvitmain D was significantly lower in dark-skinned Asian immigrants when compared to those in British Caucasians.

In two of the most recent articles, Whiting, Green and Calvo (2007) and Shrapnel and Truswell (2006) reported that there was a high prevalence of insufficiency of vitamin D among the New Zealand population based on serum 25(OH)D levels. Whiting, Green & Calvo (2007) found that Japanese people were more easily able to maintain their desirable serum 25-hydroxyvitamin D because they regularly consumed fatty fish (the richest natural source of vitamin D) in their diets. The main dietary source of vitamin D is oily fish and meat. The latest Nutrient Reference Values for Australia and New Zealand (Ministry of Health, 2006b) recommended 5 μg per day for adults 50 years age or less, 10 μg per day for adults 51-70 years of age and 15 μg per day for adults aged over 70 years, in order to maintain defined levels of plasma 25-hydroxyvitamin D, together with limited sunlight exposure. The consumption of current food sources is considered to cause difficulty in reaching the new recommendation, increased voluntary fortification of yoghurts and some reduced-fat milk has been suggested by Shrapnel and Truswell (2006). Also, both female and male participants had considerably higher intakes of sodium than the Upper Level value from the Nutrient Reference Values for Australia and New Zealand.

The inadequate nutrient intakes within the study group mentioned above are based on the values of Estimated Average Requirement (EAR) from the Nutrient Reference Values for Australia and New Zealand (Ministry of Health, 2006b). The EAR values are used to plan for an acceptably low prevalence of inadequate intakes within a group, and one of the methods for planning nutrient intakes of groups is the EAR cut-off point (Institute of Medicine, 2003). A certain proportion of the current study group with usual intakes less than the EAR values were considered to have inadequate intakes. This was only a small number of participants in the current study group, so the number was not significant enough to statistically identify the actual situation regarding inadequate intakes of nutrients. However, further research will be required to be conducted to establish the significance of these nutrients intakes.

5.9.4 Body measurements and blood test results

The incidence of overweight and/or obesity affected 43.2% of the entire participants. Additionally, 63.5% of males and 29.6% of females were overweight or obese, when aligned with the BMI values of the Chinese standard cut-off points. People with the waist circumference > 80 cm for females and > 85 cm for males have increased risks associated with excess abdominal fat in adults, according to the Chinese standard. There were 15.9% of females and 25.0% of males who had increased risks for type 2 diabetes mellitus.

Two participants had elevated fasting plasma glucose and HbA_{1c}, and 45% of female and 53% of male participants had their total cholesterol levels higher than the recommended cut-off point (5.0mmol/l) considered by the New Zealand Heart Foundation as the lower border of "high" risk. However, total cholesterol levels are not enough to estimate the risks for the development and outcomes from type 2 diabetes. A detailed serum lipid profile, including low-density, high-density, very-low-density lipoproteins and triglycerides should be investigated.

5.9.5 Physical activity levels

Physical inactivity has been shown to increase the risk for type 2 diabetes mellitus (Kriska et al., 2003; Hu et al., 2003; World Health Organization, 2003). In the current study, 37% of female and 41% of male participants had low PAL levels. When compared the average

time spent on physical activities per day between low acculturation and high acculturation groups, participants with low acculturation scores (81.1 minutes) spent more time than those participants with high acculturation scores (43.7minutes). Additionally, participants with low acculturation scores spent more time on work and transport per week (469 minutes), rather than recreational activities (98.0 minutes). In contrast, participants with high acculturation scores spent similar times on recreation activities (133 minutes) and work and transport (174 minutes). Significantly, 26.3% and 52.0% of participants having low and high acculturation scores, respectively, had low physical activity levels. As has been noted, participants within the high acculturation group were less likely to be physically active, when compared to participants with low acculturation scores. Altogether, participants in the high acculturation group possibly may have increased risks for type 2 diabetes mellitus, because physical inactivity may affect their energy balance and then lead them to gain body fat and reduce glucose metabolism. Increasing physical activity levels has been used by public health campaigns as a strategy to reduce obesity and type 2 diabetes mellitus (Bazzano et al., 2005). According to the New Zealand Guidelines (Ministry of Health, 2004), at least 30 minutes of moderate-intensity physical activity on most days of the week is recommended.

5.10 Limitations of the study

First of all, the major limitation of this study was the small sample size of Chinese people based in Palmerston North, so that the result from the study cannot be generalised to Chinese in other districts, or within New Zealand. Further, all the participants in this study were self-selected, which may introduce bias into the study result. In addition, two participants who were born in New Zealand had to be excluded from the data analysis because of their distinctively different situations in the main variables. Also, the insufficient numbers of people who were born in New Zealand limited the comparison study to other Chinese migrants. Meanwhile, seven related couples volunteered for this study, which possibly affects the validity of their data because the eating habits and food choices between each couple was considered to be identical.

Secondly, a further limitation is the nature of questionnaires. In particular, the acculturation questionnaire was modified from the SL-ASIA, which has been used mostly for Asian international students. Moreover, the validity of answers gained from the acculturation questionnaire mostly depends on the participant's full understanding. Even though the food frequency questionnaire had been abbreviated, it was still difficult for the participants to complete it properly in full. Also, errors arose from the frequency estimations and the estimation of usual serving sizes, even though some models of serving sizes had been displayed and explained carefully to the participants before they started to complete the questionnaires.

The third limitation is from the other dietary assessment method used in this study, the 24 hour dietary recall. Due to the choice of whether or not the participants decided to take the blood test, some participants only had one 24-hour dietary recall. Others had three 24-hour dietary recalls, conducted through both a face-to-face interview and following two telephone interviews. The variances within-individuals and between individuals in 24-hour dietary recalls may limit the validity of both macronutrients and micronutrients intake data. Seasonal food availability and estimating portion sizes may affect the dietary data.

Fourthly, both Chinese food composition tables (2002 and 2004) were used to calculate the nutrient content of the Chinese foods consumed which were not available from the New Zealand food composition table. Due to a different growing environment in New Zealand, the nutrient content of Chinese vegetables in the Chinese food composition table cannot reflect accurately food grown in New Zealand. Moreover, imported Chinese food may not have the same brand or nutrient contents as those in the Chinese food composition tables.

Fifthly, the Food Works Professional 2005 was used to calculated participants' dietary intakes. The Chinese participants provided their own cooking recipes where the nutrient contents of mixed cooked food are different from individual foods, and also nutrient content depends on which preparation or cooking methods individual people use.

Finally, blood pressure and detailed serum lipid profiles were not measured in this study, although such measures would be good indicators for the risk factors of type 2 diabetes

mellitus. In addition, a significantly high sodium intake was found in this study group. Elevated blood pressure is considered to be related to dietary sodium intake. Detailed serum lipid profiles may provide a better understanding of the risks for the development and outcomes of type 2 diabetes mellitus, and even cardiovascular diseases.

Chapter 6 CONCLUSION and RECOMMENDATIONS

This study was conducted to investigate acculturation levels, dietary changes during the process of acculturating to a new culture, and risk factors for type 2 diabetes mellitus among Chinese in New Zealand. An increased number of Chinese have migrated to New Zealand, a multicultural country, and their food choice and eating patterns have been affected by this new cultural environment to a greater or lesser extent. The process of acculturation among these Chinese participants has gradually influenced their eating patterns and lifestyles, and it may affect their future health outcomes.

The study sample of 46 participants was self-selected from a single city, Palmerston North. The majority of the study group was from Mainland China, but two participants were born in New Zealand with Chinese parents. During the process of data analysis, these two participants were excluded because of their distinctively different eating patterns and lifestyles, and also the number in this group was too small to draw significant conclusions. Relatively, this study group had a high socioeconomic status, when compared to either Palmerston North in general or the wider New Zealand population. The most interesting point gathered from sample characteristics was that 40% of the entire study group had a family history of diabetes, which may be the trigger for them to take part in this study. Moreover, Chinese participants were less likely to visit their preferred General Practitioners regularly unless they felt unwell, when compared to the usual habits of the New Zealand population.

The findings from this study indicated that participants with high acculturation scores had adopted some Westernised meal eating patterns, food choices and lifestyles. They tended to have a Western style breakfast: toast, table spread, peanut butter, or jam, together with coffee, regularly, instead of Chinese-style breakfast (rice, steamed buns, or noodles). In addition, many participants in the high acculturation group were working with Western colleagues, and they accepted the routine to have morning tea or afternoon tea with other

staff members. Normally, there was coffee or Western tea, together with muffins, biscuits, cakes. Potentially, the participants in this high acculturation group increased their consumption of sweets, desserts and caffeine containing drinks by eating Western breakfast or drinking morning or afternoon tea. It is important nutritionally to reduce the consumption of sweet foods for these participants, by encouraging them to eat fresh fruits or drink green tea during their tea break time. Moreover, bread or cereals made from whole grains should be consumed for breakfast because they are good sources of thiamin, fibre, and significant amounts of minerals.

Participants in the low acculturation group tended to eat more fruits or vegetables, in particular, available Chinese fresh or seasonal vegetables, when compared to those consumed by the highly acculturated group; however, the difference was not statistically significant ($P > 0.05$). It will be useful in the future to estimate fruit or vegetable intakes by collecting more data about how many serving sizes of fruits and vegetables people eat regularly.

In this study, the acculturation score was found to be positively associated with the residency length. In other words, the longer time participants had been living in New Zealand, the greater score they amassed. When they had been living in a new environment for a certain period of time, their food choice and eating patterns would be impacted by their Western friends, colleagues, even their young children. The advantages from acculturating to a New Zealand diet were to increase the consumption of dairy products and meat. However, cheap convenient takeaway foods, sweets, desserts and processed meat products were available also. Traditional Chinese diets consist of low fat and high carbohydrate intakes, and a variety of fruits and vegetables, which should be maintained by the participants, even though they were slowly acculturating to the new culture. Meanwhile, they need to stay away from a typical Western-style diet which contained high fat, high sugar and low carbohydrates. Nutrition education programmes should be developed for targeting Chinese in New Zealand in order to enhance their knowledge in health eating and physical wellbeing, because most of the education programmes available were aimed at the local population.

