Filipino Women's Health Study

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ABSTRACT

Background: Western acculturation has been shown to be detrimental to health outcomes. Recently, more Filipinos are migrating to New Zealand, which may increase lifestyle-related chronic diseases. Furthermore, Filipino populations already have a higher incidence of chronic disease and less favourable health outcomes than their Western counterparts. Understanding their risk will assist development of public health initiatives which can be utilised to protect the health of the growing Filipino New Zealand migrant population. **Aim:** The aim of this study was to investigate the risk of developing type 2 diabetes mellitus and cardiovascular disease among recently immigrated Filipino women **Method:** 62 recently-immigrated Filipino women, aged 19-45, were recruited from Auckland, New Zealand. A health and demographic information questionnaire was completed. Anthropometric measurements (height, weight, and waist circumference) and blood pressure were measured. Both total and percent body fat were determined using dual energy X-ray absorptiometry. Fasting glucose, insulin, and lipids were measured. Physical activity data was monitored by accelerometers and two-day food diaries were completed. Homeostasis Model Assessment 2 was used to quantify insulin resistance. The 30-year Framingham Risk Score was used to classify participants into low-, medium-, or high-risk of developing cardiovascular disease. Prevalence of metabolic syndrome according to the modified National Cholesterol Education Programme criteria was determined. **Results:** Body mass index, waist circumference, and percent body fat were positively correlated with higher insulin resistance. Smokers had higher insulin resistance than non-smokers. However, 90% of participants had a low long-term risk of developing cardiovascular disease and 10% of participants met the metabolic syndrome criteria. This study was cross-sectional and provided used self-selection sampling. **Conclusion:** Anthropometric measures and smoking were associated with higher insulin resistance in participants. Participants with metabolic syndrome (10%) were at a greater risk of developing type 2 diabetes mellitus. This study highlights the risk of diabetes and cardiovascular disease development, and the need for further research, in this Filipino migrant population. These findings also create a platform for improving New Zealand health programmes by targeting appropriate risk factors to improve insulin sensitivity and reduce risk of developing diabetes, and will help to raise awareness in the Filipino community.

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ABBREVIATIONS

AHA	American Heart Association
AMDR	Acceptable Macronutrient Distribution Range
BMI	Body Mass Index
CHIS	California Health Interview Survey
CVD	Coronary Heart Disease
cm	Centimetre
CVD	Cardiovascular Disease
DXA	Dual-Energy X-Ray Absorptiometry
FNRI	Food and Nutrition Research Institute
IDF	International Diabetes Foundation
kg	Kilogram
m	Metre
MetS	Metabolic Syndrome
MOH	Ministry of Health
NCEP ATP III	National Cholesterol Education Programme Adult Treatment Panel III
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung and Blood Institute
NRV	Nutrient Reference Value
T2DM	Type 2 Diabetes Mellitus
VAT	Visceral Adipose Tissue
WC	Waist Circumference
WHO	World Health Organisation
WHR	Waist-to-Hip Ratio

CHAPTER 1: INTRODUCTION

1.1 Background

Type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) were among the top 10 causes of death globally in 2015, resulting in the deaths of over 15 million people in 2015 (World Health Organisation [WHO], 2017). The global prevalence of diabetes is 8.5%, with an estimated 422 million adults in 2014 (WHO, 2016c). These two diseases are responsible for over one third of all deaths in the Philippines (39%) and in New Zealand (35%) (WHO, 2016a, 2016b). T2DM and CVD share many risk factors, furthermore, the hyperglycaemic state of diabetes appears to increase CVD risk (Ryden et al., 2007). In individuals with diabetes, CVD is the major cause of mortality and morbidity (Laakso, 1999; Ryden et al., 2007). Diabetes can also result in other complications such as lower limb amputation, blindness, renal failure, an increased risk of myocardial infarction and stroke (National Health Committee, 2007; WHO, 2016c). As diabetes often precedes CVD, focussing on diabetes prevention will reduce the prevalence of both diabetes and CVD.

Diabetes is also a major contributor to healthcare costs. In New Zealand, those with diabetes have hospital costs 2.5 times higher than those without, with direct costs of diabetes estimated to be $600 million NZD in 2008 (Ministry of Health, [MOH], 2009; National Health Committee, 2007). Chronic diseases impact everyone: the patients themselves, as well as carers, families, taxpayers, and health professionals (National Health Committee, 2007).

The Asian population currently represents about 6% of the total New Zealand population, which is expected to almost double to 12% by 2021 (Statistics New Zealand, 2014). In New Zealand, there is an increasing diversity of cultures and ethnic groups with a high number of immigrants. Filipinos are currently the fastest growing Asian ethnic group in New Zealand (+138% from 2006-2013) (Statistics New Zealand, 2014). Filipinos are now the third largest Asian ethnic group in New Zealand numbering 40,347 people in the 2013 New Zealand census (Statistics New Zealand, 2014).

In New Zealand, Asian adults are approximately 1.8 times as likely as non-Asians to have been diagnosed with diabetes in the last 12 months, according to the New Zealand Health Survey 2015/2016 (MOH, 2016a). This occurred despite comparatively lower rates of obesity. In both the Philippines and New Zealand, there is an increasing trend of diabetes

prevalence, as shown in Figure 1.1. Despite this rapid growth of Filipino migrants in New Zealand, there is no data on the prevalence of diabetes in Filipino New Zealanders. Therefore, efforts should be turning towards understanding the factors impacting on health outcomes of Asian immigrant population (MOH, 2006a).

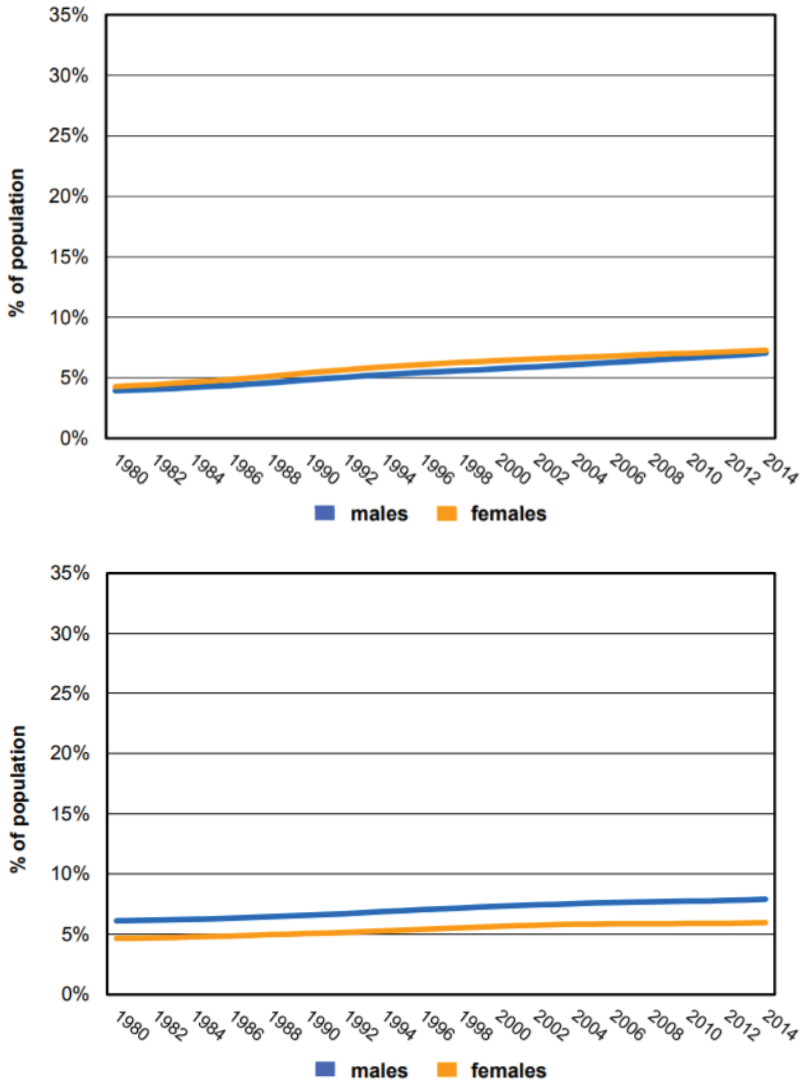


Figure 1.1. Trends in diabetes prevalence in the Philippines (above) and in New Zealand (below). From "Diabetes country profiles: Philippines," by WHO, 2016a (http://www.who.int/diabetes/country-profiles/phl_en.pdf) and "Diabetes country profiles: New Zealand," by WHO, 2016b (http://www.who.int/diabetes/country-profiles/nzl_en.pdf).

In other countries, Filipinos have also been shown to be at a disproportionate risk of developing diabetes (Araneta, Wingard, & Barrett-Connor, 2002; Palaniappan, Wong, Shin, Fortmann, & Lauderdale, 2011). While body mass index (BMI) is a known risk

factor for diabetes, emerging research suggests that these chronic diseases are occurring at lower BMI levels in some ethnic groups than previously thought (Abate & Chandalia, 2001; Araneta & Barrett-Connor, 2005). This raises concern as Filipinos have been shown to display this characteristic, possibly due to disproportionate accumulation of visceral adipose tissue or a genetic disposition (Araneta et al., 2006). Therefore, a point of interest rises in investigating the change in risk factors among Filipinos who now reside in New Zealand.

Furthermore, as Filipinos move to New Zealand, immigration exposes them to the effects of acculturation; adoption of the attitudes, values, customs, beliefs, and behaviours of the host country (Abraido-Lanza, Armbrister, Florez, & Aguirre, 2006). This leads to a change in health behaviours, which may include adopting the host country's lifestyle patterns, leading to an alteration in these lifestyle-related diseases. Acculturation has been associated with poorer health outcomes in many migrant populations (Schwartz, Unger, Zamboanga, & Szapocznik, 2010).

The prevalence of risk factors for T2DM and CVD are also rising. The Philippines 8th National Nutrition Survey (NNS) reports that 20% of Filipino women (Filipina) were hypertensive (blood pressure [BP] >140/90mmHg) and 31% of Filipino adults were overweight or obese (BMI>25) (Food and Nutrition Research Institute [FNRI], 2013). Additionally, rates of overweight and obesity, waist circumference (WC), and T2DM are increasing (Republic of the Philippines Department of Health, n.d.). The 2014/2015 New Zealand Health survey found 16% of New Zealand adults were hypertensive (medicated for high BP) and 66% of New Zealand adults were overweight or obese (BMI$\geq$25) (MOH, 2015). The prevalence of T2DM and CVD and their risk factors in both New Zealand and the Philippines are high. This indicates a likelihood of considerable risk among Filipinos in New Zealand which may worsen with increased length of stay.

A precursor to diabetes and CVD is the metabolic syndrome (MetS); MetS affects approximately 20-25% of the global population (IDF, 2006). MetS is a cluster of interrelated risk factors promoting the development of CVD and T2DM. The International Diabetes Foundation (IDF) considers this cluster of risk factors as the driving force for the new CVD epidemic, as it directly promotes the development of atherosclerotic CVD (Grundy et al., 2005; IDF, 2006). Those with MetS are five times more likely to develop T2DM, and three times more likely to have a heart attack or stroke (IDF, 2006; Stern,

Williams, Gonzalez-Villalpando, Hunt, & Haffner, 2004). Thus, MetS will also be discussed as a method of determining the risk of diabetes and CVD development.

Focussing on prevention of the development of T2DM will have a flow on effect to reduce the risk of cardiovascular morbidity and mortality. Therefore, investigation of the diabetic risk factors impacting the Filipino immigrant population in New Zealand will assist the development of targeted interventions to reduce the incidence of disease. The information obtained from this research aims to raise awareness and highlight the importance of health among the Filipino community. In addition, it will be communicated with government authorities that protect migrants' health and rights for potential programmes that promote good health among Filipinos living in New Zealand.

It is well known that investigation of health needs and risk factors in different population groups are needed to target interventions to their specific needs (MOH, 2006b). Therefore, the overall aim of this research is to assess the risk, and associated risk factors, of developing T2DM and CVD among Filipino women who have recently immigrated to Auckland, New Zealand.

1.2 Purpose of the Study

The economic and social burden of T2DM and CVD on the healthcare industry and affected individuals is substantial. The prevalence of CVD and T2DM in New Zealand as well as the Philippines are high. This study will provide more information about the risk factors for these chronic diseases in recently-immigrated Filipino women. Such information is currently unknown, yet it is required to assist the development of public health initiatives which may be utilised to protect the health of the growing migrant population in New Zealand.

1.3 Aims and Objectives

1.3.1 Aim

- To investigate the risk of developing T2DM and CVD among Filipino women who have immigrated to New Zealand in the last five years.

1.3.2 Objectives

- To examine the contributing modifiable and biological risk factors for T2DM by assessing the association between insulin resistance using homeostasis model

assessment 2 (HOMA2) with age, family history, body composition (body fat percentage, waist circumference, and BMI), macronutrient distribution ranges including saturated fat (2-day food diary), energy expenditure (accelerometer), and duration of stay in New Zealand

- To determine the risk for developing CVD using the Framingham risk assessment tool
- To determine the risk of MetS using the NCEP ATP III criteria

1.4 Thesis Structure

This thesis consists of four chapters. The first chapter introduces the study and outlines the scope of the research. Chapter Two is a review of the recent literature discussing the effects of acculturation on the health of Filipinos migrating to New Zealand. This is followed by Chapter Three which is the complete presentation of the research study conducted in the form of a research manuscript. The last chapter concludes the study and ends with an overview and discussion of the strengths, limitations, and final recommendations.

1.5 Researchers' Contributions

Table 1.1

Researchers' contributions

Contributors	Roles
Dr Pamela von Hurst	Academic supervisor, research design, applied for ethics, assisted with statistical analysis and interpretation of results, revised and approved the thesis manuscript.
A/Prof Rachel Page	Academic co-supervisor, research design, assisted with interpretation of results, and revised the thesis manuscript.
Liana Norrish	Student researcher, assisted with participant recruitment and collected data, analysed data and performed statistical analysis, interpreted results, prepared thesis manuscript.
Rosario Monzales	Student researcher, recruited participants and collected data.

CHAPTER 2: LITERATURE REVIEW

2.1 Filipino Migration into New Zealand

From the 1970s, immigration to New Zealand has been actively encouraged by the Philippine government due to high unemployment in the Philippines and a labour shortage in other countries (Statistics New Zealand, 2007). After the introduction of the Skilled Migrant Category in New Zealand in December 2003, the Philippines was recognised as a comparable labour market (Statistics New Zealand, 2007). In 2007, the Philippines was the second largest contributor to net permanent and long-term migration to New Zealand (Statistics New Zealand, 2007). Filipinos are now the fastest growing Asian ethnic group in New Zealand with a 138.2% increase from 2006 to 2013 (see Figure 2.1) (Statistics New Zealand, 2013, 2014). This contrasts with the more studied population groups in New Zealand; growth was 16.2% for Chinese and 48.4% for Indian (Statistics New Zealand, 2014). There is concern whether migration affects the health outcomes of Filipino migrants. One perspective is that as migrants move to their host country, their environment changes which can increase their risk of the life-style related diseases. As migration benefits New Zealand's growth and development, emphasis should shift toward investigation of the effects of migration to protect New Zealand's new immigrant population.

