CHANGES IN BODY MASS INDEX, DIETARY INTAKE AND PHYSICAL ACTIVITY OF SOUTH AFRICAN IMMIGRANTS IN HOBART, AUSTRALIA

By

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DECLARATION OF AUTHENTICITY

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ABSTRACT

INTRODUCTION: Immigration, especially to countries with a higher prevalence of overweight and obesity, has been found to exacerbate these conditions in immigrants. This study investigated the change in dietary intake, physical activity and body mass index (BMI) of South African immigrants in Hobart, Australia.

OBJECTIVES: The objectives were to determine the change in BMI, the current and usual dietary intakes and perceived dietary changes and the current physical activity levels and perceived changes in physical activity since immigration of South African immigrants residing in the Greater Hobart Area.

DESIGN: This study had descriptive, cross-sectional as well as analytical components.

SAMPLING: Forty seven participants were recruited by contacting known immigrants, postings in newspapers, contacting immigrant social groups, contacting the Department of Economic Development as well as using the social networking program, “Facebook”. All participants had to be between the ages of 20 and 50 and have lived in Australia for longer than six months, but shorter than five years. Thirty participants completed the study with a mean age of 37.17 years.

METHODS: Participants were required to complete a self-administered socio-demographic questionnaire, a 3-day diet record, physical activity questionnaire and quantified food frequency questionnaire (QFFQ). The investigator administered a weight change questionnaire. Anthropometric measurements included weight, height and waist circumference measurements.

RESULTS: There was no significant difference between the BMIs of participants pre- and post-immigration ($p=0.06$), but the percentage of overweight female participants increased from 24% (n=4) to 29% (n=5) and the percentage of overweight male participants increased from 46% (n=6) to 69% (n=9). The percentage of obese female participants increased from 6% (n=1) to 12% (n=2) post-immigration with the male participants showing no increased prevalence of obesity. Participants appeared aware of their weight classifications with 60% (n=18) reporting that they considered themselves overweight. Mean waist circumference values of male and female participants were classified as action level 1. Forty one percent (n=7) of female participants and 31% (n=4) of male participants had waist circumference values

classified as action level 2. Carbohydrate intakes were below the Nutrient Reference Values (NRV) recommendations for 84% (n=25) and 62% (n=19) of participants as indicated by the QFFQ and diet records respectively and the mean carbohydrate intake values of male and female participants (QFFQ and diet records) were below the NRV recommendations as well. Fibre intakes were below the NRV recommendations for 76% (n=23) and 82% (n=25) of participants as indicated by the QFFQ and food records respectively. Saturated fat and sodium intakes were high. Folate, calcium and potassium were consumed in lower than recommended amounts by a large proportion of participants. Sixty seven percent (n=20) of participants reported an increase in physical activity post-immigration and 70% (n=21) of participants anticipated a future increase in physical activity levels.

CONCLUSION: The study population experienced an increase in weight. A number of other risk factors for cardiovascular and other chronic diseases were also identified including high waist circumference values, high saturated fat and sodium intakes and low fibre, folate, calcium and potassium intakes. Interventions aimed at decreasing the risk of South African immigrants in Hobart becoming overweight/obese and developing chronic diseases should probably be aimed at lower saturated and total fat intake, higher carbohydrate and fibre intake and plenty of dietary variation and should further encourage physical activity, but this needs to be confirmed by larger prospective studies.

OPSOMMING

INLEIDING: Daar is gevind dat immigrasie, veral na lande met 'n hoër prevalensie van oorgewig en vetsugtigheid, hierdie toestande in immigrante kan vererger. Hierdie studie het die veranderinge in dieetinname, fisiese aktiwiteit en liggaamsmassa-indeks (LMI) van Suid-Afrikaanse immigrante in Hobart, Australië ondersoek.

DOELWITTE: Die doelwitte was om die verandering in LMI na immigrasie, die huidige en gewoontelike dieetinname en gerapporteerde dieet veranderinge na immigrasie asook die huidige fisiese aktiwiteit en gerapporteerde fisiese aktiwiteit veranderinge van Suid-Afrikaanse immigrante, wat in die groter Hobart area woon, te ondersoek.

ONTWERP: Die studie het beskrywende asook analitiese komponente gehad.

STEEKPROEFTREKKING: Respondente is gewerf deur alle bekende immigrante te kontak, koerant boodskappe te plaas, sosiale groepe vir immigrante te kontak, die Department van Ekonomiese Ontwikkeling te kontak asook deur die sosiale netwerk program, "Facebook", te gebruik. Alle respondente moes tussen die ouderdomme van 20 en 50 wees en moes langer as ses maande, maar korter as vyf jaar in Australië woon.

METODES: Respondente het 'n sosio-demografiese vraelys asook 'n drie dag voedselrekord, 'n voedselfrekwensie vraelys en 'n fisiese aktiwiteit vraelys voltooi. Die navorser het 'n gewigsverandering vraelys afgeneem. Antropometriese metings het gewig, lengte en middelomtrek ingesluit.