Physical inactivity is another increased risk factor in the development of type 2 diabetes in terms of failing to keep an appropriate energy balance. The participants in the high acculturation group had much lower physical activity levels in the workplace and in travel, when compared to those with low acculturation scores. Some of participants with high acculturation scores did spend some time at recreation centers, but their physical activity levels were not enough to reach the recommendations from New Zealand Ministry of Health. Both low and high acculturated groups of participants should be encouraged to increase their physical activities on a daily basis.

According to the group dietary intakes in this study, low dietary fibre, vitamin D and calcium, together with extreme high sodium intakes were all observed. Only female participants aged 30 to 50 had low dietary iron intakes. Less regular consumption of dairy products and fish or seafood could lead to low calcium and vitamin D intake. Participants who frequently ate pickled vegetables or canned processed foods would have high intakes of sodium, which increases the urinary secretion of calcium. In addition, staying indoors or having less physical exercises could reduce the exposure to the sunlight, which is another way to increase serum 25-hydroxyvitamin D. Recently, low vitamin D and calcium intakes have been discussed as being likely to increase the risks to type 2 diabetes mellitus or metabolic syndrome, and the combination of dietary supplements in vitamin D and calcium are thought to have beneficial influences in reducing the risk of diabetes. To summarise, low dietary intakes of vitamin D, calcium and fibre may be leading to increased risk factors for the development of type 2 diabetes mellitus among this Chinese group. Further research of vitamin D, calcium and dietary fibre intakes should be seriously considered to obtain more data for analysis of this important research finding.

Findings also showed that 43.2% of the participants were either overweight or obese based on the Chinese Standard of BMI values. Furthermore, a greater percentage of participants within the low acculturation group were overweight or obese than those with high acculturation scores. However, this phenomenon may be directly affected by age and gender distribution in two acculturation groups as well as their diet and physical activity levels.

There were two participants who had abnormal fasting plasma glucose and HbA_{1c} values among the thirty-three participants who volunteered to draw blood samples. Elevated total cholesterol levels were found among 16 out of 33 participants. However, listing only total cholesterol levels is not enough to estimate the risks for the development and subsequent outcomes from type 2 diabetes mellitus.

Recommendations

The number of the participants who were self-selected in the study sample limited the ability for the study to be generalised to other Chinese groups in New Zealand. A random selection of participants of a larger number is suggested for a future study of Chinese migrants in New Zealand, in order to reduce selection bias and to be representative of Chinese migrants settling in New Zealand.

Furthermore, two participants who were born in New Zealand took part in this study, giving some data which could not be used in comparison with other Chinese migrants. Since these two participants had distinctive acculturation scores, eating patterns and lifestyles, it would be worthwhile to have more participants who are born in New Zealand in a future study. Then it may be possible to compare Chinese born in New Zealand to Chinese who migrated here in their later lives.

This current study did not collect the data of participants' nutrition knowledge, which is one of factors in changing diets and eating habits. Future studies may investigate the knowledge of nutritional aspects, which will indicate the necessity of nutrition education in encouraging healthy eating and physical activity.

In addition, further blood tests of lipid profiles will be useful in estimating risks for the outcomes of type 2 diabetes mellitus and in the specifying of individual risk factors versus a five-year cardiovascular risk-prediction equation, derived from the Framingham Heart Study.

Furthermore, low dietary vitamin D intakes were observed in this study group, which did not determine whether they had a vitamin D deficiency or insufficiency. Further blood tests with serum 25-hydroxyvitamin D (25-OHD) concentration should be conducted in this high risk group.

Finally, nutrition education programmes should be developed for targeting Chinese in New Zealand. The programme should include encouraging them to maintain their healthy dietary patterns and to increase the consumption of vegetables and fruits. Also, the proramme should encourage Chinese migrants to take part in a wide variety of physical activities.

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APPENDIX A

Human Ethics Approval

Massey University

OFFICE OF THE ASSISTANT
TO THE VICE CHANCELLOR
(Ethics & Equity)
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2 August 2006

Ying Jin
133 Albert Street
PALMERSTON NORTH

Dear Ying

Re: HEC: Southern A Application – 06/38
Dietary acculturation of Chinese in the Manawatu in association with risk factors for type 2 diabetes

Thank you for your letter received 26 July 2006.

On behalf of the Massey University Human Ethics Committee: Southern A, I am pleased to advise you that the ethics of your application are now approved. Approval is for three years. If this project has not been completed within three years from the date of this letter, reapproval must be requested.

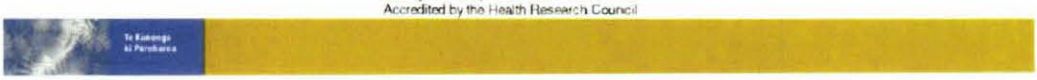
If the nature, content, location, procedures or personnel of your approved application change, please advise the Secretary of the Committee.

Yours sincerely

Professor John O'Neill, Chair
Massey University Human Ethics Committee: Southern A

cc Dr Jeanne Lawless
IFNHH
PN452

Prof Richard Archer, HoI
IFNHH
PN452



APPENDIX B

Advertisements and fliers used in recruitment (English and Chinese)

Massey University

DIET AND HEALTH

Would you like to help out with a study looking at the diet and health of Chinese (New Zealand-born and overseas-born) who live in the Manawatu region of New Zealand? In specific, we are interested in looking at how diet is related to increased risk for diabetes. The study will be conducted between July and December 2006 in Palmerston North at Massey University's Turitea campus, by Ying Jin, a Master's student, under the supervision of Dr. Jane Coad, a senior lecturer, from the Institute of Food, Nutrition and Human Health (IFNHH). Your involvement will not only help to learn more about how diet and other lifestyle practices influence the health of Chinese living in Manawatu with respect to diabetes risk factors, but you will also learn more about your own specific dietary intakes and health outcomes.

If you are

-30 years of age or older;

-50% - 100% Chinese descent; (e.g. You have both parents who are Chinese or at least one parent who is Chinese born in New Zealand or overseas);

*-**NOT** living here in New Zealand on a student visa;*

And if you

-have never been diagnosed with type 1 or 2 diabetes;

Then you may join the study.

-If you would like additional information about the project, you may contact one of us and we will send you an information packet.

For inquiries in English
Chris Booth,

IFNHH,
Massey University,
Palmerston North
P: (06)350-5901; 0800 0800 28
E: C.L.Booth@massey.ac.nz

For inquiries in Chinese
Ying Jin
MSc student
IFNHH,
Massey University
Palmerston North
P: (06) 350 5532
E: yingjin816@yahoo.com.cn

For any other requires relating to the project overall
Dr. Jane Coad
Supervisor
IFNHH,
Massey University
Palmerston North
P: (06) 350 5962
E: j.coad@massey.ac.nz

This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern A, Application 06/38. If you have any concerns about the conduct of this research, please contact Dr John O'Neill, Chair, Massey University Human Ethics Committee: Southern A, telephone 06-3505799 x 8635, email humanethicsoutha@massey.ac.nz

YES, I would like more information please about the study on the Diet of Chinese in the Manawatu in relation to health/diabetes risk! Please send an information packet to me at the following address:

Surname: _____ First Name:_____

Mailing Address: _____ Contact Telephone No._____

Return this slip to:Chris Booth, Institute of Food Nutrition and Human Health, P/Bag 11 222, Massey University, PN

Massey University 

征集志愿者

饮食和健康

你愿意协助我们进行居住在玛那瓦图地区的中国人的膳食摄入和健康状况的研究吗？特别是饮食改变和患二型糖尿病风险的研究。 这项研究会由金莹， 梅西大学在读硕士生，具体负责， 她的导师是 Jane Coad, 梅西大学食品营养人类健康学院的讲师，在梅西大学北帕默斯顿校区实施大约在 2006 年的 8 月到 12 月。 你的参与不仅能帮助我们了解饮食和其它生活习惯对患二型糖尿病风险的影响，而且你还能了解你自己的饮食和健康状况。所有的志愿者都会收到一份他们自己的膳食模式和体格测量的分析报告， 参加血检测的志愿者会收到一份完整的血液分析报告。

参加的要求：

如果你是：

- 30 岁或以上；

- 100%中国血统或至少 50% 中国血统；（也就是说父母亲中至少有一个的父母亲是完全的中国血统，无论出生在哪里；

- 居住在新西兰，持有学生签以外的其它签证；

如果你

从来没有被诊断过一型或二型糖尿病，

那么你就可以参加这项研究。

如果你对这项研究感兴趣，请和我们联系，我们会提供给你更多相关的信息和解答任何相关的问题。

要求英文
Chris Booth,
食品，营养 和人类健康学院，
梅西大学， 北帕默斯顿
联系电话: (06)350-5901，
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要求中文
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食品，营养 和人类健康学院，
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这项研究已经被梅西大学人伦委员会 Southern A 备案和通过，编号是 06/38。 如果你对这项研究有任何的问题， 请联络梅西大学 Southern A 主席， Dr John O'Neill， 电话是 06 350 5799 x 8635, 电子邮件地址是： humanethicsoutha@massey.ac.nz.

是的，我愿意了解更多有关这项研究的信息，请寄给我有关的文件，联系地址如下。

姓－－－－－－－－－－名－－－－－－－－－－

邮寄地址：－－－－－－－－－－－－－－－－－－ 联系电话：－－－－－－－－－－－－－－－－－

请将这页寄回 Chris Booth, Institute of Food, Nutrition and Human Health, P/Bag 11 222, Massey University, Palmerston North.