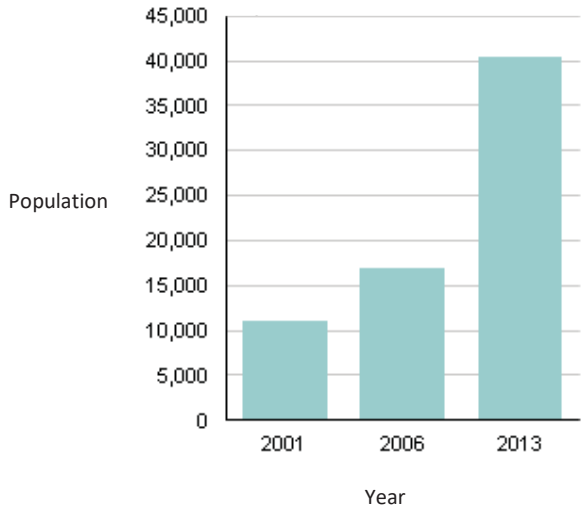


Figure 2.1 Filipino Ethnic Group in New Zealand from the 2001, 2006, and 2013 Censuses. From "2013 Census ethnic group profiles: Filipino," by Statistics New Zealand, 2013a (http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/ethnic-profiles.aspx?request_value=24729&parent_id=24726&tabname=#).

2.2 Health of Filipinos in New Zealand

CVD is the leading cause of death in the Philippines, responsible for one third of all deaths, with diabetes responsible for 6% of all deaths (see Figure 2.2) (WHO, 2014c). These figures are similar to New Zealand data (see Figure 2.2). Wild, Roglic, Green, Sicree, and King (2004) anticipate that the Philippines would reach the list of the top ten countries with the highest number of cases of diabetes by 2030 (an estimated 7.8 million people). Partially due to population growth, the growth in the prevalence of diabetes is also affected by ageing, urbanisation, and the rise in obesity and physical inactivity (Wild et al., 2004). This raises the question whether these health outcomes are reflective of the Filipino population in New Zealand.

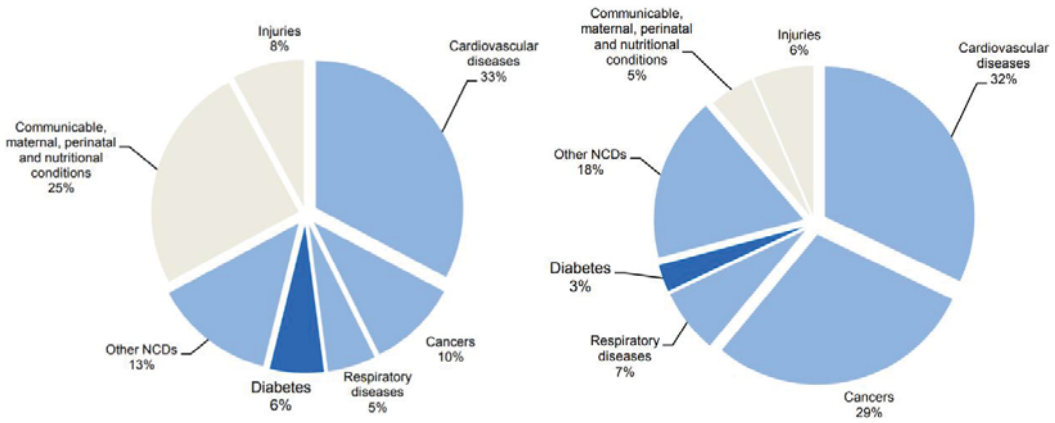


Figure 2.2 Proportional mortality in the Philippines (left) and New Zealand (right) (% of total deaths, all ages, both sexes). NCD, Non-Communicable Disease. From "Diabetes country profiles: Philippines," by WHO, 2016a (http://www.who.int/diabetes/country-profiles/phl_en.pdf) and "Diabetes country profiles: New Zealand," by WHO, 2016b (http://www.who.int/diabetes/country-profiles/nzl_en.pdf).

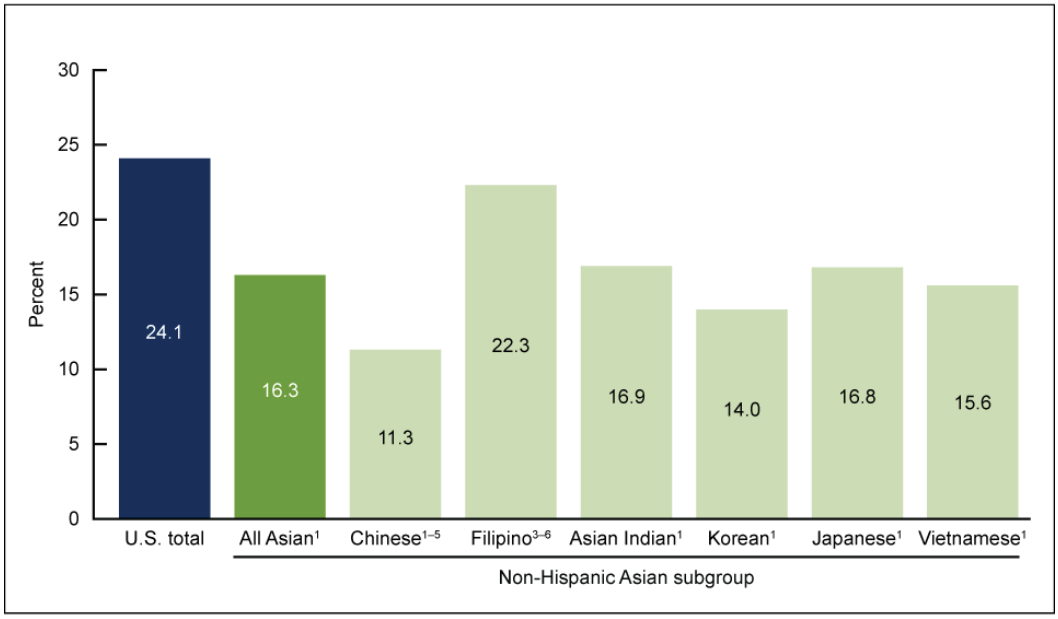
The New Zealand health survey 2006-07 was used to conduct a health needs analysis reporting the health of Asian New Zealanders. Asians were categorised into the subgroups: Chinese, South Asian, and Other Asian. The Other Asian category included more than fifteen other Asian countries including Filipinos (MOH, 2006a). Despite Filipinos comprising a large proportion of the Asian population of New Zealand, this health needs analysis reflects most of the published Asian health data in New Zealand which does not distinguish Filipinos from other Asian groups. The term 'Asian' encompasses a large diversity of cultures and people, without accounting for all of the cultural, dietary, language, religious, socioeconomic, and migration differences (Wong,

2015). New Zealand data does not sufficiently recognise the different beliefs, attitudes, and outcomes that different ethnic and cultural groups have in response to health and illness. the heterogeneity among Asian subgroups reinforces the need to distinguish New Zealand Filipinos in public health practice and research (Gomez, Kelsey, Glaser, Lee, & Sidney, 2004).

The gap in information on the health status of Filipino New Zealanders is particularly concerning with regard to the high prevalence of diabetes and CVD both in the Philippines and in Western countries. There is, however, literature from other Western countries where researchers have identified these conditions as major health risks in Filipino migrants. Therefore, for comparison this literature review will be extended to investigate (i) the health of Filipino migrants into other Western countries, as well as (ii) the health of other Asian groups in New Zealand.

2.3 Health of Immigrated Filipinos in Other Western Countries

Most research in this area is from the United States, where Filipinos are the second largest Asian group. Recently, the 2010-2014 NHIS (n=165,950) found that Filipino American adults were more likely to have multiple chronic conditions (22.3%) than other Asian subgroups (16.1%), and almost equally likely as American adults (24.1%) (see Figure 2.3) (Centers for Disease Control and Prevention, 2016). These statistics emphasise the need for more in-depth research for Filipino immigrants to New Zealand.



[1]Signficantly different than United States ($p < 0.05$).
[2]Signficantly different than Filipino ($p < 0.05$).
[3]Signficantly different than Asian Indian ($p < 0.05$).
[4]Signficantly different than Japanese ($p < 0.05$).
[5]Signficantly different than Vietnamese ($p < 0.05$).
[6]Signficantly different than Korean ($p < 0.05$).
NOTES: Chronic conditions include two or more of the following 10 conditions: hypertension, coronary heart disease, stroke, diabetes, cancer, arthritis, hepatitis, weak or failing kidneys, asthma, and emphysema and/or chronic bronchitis. Access data table for Figure 2 at: http://www.cdc.gov/nchs/data/databriefs/db247_table.pdf#2.
SOURCE: NCHS, National Health Interview Survey, 2010–2014.

Figure 2.3 Adults with multiple chronic conditions in the United States, by non-Hispanic Asian subgroup, 2010-2014. From "Health of non-Hispanic Asian adults: United States, 2010-2014," by Centers for Disease Control and Prevention, 2016 (https://www.cdc.gov/nchs/products/databriefs/db247.htm).

MetS prevalence has also been expectedly high amongst Filipino Americans. In a multi-ethnic population (n=1,450), the estimated prevalence of MetS (NCEP ATP III criteria) in Filipinos was 39.6% compared to Caucasians at 14.5% (Grandinetti, Chang, Theriault, & Mor, 2005). Filipinos had the highest odds for MetS among all ethnic groups, after adjusting for BMI and age. About three quarters of Filipino participants indicated that they still consumed a traditional Filipino diet; hence Grandinetti et al. (2005) proposed that this population may be at an even higher risk in the future as they move from a traditional lifestyle to a more Westernised one. However, this study was cross-sectional and set in rural Hawaii, possibly limiting its generalisability to the broader Filipino migrant population. Mitigating this limitation is the fact that this data was supported by a smaller study in the San Diego area. Community-dwelling Filipinas (aged 50-69 years, n=294) had a six-fold higher risk of diabetes (age-adjusted odds ratio 6.23) and more than a three-fold higher risk of MetS (age-adjusted odds ratio 3.58) than Caucasians (n=379) (Araneta et al., 2002). More recently, research from San Francisco of 43,507 women found that Asian Indians and Filipinos had similar BMIs to Caucasians, but had a higher

prevalence of MetS for every BMI category (Palaniappan et al., 2011). This research highlights the high risk of chronic disease development in Filipino migrants, and further investigation is needed to confirm whether these trends hold true for Filipino migrants in New Zealand.

2.4 Asian Health in New Zealand

In New Zealand, the prevalence of obesity in Asian adults (BMI≥25) has increased from 26% in 2002-2003, to 41% in 2006-07 (Scragg, 2010). Additionally, the "Other Asians" subgroup was twice more likely to be on treatment for diabetes than Europeans. The 2006-07 New Zealand Health Survey showed the proportion of those eating the recommended daily servings of fruit and vegetables was lower in the Other Asian subgroup (41%) than in Europeans (57%) (Scragg, 2010). The Other Asian subgroup (45%) were also less likely to be physically active than Europeans (54%). On the other hand, Asian women were less likely to be current smokers than European women (4% vs 15%), while Asian men and European men had similar rates of smokers (17% vs 15%) (Scragg, 2010). Asian people were also less likely to drink alcohol, binge drink, or gamble (Scragg, 2010). The longer the Other Asian subgroup remained in New Zealand, the greater the risk that they became overweight and obese, started drinking alcohol, and started smoking. Thus, further research is required to focus on Filipinos in New Zealand to investigate how to effectively intervene and reduce chronic disease risk.

While the health of migrants may decline as length of residence increases, Asian immigrants have been shown to have a mortality advantage compared to New Zealand-born Asians (Hajat, Blakely, Dayal, & Jatrana, 2010). This contrasting finding may be attributed to the 'healthy immigrant effect' which has been seen in countries such as Canada, Australia, the United Kingdom, and the United States (Kennedy, Kidd, McDonald, & Biddle, 2015; Newbold, 2006; Ng, Wilkins, Gendron, & Berthelot, 2005). A New Zealand study postulated that reasons for this initial mortality advantage may include being more financially stable (assuming migrants had the financial ability to migrate to New Zealand); New Zealand's immigration policies attracting those who can make economic contributions to New Zealand or fill a gap in the labour force; and migrants being subject to a health screening (Hajat et al., 2010). However, this 'healthy immigrant effect' diminishes over time, which may be explained by the acculturation process. More specifically, a possible decline in economic and social position may be occurring – in New Zealand, Asians are more highly educated than non-Asians, but have

lower incomes and are more likely to live in more economically deprived areas (Scragg, 2010). Additionally, Asians are less likely to access health services than non-Asians (Scragg, 2010). This may indicate a lack of accessibility of, and familiarisation with, the healthcare system.

2.5 Defining Metabolic Syndrome (MetS)

There is some difficulty in identifying the risk of individuals to develop T2DM and CVD in the future. MetS is one way which has been found to be clinically useful to identify individuals at increased T2DM and CVD risk (Grundy et al., 2005). First described by Reaven (1988) as *syndrome X*, over the years this definition has been refined and several different classifications for MetS have now been proposed. The first diagnostic criteria were developed by the WHO (Alberti, Zimmet, & W. H. O. Consultation, 1998). More recently, the modified NCEP ATP III definition, updated by the American Heart Association and the National Heart Lung and Blood Institute (AHA/NHBLI) in 2005 is one of the most common and widely used criteria of MetS (Grundy et al., 2005; Huang, 2009). According to this modified NCEP ATP III criteria, MetS is the presence of any three of the five following criteria listed in Table 2.1 (Grundy et al., 2005).

Table 2.1

Clinical diagnosis of metabolic syndrome using the modified NCEP ATP III definition

Any three of the five following conditions:	
Elevated waist circumference†	≥102 cm (≥40 inches) in men
	≥88 cm (≥35 inches) in women
Elevated triglycerides	≥150 mg/dL (1.7 mmol/L) OR On drug treatment for elevated triglycerides
Reduced HDL-C	<40 mg/dL (1.03 mmol/L) in men
	<50 mg/dL (1.3 mmol/L) in women
	OR On drug treatment for reduced HDL-C
Elevated blood pressure	≥130 mm Hg systolic blood pressure OR ≥85 mm Hg diastolic blood pressure OR On antihypertensive drug treatment in a patient with a history of hypertension
Elevated fasting glucose	≥100 mg/dL (5.6mmol/L) OR On drug treatment for elevated glucose

† Lower waist circumference cut-point (eg. ≥90 cm in men and ≥80 cm in women) appears to be appropriate for Asian Americans (IDF, 2006).

Note. HDL-C = High Density Lipoprotein-Cholesterol. Adapted from "Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement," by Grundy et al., 2005, *Circulation, 112,* p. 2739.

Despite the numerous revisions of the definition of MetS, limitations still exist. Different studies have used different definitions of MetS which limits the comparability of these studies. Furthermore, there is limited research regarding cut-off points for different ethnic groups, potentially limiting its usefulness in non-Caucasian populations (Aguilar-Salinas et al., 2005). The IDF have suggested a cut-off for WC that is specific for Asian populations; ≥90 cm for men and ≥80 cm for women (IDF, 2006). Despite the debate surrounding the different definitions of MetS, there is no doubt that those with MetS are at an increased risk of T2DM and CVD (Alberti et al., 1998; Grundy et al., 2005).