APPENDIX C

Participants' consent form (English)

Project Title: Dietary acculturation of Chinese in the Manawatu in association with risk factors for type 2 diabetes

PARTICIPANT CONSENT FORM

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

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I understand I have the right to withdraw from the study at any time and have the right to decline to answer any particular questions. I agree to provide information to the researcher on the understanding that my name will not be used.

I, _____, consent to participate as a subject in this study under the conditions set out in the Information Sheet.

OPTIONAL BLOOD SAMPLING COMPONENT AND TWO Additional 24-HOUR DIET RECALLS.

CIRCLE ONE:

I, _____, agree / do not agree to participate in the blood sampling component and two additional 24-hour diet recalls of this study.

Signature: ..... **Date:** .....

Full Name - printed

.....

Massey University

自愿参加者意向书

在玛那瓦图地区的中国人的饮食文化适应和患二型糖尿病风险因素的关系
这个意向书会被保存 5 年

我已经阅读了有关需要我不配合的资料并且了解了这项研究的具体情况。我的所有有关这项研究的问题已经得到满意的回答，我清楚地知道在参加研究的过程中任何时候我都可以提出任何问题并得到回答。我明白我有权在任何时候退出该研究和拒绝回答任何特殊问题。在未经我同意不能使用我的名字的前提下，我会给研究者提供我个人的资料。

我，————————，同意作为研究对象参加这项研究，条件与前面关于该课题的解释相同。

可选择的抽血检测和两次 24 小时饮食记录，选择一个答案：

我，————————，**同意、不同意** 参加这项研究中的抽血检测和两次 24 小时饮食记录。

签名：————————————　日期：————————————

印刷体的姓名：————————————

APPENDIX D

Participants' information sheet (English and Chinese)

Massey University

DIET OF CHINESE IN THE MANAWATU IN RELATION TO HEALTH

Do you want to know how your diet affects your health?

INFORMATION SHEET

What is the study?

We are looking at the diet and health of Chinese (New Zealand-born and overseas-born) who live in the Manawatu region of New Zealand. Specifically, we are interested in examining how diet relates to risks for type 2 diabetes.

Who are we?

Ying Jin, a Master's student in nutrition at Massey University, is doing this study. Her supervisor is Jane Coad, Senior Lecturer, Institute of Food, Nutrition and Human Health (IFNHH), Massey University. Chris Booth, also of the IFNHH, will be helping to recruit participants.

If you are

- 30 years of age or older;

- 100% Chinese descent, or at least 50% Chinese descent ;(e.g. You have both parents who are Chinese or at least one parent who is Chinese born in New Zealand or overseas).

*-**NOT** living in New Zealand on a student visa;*

And if you

-have never been diagnosed with type 1 or 2 diabetes,

Then you may join the study.

How will we use the data?

Data from this project will be used to look at the diet and health of Chinese. All of the information we collect from you will be kept confidential. No one apart from the researcher and her supervisor will be able to access the data. Your name will not be linked with any of the information that goes into reports about the study. After we have analyzed your data, we will send you a summary report about your own diet and clinical exam results.

How can you get more information about the study?

We have placed advertisements in several Chinese newspapers found in Palmerston North, including *The Trolley, Chinese Weekly PN,* and other newsletters, and Massey News. We also have placed fliers at relevant markets, churches, surgeries, and agencies. If you have any other questions about the study, please call either Chris Booth (for inquiries in English) or Ying Jin (inquiries in Chinese) at the contact numbers provided below. We will be recruiting a total of **150** participants. You will be reimbursed the cost of petrol or round-trip bus fare in order to come to one of the locations for this study.

What is involved?

You may come to ONE of the following locations (whatever is best for you):

-the Human Nutrition Lab at Massey University, Palmerston North
-the Manawatu Branch of New Zealand Chinese Association meeting room on Napier Road, Palmerston North
-the Ethnic Centre on Church Street, Palmerston North
-the piano room in the Palmerston North City Library, OR
-Tararua Medical Centre, Winchester Street, Levin

If you are interested in participating in this study, but are unable to leave your home, please contact one of the researchers. In exceptional circumstances, it might be possible for the researcher to come to your home.

You will complete:

1. *A Primary Questionnaire* which asks questions about your eating and activity habits and some background information about you; and a single 24-hour diet recall; and a *Food Frequency Questionnaire* (or it can be filled out in your own time and mail back).

2. *A clinical exam* where you will answer medical history questions and have measurements taken of your weight, height, waist and hip circumferences, and a non-diagnostic blood pressure.

3. **OPTIONAL** *FASTING BLOOD TEST* and an additional *TWO 24-HOUR DIET RECALLS.* If you **consent**, you may have your blood sampled at Medlab Central LTD in Palmerston North or the Medlab Tararua Collection rooms in Levin. Diet recalls will be done by telephone interviews at times that you tell us are "best times to call." You will report early in the morning before you eat, having fasted for 12 hours, and 20 mls of your blood will be taken by professional health care workers. This will measure your fasting blood glucose, HbA1c (glycosylated hemoglobin), and total blood cholesterol levels. Your

results will be reviewed by a physician and a summary report will be sent to you by the researcher. **You may withdraw your consent to have your blood drawn at any time.**

All of this will take between 3 to 5 hours of your time, depending on where you live and whether or not you are willing to have your blood sampled.

Are any of the procedures harmful or painful?

There will be minimal discomfort to you. You will feel a slight build up of pressure in your upper arm at the time your blood pressure is taken. If you would like to take part in the optional blood sampling, you may feel a slight discomfort from the needle prick. Professionals at Medlab will be collecting the blood samples, which will help lower any possibilities of discomfort.

What are your rights?

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- access to a summary of the project findings when it is concluded

What is the support process?

Participants who elect to have their blood sampled and have normal results, will receive a summary report of this. In order to discuss their results with a physician in the situation where abnormal blood results are obtained, the participants will have the option of either (1) coming in to the Human Nutrition Lab at Massey University for an appointment with Dr. Roger Lentle, a GP affiliated with the Human Nutrition Lab, OR (2) having their blood results sent to a physician of their choice. Participants electing to have their abnormal blood results sent out will designate this preference in Consent for Release of Information form that they will sign when they enroll in the study.

Contact details

If you have any questions about the project, or if you wish to participate in the study, you may contact one of us at:

For inquiries in English
Chris Booth, Institute of Food Nutrition and Human Health, Massey University, Palmerston North:
Office tel: (06)350-5901 0800 0800 28
Email: C.L.Booth@massey.ac.nz

For inquiries in Chinese
Ying Jin, MSc student, Institute of Food Nutrition and Human Health, Massey University, Palmerston North:
Phone number: (06) 350 5532
Email: yingjin816@yahoo.com.cn

For any other inquiries relating to the project

Jane Coad, PhD; Supervisor, Institute of Food Nutrition and Human Health, Massey University, Palmerston North:
Office tel: (06) 350-5962
Email: j.coad@massey.ac.nz

Compensation for Injury

If physical injury results from your participation in this study, you should visit a treatment provider to make a claim to ACC as soon as possible. ACC cover an entitlements are not automatic and your claim will be assessed by ACC in accordance with the Injury Prevention, Rehabilitation and Compensation Act 2001. If your claim is accepted, ACC must inform you of your entitlements, and must help you access those entitlements. Entitlements may include, but not be limited to, treatment costs, travel costs for rehabilitation, loss of earnings, and/or lump sum for permanent impairment. Compensation for mental trauma may also be included, but only if this is incurred as a result of physical injury.

If your ACC claim is not accepted you should immediately contact the researcher. The researcher will initiate processes to ensure you receive compensation equivalent to that to which you would have been entitled had ACC accepted your claim.

This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern A, Application **06/38**. If you have any concerns about the conduct of this research, please contact Dr John O'Neill, Chair, Massey University Human Ethics Committee: Southern A, telephone 06-3505799 x 8635, email humanethicsoutha@massey.ac.nz.

Massey University

面纳威吐地区中国人的健康和饮食的研究

你想了解你的饮食如何影响健康吗？

INFORMATION SHEET

研究的内容

在这项研究中， 我们将会调查居住在面纳威吐地区中国人（包括出生在新西兰和以外国家的）的健康情况和饮食习惯,特别是饮食习惯和患二型糖尿病风险的关系。

参加研究的人员

此研究由正在梅西大学攻读营养硕士学位的金莹具体进行。她的导师是 Jane Coad， 梅西大学食物与营养和人类健康学院的高级讲师。Chris Booth, 也是在梅西大学食物与营养和人类健康学院工作， 协助征集志愿者。

如果你是：

- 30 岁或以上；

- 100％中国血统或至少 50％ 中国血统；（也就是说父母亲中至少有一个的父母亲是完全的中国血统，无论出生在哪里；

- 居住在新西兰，持有学生签以外的其它签证；

如果你

从来没有被诊断过 一型或二型糖尿病，

那么你就可以参加这项研究。

数据的使用

从研究中得到的所有数据都是匿名和保密的，将用来研究中国人的饮食和健康状况的关系。 所有的研究结果严格遵守保密原则，只有研究者和她的导师可以接近这些数据。你的姓名不会和报道这项研究的信息有关联。所有收集的资料在 10 年里将会被保存在一间有锁的橱柜里。在我们分析过你的数据后，我们会寄出一份完整的你的饮食和临床检查的报告。

怎样了解更多有关这项研究的信息？

我们在北帕默斯顿地区的几份中文报纸上刊登了广告，*The Trolley 双语报, Chinese Weekly PN,* 和其它时事通讯，还有 MASSEY NEWS, 另外还在相关的超市，教堂， 诊疗室， 和中介机构放置了宣传传单。 如果你有任何有关这项研究的问题，请联系 Chris Booth (要求英文)或金莹（要求中文）。我们将需要 150 个志愿者。因为参加这项研究志愿者需要从我们提供的地点中选一个来参加这项研究，我们会补偿来回的交通费用。

志愿者参与的项目

你可以从下列地点中选一个参加我们的研究（最适合你的地点）：

— 梅西大学营养研究实验室， 北帕默斯顿

— 北帕新西兰华人联谊会议中心， Napier Road, 北帕默斯顿

— The Ethnic Centre, 300 Church St. 北帕默斯顿

— 钢琴室， 市立图书管

— Tararua Medical Centre, Winchester Street, Levin

另外，如果你非常感兴趣这项研究，但是你又不能离开你住的地方，请联系任何一个参与下这项研究的人员。 在例外的情况下， 我们将去你的住处完成这项研究。

一旦你参加了这项研究，你将需要完成下列的项目：

1. 一份初步的问卷调查包括基本文化适应，参加文体活动，您的基本背景信息；和一次 24 小时饮食记录；和一份饮食频率的问卷调查（可选择在你自己的时间完成，然后请寄给我们）。
2. 一个临床的检查。它包括询问您的家族疾病史，检测你的体重，身高，腰围和臀围，血压（非诊断性的）。
3. 可选择的**血检查**和另外的两次 24 小时饮食记录。如果你愿意，血样的采集将在 Medlab Central LTD，一个在北帕默斯顿的诊疗实验室， 或者在 Medlab Tararua Collection rooms in Levin, 24 小时饮食记录将通过电话完成，将选择适合你的时间。在抽血前，你需要空腹 12 小时，血样本大约需要 20 毫升的静脉血，用来检测你的空腹血糖，糖基化血红蛋白，和血胆固醇水平。检查结果将由我们通知你。 **你可以在任何时候退出参加血液检查不需要给出任何理由。**

我们估计完成所有的调查需要 1 到 3 个小时，要根据您是否参加血检测和你到梅西要花的时间。

研究中会有伤害或疼痛吗？

我们将尽量减少参加者的不舒适程度。当我们测您的血压时，可能你会感觉到你的上臂有轻微的压迫感；如果你参加血检测， 当抽血员使用针头采血样时，您可能会有轻微的不适感，专业的抽血员会尽量减少这种不适感。

什么是你的权利？

您没有任何义务接受这个邀请。如果您决定参加这项研究，你有权利：

—拒绝回答任何特别的问题；

—在任何时候推出这项研究；

—在参与的过程中询问任何有关这项研究的问题；

—提供任何信息，没有你的允许你的姓名将不会被使用；

—获得一份完整的研究结果报告。

什么是支持程序？

如果你参加抽血检查，你的检验结果正常，你将会收到一份血检测结果的报告。如果你的血检测结果异常，为了和一个医生讨论这个结果，你可以选择 1）到梅西大学的营养实验室来见 D r. Roger Lentle, 他是这里的专业医生；或者 2） 将血的检测结果寄给你要求的医生。所有的参加血检测的志愿者，如果要求见自己选的医生，在研究开始前，你需要签一个协议书说明你选择的医生的住址和联系方式。

研究人员的联系方式：

如果您有任何有关这项研究的问题，或者您愿意参加这项研究您可以联系我们当中的任何一个人：
(要求英文)

Chris Booth, 食品，营养 和人类健康学院， 梅西大学， 北帕默斯顿
办公室电话: (06)350-5901， 0800 0800 28
电子邮件地址: C.L.Booth@massey.ac.nz

(要求中文)

金莹， 在读硕士生，食品，营养 和人类健康学院， 梅西大学， 北帕默斯顿
电话：(06) 350 5532
电子邮件地址：yingjin816@yahoo.com.cn

Jane Coad, PhD，导师，食品，营养 和人类健康学院， 梅西大学， 北帕默斯顿
办公室电话：(06) 350-5962
电子邮件地址: j.coad@massey.ac.nz

伤害赔偿原则

如果在参加这项研究的过程中，你受到任何身体上的伤害，你需要去见你的诊疗者并尽快通知 ACC。 ACC 的赔偿不是自动生成的， 你的申请需要通过 the Injury Prevention, Rehabilitation and Compensation Act 2001 认可，然后他们会通知你所有的权利。所有的权利包括，但不是仅限于此， 治疗费， 用于康复的交通费，收入的损失或一次性对永久伤害的赔偿。 另外对心里伤害的赔偿也包括在内，但是仅限于由身体损伤造成的伤害。如果你的 ACC 申请没有被接受，请尽快联系研究人员。我们将确保你收到你应该得到的赔偿。

这项研究已经被梅西大学人伦委员会 Southern A 备案和通过，编号是 06/38。 如果你对这项研究有任何的问题， 请联络梅西大学 Southern A 主席，Dr John O'Neill， 电话是 06 350 5799 x 8635, 电子邮件地址是： humanethicsoutha@massey.ac.nz

APPENDIX E

Health checklist form

Health Checklist:

ID # _____

Interview Date: _____

Health History

1. Where were your parents born?

2. Where were your grandparents born?

3. Where were you born?

4. Do you have hypertension (high blood pressure)?
   When did it start?

5. Have you taken any tablets or medications to control your blood pressure?
   If yes, specify.

6. Have you ever had a heart attack or stroke?
   Do you have any other heart problems that you know of?
   Explain.

7. Have you been told that you have a problem with your blood cholesterol,

for example, high total blood cholesterol levels?

8. Have you been told that you have Impaired Glucose Tolerance or Impaired fasting glucose or sweet urine (the body cannot properly use insulin or blood glucose)?

9. Do you have any sisters or brothers (including sisters or brothers who are no longer living) with diabetes?
How many?
What type(s) of diabetes?

10. Do you have a parent with diabetes? What type(s) of diabetes?

11. Do you have blurred vision all the time? When did it start?

12. Do you have increased thirst or are you urinating more frequently? When did it start?

13. Have you had repeated infections, such as skin or bladder infections?

14. Have you ever had any surgeries? If you have, specify please.

15. Do you take any western medications? Give details please.

16. Do you take any Chinese medications? Give details please.

17. How often do you go to see your health advisor/doctor(s) ?
Explain.

18. Do you smoke cigarettes? How many per day? When did you start smoking?

19. (females only): Have you ever had polycystic ovary syndrome? When were you diagnosed?

20. (females only): Have you ever given birth? Have you had a baby weighting more than 4kg at birth?

21. (females only): Have you been told that you had an abnormally high blood sugar level during your pregnancy (gestational diabetes)?

Body measurements (Person taking measurements: _____)

Body weight: _____kg _____ kg _____kg

Body height: _____cm _____cm _____cm

Waist circumference: _____cm _____cm _____cm
(In triplicate)

Hip circumference: _____cm _____cm _____cm
(In triplicate)

APPENDIX F

Subjects ID and Contact form (English and Chinese)

Subject ID# _____

Diet of Chinese in the Manawatu

In order for us to call you to complete the 24 hour recalls, and to send you a copy of the results of this study, please give your contact details below. (This information will be kept confidential).

Name: _____

Address: _____

_____

Phone number: _____

Email address: _____

Please specify the best times to call you for 24 hour recalls:

_____

Subject ID# _____

Diet of Chinese in the Manawatu

In order for us to send you a copy of the results of this study, please give your contact details below. (This information will be kept confidential).

Name: _____

Address: _____

_____

Phone number: _____

Email address: _____

_____

志愿者的编号# _____

在马那瓦图地区中国人的饮食调查

为了完成 24 小时饮食记录，并邮寄给你一份这次调查的结果报告，请提供你的联系方式。（所有你提供的信息都会保密的）。

姓名: _____

地址: _____

_____

电话号码: _____

电子邮件地址: _____

请提供我们你认为方便的时间做电话的 24 小时饮食记录调查：

_____

志愿者的编号# _____

在马那瓦图地区中国人的饮食调查

为了邮寄给你一份这次调查的结果报告，请提供你的联系方式。（所有你提供的信息都会保密的）。

姓名: _____

地址: _____

_____

电话号码: _____

电子邮件地址: _____

_____

APPENDIX G

Primary questionnaire (English and Chinese)

Primary Questionnaire ID #____

These questions are to ask about the time you spend doing different types of physical activities in a typical week.

Think first about the time you spend doing work. Work is define as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting, seeking employment.

1. Does your work involve vigorous-intensity activity for at least 10 minutes continuously? (See above definition)

☐Yes ☐No

If you answer No, please move to Q4.

2. How many days do you do vigorous-intensity activity as part of your work in a typical week?

☐One day a week ☐Two to three ☐Four to six ☐Everyday

3. How much time do you spend doing vigorous-intensity activities at work on a typical day?

_____Hours _____Minutes

4. Does your work involve moderate-intensity activities that cause a small increase in breathing or heart rate for at least 10 minutes continuously?

☐Yes ☐ No

If you answer No, please move to Q7.

5. How many days do you do moderate-intensity activity as part of your work in a typical week?

☐One day a week ☐Two to three ☐Four to six ☐Everyday

6. How much time do you spend dong moderate-intensity activity at work in a typical day?

_____Hours _____Minutes

For Q 7- Q9, do not consider any of the physical activities that you have considered above. I would like ask you about the usual way you travel to and from places.

7. Do you walk or use a bicycle for at least 10 minutes continuously to get to and from places?

☐Yes ☐No

If you answer No, please move to Q10.

8. How many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?

☐One day a week ☐Two to three ☐Four to six ☐Everyday

9. How much time do you spend on walking or bicycling for traveling on a typical day?

_____ Hours _____ Minutes

For Q 10-Q15, do not consider any of the physical activities that you have already considered above. I would like ask you about sports, fitness and recreational activities.

10. Do you do any vigorous-intensity sports, fitness or recreational activities that cause **large** increases in breathing or heart rate for at least ten minutes continuously?

☐Yes ☐ No

If you answer No, please move to Q 13.

11. How many days do you do vigorous intensity sports, fitness or recreational activities in a typical week?

☐One day a week ☐Two to three ☐Four to six ☐Everyday

12. How much time do you spend on doing vigorous-intensity sports, fitness or recreational activities on a typical day?

_____ Hours _____ Minutes

13. Do you do any moderate-intensity activities that cause a **small** increase in breathing or heart rate at least ten minutes continuously? ☐Yes ☐No

If you answer No, please move to Q 16.