2.6 Risk Factors for Type 2 Diabetes Mellitus and Cardiovascular Disease

T2DM risk is affected by both non-modifiable and modifiable risk factors. Non-modifiable risk factors include age, ethnicity, genetics, and a family history of diabetes. Modifiable risk factors include being overweight or obese, a poor diet, physical inactivity, hypertension, and tobacco smoking (WHO, 2016c). As expected, some overlap occurs

with CVD risk factors because those with T2DM commonly have risk factors which increase their risk of CVD.For example, having both hypertension and T2DM, which commonly occurs, doubles the risk of CVD (AHA, 2015). Non-modifiable risk factors for CVD include age, male gender, and a family history of premature CVD. The main modifiable risk factors include atherogenic dyslipidaemia, hypertension, smoking, diabetes, being overweight or obese, physical inactivity, and an atherogenic diet (NCEP ATP III, 2002). The AHA/NHLBI states the underlying risk factors of MetS appear to be predominantly abdominal obesity and insulin resistance. Numerous complex factors underlie the development of these chronic diseases including "genetic, physiological, psychological, familial, social, economic, and political" factors (Candib, 2007, p. 547). Further research is important to gain a better understanding to address this worsening health problem. The following sections discuss key risk factors for T2DM and CVD, logically overlapping with MetS risk factors, focussing on Filipino immigrant populations.

2.6.1 Risk Assessment of Cardiovascular Disease

CVD risk factors have been used to develop risk scores for future development of CVD. The Framingham Risk Score (FRS) was based on participants from the Framingham cohort who were followed over time to assess their risk of developing general CVD (n=8,491) or individual CVD events (n=4,506) over the next 10 or 30 years (D'Agostino et al., 2008; Pencina et al., 2009). Another example of a risk score is the American College of Cardiology/American Heart Association (ACC/AHA) atherosclerotic coronary artery disease (ASCVD) algorithm. This estimates an individual's 10-year risk of a first CVD event (Goff et al., 2014). This risk score was built upon the Framingham equation but included additional risk factors to be more racially and geographically diverse, but still only included non-Hispanic African-American and non-Hispanic Caucasian individuals (n=24,626) (NHLBI, 2013). However, both risk assessment tools were not developed for specific subgroups (Goff et al., 2014). Furthermore, some well-known risk factors were not included in these calculations. Another limitation of the FRS is its use in women; CVD risk in women is generally under-recognised. Even if women possess many risk factors, very few would be considered high risk even though they will develop CVD in the long-term future (Schlendorf, Nasir, & Blumenthal, 2009). Women exhibit the risk about ten years later than men (Redon, 2016). Nevertheless, the FRS is an internationally renowned method. Its 30-year risk score can be used in individuals as young as 20 years

old. Using the more commonly used method would increase its comparability against other international studies.

New Zealand-based risk scores have been developed for clinical use. The 'Your Heart Forecast' tool is a cardiovascular risk score supplied by the Heart Foundation (2017). Similarly, a 5-year risk score has been developed based on the New Zealand-based PREDICT cohort (The University of Auckland, n.d.). This web-based tool incorporates the Framingham predictors alongside New Zealand-adjusted Framingham predictors such as ethnicity (Maori, Pacific Island, Indo-Asian). However, it has been argued that the focus should not lie with a cardiovascular risk score, but the separate variables should be treated if they are at unsatisfactory levels. Thus, while several risk assessment tools are available and may be useful, one must choose carefully and consider their limitations.

2.6.2 Age

The increased risk of T2DM and CVD with advancing age somewhat reflects the cumulative exposure of risk factors (NCEP ATP III, 2002; WHO, 2016c). The median age of Filipinos in New Zealand was 30.8 years in 2013, lower than 32.2 years in 2006 (Statistics New Zealand, 2014). This age is higher than the Philippines 2010 census (23.4 years) but lower than the mean age of general population from the New Zealand 2013 census (38.0 years) (Philippine Statistics Authority, 2010). Given the relatively young age of Filipinos in New Zealand (30.8 years) compared to the general New Zealand population (38.0 years), the risk amongst Filipinos may not yet be evident, but it may manifest in the future.

2.6.3 Atherogenic Dyslipidaemia

Certain ethnic groups such as Asian Indians, Filipinos, and Hispanics have a higher risk of dyslipidaemia (Pu et al., 2015). This is supported by a large study from northern California (n=169,430) which sought to identify racial/ethnic differences in dyslipidaemia among minorities, including Asian Americans (Frank et al., 2014). Compared to non-Hispanic Whites, all minority groups except for African Americans had a higher prevalence of elevated triglycerides and low HDL-C. Additionally, Filipinos, Indians, Japanese, and Vietnamese had a higher prevalence of elevated LDL-C. A smaller study compared lipid profiles in the Philippines (n=1,877) with American participants from the National Health and Nutrition Examination Survey (NHANES) study (n=477) (Rutherford, McDade, Feranil, Adair, & Kuzawa, 2010). Despite lower BMIs, Filipinos

had slightly higher LDL-C and triglyceride levels, and a significantly higher prevalence of low HDL-C levels (28.8% vs 2.10%). In these studies, temporal relationships between dyslipidaemia and health outcomes were not examined, thus causality between them was not established. Although, current research suggests that Filipinos have a higher prevalence of dyslipidaemia than comparison groups, but its cause and significance require further investigation.

2.6.4 Insulin Resistance

There are ethnic differences in the development of insulin resistance. This may be attributed to certain ethnic groups possessing higher amounts of visceral adipose tissue (VAT). The first study to demonstrate the higher levels of VAT in non-obese Asian Americans was by Park, Allison, Heymsfield, and Gallagher (2001). This study found that Asian American women had higher VAT levels than European American women (n=107, aged 18-44 years). This was supported by another small study (n=60) where Japanese American women had greater abdominal and visceral fat than Caucasian women with similar adiposity (Lim et al., 2011). Another well-established example is Asian Indians. A small study in the United States found Asian Indians had insulin resistance even with a mild increase in body fat due to their altered body fat distribution (n=14) (Raji, Seely, Arky, & Simonson, 2001). This may be due to a genetic predisposition or environmental factors (Raji et al., 2001). This may explain the three-fold higher prevalence of self-reported diabetes in Asian Indians than the total New Zealand population, reported by the MOH (2006a). While it is important to note that these studies were small, they all support the suggestion that some Asians may be insulin resistant despite not being clinically classified as obese, due to higher amounts of VAT (Grundy et al., 2005).

A study investigating T2DM among Filipino women (55-80 years) found that prevalence of T2DM was higher than Caucasian or African-American women in America (n=570) (Araneta & Barrett-Connor, 2005). Filipino women had higher VAT levels than Caucasian women despite similar BMI and WC measurements. Although the prevalence of T2DM was higher for every level of VAT, VAT did not explain the increased risk. However, this finding amongst Filipino women has not been replicated in other studies. Further studies investigating the risk of insulin resistance and the factors affecting it in the Filipino migrant population would be valuable, with a particular focus on VAT.

2.6.4.1 Measuring Insulin Resistance

Insulin resistance is one of the most powerful predictors of T2DM and a major risk factor for CVD (Sowers, 2004). The "gold standard" method to measure insulin resistance is the hyperinsulinemic euglycemic clamp (HEC) (Gutch, Kumar, Razi, Gupta, & Gupta, 2015, p. 160). The hyperglycaemic and euglycemic clamp techniques are both highly reproducible methods to measure insulin sensitivity (Defronzo, Tobin, & Andres, 1979). More simple methods to predict diabetes development include insulin sensitivity indices, for instance, the homeostasis model assessment (HOMA), quantitative insulin sensitivity check index (QUICKI), and the Matsuda index (Gutch et al., 2015). The chosen method depends upon factors such as population characteristics and available resources (Gutch et al., 2015).

HOMA and QUICKI require fasting plasma insulin and glucose concentrations, and have been well-validated in several populations (Muniyappa, Lee, Chen, & Quon, 2008; Wallace, Levy, & Matthews, 2004). Among 23 individuals aged between 23 and 68, estimates of insulin resistance measured by HOMA correlated with estimates from the euglycemic clamp ($r = 0.89$, $n = 23$, $p<0.001$) (Matthews et al., 1985). However, in this study, HOMA was limited by its imprecision with a coefficient of variation for insulin resistance at 31%.

Therefore, in 1998 this computer model was updated to HOMA2 to provide a more accurate measure of insulin resistance (Levy, Matthews, & Hermans, 1998). HOMA2 assesses absolute insulin resistance and beta-cell function (Wallace et al., 2004). In 2004, HOMA2 was recalibrated to provide values of 100% for %B (beta-cell function) and %S (insulin sensitivity) in normal young individuals. However, a difference between ethnic groups may exist. Ideally, an ethnic specific baseline should be established from a euglycemic population; this has not yet been done in Filipino populations (Wallace et al., 2004). Nevertheless, HOMA and QUICKI are the most extensively validated simple surrogates for the glucose clamp in large epidemiological studies, prospective clinical trials, and clinical research studies (Muniyappa et al., 2008). The HOMA model has been used in at least 500 publications, and has been described as a robust clinical and epidemiological tool (Wallace et al., 2004).

2.6.5 Hypertension

The prevalence of hypertension in 2008 reported by the WHO was 22.6% (25.0% males; 20.4% females) in the Philippines and 21.6% (25.0% males; 18.3% females) in New Zealand (WHO, 2014b, 2014c). In New Zealand, the national health survey 2011/12 revealed that the percentage of Asian adults taking BP medication was lower than the European/Other subgroup (10% vs 17%) (MOH, 2012). This may reflect less Asians being hypertensive (the Chinese and Other Asians subgroups appear to have a lower prevalence of HTN), or having reduced healthcare access. Additionally, longer duration of residence in New Zealand has been associated with increased likelihood of reporting high BP in Asian New Zealanders (MOH, 2006a). This has been suggested to be due to acculturation, waning of the healthy migrant effect, or improved access to health services (MOH, 2006a). As in New Zealand, length of stay in the United States has also been associated with increased risk of hypertension, suggesting an effect of acculturation (n=1,028) (Ursua, Islam, et al., 2013).

Hypertension is one of the main health problems in the immigrated Filipino American population (Ye, Rust, Baltrus, & Daniels, 2009). Studies in various geographical regions in America have reported disproportionately high prevalence of hypertension in the Filipino immigrant population compared to Caucasians and other Asian groups (Araneta & Barrett-Connor, 2004; Ma et al., 2017; NHLBI, 2003; T.-Y. Wu, Hsieh, Wang, Yao, & Oakley, 2011). National data from the NHIS confirms that Filipino Americans were the most likely to have been told they have hypertension (27%) compared to other Asian subgroups and even Caucasians (25%) (Barnes, Adams, & Powell-Griner, 2008). Risk factors included the male gender, added salt, physical inactivity, and older age (Ma et al., 2017; Ursua, Islam, et al., 2013). In a recent study of Filipino American immigrants, those who were hypertensive also commonly have other CVD risk factors such as hyperglycaemia, hyperlipidaemia. (Ursua, Aguilar, et al., 2013; Ursua, Islam, et al., 2013). Furthermore, obese individuals were 2.9 times more likely to be hypertensive, further increasing their risk of MetS and CVD. Contrastingly, an older study conducted in 1998 found that Filipino American women (n=1,929) were less overweight, but had a higher prevalence of hypertension at every level of BMI, than non-Hispanic Whites and Mexican Americans (Bell, Adair, & Popkin, 2002). Overall research indicates that the Filipino population tend to have higher rates of hypertension than Caucasians.

This has been proposed to be due to ethnic traits and/or poor knowledge of hypertension prevention and treatment (Ye et al., 2009). Filipinos have also been shown to have low

adherence to anti-hypertensive drugs, although this was conducted in a population in Hawaii (n=28,395) (Taira et al., 2007). Interviews from the Filipino community in California identified barriers to lowering BP being a results of not monitoring food consumption and poor knowledge about controlling hypertension (NHLBI, 2003). These findings are consistent with interviews from Cruz and Galang (2008) in Los Angeles and San Diego. Their identified barriers were lifelong ethnic and cultural dietary practices, availability and affordability of different foods, lack of time, and stress. Research reveals the need for culturally appropriate interventions for risk reduction (Grundy et al., 2005). Hypertension remains a significant problem both in the Philippines and in New Zealand and further research is required to examine hypertension among Filipinos residing in New Zealand.

2.6.6 Diet

Dietary acculturation is "the process that occurs when members of a minority group adopt the eating patterns/food choices of the host country" (Satia-Abouta, Patterson, Neuhouser, & Elder, 2002, p. 1106). While this may introduce positive changes, numerous studies have investigated the effect of dietary acculturation on immigrants to Western countries and found that dietary acculturation is often associated with an increased risk of diet-related chronic diseases (Satia & Shatenstein, 2010). A systematic review of the literature suggested that upon migration to Europe, some ethnic groups have changed from traditional diets to more Western diets comprising of energy-dense, processed foods, high in sugar, salt, and fat, although staple foods more or less remained (Gilbert & Khokhar, 2008). Another systematic review focused on South Asians in Europe. Similar trends were found, with a substantial increase in energy and fat intake, a reduction in carbohydrate and fibre (Holmboe-Ottesen & Wandel, 2012). These findings are supported by studies in Asian Americans such as Latino and Korean Americans, where more acculturated groups consumed more fast food (Ayala, Baquero, & Klinger, 2008; Kim, Lee, Ahn, Bowen, & Lee, 2007). Overall, research indicates that Westernisation often introduces unhealthy food practices.

While recent concerns about Western dietary acculturation in immigrants have generated a considerable body of research, few attempts have been made to investigate the risk in Filipinos. However, a small cardiovascular needs assessment (9 focus group participants; 4 key informant interviews; and 26 community in-depth interviews) has examined Filipino diets in California (NHLBI, 2003). Their diets were high in sodium, such as fish

sauce, shrimp paste, anchovies and anchovy paste, and soy sauce, a risk factor for high BP (Ma et al., 2017; Vollmer et al., 2001). Traditional Filipino dishes were also rich in saturated fat – such as fried fish, roast pork, and other fried foods (see Table 2.2), a component of an atherogenic diet which is associated with CVD. Although participants ate plenty of fruit and vegetables, desserts were frequently rich in sugar and starch. Steamed white rice, a refined carbohydrate with a high glycaemic index, was the most commonly eaten food item (Johnson-Kozlow et al., 2011). Rice intake is particularly difficult to reduce for Filipinos as it is embedded in daily life (Becker, 2003; Dela Cruz, Lao, & Heinlein, 2013).

Table 2.2

Traditional Filipino Foods

Traditional dish	Description
Pancit	Sautéed vegetables, shredded chicken, shrimp, and rice noodles
Lumpia (fried egg rolls)	Ground beef or pork with mixed vegetables
Adobo	Onions, garlic, pork or chicken, soy sauce, and vinegar
Dinuguan (chocolate meat)	Pork blood, pork, tripe, onions, garlic, and peppers
Kare-kare	Ox tail, peanut butter, bok choy, long green beans, salt, pepper, and shrimp paste
Sinigang	Beef, salmon, milk fish, or pork ribs with fresh tamarind or tamarind mix, tomatoes, long green beans, onions, taro root, and fish sauce
Lechon	Roasted pig
Crispy pata	Deep fried pork leg
Chicharon	Pork rinds served with vinegar and chili
Fried chicken	Chicken deep fried in oil
Fried fish	Fish deep fried in oil

Note. Adapted from "Cardiovascular risk in the Filipino community," by NHLBI, 2003 (https://www.nhlbi.nih.gov/files/docs/resources/heart/filipino.pdf).