14. How many days do you do moderate-intensity activities in a typical week?

☐One day a week ☐Two to three ☐Four to six ☐Everyday

15. How much time do you spend on doing moderate-intensity activities in a typical day?

_____ Hours _____ Minutes

16. How much time do you usually spend on sitting or reclining at work, at home, getting to and from places, or with friends on a typical day including time spent (sitting at a desk, sitting with friends, traveling in car, bus, train, reading, playing cards or watching television, but **do not include time spent sleeping**)?

_____ Hours _____ Minutes

These questions ask about your historical background as well as more recent behaviours which relate to your cultural identity. Please choose the one answer which best describes you.

17. How do you identify yourself?

☐Oriental ☐Chinese

☐Asian- New Zealander ☐Chinese-New Zealander

☐European-New Zealander ☐Other, specify: _____

18. Which language do you **prefer to use**?

☐Chinese only ☐Mostly Chinese, some English

☐Chinese and English about equally (bilingual) ☐English only

☐Mostly English, some Chinese ☐Other, specify: _____

(**Chinese ethnic groups**: Chinese, Singapore, Malaysian, Thai, and other ethnic Chinese)

19. What was the ethnic origin of the friends and peers you had, **as a child, up to age six?**

☐Almost all of them are Chinese, Chinese-New Zealanders, and/or Orientals

☐Mostly Chinese, Chinese-New Zealanders, and/or Orientals

☐About equally Chinese ethnic groups and European-New Zealander groups
☐Mostly European-New Zealander groups
☐Almost all of them are European-New Zealander groups
☐None of the above, specify: _____

20. What was the ethnic origin of the friends and peers you had, as a child from age 6 to 18?
☐Almost all of them were Chinese, Chinese-New Zealanders, and/or Orientals
☐Mostly Chinese, Chinese-New Zealanders, and/or Orientals
☐About equally Chinese groups and European-New Zealander groups
☐Mostly European New Zealander groups
☐Almost all of them were European New Zealander groups
☐None of the above, specify: _____

21. Where were you raised the first 18 years of your life?
☐In China only ☐Mostly in China, some in New Zealand
☐Equally in China and New Zealand ☐Mostly in New Zealand, some in China
☐In New Zealand only ☐Other, please specify: _____

22. With whom do you prefer to associate in the community?
☐Almost all of them were Chinese, Chinese-New Zealanders, and/or Orientals
☐Mostly Chinese, Chinese-New Zealanders, and/or Orientals
☐About equally Chinese groups and European-New Zealander groups
☐Mostly European-New Zealander groups
☐Almost all of them were European-New Zealander groups
☐None of the above, specify: _____

23(a). What is your movie preference?
☐Chinese- language movies only
☐Chinese- language movies mostly
☐Equally Chinese and English language movies
☐Mostly English-language movies only
☐English-language movies only

If you watch English-language movies, please answer the question 23(b)

23(b). When you watch English-language movies, which do you prefer
☐All the time with Chinese subtitles ☐Some of the time with Chinese subtitles
☐All the time with English subtitles ☐Some of the time with English subtitles
☐Never with subtitles

24. What is your music preference?
☐Only Chinese music ☐Mostly Chinese ☐Western only
☐Equally Chinese and Western music ☐Mostly Western music ☐None of above

Western diet foods: foods eaten by European, Canadian, Australia and North American

25. What is your food preference at home?
☐Always Chinese food
☐Mostly Chinese food, some Western diet foods
☐About equally Chinese and Western diet foods
☐Mostly Western diet foods
☐Always Western diet foods

26. What is your food preference in restaurants?
☐Always Chinese food ☐Mostly Chinese food, some Western diet foods
☐Mostly Western diet foods ☐About equally Chinese and Western diet foods

☐Always Western diet foods

27. Do you participate in Chinese events, holidays, traditions, etc.?
☐All of them ☐Most of them ☐Some of them
☐Almost none of them ☐None at all

28. If you consider yourself a member of Chinese group (Oriental, Chinese, Chinese-New Zealanders, Asian- New Zealander, etc. whatever term you prefer), how much pride do you have in this group?
☐Extremely proud ☐Moderately proud ☐Little pride
☐No pride, but do not feel negative toward group
☐No pride, but do feel negative toward group

29. Which of the following best describe you? (please only pick up one)
☐I was born in China or a country other than New Zealand (NZ)
☐I was born in NZ, and either parent was born in China or a country other than NZ
☐I was born in NZ, both parents were born in NZ, and all grandparents were born in China or a country other than NZ
☐I was born in NZ, both parents were born in NZ, and at least one grandparent was born in China or a country other than NZ, and one grandparent born in NZ
☐Do not know what best fits since I lack some information
☐None of the above descriptions fits me, my situation is: _____

30. Rate yourself on how much you believe in Chinese values (e.g. about marriage, families, education, and work):
1 2 3 4 5
(Do not believe) (Strongly believe in Chinese values)

31. Rate yourself on how much you believe in New Zealand (Western) values:
1 2 3 4 5
(Do not believe) (Strongly believe in Western values)

32. There are many different ways in which people think of themselves. Which ONE of the following most closely describes how you view yourself?
☐ I consider myself basically Chinese even though I live and work in New Zealand, I still view myself basically as a Chinese person
☐ I consider myself basically as a New Zealander even though I have a Chinese background and characteristics, I still view myself basically as a New Zealander
☐ I consider myself as a Chinese-New Zealander, although deep down I always know I am a Chinese
☐ I consider myself as a Chinese-New Zealander, although deep down, I view myself as a New Zealander first.
☐ I consider myself as a Chinese-New Zealander. I have both Chinese and New Zealand characteristics, and I view myself as a bicultural person

Demographic Questions:

These questions are personal information about you to help interpret the results gained from the study. Remember this survey is confidential and the information will not be linked with your name.

What is your date of birth? _____Year _____Month _____Day

34. What is your gender? ☐Female ☐Male

Where were you born (City or Town, Province or District, and Country)

_____

36. When did you come to New Zealand if you were not born in New Zealand?
_____Year _____Month
37. What was your body weight the last time you measured it?
_____ Kg approximate date last time measured _____
38. What was your height the last time you measured it?
_____ cm approximate date last time measured_____
39. What is your highest education level?
☐Less than high school ☐High school ☐Diploma
☐Bachelor's Degree ☐Bachelor degree with Honors ☐Master's Degree
☐Higher than Master Degree ☐Other, specify_____

40. What is your employment status?
☐Employed full-time in the work place
☐Employed part-time in the work place
☐Unpaid full-time in farm, family or home business
☐Unpaid part-time in farm, family or home business
☐Unemployed, seeking work
☐Unemployed, not seeking work
☐Student, employed part-time
☐Student, not seeking work
☐Retired, employed part-time
☐Retired, not seeking work
☐Other, specify_____
41. Who do you live with?
☐Your family member(s) ☐Your Chinese friend(s)
☐Your Asian friend(s) ☐Your non-Asian friend(s)
☐Both Chinese and non-Asian (European, Maori, Pacific Island people) friend(s)
☐By yourself

42. Which of the following categories best describes your total household income last year?
☐Less than NZ $15,000 ☐$15,000 – $30,000 ☐$30,000 - $35,000
☐$35,000 – 40,000 ☐Over $40,000

If you are female and have had a baby, please answer the last two questions:

43. Have you ever had gestational diabetes during a pregnancy?
☐ Yes ☐ No
44. Have you ever given birth to a large baby weighing more than 4 kg?
☐ Yes ☐ No

That is the end of this survey. Thank you very much for your kind assistance.

Massey University

Institute of Food Nutrition & Human Health

Te Kunenga ki Pūrehuroa

基本问卷调查　　编号#_____

以下的问题是想要了解在一周内您花多少时间参加文艺或是体育活动。
首先是在工作中，在这里工作的定义是有薪或无薪，学习或培训，家务杂事，收获食物或粮食，钓鱼或打猎，找工作。

1. 在您的工作中，会连续 10 分钟以上有很剧烈的运动吗？
   □是　　□否
   如果您回答否，请继续回答问题 4。
2. 有多少天您会做这种工作？
   □一周一天　□一周 2 到 3 天　□一周 4 到 6 天　□每天
3. 在一天中，会有多少时间做这种工作
   _____ 小时　_____ 分钟
4. 您的工作中是否包括中等程度的运动，会有至少 10 分钟您的呼吸和心跳有轻微的增加吗？
   □是　　□ 否
   如果您回答否，请继续完成问题 7。
5. 会有多少天，您要做这种工作？
   □一周一天　□一周 2 到 3 天　□一周 4 到 6 天　□每天
6. 在一天中，会有多少时间做这种工作？
   _____ 小时　_____ 分钟

回答下列问题时，请除外上面已经提到的文体活动，这里我会询问您经常花在交通上的时间。

7. 您从一个地方到另一个地方，您会至少步行或是骑车 10 分钟吗？
   □是　　□否
   如果您回答否，请继续回答问题 10。
8. 您走路或骑车的频率是：
   □一周一天　□一周 2 到 3 天　□一周 4 到 6 天　□每天
9. 在一天里，您步行或骑车的时间是
   _____ 小时　_____ 分钟

除外以上提到的文体活动，这里我会询问您花在参加体育运动，健身活动和娱乐活动的时间。

10. 您会连续做剧烈的体育运动十分钟以上，引起您的呼吸和心跳剧烈增加吗？
    □是　　□ 否
    如果您回答否，请继续回答问题 13。
11. 在一周内多少天您会参加这种体育活动？
    □一周一天　□一周 2 到 3 天　□一周 4 到 6 天　□每天
12. 一天中，您会花多长时间完成这些剧烈的体育运动？
    _____ 小时　_____ 分钟
13. 会参加能引起您的呼吸和心跳轻微增加的中等程度的体育运动吗？
    □是　　□ 否
    如果您回答否，请回答问题 16。
14. 在一周中，您会花多少天做这种中等程度的运动？
    □一周一天　□一周 2 到 3 天　□一周 4 到 6 天　□每天

15. 在一天中，您会花多少时间做这种运动？

_____ 小时 _____ 分钟

16. 在一天中，您有多少时间坐或躺在家中，坐在桌旁和朋友聊天，使用汽车，公交车，火车等交通工具旅行，读书，玩卡片，或看电视 （不包括睡觉的时间。）

_____ 小时 _____ 分钟

这里的这些问题是有关您的文化背景和目前的文化信仰。 请选择一个最能诠释您自己的答案。

17. 您觉得您是？

□本土人 □中国人

□亚裔新西兰人 □华裔新西兰人

□欧洲的新西兰人

18. 您比较喜爱使用下列哪种语言？

□只用中文 □大部分中文，有一些英语

□可以同样用中文和英语 □只用英

□大部分英语，有一些中文 □其它，请指出：————————

（华人包括：中国人，新加坡，马来西亚，泰国，和其它华裔的中国人）

19. 在您六岁之前， 您的朋友或同学都来自哪里？

□几乎都是中国人，华裔新西兰人，或来自本土的人

□大部分是中国人，华裔新西兰人，或来自本土的人

□大约一半一半的华人和欧洲的新西兰人

□大部分是来自欧洲的新西兰人

□几乎都是来自欧洲的新西兰人

□以上都不是，请指出：————————

20. 在你 6 到 18 岁之间，您的朋友或同学都来自哪里？

□几乎都是中国人，华裔新西兰人，或来自本土的人

□大部分是中国人，华裔新西兰人，或来自本土的人

□大约一半一半的华人和欧洲的新西兰人

□大部分是来自欧洲的新西兰人

□几乎都是来自欧洲的新西兰人

21. 您在哪里长大的(18 岁之前)？

□全都在中国 □大部分时间在中国，少量时间在新西兰

□一半在中国，一半在新西兰 □大部分时间在新西兰，少量时间在中国□全都在新西兰 □其它，请指出：－－－－－

22. 您平常联系的朋友————————。

□几乎都是中国人，华裔新西兰人，或来自本土的人

□大部分是中国人，华裔新西兰人，或来自本土的人

□大约一半一半的华人和欧洲的新西兰人

□大部分是来自欧洲的新西兰人

□几乎都是来自欧洲的新西兰人

□以上都不是，请写出：－－－－

23(a) 您喜欢观赏哪种电影？

□只有中文电影

□ 大部分是中文电影

□中文和英文的电影都有

□大部分是英文电影

□只有英文电影

如果您看英文电影，请回答问题 23(b)

23. (b) 当您看英文电影的时候，您会怎么做？

□都会用中文字幕 □有时会用中文字幕

□全都会用英文字幕 □有时会用英文字幕

□从来不用字幕

您喜欢聆听哪种音乐?

□几乎都是中国音乐　□大部分是西方音乐　□大部分中国音乐

□有中国音乐也有西方音乐 □几乎都是西方音乐　□以上都不是

西方饮食中的食品：欧洲人，加拿大人，澳大利亚人，和北美人经常吃的食物

25. 您在家大部份是吃哪种食物?

□几乎都是中国菜

□大部分中国菜，有时是西方的饮食

□一半中国菜，一半西方的饮食

□大部分是西方的饮食

□几乎都是西方的饮食

26. 上餐馆时，您喜欢吃哪种食品?

□几乎都是中国菜　□大部分中国菜，有时是西方的饮食

□大部分是西方的饮食　□一半中国菜，一半西方的饮食

□几乎都是西方的饮食

27. 您会参加中国人的聚会，度假，或各种活动吗?

□全部都会参加　□大部分都会参加　□会参加其中的一部分

□偶尔会参加　□几乎不参加

28. 如果您是中国团体中的一员（无论是本土人，中国人的，或华裔新西兰人的，亚裔新西兰人的，等等）您会因此觉得自豪吗?

□非常自豪　□中等程度的自豪　□有一点自豪

□不觉得自豪，但是也不会觉得反感

□不觉得自豪，反而觉得反感这个群体

29. 下列哪项描述最适合您?(请尽量选择最适合你的一项)

□我出生在中国或新西兰以外的国家

□我出生在新西兰，我的父亲或母亲有一人出生在中国或新西兰以外的国家

□我出生在新西兰，我的父母亲也出生在新西兰，我的爷爷奶奶都出生在中国或新西兰以外的国家

□我出生在新西兰，我的父母亲也出生在新西兰，我的爷爷奶奶之中有一人出生在中国或新西兰以外的国家，另一人出生在新西兰

□不知道第几代是适合我的因为没有这方面的信息

□上述描述没有一个适合我，我的描述是：_____

30. 您的价值观有多少偏向中国式的想法呢？（例如：婚姻，家庭，教育，工作等等）

1　2　3　4　5

(一点不相信)　(绝对相信)

31. 您的价值观有多少偏向西方式的想法呢?

1　2　3　4　5

(一点不相信)　(绝对相信)

32. 人们从不同的角度看待他们自己。下列哪一项最能描述您自己?

□ 我认为我基本上还是中国人，尽管我生活工作在新西兰，我看我自己还是中国人。

□ 我认为我基本上是新西兰人，尽管我有中国人的背景和特征，我还是看我自己是新西兰人。

□ 我认为我是华裔新西兰人，尽管我深深知道我是中国人。

□ 我认为我自己是华裔新西兰人，尽管我看我自己首先是新西兰人。

□ 我认为我是华裔新西兰人，我同时有中国人和新西兰人的特征，我看我自己是拥有双重文化背景的人。

背景资料

以下的问题是有关您的个人信息来帮助我们分析试验的结果。这次的调查是保密的，所有关于您资料的分析结果都会以匿名方式来处理。

33. 您的出生年月日是： —— 年——月——日

34. 您的性别是 ☐女性 ☐男性

35. 您的出生地是：————，————，————（城市或村镇，省市或地区，和国家）

36. 如果您不是在新西兰出生， 您是什么时候到新西兰的？——年——月

37. 根据您最近的一次测量，你的体重是：
——公斤 大概的 测量时间——

38. 根据您最近的一次测量， 你的身高是：
——厘米 大概的 测量时间——

39. 下列哪一个是您的最高学历？
☐不到高中 ☐高中 ☐大专
☐学士 ☐荣誉学位 ☐硕士学位
☐高于硕士学位 ☐其它，请指出：————————

40. 您目前从事的工作最符合下列哪一项的描述?
☐全职工作
☐业余工作
☐没有薪水的全职工作在农场，家庭，个人商业
☐没有薪水的业余工作在农场，家庭，个人商业
☐没有工作，正在寻找
☐没有工作，也没有打算找
☐学生，有业余工作
☐学生，没有工作
☐退休， 有业余工作
☐退休，没有找工作
☐其它， 请指出：————————

41. 您和谁住在一起？
☐您的家庭成员（们） ☐您的中国朋友（们）
☐您的亚洲朋友（们） ☐您的非亚裔的朋友（们）
☐有中国朋友，有非亚裔的朋友（欧洲人，毛利，太平洋岛的人）
☐自己一个人

42. 下列哪一项最接近您的家庭去年的年收入？
☐不到 NZ $15000 ☐$15000 – $30000 ☐$30,000 - $35,000
☐$35000－$40,000 ☐超过$40,000

如果您是女性并至少曾经怀过一个孩子， 请回答以下问题：

43. 在您的怀孕期间，您是否曾经有得过糖尿病？
☐ 是 ☐ 否

44. 所有您的孩子中是否有在出生时的体重是否超过 4 公斤？
☐ 是 ☐ 否

到这里全部的问卷都结束了。真诚感谢您的帮助。

APPENDIX H

Food Frequency Questionnaire (English and Chinese)

	HOW OFTEN?										PORTION SIZE OF YOUR USUAL INTAKE		
	never	a few times a year	once a month	2-3 times a month	once a week	2-3 times a week	4-6 times a week	once a day	more than once a day		small per time	medium per time	large per time
Bakery Products													
muffin	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
doughnut	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
bread (toast/sandwich)	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
cake	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
cracker	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
biscuits	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
pastries	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
Beverages													
green tea	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
Chinese herbal tea	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
western tea	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
beer	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
wine	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
spirits/liquors	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
coffee	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
coffee (decaf)	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
chocolate drinking	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
juice (sweetened)	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
juice (unsweetened)	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
soft drink	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
Breakfast Cereal													
weet-bix	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
porridge with milk	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
porridge with water	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
oatmeal	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
pasta	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
boiled noodles	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
boiled rice	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍

	HOW OFTEN?										PORTION SIZE OF YOUR USUAL INTAKE		
	never	a few times a year	once a month	2-3 times a month	once a week	2-3 times a week	4-6 times a week	once a day	more than once a day		small per time	medium per time	large per time
spaghetti boiled	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
spaghetti (canned)	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
Dairy													
milk (standard)	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
milk (low fat)	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
soy milk	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
butter	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
cheese spread	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
cottage cheese	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
processed cheese	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
cream (standard)	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
cream (reduced fat)	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
yoghurt (plain)	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
yoghurt (low fat)	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
ice cream	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
Eggs													
fried eggs	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
salted eggs	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
boiled eggs	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
poached eggs	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
eggs in tea	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
Fast Foods													
hot dogs	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
burger	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
deep fried fish	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
croquette, KFC	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
meat pie	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
spring rolls	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍
pizza	❍	❍	❍	❍	❍	❍	❍	❍	❍	▸▸ ▸▸	❍	❍	❍