When individuals migrate, factors such as availability, convenience, and affordability of food in the region, as well as the influence of cultural food traditions can significantly impact the diet in their new country. The above study found that American foods such as fast-food chains and take-outs which were unaffordable to them in the Philippines, became more affordable in America (NHLBI, 2003). Dela Cruz et al. (2013) also conducted a small study in 30 Filipinos examining dietary changes upon migration to America. Nearly two thirds ate more meat and poultry, with a significant increase in milk

and dairy. The reduction of native food consumption was due to lack of availability. Even cooking methods differed from native cooking methods (Dela Cruz et al., 2013). Other dietary changes may reflect increased socio-economic status (SES) (purchase of expensive meat and dairy products) and the increased consumption and availability of fresh vegetables, fruit and seafood in the area reflected high availability of these foods in the area. Investigation of these factors may be important when assessing diets of Filipino migrants in New Zealand. The significance of this has been demonstrated in a few studies in Filipino Americans where it was found that Western dietary acculturation was a significant indicator of increased BMI, WHR, weight, and WC (R. C. Serafica, Ceria-Ulep, & Lane, 2011; Vargas & Jurado, 2015).

However, some limitations exist when interpreting dietary data. This includes varied dietary assessment methods and the lack of food composition data for different ethnic groups. The few Filipino studies consist of small sample sizes and are cross-sectional in nature. Larger longitudinal studies would provide more information and increase the reliability of these findings. Regardless of this, research suggests that Western dietary acculturation results in less healthy diets, and may worsen health outcomes. Therefore, investigating the effect of migration on the diets of Filipinos in New Zealand is of importance when examining their risk of T2DM and CVD.

2.6.7 Physical Inactivity

A sedentary lifestyle modifies risk factors such as insulin sensitivity, hyperlipidaemia, and hypertension (NCEP ATP III, 2001). According to the New Zealand health survey 2014/2015, only around half of adults (51%) met the recommendation for at least 30 minutes of physical activity on 5 or more days per week, and physical inactivity rates (14.5%) are increasing (MOH, 2015). In the Philippines, the proportion of adults not meeting physical activity recommendations in 2013 was 45.2% (Capanzana, 2014). According to the WHO, a comparable estimate of the age-standardised prevalence of physical inactivity was 39.8% in New Zealand (2012) and 15.8% in the Philippines (2003) (WHO, 2014a). Additionally, 'Other Asians' in New Zealand (45%) were less likely to be physically active than European (54%) or Maori (57%) (Scragg, 2010). Overall, the data confirms significant levels of inactivity in both the Philippines and in New Zealand, and acculturation may be leading to even higher rates of physical inactivity in Filipino New Zealanders.

Asian immigrants in Western countries have also shown high rates of physical inactivity. National data examining physical activity in Asian Americans (NHIS 2003-2005) revealed that 38.2% of Filipino Americans reported no vigorous activity or moderate activity per week (Ye et al., 2009). Kandula and Lauderdale (2005) used data from the 2001 California Health Interview Survey (CHIS) which included 667 Filipinos, and found that Asian Americans were significantly less likely to meet recommended levels of leisure-time physical activity, and more likely to be physically inactive, than American-born non-Asians. However, leisure-time physical activity was positively associated with duration of residence in America and English language use. An older study from Northern California (n=5,581, 1996-2001) found that Filipinos had the lowest prevalence of engaging in low-impact/stretching (28.0%) and recreational (60.7%) exercises, but had the highest prevalence of engaging in household exercises (62.6%) compared to Caucasians and other Asians (Gomez et al., 2004). Thus, while many studies reported high rates of physical inactivity, it is important to determine the types of physical activity.

Kandula and Lauderdale (2005) found that in Asian Americans, education and income were associated with increased leisure-time physical activity, and lower non-leisure time and occupational physical activity. Amongst Filipinos, other studies have found increased physical activity levels were positively associated with having more than a high school education, and living alone, while neighbourhood safety was a significant barrier to increasing physical activity (Becerra, Herring, Marshak, & Banta, 2015; Gomez et al., 2004). This highlights the need for investigation and subsequent health messages to be targeted at specific subgroups.

Physical inactivity may be an important risk factor for diabetes in Filipino Americans. A small study amongst Filipino Americans has indicated that physical inactivity may be a significant risk factor for hypertension (n=200) (Ma et al., 2017). The 2007 CHIS showed that Filipinos with diabetes had a lower percentage of vigorous activity than those without (S. E. Choi, Chow, Chung, & Wong, 2011). However, the 2007 CHIS also showed that Filipinos had the highest age-adjusted prevalence T2DM (8.05%), yet still had a greater risk of T2DM than Caucasians even after accounting for traditional risk factors. Thus, while physical inactivity is an important risk factor, other non-traditional risk factors also play a role in diabetes development. Studies focusing upon Filipinos in New Zealand are needed to investigate the factors affecting physical activity and its significance in this subgroup.

2.6.8 Cigarette Smoking

Cigarette smoking, a strong risk factor for CVD development, has been proposed to increase VAT accumulation and insulin resistance (NCEP ATP III, 2002; Willi, Bodenmann, Ghali, Faris, & Cornuz, 2007). In New Zealand, smoking is the leading modifiable risk factor responsible for 18% of total deaths. In 2012, the age-standardised prevalence of tobacco smokers in the Philippines was 27.4% (46.3% of males, 8.9% of females) and in New Zealand was 18.9% (19.7% of males, 18.1% of females) (WHO, 2014a). The lower prevalence in New Zealand may be due to the cost and anti-social view of smoking in New Zealand.

According to the 2003-2005 American NHIS, 27.5% of Caucasians were current smokers, with 17.7% of Filipino Americans (Chinese 9.2%, Asian Indians 7.6%, Other Asians 18.4%) (Ye et al., 2009). Contrastingly, according to the 2001 CHIS, smoking rates were the highest amongst Filipino Americans (24%) compared to Non-Hispanic Whites (17%) (African Americans 20%, Hispanics 8%, Chinese, 6%) (n=55,428) (Maxwell, Bernaards, & McCarthy, 2005). Furthermore, among 300 Filipino Americans aged 35-75 years in Nevada, smoking rates in Filipinos were as high as 35% (Dalusung-Angosta & Gutierrez, 2013). This disparity may result from regional differences, whereas the NHIS is more representative of the national population. In Australia, rates amongst Filipinos were 33% (n=552) (Maneze et al., 2015), double the rate in the general Australian population of 16% (Australian Bureau of Statistics, 2012). Despite the varied rates shown amongst studies, smoking rates of Filipinos in Western countries may be higher than Caucasians. In New Zealand, this suggests the possibility that smoking rates may remain high even after migrating from the Philippines to New Zealand.

Smoking may be a way to cope with the stress of migration. Research assessing cardiovascular risk in Filipino communities in California (9 focus group participants; 4 key informant interviews; and 26 community in-depth interviews) found that new Filipino American immigrants were particularly vulnerable to work and family stresses, with coping strategies including unhealthy eating and smoking (NHLBI, 2003). About two-thirds of smoking men (n=318) interviewed in a research study by Maxwell, Garcia, and Berman (2007) agreed that smoking can ease stress, depression, and boredom, as well as being an important social exchange – reflecting the Filipino culture which places great importance on relationships. Being married has also been found to be protective against smoking in amongst all ethnic groups examined, as well as having a high school education

(except for Filipino males), being at an older age, and possibly a higher income, English fluency and language use (Maxwell et al., 2005; Maxwell et al., 2007). Therefore, further investigation of the influencing factors on tobacco smoking in Filipino New Zealanders, such as acculturation, may be vital to reducing CVD risk.

2.6.9 Overweight/Obesity

In the Philippines, three of ten (31.1%) adults were overweight or obese in 2013 (FNRI, 2013). High WHR has also been rising and prevalence is 61.5% (FNRI, 2013). In New Zealand, the 2015/16 health survey reported worse obesity rates than the Philippines, with 35% of adults being overweight, and a further 32% being obese (MOH, 2016a). In 2014, the mean BMI in the Philippines was 23.2kg/m^2 and in New Zealand was 27.9kg/m^2 (WHO, 2014a). The MOH (2006a, p. 88) have reported a significant association between duration of residence and obesity (using ethnic-specific cut-offs) due to "acculturation and/or waning of selection pressure." The question remains whether Filipino rates of obesity converge with New Zealand's after migration.

Consistent evidence has found Filipinos to have higher rates of obesity than other ethnicities. In America, the 2010-2014 NHIS found Filipino adults to have the highest likelihood of obesity in all non-Hispanic Asian subgroups in America (Centers for Disease Control and Prevention, 2016). In the San Francisco Bay area (n=43,507), rates of obesity were 26% and 24% in non-Hispanic Whites and Filipino Americans, respectively. Again, this was significantly higher than all other Asian subgroups (Palaniappan et al., 2011). Furthermore, compared to the Philippines (5.2%, n=479), the prevalence of obesity was higher in migrant Filipino women in both Hawaii (20%, n=109) and San Diego (9.3%, n=446) (Araneta et al., 2006). However, these data were obtained from three independent studies, limiting comparability of the data. Overall, research has revealed that Filipinos likely have an increased risk of obesity compared to other ethnicities, with migration possibly further increasing obesity risk. The WHO Expert Consultation (2004) concluded that Asians generally have a higher body fat percentage than Caucasian people (of the same age, sex, and BMI), which may account for this difference in risk.

Excessive VAT has been correlated more strongly with MetS than weight, BMI, or subcutaneous fat (Despres et al., 2008). Compared to African-American and Caucasian women, VAT was highest amongst Filipinas despite a similar BMI and WC as Caucasians

(Araneta & Barrett-Connor, 2005). In New Zealand, for the same body fat percentage, BMI was 2-3 units lower in Pacific Islanders and 3-6 units lower for Asian Indians (Rush et al., 2004). Araneta and Barrett-Connor (2005) propose that future studies should consider reduction of VAT accumulation in ethnic groups that may not be classified as overweight. Because of this research, the WHO Expert Consultation (2004) have considered population-specific BMI cut-offs, suggesting ≥23kg/m^2 for increasing risk. The IDF (2006) also suggested a reduced WC cut-off for Asian populations at ≥90 cm for men and ≥80 cm for women. Therefore, there is a need to target rising obesity rates, as well as investigate the increased risk with lower BMI levels.

A large study (n=43,507) examined the relationship between BMI and metabolic syndrome in Asian Americans (including Filipinos) and non-Hispanic Whites. The mean BMI of Filipinos was equal to that of non-Hispanic Whites, and higher than other Asians (26.5 vs 24.6kg/m^2). Of further interest, is that Filipinos and Asian Indians had a higher risk of MetS in each BMI category compared to other ethnicities, including non-Hispanic Whites (Palaniappan et al., 2011). A smaller study by Araneta et al. (2002) found that even after adjusting for age, body size, fat distribution and percentage body fat, Filipino American women had significantly higher prevalence of MetS and T2DM than Caucasian women (n=673) (Araneta et al., 2002). Furthermore, only 10% of Filipinos with diabetes were obese compared to one-third of Caucasians, suggesting diabetes is occurring even in non-obese women. However, this was an older study (1992-1999) which used a non-random sampling method, in addition the study was conducted only in the San Diego area, limiting its generalisability to all migrant Filipino women. Nevertheless, there is a body of research to suggest the presence of possible 'diabetogenic factors' even in non-obese and active Filipinas (Jih et al., 2014; Palaniappan et al., 2011). Thus, while more robust research needs to be conducted to confirm this finding, these studies reinforce the need for awareness of ethnic differences when assessing health risk. Furthermore, the increasing obesity rates remain a growing concern.

2.6.10 Socio-Economic Status

Socio-economic status (SES) may negatively influence health-seeking behaviours and health outcomes. A systematic review found a positive association between SES and obesity in low-income countries (Dinsa, Goryakin, Fumagalli, & Suhrcke, 2012). In the Philippines, a study of 2,592 Filipino women found a positive relationship between obesity and SES, with obesity being more prevalent in wealthier and more population-

dense communities (Colchero & Bishai, 2008). Supporting evidence was found by the Philippines 8th NNS which showed a positive correlation between wealth and overweight/obesity (FNRI, 2013). Therefore, Dahly, Gordon-Larsen, Popkin, Kaufman, and Adair (2010) suggested that as the Philippines develop economically, the burden of obesity will continue to rise (Dahly et al., 2010). Therefore, obesity prevention should perhaps focus on those of higher SES in the Philippines.

Amongst middle-income countries, however, Dahly et al. (2010) found that this association was mixed for men and negative for women. This reversal in association between SES and obesity was reflected by New Zealand data. Those residing in the most deprived areas were 1.7 times more likely to be obese (MOH, 2016a). While Asian New Zealanders exhibit a socioeconomic mortality gradient, it is shallower than those of Maori and European New Zealanders (Tobias & Yeh, 2006). Due to the shallow mortality gradient, Tobias and Yeh (2006) recommend caution when using socioeconomic measures as proxy indicators of need for health services. Therefore, more research investigating the influence of SES on obesity risk in New Zealand Asian migrants may be of value, particularly amongst Filipinos.

While studies amongst Filipino New Zealanders are scarce, Filipino Australians have been shown to possess an underlying cultural importance to improve socioeconomic positions and support family living overseas (n=552) (Maneze et al., 2015). In New Zealand, the employment rate, likelihood to own homes, incomes, and English language competence of Asians in New Zealand are lower than the total population. This has occurred despite Asians having a higher educational attainment (35% having a university degree or post-graduate degree) (MOH, 2006a; Scragg, 2010). Asians in New Zealand are also more likely to live in lower socio-economic decile regions, which is concerning considering the negative association between SES and obesity in New Zealand (Scragg, 2010).

2.6.11 Sleep Disturbances

Sleep disturbances caused by shift work have received little attention as a chronic disease risk factor. Night work may contribute to obesity, poor cardiovascular health and other metabolic disorders; with associations existing between shift work, CVD and diabetes (Brum, Filho, Schnorr, Bottega, & Rodrigues, 2015; Knutsson, 2003; Spiegel, Tasali, Leproult, & Van Cauter, 2009). This is of importance amongst Filipinos in New Zealand

because almost a quarter of the population work in the healthcare industry, many as nursing staff and healthcare assistants with night shift hours.

A recent meta-analysis investigated whether the effect of sleep disturbances on increasing the risk of developing diabetes was comparable to traditional risk factors (Anothaisintawee, Reutrakul, Van Cauter, & Thakkinstian, 2016). Thirty-six studies were included to identify the relative risk of: short sleeping time (≤5 hours), long sleeping time (≥9 hours), poor sleep quality, obstructive sleep apnoea, and shift work, upon diabetes development. The relative risk was identified to be 1.48, 1.18, 1.40, 2.02, and 1.40, respectively. The impact of sleep disturbances on diabetes risk were comparable to being overweight, having a family history of diabetes, and being physically inactive, with relative risks of 2.99, 2.33, and 1.20, respectively. Therefore, poor sleep should be considered as a potential T2DM risk factor.

Further research is emerging which supports the risk of night shift work on diabetes. The Danish Nurse Cohort (n=28,731) reported that night shift workers were 1.58 times more likely to develop diabetes than day shifts workers (Hansen, Stayner, Hansen, & Andersen, 2016). Kecklund and Axelsson (2016)'s literature review (based on 38 meta-analyses and 24 systematic reviews) concluded that moderate support exists for an association between night/shift work and T2DM (relative risk 1.09-1.40) as well as coronary heart disease (relative risk 1.23). Mechanisms for shift work increasing the risk of chronic diseases includes altered health behaviours which leads to circadian disruption, disturbed sleep, risk behaviours and psychosocial stress (Kecklund & Axelsson, 2016). Arble, Bass, Laposky, Vitaterna, and Turek (2009) also suggest that the circadian timing of food intake may contribute to weight gain, with poor sleep leading to increased food intake, with subsequent development of obesity and other metabolic disorders.