	HOW OFTEN?										PORTION SIZE OF YOUR USUAL INTAKE		
	never	a few times a year	once a month	2-3 times a month	once a week	2-3 times a week	4-6 times a week	once a day	more than once a day		small per time	medium per time	large per time
wedges	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
french fries/chips	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
fried noodles	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
fried rice	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
dumplings/wonton (boiled)	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
dumplings/wonton (fried)	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
Oils													
canola oil	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
coconut oil	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
olive oil	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
soyabean oil	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
sesame oil	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
sunflower oil	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
vegetable oil	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
lard	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
Fish													
dried and salt fish	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
smoked fish	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
canned fish	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
steamed fish	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
baked fish	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
Fruit													
fruit smoothies	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
dried fruits	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
canned fruit	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
apple	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
banana	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
orange	○	○	○	○	○	○	○	○	○	›› ››	○	○	○
pear	○	○	○	○	○	○	○	○	○	›› ››	○	○	○

	HOW OFTEN?										PORTION SIZE OF YOUR USUAL INTAKE		
	never	a few times a year	once a month	2-3 times a month	once a week	2-3 times a week	4-6 times a week	once a day	more than once a day		small per time	medium per time	large per time
kiwifruit	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
mango	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
olives	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
grape	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
pineapple	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
watermelon	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
Meat													
stewed beef	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
beef mince	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
beef steak	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
spare ribs	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
fried chicken	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
chicken (skinless)	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
fried lamb	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
grilled lamb	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
roast pork	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
fried pork	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
Meat Products													
bacon	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
ham	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
chicken nuggets	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
sausage	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
Nuts and Seeds													
almond	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
cashew	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
peanut	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
peanut butter	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
walnut	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
sunflower seeds	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
sesame seeds	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○

	HOW OFTEN?										PORTION SIZE OF YOUR USUAL INTAKE		
	never	a few times a year	once a month	2-3 times a month	once a week	2-3 times a week	4-6 times a week	once a day	more than once a day		small per time	medium per time	large per time
salted nuts and seeds	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
Sauces & Condiments													
oyster sauce	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
sweet & sour sauce	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
salad dressing	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
black ground pepper	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
tomato sauce	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
soy sauce	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
chilli sauce	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
chicken essence	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
vinegar	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
chilli powder	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
curry	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
Shellfish													
prawn	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
dried shrimp	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
crab	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
mussels	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
squid	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
scallop	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
Snacks													
muesli bars	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
popcorn	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
potato crisps	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
chocolate	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
candies	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
sugar	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
honey	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
jam	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○
marshmallows	○	○	○	○	○	○	○	○	○	▸▸ ▸▸	○	○	○

	HOW OFTEN?										PORTION SIZE OF YOUR USUAL INTAKE		
	never	a few times a year	once a month	2-3 times a month	once a week	2-3 times a week	4-6 times a week	once a day	more than once a day		small per time	medium per time	large per time
golden syrup	○	○	○	○	○	○	○	○	○	» »	○	○	○
chinese snacks	○	○	○	○	○	○	○	○	○	» »	○	○	○
Vegetables													
asparagus	○	○	○	○	○	○	○	○	○	» »	○	○	○
soy beans	○	○	○	○	○	○	○	○	○	» »	○	○	○
mung beans	○	○	○	○	○	○	○	○	○	» »	○	○	○
red beans	○	○	○	○	○	○	○	○	○	» »	○	○	○
carrots	○	○	○	○	○	○	○	○	○	» »	○	○	○
pumpkin	○	○	○	○	○	○	○	○	○	» »	○	○	○
bean sprout	○	○	○	○	○	○	○	○	○	» »	○	○	○
bok choi	○	○	○	○	○	○	○	○	○	» »	○	○	○
bamboo shoots	○	○	○	○	○	○	○	○	○	» »	○	○	○
ginger	○	○	○	○	○	○	○	○	○	» »	○	○	○
garlic	○	○	○	○	○	○	○	○	○	» »	○	○	○
onion	○	○	○	○	○	○	○	○	○	» »	○	○	○
leeks	○	○	○	○	○	○	○	○	○	» »	○	○	○
spring onion	○	○	○	○	○	○	○	○	○	» »	○	○	○
capsicum	○	○	○	○	○	○	○	○	○	» »	○	○	○
eggplant	○	○	○	○	○	○	○	○	○	» »	○	○	○
stir-fried vegetables	○	○	○	○	○	○	○	○	○	» »	○	○	○
vegetable soup	○	○	○	○	○	○	○	○	○	» »	○	○	○
seaweed	○	○	○	○	○	○	○	○	○	» »	○	○	○
radish	○	○	○	○	○	○	○	○	○	» »	○	○	○
brussel sprouts	○	○	○	○	○	○	○	○	○	» »	○	○	○
chinese brocolli	○	○	○	○	○	○	○	○	○	» »	○	○	○
corn on the cob	○	○	○	○	○	○	○	○	○	» »	○	○	○
mushroom	○	○	○	○	○	○	○	○	○	» »	○	○	○
lettuce	○	○	○	○	○	○	○	○	○	» »	○	○	○
tomato	○	○	○	○	○	○	○	○	○	» »	○	○	○
pickled/preserved veges	○	○	○	○	○	○	○	○	○	» »	○	○	○

	HOW OFTEN?										日常饮食的分量		
	没有	一年几次	一个月一次	2到3次一个月	一周一次	2到3次一周	4到6次一周	一次一天	超过一天一次		小	中	大
烘烤制品													
松饼 (muffin)	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
油炸圈饼	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
面包	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
蛋糕	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
cracker	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
饼干	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
油酥面点	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
饮料													
绿茶	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
中药茶	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
西方茶	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
啤酒	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
葡萄酒	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
白酒	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
咖啡	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
低因咖啡	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
巧克力饮料	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
果汁（加糖）	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
果汁（不加糖）	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
软饮料	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
早餐麦片													
weet-bix	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
牛奶麦片	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
水冲的麦片	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
燕麦粥	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
意大利面	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
水煮的面条	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍
水煮的米饭	❍	❍	❍	❍	❍	❍	❍	❍	❍	›› ››	❍	❍	❍

APPENDIX I

24-Hour Dietary Recalls Form

Chinese Diet Study 2006 ID # _____

Date _____

Note: Eating time

Breakfast = "B" Lunch = "L" Morning Tea = "MT" Dinner = "D"

Afternoon Tea = "AT" Evening = "E"

Food items	Description of food	Eating time

Chinese Diet Study 2006

ID # _____
Date _____

24 Diet Recall

Comments: including cooking methods, portion sizes.

Ingredients	**Comments (details)**

APPENDIX J

Photos used in Food Frequency Questionnaire and 24-Hour Dietary Recalls

Photos for showing models used in Food Frequency Questionnaire for helping estimate portion sizes.

Figure J-1 Three sizes of solid food intakes used for portion sizes in the FFQ.

Figure J-2 Portion sizes of lipid food items (left side: 250ml, right side:180ml) in FFQ.

Figure J-3a Small, medium and large portion sizes of food in one standard plate

Figure J-3b Small, medium and large portion sizes of food in one standard ball

Photos for showing some food models used in 24-hour dietary recalls

Figure J-4 Meat and vegetables models used in 24-hour dietary recalls.