As expected, an association also exists between night shift workers and MetS. A meta-analysis based on 13 observational studies confirmed a significant association between night shift work and risk of MetS. Furthermore, a positive dose-response relationship was seen with duration of exposure to night shift working (relative risk 1.77) (Wang et al., 2014). Similar associations were found from the Korean National Health and Nutrition survey 2001 (n=4,222) found a U-shaped pattern with sleeping duration; seven hours per night showed the lowest MetS risk (K. Choi et al., 2008). In Japan, an association was found between sleep latency and sleep disturbance with MetS (n=1,481). In Chinese

adults (n=25,184), longer daytime napping rather than night-time sleeping was associated with MetS in females (J. Wu et al., 2015).

Asian Americans were more likely to report insufficient sleep duration (<7hours/day) than Caucasians (33 vs 28%) in a large cross-sectional study (n=125,610). The largest difference was among those in the finance/information and healthcare industries (Jackson, Kawachi, Redline, Juon, & Hu, 2014). Among the Asian category, 24% were Filipinos. Filipinos had the highest prevalence of short sleep duration (37.4%). These studies suggest that poor sleeping patterns are a risk factor for Filipinos, especially in the healthcare industry, with night shift work. Further research examining the impact of sleep disturbances in New Zealand Filipinos may be necessary, considering that 23.3% of New Zealand Filipinos work in the healthcare industry, often involving night shift work (Statistics New Zealand, 2013).

2.6.12 Genetics

Filipinos may have a genetic disposition to chronic disease risk factors. Araneta and Barrett-Connor (2004) suspect that Filipina have diabetogenic factors, due to their increased risk of T2DM independently of BMI (Araneta et al., 2006). The increased T2DM risk in Filipino women (23%) compared to Caucasians (2%) or African-American women (7%) was found even with low VAT levels (≤46cm^3, n=570) (Araneta & Barrett-Connor, 2005). Therefore, genetic susceptibility may play a role in T2DM development.

Araneta et al. (2002) also found that amongst Filipino women living in California (50-69 years, n=294), 90% of those with diabetes (n=107) were not obese (BMI<30kg/m^2). No association was found between diabetes and truncal fat, while an independent association existed in Caucasian women. This reinforces the possible altered relationship between body composition and fat distribution in Filipinos compared to other ethnicities. However, further research is warranted to explore the role that genes have on their health outcomes. This emphasises the need for more attention to be placed on the role of non-traditional risk factors in Filipinos.

2.7 Health Care and Cost Implications

A large proportion of New Zealand nurses are trained overseas (26%) and 23.3% of Filipinos in New Zealand work in the healthcare and social assistance industry (MOH, 2016b). However, research from New Zealand found Asians were less likely to use healthcare if they had been in New Zealand for five years or less (Ameratunga, Tin,

Rasanathan, Robinson, & Watson, 2008). Additionally, Asians in New Zealand (except for South Asians) were less likely to use a health practitioner or service when first unwell, compared to non-Asians (Scragg, 2010). While many Filipinos work in the healthcare/social assistance industry, Filipinos themselves may not access the level of healthcare they require (National Health Committee, 2007).

Chronic conditions such as diabetes and CVD affect individuals, family members, the community, and the health sector – this involves direct, indirect, and intangible costs (MOH, 2009). The Ministry of Health has conducted cost-of-illness studies by illness and by risk factor. Information is limited on the actual cost of healthcare in New Zealand from chronic diseases. A 1992 study in New Zealand revealed that CVD itself costed an estimated $179 million in direct costs, $14 million in indirect costs, and $114-264 million in intangible costs. This emphasises not only the health and social burden, but also the large economic burden that is placed upon society by chronic diseases (MOH, 2009).

2.8 Summary

Filipinos are an understudied ethnic group in New Zealand despite being the fastest growing Asian ethnic group here. Filipinos have an elevated risk of developing diabetes and CVD and thus MetS. Upon migration, there is considerable evidence that acculturation to a Western country may aggravate several risk factors. Filipinos may also be genetically predisposed to developing diabetes, as suggested by research showing high prevalence even at a low BMI levels, further increasing their risk. Preventative strategies to reduce the risk of these diseases will reduce healthcare costs to the government and improve the quality of life for Filipinos in New Zealand. As a key developmental stage of these strategies, further research is needed to investigate the pertinent risk factors particularly affecting the risk of Filipino migrants in New Zealand. Therefore, this information is vital to develop appropriate health services tailored to meet their needs to reduce the risk of T2DM and CVD.

CHAPTER 3: RESEARCH STUDY MANUSCRIPT

This research study manuscript was prepared according to the Author's Instructions of the Asia Pacific Journal of Clinical Nutrition.[1] *Minor alterations have been made for the submission of this thesis and ease of reading.*

Investigation of the risk of type 2 diabetes in recent Filipino migrants to New Zealand

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3.1 Abstract

Background and Objectives: Filipinos are the fastest growing ethnic group in New Zealand. Research reports Filipinos may have worse health outcomes than their Western counterparts. The primary objective of this study was to examine the contributing risk factors for type 2 diabetes mellitus and their association with insulin resistance. The second and third objectives were to determine the risk of developing cardiovascular disease and metabolic syndrome. **Methods and Study Design:** Recently immigrated Filipino women (n=62), aged 19-45 years, were recruited from Auckland, New Zealand. Health and demographic information, anthropometric measurements, blood pressure, fasting glucose, insulin and lipids were measured. Body fat distribution was determined using dual energy X-ray absorptiometry. Accelerometers measured physical activity and two-day food diaries were completed. Homeostasis Model Assessment 2 quantified insulin resistance and Framingham Risk Score evaluated cardiovascular disease risk. The modified National Cholesterol Education Program's criteria determined metabolic syndrome risk. **Results:** Body mass index, waist circumference, and percent body fat were positively correlated with insulin resistance, r=0.641, 0.645, 0.439, $p<0.001$, respectively. Smokers had higher insulin resistance even after adjusting for age, r=0.404, $p=0.001$. 90% of participants had a low long-term risk of developing cardiovascular disease and 10% had metabolic syndrome. **Conclusions:** Anthropometric measures and smoking were associated with higher insulin resistance in participants. 10% had metabolic syndrome and are at greater risk of developing diabetes. These findings highlight the risk of diabetes development in this growing migrant population and create a platform for improving New Zealand health programmes by targeting appropriate risk factors.

Key words: insulin resistance, cardiovascular disease, diabetes, Filipino, metabolic syndrome

3.2 Introduction

Type 2 diabetes mellitus (T2DM) is a life-threatening disease and a major contributor to healthcare costs and poor quality of life; yet it is largely preventable. Over time, abnormal levels of blood glucose can damage the heart, blood vessels, eyes, kidneys, and nerves.[2] Complications may include lower limb amputation, blindness, renal failure, and an increased risk of myocardial infarction and stroke.[2,3] Diabetes is a serious problem which impacts the patients themselves, as well as carers, families, taxpayers, and health professionals.[3] The most recent data in New Zealand estimates direct costs of T2DM to be $600 million NZD (2008).[3,4] Those with diabetes in New Zealand have average hospital costs 2.5 times greater than those without.[3]

Globally, 422 million adults had diabetes in 2014, with a prevalence of 8.5%.[5] A similar prevalence is found in New Zealand (8.5%), with Maori and Pacific Islanders being three times as likely to develop diabetes.[6] Filipinos have also been shown to be at a disproportionate risk of developing this disease.[7,8] Filipinos are migrating to New Zealand to pursue higher education and, due to a recent law change to consider the Philippines as a comparable labour market, encountering more job opportunities.[9] Due to this recent surge, Filipinos are now the third largest Asian ethnic group in New Zealand (40,250 people), after Chinese and Indian, and are the fastest growing Asian population group in New Zealand (+138% from 2006-2013).[10] Despite this rapid growth, research has so far neglected the investigation of diabetes prevalence in Filipinos residing in New Zealand.

According to the 2010-2014 National Health Interview Survey in the United States, Filipino American adults were more likely to have multiple chronic conditions (22%) than other Asian subgroups (16%), and almost equally likely as American adults (24%).[11] Furthermore, Filipinos have been reported to have a higher prevalence of T2DM than Caucasians even at lower body mass index (BMI) levels. [7,8] This may be explained by their higher amounts of visceral adipose tissue. However, the higher amounts of visceral adipose tissue do not entirely explain the increased risk, thus traditional risk factors may not fully explain their elevated risk.[7,8]

Genetic and metabolic factors increase the risk for diabetes. These factors include age, ethnicity, a family history of diabetes, and modifiable factors such as being overweight/obese, poor nutrition, physical inactivity, hypertension, and smoking.[2] Having metabolic syndrome (MetS) also increases the risk of developing T2DM five-fold, and increases the risk of having a heart attack or stroke three-fold.[12] The prevalence

of MetS in the Philippines, and amongst Maori and Pasifika in New Zealand, is comparatively higher than among Europeans in New Zealand.[13-15] One reason for this has been suggested to be due to migrants being exposed to the process of acculturation – adoption of the host country's attitudes, values, customs, beliefs, and behaviours.[16] Over the short-term, this may be offset by the 'healthy migrant effect' where recent immigrants have a mortality advantage due to having good health and financial ability to migrate.[1718-21]

One in three Filipino women work in the healthcare and social assistance industry in New Zealand.[22] Many of these women are night shift workers. Sleep disturbances, including shift work, are now being considered as potential T2DM risk factors, even comparable to traditional risk factors.[23] Although many Filipino women work in healthcare, as an ethnic minority group in New Zealand, they encounter more barriers to accessing culturally appropriate services than New Zealand Europeans and are unlikely to access the quality of healthcare they require.[3]

In women with T2DM, the risk of CVD increases 3- to 7-fold.[24] Thus, focusing on prevention of the development of T2DM will have a flow on effect to reduce the risk of cardiovascular morbidity and mortality, and associated costs. CVD is responsible for one in three deaths in both New Zealand (32%) and the Philippines (33%).[25,26]

Many diabetes interventions in New Zealand are currently focussed on reducing health inequalities among Maori and Pacific ethnicities. Only a few Asian health promotion initiatives exist; and these initiatives tend to treat Asians as a homogenous group without recognising the diversity of the New Zealand Asian population. Developing tailored disease prevention initiatives firstly requires understanding the target audience and assessment of the risk factors responsible for their poor health outcomes. Currently, there is a paucity of information on the health of Filipinos in New Zealand. This is the first study to examine the risk factors of T2DM in Filipino New Zealanders. The aim of this cross-sectional study was to investigate the risk of developing T2DM among Filipino women who have immigrated to New Zealand in the last five years. Assessing the risk of T2DM and factors associated with this risk, may provide valuable insights to address health inequalities and improve the health and wellbeing of New Zealand migrants. This study will also widen its scope to investigate the risk of MetS and CVD, which are strongly associated with T2DM.

3.3 Materials and Methods

A cross-sectional study was conducted from September 2016 to March 2017 among Filipino women living in the Auckland region. This project was reviewed and approved by the Massey University Human Ethics Committee: Southern A, Application 16/31. All participants gave written informed consent to participate in the study (Appendix A).

3.3.1 Study participants

Participants were recruited through Filipino community gatherings (i.e. Sunday masses and cultural markets), word-of-mouth, social media, posters, and flyers. All participants were self-selected and then screened to ensure they met the inclusion and exclusion criteria through an online or paper screening questionnaire. Those who did not qualify were notified via email. The inclusion criteria were as follows: a) female gender, b) 20-45 years of age, c) regular menstruation, d) Filipino ethnicity, and e) recently immigrated to New Zealand (<5 years). Potential confounding factors were controlled by the exclusion criteria: a) pregnant or lactating, b) peri- or post-menopausal, and c) on medications affecting metabolic health (e.g. cholesterol lowering, blood glucose regulating, blood pressure [BP] lowering).

3.3.2 Study design

Eligible participants were invited for two visits (approximately 45 minutes each) to the Human Nutrition Research Unit, Albany Campus, Massey University (HNRU); one visit required an overnight fast. At the first visit, the purpose of the research study was explained, and participants were provided with an information sheet (Appendix B). Any questions regarding the research study were answered. The co-researcher was fluent in both English and the Filipino language (Tagalog). Over the two visits, the selected trial participants completed questionnaires, anthropometry assessments and body composition examinations, biochemical and clinical assessments, physical activity monitoring and dietary assessments.

3.3.3 Criteria for the metabolic syndrome

According to the modified National Cholesterol Education Programme Adult Treatment Panel III definition modified by the AHA/NHLBI (modified NCEP) for women, MetS occurs when any three of the following criteria are met: elevated waist circumference (WC) (≥80cm); elevated triglycerides (≥1.7 mmol/L); reduced high-density lipoprotein-cholesterol (HDL) (<1.3mmol/L); elevated BP (systolic ≥130 or diastolic ≥85mmHg); and elevated fasting glucose (≥6.1 mmol/L).[27]

3.3.4 Health and demographic characteristics

Health and sociodemographic information was obtained through a questionnaire to collect information on age, duration of stay in New Zealand, details about employment (occupation, working hours, night shifts), cigarette smoking, alcohol consumption, last menstrual cycle, past medical history, family medical history, diet, and medication and supplement use (including relevant type/brands, dosage, and frequency of consumption) (Appendix C).

3.3.5 Anthropometric measurements

Height and weight were measured using a stadiometer (SECA 213, Hamburg, Germany) and calibrated weighing scale (BIA Inbody230, South Korea), respectively. National Health and Nutrition Examination Survey (NHANES) Anthropometry Procedures served as standard procedure for the assessments.[28] Waist circumference was measured according to the World Health Organisation (WHO) guidelines, using a non-stretchable measuring tape.[29] A population-specific waist circumference cut-off has been established by the IDF which is >80cm for women for Europids, South Asians, Chinese, and Japanese. [29] BMI was calculated using the following formula: weight (kg)/height squared (m^2), and classified according to WHO international and Asian-specific classification, for comparison purposes (Table 3.1).

Table 3.1. WHO International BMI Classification †

Classification	International BMI cut-offs (kg/m^2)	Asian-specific BMI cut-offs (kg/m^2)
Underweight	Below 18.5	Below 18.5
Normal weight	18.5-24.9	18.5-22.9
Overweight	25.0-29.9	23.0-27.4
Obesity class I	30.0-34.9	27.5-32.4
Obesity class II	35.0-39.9	32.5-37.4
Obesity class III	Above 40.0	Above 37.5

† Recognised classification for BMI as per the WHO [30]
WHO, World Health Organisation
BMI, Body Mass Index

3.3.6 Total body composition

Dual-energy X-ray Absorptiometry (DXA) (Discovery A, Hologic Inc., Marlborough, MA, USA) scans were used to report body fat percentage (BF%) expressed as standard deviations (SD). Lean mass (g) was calculated using the following formula: (total mass (g) - [whole body total bone content (g) + total fat mass (g)]) and used as a proxy for muscle mass. The procedure was conducted in the HNRU by an accredited DXA technician.