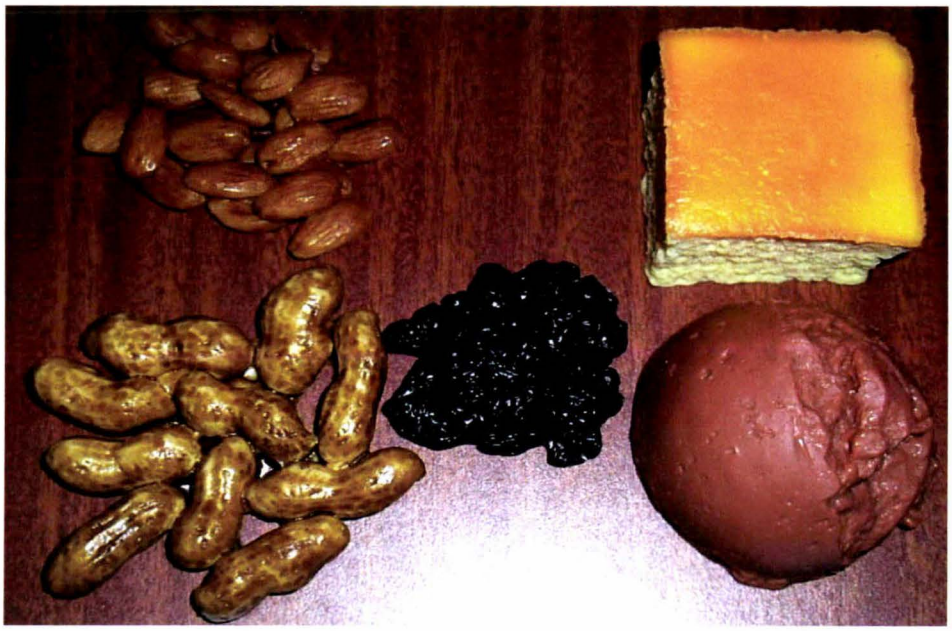


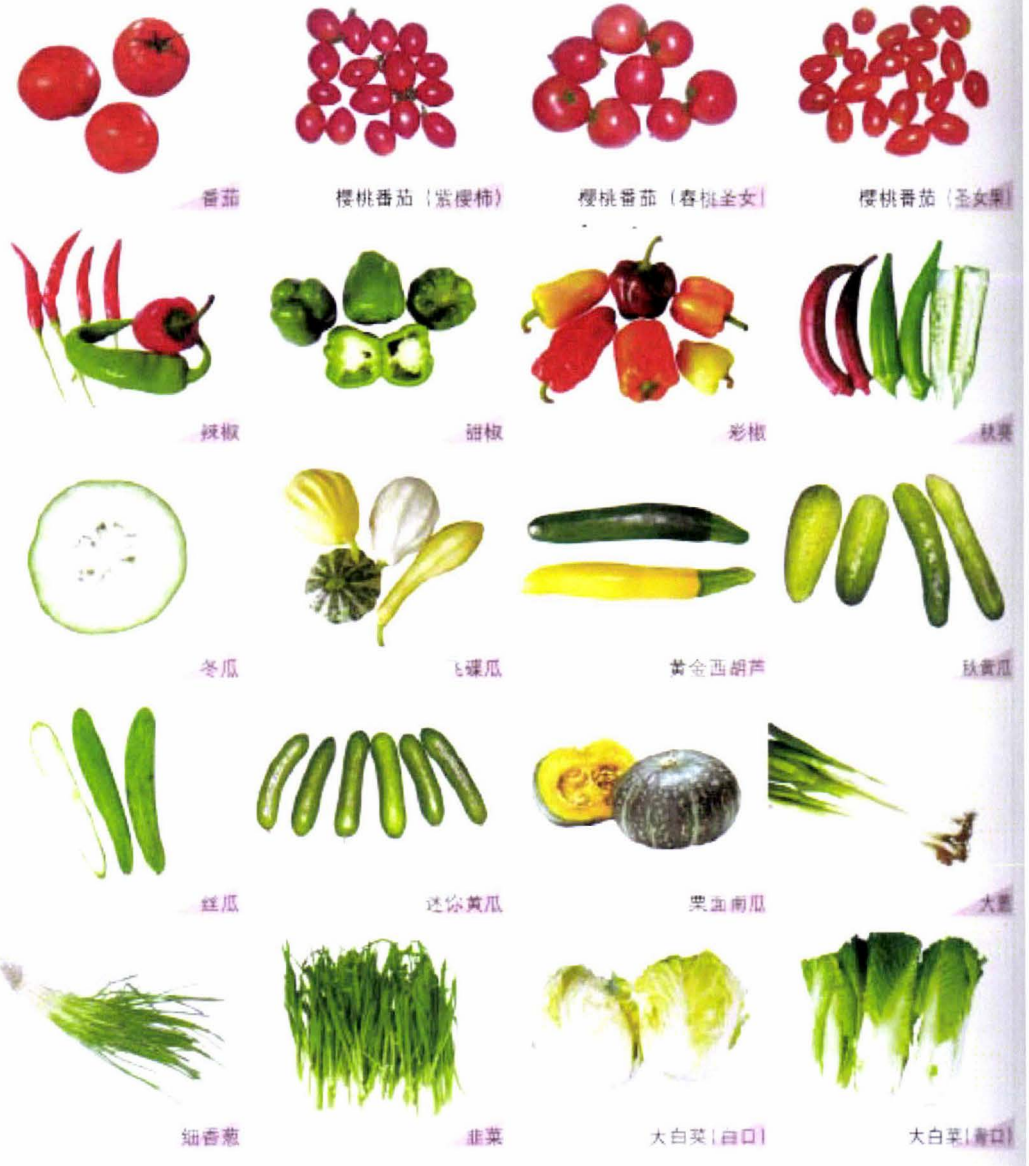
Figure J-5 Nuts and dessert models

Figure J-6 Cooking measurements for estimating portion sizes during 24-hour dietary recalls.

APPENDIX K

Chinese food photos and Chinese Food Composition Table

蔬菜


番茄
樱桃番茄（紫樱桃）
樱桃番茄（春桃圣女）
樱桃番茄（圣女果）
辣椒
甜椒
彩椒
秋葵
冬瓜
丝瓜
迷你黄瓜
大葱
细香葱
韭菜
大白菜（白口）
大白菜（青口）

速食食品 Fast foods

编码 Code	食物名称 Food name	食部 Edible	水分 Water	能量 Energy		蛋白质 Protein	脂肪 Fat	碳水化合物 CHO	膳食纤维 (Dietary fiber) 总 Total	可溶性 Soluble	不溶性 Insoluble	胆固醇 Cholesterol	灰分 Ash	维生 Vit A	胡 Ca
		%	g	kcal	kJ	g	g	g	g	g	g	mg	g	μgRE	
15-2-218	海鲜鸡汁味米线（米线+调味料+蔬菜+肉酱）	100	58.1	167	699	4.5	1.0	35.5	—	—	0.5	—	0.9	–	
15-2-219	海鲜鸡汁味米线（米线+调味料+蔬菜）	100	58.8	un	un	3.9	—	37.2			0.5	—	0.1		
15-2-220	肉鱼（海鲜鸡汁味米线）	100	7.9	un	un	7.2	—	69.0		—	—	—	15.9	–	
15-2-221	冬菜虾仁混饨	100	58.9	180	753	9.1	4.3	26.5	2.3	—		44	1.2	1	
15-2-222	菜蕊合子	100	59.7	211	883	7.5	11.3	20.3	1.4	—	—	36	1.2	219	
15-2-223	糯米烧卖	100	37.0	333	1393	5.9	17.6	38.3	1.1			60	1.2	13	
15-2-224	什锦炒饭	100	58.7	166	787	5.0	5.6	29.7	2.0	—		37	1.0	69	
15-2-225	虾仁炒饭	100	64.8	138	577	4.7	1.7	26.3	2.7		—	11	2.5	0	
15-2-314	面包条（白）	100	33.8	283	1184	8.3	5.2	51.1			0.4	—	1.6	2	
15-2-315	面包屑	100	8.1	355	1485	14.2	3.7	72.4	—	—	0.2	—	1.6	0	
15-2-316	葡萄干面包	100	38.0	260	1088	6.6	3.7	50.1	—	—	0.2	—	1.6	0	
15-2-415	饼干（咖啡）	100	2.0	515	2156	7.1	30.4	57.9	4.6	—			2.6	127	6
15-2-416	饼干（夹心）	100	1.4	449	1877	6.2	15.9	75.3	5.1		—	0	1.2	–	
15-2-417	饼干（起酥夹心）	100	2.3	552	2329	5.6	35.1	55.6			1.0	—	1.4	–	
15-2-418	饼干（苏打夹心）	100	1.6	463	1936	7.6	19.3	69.8	3.2	—	—	—	1.7		
15-2-419	饼干（发）	100	1.4	496	2075	8.4	25.6	62.7	4.7			5	1.9	26	
15-2-420	曲奇饼（加奶油）	100	1.5	526	2201	6.4	27.2	64.0	—	—	0.1	—	1.0	8	
15-2-421	早茶饼	100	3.4	440	1840	8.1	14.5	72.2	3.0	—	—	—	1.8	–	
15-2-501	饺子（素馅）	100	53.4	198	827	6.8	5.6	32.7	2.7	—	—	—	1.5	–	
15-2-502	饺子（三鲜馅）	100	50.7	240	1002	8.8	12.3	26.6	3.2	—	—	2	1.6	–	
15-2-503	饺子（猪肉白菜馅）	100	54.2	218	914	7.5	10.8	26.0	3.2	—	—	—	1.5	–	
15-2-504	饺子（猪肉韭菜馅）	100	51.2	250	1046	7.0	14.4	26.0	2.9	—	—	2	1.4	17	1

小吃、甜饼 Ethnic foods and cakes

编码 Code	食物名称 Food name	食部 Edible	水分 Water	能量 Energy		蛋白质 Protein	脂肪 Fat	碳水化合物 CHO	膳食纤维 (Dietary fiber) 总 Total	可溶性 Soluble	不溶性 Insoluble	胆固醇 Cholesterol	灰分 Ash	Vit
		%	g	kcal	kJ	g	g	g	g	g	g	mg	g	μg
小吃														
14-1-038	春卷(素馅)	100	55.2	182	762	4.9	4.6	33.8	3.5	—	—	—	1.5	-
14-1-039	黑芝麻汤圆	100	37.2	311	1300	4.4	13.8	44.2	2.0	—	—	4	0.4	-
14-1-040	酸糟	100	74.3	100	418	2.6	0.2	22.4	0.5	—	—	—	0.1	0
14-1-041	煎饼	100	16.0	317	1327	9.5	3.5	70.0	8.1	—	—	—	1.0	-
14-1-042	过桥米线	100	79.4	92	385	4.0	3.8	11.8	—	—	1.4	6	1.0	1
蛋糕、甜点														
14-2-108	蛋糕(巧克力)	100	24.1	437	1828[e]	4.7	30.4	40.2	—	—	0.2[b]	—	0.6	7
14-2-109	蛋糕(水果)	100	25.3	347	1452[e]	2.9	9.1	61.6	—	—	—	—	1.0	
14-2-209	月饼(蛋黄)	100	23.0	399	1669	6.0	20.0	50.2	1.5	—	—	—	0.8	4
14-2-210	月饼(豆沙)	100	22.3	325	1362	5.4	6.9	64.8	4.4	—	—	—	0.6	1
14-2-211	月饼(桂花提浆)	100	20.8	331	1386	5.7	6.6	66.3	4.0	—	—	—	0.6	4
14-2-212	月饼(奶油蓬松)	100	20.5	361	1510	5.5	13.0	60.4	—	—	4.9[f]	—	0.6	1
14-2-332	沙琪玛蛋酥	100	8.0	506	2116	5.9	30.4	55.1	3.0	—	—	—	0.6	1
14-2-333	香橙水果馅饼	100	10.7	445	1864	4.8	19.0	64.2	—	—	0.4[f]	—	1.3	1

APPENDIX L

Blood test report form (English and Chinese)

Date:_____

Dear _____,

Thank you very much for taking part in my study. Your assistance and cooperation in the data collection is greatly appreciated. Below are the results of the blood sample tests. Your results are all within normal range. We are also attaching a copy of the Medlab report for your records.

Thanks again for your help.

Regards,

Ying Jin
MSc student
Massey University

Results of your blood tests

Date of taking blood sample: _____

Blood test items	Your results	Medlab Normal Range
Total cholesterol	mmol/l	None; values>5.0mmol/l upper limit
Fasting serum glucose	mmol/l	3.5-6.0mmol/l
HbA_{1c}	%	None diabetics: 4-6%