3.3.7 Biochemical measurements

Fasting insulin, glucose, and lipids (total cholesterol, triglycerides, HDL, and low-density lipoprotein-cholesterol [LDL]) were analysed by obtaining a 10 ml venous blood sample from an antecubital vein in the forearm, taken by a qualified phlebotomist. The serum aliquots were centrifuged at 2000 rpm for 10 minutes, stored immediately in labelled 3 ml Eppendorf tubes, and frozen at -80˚C prior to assay. Assays were sent to the Waitemata District Health Board Laboratory Service for processing. All personnel handling blood samples had appropriate vaccinations and training for safety.

3.3.8 Dietary assessment

A self-administered estimated two-day food diary was completed by participants (Appendix D). Portion sizes were estimated using standard household measures and participants received training at the on-site visit. Food diaries were reviewed at the second on-site visit for incomplete information and clarification. Food records were analysed utilising FoodWorks 8 (Xyris Software Australia) with the New Zealand FOODfiles 2014. Food items not in the New Zealand database were supplied by the Australian food composition database (AUSNUT 2011-2013).[31] The Goldberg cut-off technique was used at the individual level to identify implausible records (under- or over-reporters).[32]

3.3.9 Physical activity

Participants were trained to utilise accelerometers (Actigraph Model GTX3, ActigraphCorp, Florida, USA) and fitted at the first visit. The actigraph was worn for 48 hours and a physical activity diary was completed to provide additional information (Appendix E). Actigraph data was analysed using ActLife v6.13.2. A wear-time validation algorithm was utilised to remove periods when the actigraph was not worn.[33] The Freedson VM3 Combination method was used to score remaining data to calculate energy expended in activity.[34] Total estimated energy expenditure (EER) was calculated as EER = basal metabolic rate (BMR) + energy expenditure of activity. BMR was estimated by the Schofield equations using height and weight, suggested by the European Food Safety Authority (EFSA).[35]

3.3.10 Blood pressure

BP was measured three times with a floor-standing sphygmomanometer (Omron HEM-907) at each of the two visits, according to the American Heart Association recommendations for BP measurement.[36]

3.3.11 Insulin resistance

The homeostasis model assessment 2 (HOMA2) computer model was used to determine insulin resistance (IR), beta cell function (BCF), and insulin sensitivity.[37] Normal BCF

and insulin sensitivity is reported as 100% and normal HOMA2-IR is reported as 1.0. This simple method for assessing IR and BCF has shown good correlation with both the euglycaemic and hyperglycaemic clamp.[38]

3.3.12 Cardiovascular risk assessment

The Framingham Risk Score (FRS) was used to determine the 30-year risk of developing "full" CVD (coronary death, myocardial infarction, coronary insufficiency, angina, ischemic stroke, haemorrhagic stroke, transient ischemic attack, peripheral artery disease, or heart failure) and "hard" CVD (coronary death, myocardial infarction, or stroke) as it is widely used and is appropriate for this age range (20-59 years).[39]

3.3.13 Statistical analysis

All data were processed through IBM SPSS Statistics version 24 (IBM Corp., New York, USA). The baseline population was defined using descriptive statistics (i.e. mean and standard deviation or mean and 95% confidence interval for normally distributed data; and median and 25th and 75th percentile for data with skewed distribution). Kolmogorov-Smirnov and Shapiro-Wilk tests and box plots were utilised to assess the data for normality while Levene's test checked for the homogeneity of variance. Counts and percentages were used to describe categorical data. Pearson's or Spearman's correlations were conducted to identify correlations between HOMA2-IR score and T2DM risk factors. Mann-Whitney tests and one-way analysis of variance (ANOVA) were used to compare differences between groups of non-parametric or parametric scale data, respectively; p-values <0.05 were considered statistically significant.

3.4 Results

The aim of this study was to investigate the risk of developing T2DM and CVD in Filipino women recently immigrated to New Zealand. A total of 62 Filipino women were recruited from the Auckland region. The median stay of participants in New Zealand was 17.5 (9.8, 24.0) months. The participants' professions were as follows: caregivers/healthcare assistants/community support workers (53%, n=33), students (14%, n=9), registered nurses (10%, n=6) and others (23%, n=14). Among the 62 participants, 13 (21.0%) were night shift workers.

According to the international BMI classification, about half (51.6%) of the participants were normal weight, with 45.2% of participants being overweight and above. In comparison, the Asian-specific cut-offs show 30.6% being normal weight, and 66.1% being overweight and above. Furthermore, 19 participants (30.6%) had high WC

(≥80cm). The characteristics of all participants are shown in Table 3.2. Strong correlations existed between all anthropometric risk factors: WC and BMI (r=0.933, p<0.001), BMI and BF% (r=0.700, p<0.001), and BF% and WC (r=0.662, p<0.001).

Table 3.2. Characteristics of all participants

Variable	Participants (n=62) †
Age (years)	28.4 (26.2, 33.6)
Waist circumference (cm)	76.6 (95%CI=74.0, 79.3)
Body Fat (%)	34.8±4.7
Lean mass (kg) ‡	37.70 (95%CI=36.11, 39.36)
Height (cm)	156.0±5.1
Weight (kg)	60.9 (95%CI=57.7, 64.2)
BMI (kg/m^2)	25.1 (95%CI=23.9, 26.3)
International classification of BMI categories §	
Underweight (BMI<18.5kg/m^2)	2 (3.2)
Normal weight (BMI 18.5-24.9kg/m^2)	32 (51.6)
Overweight (BMI 25.0-29.9kg/m^2)	16 (25.8)
Obese Class I (BMI 25.0-29.9kg/m^2)	8 (12.9)
Obese Class II (BMI 34.9-39.9kg/m^2)	4 (6.5)
Asian-specific classification of BMI categories §	
Underweight (BMI<18.5kg/m^2)	2 (3.2)
Normal weight (BMI 18.5-22.9kg/m^2)	19 (30.6)
Overweight (BMI 23.0-27.4kg/m^2)	24 (38.7)
Obese Class I (BMI 27.5-32.4kg/m^2)	10 (16.1)
Obese Class II (BMI 32.5-37.4kg/m^2)	7 (11.3)

† Continuous normally distributed variable expressed as mean ± standard deviation or mean [95% CI], continuous non-normally distributed variables expressed as median [25, 75 percentiles] and categorical variables as n (%)
‡ Lean mass was calculated (total mass - [whole body total bone content + total fat mass])
§ Recognised classification for BMI as per the WHO [30]
BMI, Body Mass Index; WHO, World Health Organisation

Mean systolic and diastolic BP (Table 3.3) fell within the normal range (<130/80mm Hg).[40] A significant positive correlation was found between age and diastolic BP (r=0.317, p=0.013) and systolic BP (r=0.494, p<0.001). Alongside this, there were high rates of reporting a family history of hypertension (HTN) (72.6%, n=45). However, there was no significant difference in mean BP between those with a family history of HTN and those without.

Mean fasting blood glucose (Table 3.3) sat on the upper end of the reference range for healthy individuals. Their fasting lipid profile varied – mean total cholesterol and LDL was higher than the healthy range. However, mean fasting triglycerides, HDL, and total

cholesterol/HDL ratio were within the healthy range. Significant positive correlations were found between age and total cholesterol (r=0.369, *p*=0.003) and LDL (r=0.375, *p*=0.003), but not HDL or triglycerides.

Table 3.3. Blood pressure and biochemical measurements of all participants

Variable	Participants (n=62) †	Normal reference ranges ‡
Blood pressure		
Systolic BP (mm Hg)	111±10	<130
Diastolic BP (mm Hg)	71±9	<80
Biochemical measurements §		
Fasting blood glucose (mmol/L)	5.0±0.5	≤6.0
Fasting insulin (mU/L)	11.3 (95%CI=9.7, 13.1)	-
Fasting triglycerides (mmol/L)	1.0 (95%CI=0.9, 1.1)	<1.7
Total cholesterol (mmol/L)	5.1±0.8	<4.0
HDL-cholesterol (mmol/L)	1.68 (95%CI=1.59, 1.79)	≥1.0
LDL-cholesterol (mmol/L)	2.9±0.8	<2.0
TC/HDL-cholesterol ratio	3.0 (95%CI=2.8, 3.2)	<4.0

† Continuous normally distributed variable expressed as mean ± standard deviation or mean [95% CI]
§ (n=61), due to the difficulty of extracting blood sample from one of the participants
‡ Optimal levels for people with known CVD, or CV risk > 15% or diabetes according to the Ministry of Health [41]
BP, Blood Pressure; HDL, High-Density Lipoprotein; LDL, Low-Density Lipoprotein; TC, Total Cholesterol

Approximately two-thirds (66.1%, n=41) of participants had a family history of diabetes, one-third (33.9%, n=21) had a family history of heart disease, and 29.0% (n=18) had a family history of both.

Insulin resistance measured by HOMA2 (Table 3.4) was used to identify those at risk of developing T2DM in the future. Results showed 67.2% (n=41) participants had HOMA2-IR values above 1.0. Additionally, median beta-cell function (%B) was higher than the normal value of 100% and median insulin sensitivity (%S) was below the normal value of 100%. Significant positive correlations were found between HOMA2-IR and the anthropometric risk factors: WC (r=0.645, *p*<0.001), BMI (r=0.641, *p*<0.001), and BF% (r=0.439, *p*<0.001). Smaller correlations also existed between HOMA2-IR and systolic (r=0.353, *p*=0.006) and diastolic blood pressure (r=0.388, *p*=0.002). Furthermore, HOMA2-IR was significantly higher in smokers (n=4) compared to non-smokers (U=39.0, *p*=0.029), even after controlling for age (r=0.404, *p*=0.001).

The long-term risk of developing "full" CVD and "hard" CVD was also calculated using the Framingham risk score (Table 3.4). The majority of participants were at low risk of "full" CVD and "hard" CVD.

Table 3.4. HOMA2-score and Framingham 30-year cardiovascular risk score of all participants

Variable	Participants †
HOMA2 index **(n=61) ‡**	
Beta cell function (%B)	126.9 (95%CI=115.5, 139.4)
Insulin sensitivity (%S)	69.0 (95%CI=59.4, 80.1)
Insulin resistance (100/%S)	1.4 (95%CI=1.25, 1.68)
Framingham 30-year risk score **(n=60) ¶**	
Low risk (<10%) full CVD	54 (90)
Intermediate risk (≥10-<20%) full CVD	5 (8)
High risk (≥20%) full CVD	1 (2)
Low risk (<10%) hard CVD	59 (98)
Intermediate risk (≥10-<20%) hard CVD	1 (2)
High risk (≥20%) hard CVD	0 (0)

† Continuous variables expressed as mean [95% CI] and categorical variables expressed as n (%)
§ The programme HOMA calculator v2.2.2 accessed from the Diabetes Trials Unit [37] was used to determine the HOMA2 index. %B and %S values are 100% in normal young subjects. Insulin resistance below 1.0 shows the population is less insulin resistant than normal young subjects; insulin resistance above 1.0 shows the population is more insulin resistant than normal young subjects; (n=61), due to the difficulty of extracting blood sample from one of the participants
‡ (n=60), due to the difficulty of extracting blood sample and blood pressure from two of the participants
¶ The Framingham 30-year risk score accessed from the Framingham Heart Study [39] was used to determine the 30-year risk score
CVD, Cardiovascular Disease; HOMA, Homeostasis Model Assessment

The MetS criteria were investigated in the study participants. Six participants (10%) met the definition of MetS with five participants having 3 of the 5 criteria, and one participant having 4 of the 5 criteria.

Modifiable lifestyle factors were also examined. The number of current smokers were low (n=4, 6.5%). Non-smokers had significantly higher HDL levels than smokers (U=20.0, p=0.006)

The macronutrient composition of the participants' diets was reported in 2-day food records (Table 3.5). Total energy from fat exceeded the acceptable macronutrient distribution range (AMDR), with total energy from carbohydrate being below the AMDR. Of the total fat intake, saturated fat doubled the recommended AMDR of <7% (14.2±3.7%).[42] Seven participants were under-reporters and two participants were over-reporters according to the Goldberg cut-off method.[43]

Table 3.5. Dietary intake of all participants

Variable †	Participants (n=62) ‡	AMDR	2008/09 NZANS §	2008 Philippines NNS ¶
Total energy from saturated fat (%)	14.2±3.6	<7%	13.1 (12.8-13.4)	-
Total energy from carbohydrate (%)	42.5±8.0	45-65%	47.1 (46.6.-47.7)	72.0
Total energy from protein (%)	16.9±3.9	10-35%	16.5 (16.2-16.8)	13.0
Total energy from fat (%)	37.8±7.6	20-35%	33.8 (33.2-34.3)	15.0

† Percent energy from macronutrients was calculated using the following conversion factors: 16.7 kJ/g for carbohydrate, 16.7 kJ/g for protein, and 37.7 kJ/g for fat

‡ Continuous normally distributed variable expressed as mean ± standard deviation or mean [95% CI]; 9 participants were under-reporters and 2 participants were over- reporters as identified by the Goldberg cut-off method[32]

§ In New Zealand women[44]

¶ In Filipino adults, men and women, n=8,679, obtained by 2-day non-consecutive 24-hour food recall[45]

AMDR, acceptable macronutrient distribution range; NNS, National Nutrition Survey; NZANS, New Zealand Adult Nutrition Survey

The participants' energy expended during activity was 1,400±651kJ (335±156kcal) per day and total energy expenditure (BMR + energy expended during activity) was 1732±256kcal, marginally lower than the mean energy intake of 2,083±493kcal per day. No correlation was found between EER and energy intake. No significant correlations were found between body fat % and risk factors measured.

3.5 Discussion

There is evidence that Filipino migrants have a higher risk of T2DM than their Western counterparts. Despite the growing number of Filipinos in New Zealand, no studies have investigated this risk in New Zealand. Determining their risk of diabetes, and examining the contributing risk factors, is important for developing targeted public health initiatives to protect the health of this growing migrant population in New Zealand.

The first focus of this study was to measure the risk of T2DM development, using HOMA2, in 62 Filipino women residing in the Auckland region. Findings indicated that their HOMA2-IR value was 1.4 and beta cell function (BCF) was 126.9. As the HOMA2-IR and BCF results lie above normal values (HOMA2 is calibrated to give normal BCF of 100%, and a normal IR of 1.0; this is not ethnic-specific), our findings suggest beta cells are starting to compensate for the loss of insulin sensitivity, indicative of the beginning of IR. This is not conclusive because no absolute value for HOMA indices exists, nor a defined threshold for normal in this ethnic population. Thus, this data must be interpreted with caution.[37] However, a higher prevalence of T2DM has been seen in Filipino women compared to Caucasian women even with similar WC, BMI, and BF%.[46] Furthermore, two-thirds (66%) of participants in the present study reported having a

family history of diabetes. This suggests that participants may be at a higher risk of T2DM development because family history is a strong risk factor for the disease.[2]

Alongside diabetes risk, the present study also found that the majority of participants showed a low long-term risk of developing CVD, according to the FRS. The minimal risk found in these participants could have been because the FRS was developed for a Caucasian cohort, limiting its applicability to other ethnic groups. Also, the FRS increases with age, and the mean age (28 years) of the participants in this study was younger than the general population of Filipino women in New Zealand (33 years).[22] This five-year difference could be a period of significant change in the health risks of Filipino women living in New Zealand. Furthermore, this study focused on women, who also had a lower risk than men of heart disease, according to the FRS. In this study, one-third (33.9%) of the participants had a family history of heart disease; however, it is unknown whether these family members were men or women. Overall, the Filipino women in this study had a low risk of CVD, but the factors mentioned above should be considered.

Participants also showed a prevalence of MetS at 10%, with high WC as the most prevalent component. Prevalence studies using the modified NCEP criteria in the Philippines found that MetS ranged between 19% and 26% (aged ≥20).[14,15] In New Zealand, prevalence in Maori, Pacific, and other ethnicities (mainly European) was 32%, 39%, and 16%, respectively (aged 35-74 years; NCEP criteria).[13] These prevalence studies all found that risk was higher in men and increased with age, which may account for the relatively low prevalence found in these participants. Based on these data, the findings suggest that Filipino women aged 19-45 years currently have a low prevalence of MetS, but a higher risk may be found in the general Filipino population in New Zealand.

The second focus of this study examined the correlation between T2DM risk factors against HOMA2-IR and their potential as markers for development of T2DM. Bivariate analysis revealed positive correlations between HOMA2-IR and all anthropometric risk factors; between WC, BMI, and BF%, the strongest correlation existed for WC. This is consistent with an American study which reported that BMI and WC modestly predicted T2DM in Filipino women (aged 40-65 years).[47] One other study also found WC to be significantly associated with impaired fasting glucose in Filipino women (aged 35-68 years).[48] In this study, all anthropometric risk factors were significantly correlated with each other and able to predict IR. Flegal and colleagues (2009) showed that amongst a large sample from the NHANES study, BMI, WC, and

DXA-derived BF% were highly correlated within groups to distinguish categories of body fat content.[49] Furthermore, simple anthropometric measures are faster and likely to be more useful for evaluating obesity-related risk factors amongst adults. Almost a third (30.6%) of study participants in the present study had high WC. Additionally, using the WHO Asian-specific BMI cut-off (≥23kg/m^2), the percentage of overweight individuals increased significantly from 45.2% to 66.1% of participants being overweight.[50] This would indicate that a high proportion of the study participants were at risk of developing chronic diseases in the future.

A significantly higher HOMA2-IR was observed in smokers, therefore, the risk of developing T2DM in Filipino women in New Zealand may be influenced by smoking. However, there were only four smokers in this study. A recent meta-analysis has confirmed an association between active smoking and increased T2DM risk.[51] Maxwell and colleagues (2005) found that more American-born Filipino women were smokers (19.1%) compared to foreign-born Filipino women (6.8%); however smoking increased with length of stay.[52] Similar to this American study, the present study found that fewer Filipino women smoked (6.5%) when compared to national rates in the Philippines (8.9%).[53] The reduced smoking rate observed may be influenced by the cost and anti-social views of smoking in New Zealand. However, further research should investigate the effect of duration of stay in New Zealand on smoking prevalence.

Duration of stay has also been associated with increased WC and BMI values.[19-21] In this study, rates of high WC and BMI were higher than previous reports among Filipino women in the Philippines, yet lower than reports among the general New Zealand population.[54,55] Therefore, it can be postulated that length of stay in New Zealand may cause anthropometric risk factors to deteriorate over time. However, this was not a prospective study and only included women in New Zealand for less than five years, thus limiting the ability to confirm these results.

A family history of HTN was reported by 72.6% of the participants, but mean BP was within normal ranges. BP was positively correlated with age. The present study only included those between 19-45 years of age, whereas other studies have found women often present with HTN over the age of 45.[24] Overall, the data suggests that elevated BP may lead to significant health concerns in the future.

Intake of saturated fat was found to be double the Ministry of Health (MOH) recommendation of <7%, with most participants reporting a total fat intake exceeding 35% of energy.[42] Consequently, the macronutrient intake of participants reflected the

intake of New Zealanders more than the Philippines, with lower carbohydrate and higher fat intake. In the 2008 Philippines NNS and the 2008/09 NZANS, carbohydrate intake was 72% compared to 47%, and fat intake was 15% compared to 34%.[44,45] High fat diets are often high in saturated fat and energy dense, thus keeping fat intakes below 35% of total energy has been recommended by the MOH to reduce risk of CVD and obesity.[42] In Filipino American migrants, Western dietary acculturation has been significantly correlated with increased caloric intake, fat intake, and reduced carbohydrate intake, alongside increased BMI and WC.[18] This suggests that dietary acculturation is a major lifestyle change in Filipino migrants, which may ultimately increase disease risk. While the present study found that fat intakes exceeded the recommended amounts, a major limitation is that measurements were taken over two consecutive days, whereas a longer period would reduce day-to-day variability. Furthermore, intakes were self-reported and estimated; the Goldberg method identified some under- and over-reporting which could affect the reliability of the results. Ideally, further research overcoming these limitations would be conducted to confirm these findings.

The sample size of the present study was small and constrained to a sample of women in early adulthood living in Auckland, limiting the generalisability of these findings to the broader population. A study with a larger sample size could confirm the reliability of these conclusions. This study also used self-selection sampling, possibly introducing self-selection bias. Furthermore, the Schofield equation did not account for all factors which can alter energy expenditure such as the thermic effect of food.[35] Lastly, no ethnic-specific cut-off values for HOMA2 have been established in a euglycaemic Filipino population, as HOMA2 values vary with genetics and environmental factors.[56] Therefore, care must be taken when interpreting the results.

Future research is encouraged to include both men and women, as men have been shown to express different risk factors and may be at an even greater risk for T2DM and CVD. Additionally, studies on older populations should be conducted, as risk may not present itself until a more advanced age. Prospective studies on this population would clarify the effect of duration of stay in New Zealand. Finally, a larger study recruiting participants using probability sampling should be considered to more accurately represent T2DM and CVD risk in the population. The main professions of the study participants were in the healthcare industry (63%), reflective of many Filipino women in New Zealand (32%). However, further research could widen investigation to those in other professions.

In conclusion, anthropometric risk factors and smoking are associated with higher insulin resistance in these Filipino women who have recently immigrated to New Zealand. It is crucial that targeted health programmes should be identified to improve insulin sensitivity and reduce the risk of developing T2DM and CVD. These findings should also be used to raise awareness of the importance of health in the Filipino community. Further research is recommended to help to protect migrants' health and rights, as this is a crucial part of New Zealand's responsibility as a country.

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3.7 Authors Disclosures

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CHAPTER 4: CONCLUSION-RECOMMENDATION

4.1 Overview and Conclusion

Filipino adults are at a substantial risk of diabetes development and this continues to increase, particularly as they migrate to a Western country. The risk of T2DM and CVD disease of Filipino living in New Zealand had not yet been investigated. This study investigated this risk among 62 Filipino women aged between 19 and 45 years who had immigrated to New Zealand in the last five years.

The primary objective of this study was to examine the contributing modifiable and biological risk factors for T2DM by assessing the association between insulin resistance and potential risk factors. An association was found between insulin resistance and increased anthropometric risk factors (BMI, WC, and BF%) (p<0.001). Also, smokers had a significantly higher level of insulin resistance than non-smokers after controlling for age (p=0.001), however there were only four smokers in the study.

The second objective was to determine the risk for developing CVD in the next 30 years using the Framingham risk assessment tool; 90% of participants had a low long-term risk of full CVD, and 98% of participants had a low long-term risk of CVD.

The third objective of this study was to determine the risk of MetS. Using the NCEP ATP III criteria, the prevalence of MetS was 10%. The most prevalent component was WC, with 30.6% of participants showing a WC ≥80cm.

In conclusion, in this sample of 62 Filipino women who have recently immigrated to New Zealand, anthropometric risk factors and smoking were associated with higher insulin resistance. Targeted health programmes should be established which aim to improve insulin sensitivity to reduce the risk of developing T2DM and CVD. The findings in this study should raise awareness amongst the Filipino community of the future risk of T2DM and CVD development.

4.2 Strengths

There is limited research about the health of Filipinos in New Zealand. This study is the first to investigate the risk of T2DM and CVD and the associated risk factors amongst Filipino women. Thus, these findings are the first to reveal a potentially elevated risk of T2DM development in the future.

Simple measurement techniques were used in this study. HOMA2 was used to determine insulin resistance which requires only fasting blood glucose and fasting insulin. HOMA2 has also been found to correlate well with the euglycaemic and hyperglycaemic clamp (Wallace et al., 2004). The modified NCEP ATP III criteria and the Framingham Risk Score were used to assess MetS and CVD risk, respectively. These measures are widely used in international research and hence direct comparison with other literature could be shown.

4.3 Limitations

This study reached its aims; however limitations must be acknowledged. This study was cross-sectional and only showed a small snapshot of the current population. To confirm an association between chronic disease risk and duration of stay, a prospective study would be required. Participants had lived in New Zealand for less than five years thus the long-term effect of living in New Zealand was not investigated.

We were only able to recruit 62 participants due to time constraints and logistical reasons. The results from this study may not be representative of all Filipino migrants in New Zealand. A larger sample size would be needed to confirm these findings.

Participants were only from the Auckland region. Filipinos living in this area may have different health characteristics than those found in other New Zealand areas. For example, availability of international food is likely to be higher in Auckland than in other New Zealand regions due to the higher diversity of the population. Their health may also differ between rural and urban regions.

Study participants were self-selected which may have led to selection bias. Participants willing to participate in this study may have been more health-conscious, especially as many of them were health workers.

This study had strict exclusion criteria, excluding those outside the age range of 19-45 years, thus the mean age was 28 years. Risk of T2DM and CVD increases with age, therefore these findings may not represent the older Filipino population in New Zealand. The exclusion criteria also included those on medications for metabolic health, pregnant/breastfeeding, and only included women. Exclusion of these individuals may have changed the research findings and would likely have shown an increased risk of T2DM and CVD.

Dietary intake was only measured over two days, due to logistical reasons. Therefore, data may not represent day-to-day variation. Estimated food diaries have been shown to be relatively accurate methods for measuring dietary intake, however a seven-day food diary is usually recommended (Bingham et al., 1994). Furthermore, food diaries were self-reported and may have been inaccurate or incomplete. Seven participants were under-reporters and two participants were over-reporters according to the Goldberg cut-off method which may have further reduced reliability of the data (Whybrow et al., 2016). Additionally, a weighed food diary would avoid any assumptions that had to be made about serving sizes but would increase participant burden. The food diaries were analysed using both the New Zealand and the Australian database, this may also have led to inaccuracies in dietary information.

Plasqui, Bonomi, and Westerterp (2013) advise a full week of accelerometer monitoring due to day-to-day variability. This study measured energy expenditure only over two days due to the limited availability of accelerometers. Another limitation was the use of a predictive equation without addition of the thermic effect of food (Psota & Chen, 2013).

Many of the measures used in our study were not ethnic-specific. The FRS was developed for a Caucasian cohort, limiting applicability in other ethnic groups. The FRS may also under-estimate CVD disease in women (Stock & Redberg, 2012). Furthermore, no absolute value for HOMA2 indices exist, limiting its ability for comparison with other studies.

4.4 Final Recommendations

1) Further research in future years should be considered to compare the same population to investigate acculturated-related change in risk factors
2) A larger sample size should be considered in further research to more accurately represent T2DM and CVD risk and the impact of their risk factors, among Filipinos in New Zealand.
3) This study was conducted among Filipino women in the Auckland region. Further research focussing on other geographical regions of New Zealand could allow for comparisons to be made. Furthermore, inclusion of both genders in further research is recommended to compare the risk between men and women.

4) Future research should use prospective research to determine how the duration of stay in New Zealand affects T2DM and CVD risk and their risk factors, including the long-term impact among this group.
5) Due to the association between WC, BMI and insulin resistance, further investigation of appropriate cut-offs for WC and BMI among Filipino New Zealanders is required.
6) Due to logistical limitations, food diaries and accelerometers were only used for two days. Future research should extend this period to obtain a more accurate representation of dietary and physical activity habits of Filipino New Zealanders.
7) This study found that participants were likely to have increased risk of T2DM and CVD in the future. Further research should explore this risk in older Filipinos to validate this finding.

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APPENDIX A – CONSENT FORM

Note: This consent form was covering two projects, which also involved calcium intake and vitamin D status of Filipino women living in New Zealand.

Date of birth:
Participant ID:

MASSEY UNIVERSITY
COLLEGE OF HEALTH
TE KURA HAUORA TANGATA

Filipino Women's Health study

An investigation on the effects of changing dietary patterns on calcium intake and the risk of type 2 diabetes and cardiovascular disease among Filipino immigrants in Auckland

PARTICIPANT CONSENT FORM

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 agree to participate in this study under the conditions set out in the Information Sheet.

I am willing to be contacted in connection with future research projects within the Massey Institute of Food Science and Technology and for this purpose I agree to my contact information being retained on condition that it is in no way linked to the data I have supplied for this research project.

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

Full Name – Printed .....

Please send me a referral letter to my General Practitioner should any of my results fall outside the normal range.

(Put a line through this statement if you do NOT wish to be informed or receive a referral letter)

APPENDIX B – INFORMATION SHEET

Note: This consent form was covering two projects, which also involved calcium intake and vitamin D status of Filipino women living in New Zealand.

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA

Massey Institute of Food Science and Technology
Massey University
Private Bag -102-904
North Shore Mail Centre
Auckland, New Zealand

Filipino women's health study

An investigation on the effects of changing diets on calcium intake and the risk of metabolic syndrome[1] among Filipino immigrants in Auckland

Information for Study Participants

Please read this information carefully and ask questions about anything you want to clarify before deciding to take part in the research.

You have been invited to take part in a university research project that will mainly 1) examine the changes in calcium intake because of changing diets from migration; and 2) find out the risk of metabolic syndrome among recently-immigrated Filipino women living in Auckland. The research is being conducted by a team of investigators at the Human Nutrition Research Unit (HNRU) in Massey University with the following contact details:

Dr. Pamela von Hurst (Principal Investigator) Ph: (09) 213 6657 Email: p.r.vonhurst@massey.ac.nz	Rosario Pillar Monzales (MSc Student) Ph: +64220284112 Email: riomonzales@gmail.com	Liana Norrish (MSc Student) Ph: +64277807362 Email: ltnorrish@gmail.com	Owen Mugridge (Postgraduate Teaching Technician) Ph: (09) 414 0800 ext. 43650 Email: O.Mugridge@massey.ac.nz
School of Food and Nutrition, College of Health, Massey University Auckland			

What is the purpose of this research?

Calcium, which we mostly get from milk, small fishes and green leafy vegetables, is an important nutrient for bone health. A new survey suggests that the Filipino diet lacks calcium. This situation may be worsened or improved once Filipinos migrate overseas. Lack of calcium in the diet is known to increase risk of osteoporosis and incidence of fractures as we age.

[1] Metabolic syndrome is the name for a group of risk factors that raises your risk of heart disease and other health problems, such as diabetes and stroke.

Currently, there is no information on the effect of dietary changes on the calcium intake of Filipino women living in New Zealand. Therefore, this study aims to find out the effect of these changes on the calcium intake of Filipino women living in Auckland and other factors affecting their bone health.

With the increase in consumption of high-calorie food and adoption of Western lifestyle in the Philippines, diabetes, stroke and heart diseases have been increasing during the past decades. This was validated by the previous National Nutrition Survey last 2008 where 22.3% of the adult population were classified as hypertensive and 12.6% were diabetic. In New Zealand, there are no statistics among Filipinos who have recently emigrated from the Philippines. Because of this, the second aim of this study is to describe the risk factors in developing the said diseases and to find out the effect of the work environment in developing the disease risks.

The information obtained from this research will be used to raise awareness among the Filipino community and to communicate with government authorities that protect migrants' health and rights for potential programmes that promote good health among Filipino women living in New Zealand.

Why have I been invited to participate in this research?
You are invited to participate in this research because you are a 20-45 year old Filipino woman who has recently immigrated (within the last five years) to New Zealand. However, if you are pregnant, breast-feeding, or are a smoker, you are not eligible.

What is going to happen?
If you agree to participate in this research, you will be asked to visit HNRU on the Massey, Albany Campus, twice.

HNRU Visit 1

A. Study orientation, informed consent and questionnaires
You will be briefed about the study and asked for a signed consent form to move further. Afterwards, you will be asked to fill out health, family history and general questionnaires. Training on using accelerometer (a device that measures movement and physical activity), blood pressure monitor and filling out food diary, and the physical activity questionnaire will also be done. After the visit, you will be asked to wear blood pressure monitor and accelerometer and fill out a food diary for 2 days (1 weekdays and 1 weekend) and fill in a physical activity questionnaire.

B. Body measurements
We will measure your height, weight and waist circumference

C. Blood sample
Blood sample will be obtained through the forearm. You will be required to fast 10-12 hours before the blood is taken, but please make sure that you have had adequate water. From this sample we will measure your vitamin D levels, total cholesterol, fasting blood glucose and insulin.

D. Food Frequency Questionnaire (Phase 1)
A link to an online questionnaire will be sent to your email for you to complete within five days after your visit.

HNRU Visit 2
Aside from surrendering your food diary, physical activity questionnaire, accelerometer and blood pressure monitor, the following measurements will also be conducted.

A. DXA scan
With this test, you will be asked to wear a robe supplied by the researchers. DXA measures the density of your bones, and also estimates the difference between lean and fat tissue accurately through X-ray beams at different energies. We will be conducting a full body scan, as well as smaller scans of your spine and one hip. While there is no dose of radiation that is considered harmless, the dose for this scan is very low and unlikely to cause harm. The total effective dose of radiation is around 10.8 microsieverts (μSv), a much lower dose than the range normally used in medical diagnostics (for example: 50 μSv for a dental X-ray).

Because we don't want to expose unborn babies to even this small dose of X-rays, women are asked to book a time within the first 14 days from the first day of their last menstrual period to be completely sure they are not pregnant. Researchers who will undertake these measurements of body composition are fully trained and accredited.
You will need to remove all jewellery and body-piercings for the tests. To reduce risk of loss, we advise that you do this at home.

B. Food Frequency Questionnaire (Phase 2)
A link to an online questionnaire will again be sent to your email for you to complete within five days after your visit.

The total amount of time involved in each visit will be around 1 and ½ hour (90 minutes).

What are the benefits and risks of taking part in this research?
You will get a full report of your results and suggestions for further action (if required) will be sent to you via mail or email. Results that will fall within the range of abnormal values will be screened and a signed referral letter will be provided for your GP.

A summary of findings of the research will also be sent to you by February 2017. Most importantly, the major benefit in participating in this research is that you are able to contribute to research knowledge which will potentially further benefit the health of Filipino immigrants in New Zealand.

Will my taking part in the research be maintained confidential?
All study participants will be assigned a code to prevent identification and maintain confidentiality. Access to your information is limited to the primary researcher and the supervisors and all data will be stored in a secure location. Your identity will not be revealed and your confidentiality will be protected in any reports of this study which may be published or presented at seminars or conferences. No personal information, results or answers to questionnaires will be shared with any other institutions, or government authorities. All data remains anonymous and completely confidential.

Upon the completion of this research, your name and assigned code will be destroyed while any raw data which results of the research depend will be maintained in a secure storage for 10 years and after which, will also be destroyed.

Who is funding the research?
The research made possible through the funding of Massey University Graduate Research Fund and the New Zealand Aid Scholarship Post-Graduate Research and Thesis Allowance

Participants' 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;
- be given access to a summary of the project findings when it is concluded.

Massey Human Ethics Committee Approval Statement
This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern A, Application 16/31. If you have any concerns about the conduct of this research, please contact Mr Jeremy Hubbard, Chair, Massey University Human Ethics Committee: Southern A, telephone 04 801 5799 x 63487, email humanethicsoutha@massey.ac.nz.

Project contacts
For further information, questions or concerns about the project, kindly contact the principal investigators or the project supervisor (details on page 1)

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 and entitlements are not automatic and your claim will be assessed by ACC in accordance with the Accident 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.

APPENDIX C – HEALTH AND DEMOGRAPHICS QUESTIONNAIRE

Participant ID:

MASSEY UNIVERSITY
COLLEGE OF HEALTH
TE KURA HAUORA TANGATA

Filipino Women's Health study

Personal Information, Health and Demographics Questionnaire

First name:_____

Family name:_____

Name you would like to be called by:_____

Medical Practitioner:_____

Address: _____

Phone: _____

What is your first language?

English ☐

Other ☐

If other, please state:_____

I would like to receive a brief report summarizing the main findings of the project:

Yes □ No □

I am willing to be contacted in future research projects within the Massey Institute of Food Science and Technology and for this purpose I agree to my contact information being retained on condition that it is in no way linked to the data I have supplied for this research project:

Yes □ No □

Health and Demographic information

How long have you been living in New Zealand? _____

Do you have children? Yes □ No □

- How many children do you have? _____

- When was your youngest child born? __ / __ / ____ (DD/MM/YYYY)

When did your last period start? (Day / month / year) _____

Do you currently use birth control? Yes □ No □
If yes, please specify: _____

Do you have any surgical or cosmetic implants? Yes □ No □

Is your menstrual cycle regular? Yes □ No □

Are you currently in paid employment? Yes □ No □

If yes,

Full time Yes □ No □

Part time Yes □ No □

On-call Yes □ No □

If yes, specify hours per week:_____

If applicable, specify how many night shifts per week:_____

Describe your job or paid employment or work:

TITLE / DESCRIBE HOURS PER WEEK

_____

_____

Do you follow a specific diet for health reasons? Yes □ No □

Please explain

_____

Do you follow any diet for cultural or religious reasons? Yes □ No □

If yes, what type of diet do you follow? _____

_____

_____

Have you been diagnosed with bone disease (osteoporosis, osteomalacia, rickets, etc.)?

Yes □ No □

Please specify

_____

_____

Have you been diagnosed with a metabolic disease (cardiovascular disease, diabetes etc.)?

Yes □ No □

Please specify

_____

_____

Do you have a family history of bone disease or metabolic disease (cardiovascular disease, obesity/overweight, high blood pressure, hyperlipidaemia, gout, type 2 diabetes, reduced bone mineral density, senile kyphosis, fragility, fractures, parental hip fracture etc.)?

Yes □ No □

Please specify

_____

_____

Are you taking any form of medication, including traditional or homeopathic medicine and contraception? Please bring any medications with you when you come for your testing.

Yes □ No □

Please specify the condition, the medication and the dosage in the table provided.

Condition	Medication	Dosage	Frequency

Are you taking any form of supplements, including tablets or drinks? Yes □ No □

Please bring any supplements with you when you come for your testing.

If yes, what are the name, brand and dosage of the supplements you are taking?_____

Supplement	Brand	Dosage	Frequency

Do you smoke cigarettes? Yes □ No □

If yes, approximately how many cigarettes per day:_____

Do you drink alcohol? Yes □ No □

If yes, approximately how many standard drinks per week:_____

[1 standard drink = a glass of wine (120ml), 1 bottle/can of beer, I tot of spirits (45mL)]

Do you have any allergies? Yes □ No □

*Please specify*_____

_____

Please tell us how you found out about the Filipino Womens' Health study. Did you found out from:

- A friend?
    - If yes, what is his/her name?.....
      .....
- An email list?
    - If yes, what is the name of the email list?.....
      .....
- At an event?
    - If yes, which event?.....
      .....
- Flyer on noticeboard?
    - If yes, where was the noticeboard? .....
      ……
- Other……...
  …….
  …….

APPENDIX D – 2-DAY FOOD DIARY

Massey University

Participant ID:

Filipino Womens' Health study

2 Day Food Record

Thank you very much for taking part in the Filipino Womens' Health study. We are extremely grateful for your time, effort and commitment!

If you have any questions, please contact Rio Monzales on R.P.Monzales@massey.ac.nz

All information in this diary will be treated with the strictest confidence. No one outside the study will have access to this.

Please return this diary to us when you come in for your visit.

2-day food diary - what to do?

- Record all that you eat and drink for any 2 days (1 weekday and 1 weekend) before your visit.

- If possible record food at the time of eating or just after – try to avoid doing it from memory at the end of the day.

- Include all meals, snacks, and drinks, even tap water.

- Include anything you have added to foods such as sauces, gravies, spreads, dressings, etc.

- Write down any information that might indicate size or weight of the food to identify the portion size eaten.

- Use a new line for each food and drink. You can use more than one line for a food or drink. See the examples given.

- Use as many pages of the booklet as you need.

Describing Food and Drink

- Provide as much detail as possible about the type of food eaten. For example **brand names and varieties / types** of food.

General description	Food record description
Breakfast example – cereal, milk, sugar	1 cup Sanitarium Natural Muesli 1 cup Pam's whole milk 1 tsp Chelsea white sugar
Coffee	1 tsp Gregg's instant coffee 1 x 200ml cup of water 2 Tbsp Meadow fresh light green milk
Pasta	1 cup San Remo whole grain pasta spirals (boiled)
Pie	Big Ben Classic Mince and Cheese Pie (170g)

- Give details of all the **cooking methods** used. For example, fried, grilled, baked, poached, boiled…

General description	Food record description
2 eggs	2 size 7 eggs fried in 2tsp canola oil 2 size 6 eggs (soft boiled)
Fish	100g salmon (no skin) poached in 1 cup of water for 10 minutes

- When using foods that are cooked (eg. pasta, rice, meat, vegetables, etc), please record the **cooked portion** of food.

General description	Food record description
Rice	1 cup cooked Jasmine rice (cooked on stove top)
Meat	90g lean T-bone steak (fat and bone removed)
Vegetables	½ cup cooked mixed vegetables (Wattie's peas, corn, carrots)

- Please specify the **actual amount of food eaten** (eg. for leftovers, foods where there is waste)

General description	Food record description
Apple	1 x 120g Granny Smith Apple (peeled, core not eaten – core equated to ¼ of the apple)
Fried chicken drumstick	100g chicken drumstick (100g includes skin and bone); fried in 3 Tbsp Fern leaf semi-soft butter

- Because we are especially interested in your calcium intake, please take care to list **all** the milk you consume, and record what type of milk it was.

General description	Food record description
hot chocolate	I x cup hot chocolate made with Cadbury's powder and 150 mls Calcitrim milk, 100 ml hot water. No sugar

- **Record recipes** of home prepared dishes where possible and the proportion of the dish you ate. There are blank pages for you to add recipes or additional information.

Recording the amounts of food you eat

It is important to also record the quantity of each food and drink consumed. This can be done in several ways.

- By using household measures – for example, cups, teaspoons and tablespoons. E.g. 1 cup frozen peas, 1 heaped teaspoon of sugar.

- By weight marked on the packages – e.g. a 425g tin of baked beans, a 32g cereal bar, 600ml Coke

- Weighing the food – this is an ideal way to get an accurate idea of the quantity of food eaten, in particular for foods such as meat, fruits, vegetables and cheese.

- For bread – describe the size of the slices of bread (e.g. sandwich, medium, toast) – also include brand and variety.

- Using comparisons – e.g. Meat equal to the size of a pack of cards, a scoop of ice cream equal to the size of a hen's egg.

- Use the food record instructions provided to help describe portion sizes.

General description	Food record description
Cheese	1 heaped tablespoon of grated cheese 1 slice cheese (8.5 x 2.5 x 2mm) 1 cube cheese, match box size Grated cheese, size 10B

- If you go out for meals, describe the food eaten in as much detail as possible.

- ***Please eat as normally as possible - don't adjust what you would normally eat just because you are keeping a diet record and be honest! Your food record will be identified with a number rather than your name.***

Example day

Time food was eaten	**Complete description of food (food and beverage name, brand, variety, preparation method)**	**Amount consumed (units, measures, weight)**
Example7 :55am	Sanitarium weetbix	2 weetbix
" "	Anchor Blue Top milk	150ml
" "	Chelsea white sugar	2 heaped teaspoons
" "	Orange juice (Citrus Tree with added calcium – nutrition label attached)	1 glass (275 ml)
10.00am	Raw Apple (gala)	Ate all of apple except the core, whole apple was 125g (core was ¼ of whole apple)
12.00pm	Home made pizza (recipe attached)	1 slice (similar size to 1 slice of sandwich bread, 2 Tbsp tomato paste, 4 olives, 2 rashers bacon (fat removed), 1 Tbsp chopped spring onion, 3 Tbsp mozzarella cheese)
1.00pm	Water	500ml plain tap water
3.00pm	Biscuits	6 x chocolate covered Girl Guide biscuits (standard size)
6.00pm	Lasagne	½ cup cooked mince, 1 cup cooked Budget lasagne shaped pasta , ½ cup Wattie's creamy mushroom and herb pasta sauce, ½ cup mixed vegetables (Pam's carrots, peas and corn), 4 Tbsp grated Edam cheese
6.30pm	Banana cake with chocolate icing (homemade, recipe attached)	1/8 of a cake (22cm diameter, 8 cm high), 2 Tbsp chocolate icing
" "	Tip Top Cookies and Cream ice cream	1 cup (250g)
7.30pm	Coffee	1 tsp Gregg's instant coffee 1 x 300ml cup of water 2 Tbsp Meadow fresh blue top milk 2 tsp sugar

Date_____ DAY 1

Time food was eaten	Complete description of food (food and beverage name, brand, variety, preparation method)	Amount consumed

Date_____ DAY 1 continued

Time food was eaten	Complete description of food (food and beverage name, brand, variety, preparation method)	Amount consumed

Recipes (Day 1)

Date_____ DAY 2

Time food was eaten	Complete description of food (food and beverage name, brand, variety, preparation method)	Amount consumed

Date_____ DAY 2 continued

Time food was eaten	Complete description of food (food and beverage name, brand, variety, preparation method)	Amount consumed

Recipes (Day 2)

Date_____ (spare pages)

Time food was eaten	Complete description of food (food and beverage name, brand, variety, preparation method)	Amount consumed

Date_____ (spare pages)

Time food was eaten	Complete description of food (food and beverage name, brand, variety, preparation method)	Amount consumed

APPENDIX E – PHYSICAL ACTIVITY DIARY

Guidelines in using the Accelerometer

Please wear the accelerometer on the following dates

_____

_____

_____

_____

- Please put on the accelerometer as soon as you wake up.

- Please take off the accelerometer when you go to bed.

- Take the accelerometer off when showering, bathing and swimming (example: take off when in water).

- The accelerometer should be worn on the waist (just above the hip) using the elastic belt supplied. The accelerometer should be held snugly against the body.

- The accelerometer can be worn either above or below clothing. It is not necessary for the accelerometer to make skin contact.

- You will return the accelerometer together with your food diary when you come for your second appointment.

- Please take good care of the accelerometer as they are very expensive to replace.

Accelerometer Diary

Use this diary to record the time you woke up, the time you put the accelerometer on, the time you took the accelerometer off, times that you did not wear the accelerometer and the activity you were doing at these times.

Day and date	Day 1	Day 2
At what time did you wake up?		
At what time did you put the accelerometer on?		
At what time did you take the accelerometer off at the end of the day?		
At what time did you go to bed?		
At what times did you not wear the accelerometer during the day?		
What activity were you doing during these times?		
Please record the duration of any weight-training, resistance exercise or cycling you undertook whilst wearing the accelerometer		