RESULTATE: Daar was nie 'n betekenisvolle verskil tussen die LMI waardes van respondente voor en na immigrasie nie (p=0.06), maar die persentasie oorgewig vroulike respondente het toegeneem van 24% (n=4) na 29% (n=5) en die persentasie oorgewig manlike respondente het toegeneem van 46% (n=6) na 69% (n=9). Die persentasie vetsugtige vroulike respondente het toegeneem van 6% (n=1) na 12% (n=2) na immigrasie en die manlike respondente het geen toename in vetsugtigheid getoon nie. Dit het voorgekom asof respondente bewus was van hulle gewigsklassifikasies met 60% (n=18) wat gerapporteer het dat hulle hulself as oorgewig beskou. Die gemiddelde middelomtrek waardes van die manlike en vroulike respondente was geklassifiseer as aksie vlak 1. Een en veertig persent

(n=7) van die vroulike respondente en 31% (n=4) van die manlike respondente het middelomtrek waardes getoon wat as aksie vlak 2 geklassifiseer was. Koolhidraat inname was laer as the nutrient verwysingswaardes vir 84% (n=25) en 62% (n=19) van die respondente soos aangedui deur die voedselfrekwensie lys en 3-dag voedselrekord. Vesel inname was laer as the nutrient verwysingswaardes vir 76% (n=23) en 82% (n=25) van die respondente soos aangedui deur die voedselfrekwensie lys en 3-dag voedselrekord. Die gemiddelde waardes vir koolhidraat en vesel inname vir manlike en vroulike respondente (voedselfrekwensie lys en 3-dag voedselrekord) was laer as die nutrient verwysingswaardes. Versadigde vet en natrium innames was hoog. Folaat, kalsium en kalium innames van ‘n groot proporsie respondente was laer as die aanbevelings. Sewe en sestig persent (n=20) van die respondente het gerapporteer dat hulle fisiese aktiwiteitsvlakke toegeneem het na immigrasie en 70% (n=21) van die respondente het verwag dat hulle fisiese aktiwiteitsvlakke sou verhoog.

AANBEVELINGS: Die studie populase het ‘n toename in gewig en LMI ondervind. ‘n Aantal verdere risikofaktore vir kroniese en kardiovaskulêre siektes was geïdentifiseer, byvoorbeeld hoë middelomtrek waardes, hoë versadigde vet en natrium innames en lae vesel, folaat, kalsium en kalium innames. Programme wat fokus op die voorkoming van oorgewig/vetsug in Suid-Afrikaanse immigrante in Hobart, Australië moet moontlik gemik wees op laer totale en versadigde vet inname, hoër vesel en koolhidraat inname asook variasie in diet en fisiese aktiwiteit moet ook verder aangemoedig word. Sodanige aanbevelings moet egter bevestig word deur groter prospektiewe studies.

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CONTRIBUTIONS BY PRINCIPAL RESEARCHER AND FELLOW RESEARCHERS

The principal researcher, Marcile Stanton, developed the idea and the protocol. The principal researcher planned the study, undertook data collection without a research assistant, captured the data for analyses, analysed the data with the assistance of statistician, Prof. DG Nel, interpreted the data and drafted the thesis. Prof. Marietjie Herselman and Mrs. Janicke Visser provided input at all stages and revised the protocol and thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

AI	Adequate intake
ANOVA	Analysis of variance
BMI	Body Mass Index
cm	Centimeter
CHO	Carbohydrates
EAR	Estimated Average Requirement
FFQ	Food Frequency Questionnaire
Kg	Kilogram
M	Meter
NRV	Nutrient Reference Values for Australia and New Zealand
PAL	Physical Activity Level
QFFQ	Quantified Food Frequency Questionnaire
SD	Standard deviation
UL	Upper limit
WHO	World Health Organisation

LIST OF DEFINITIONS

Adipose	denoting fat[1]
Apnoea	absence of breathing[1]
Atherosclerosis	arteriosclerosis characterised by irregularly distributed lipid deposits in the intima of large and medium-sized arteries, causing narrowing of arterial lumens and proceeding eventually to fibrosis and calcification.[1]
Body Mass Index	a measure of body fat that is the ratio of the weight of the body in kilograms to the square of its height in meters [a body mass index in adults of less than 18.5 is considered underweight, 18.5 to 24.9 is considered normal, 25 to 29.9 is considered an indication of overweight, and 30 or more an indication of obesity].[1]
Cardiovascular disease	of, relating to, or involving the heart and blood vessels cardiovascular disease.[1]
Caucasian	of, constituting, or characteristic of a race of humankind native to Europe, North Africa, and southwest Asia and classified according to physical features — used especially in referring to persons of European descent having usually light skin pigmentation.[1]
Cytokines	any of numerous hormone-like, low-molecular-weight proteins, secreted by various cell types, that regulate the intensity

	and duration of immune response and mediate cell-cell communication.[1]
Dyslipidaemia	a condition marked by abnormal concentrations of lipids or lipoproteins in the blood.[1]
Hepatic Steatosis	yellow discoloration of the liver due to fatty degeneration of liver parenchymal cells.[1]
Homocysteine	a homolog of cysteine, produced by the demethylation of methionine, and an intermediate in the biosynthesis of L-cysteine from L-methionine via L-cystathionine. Elevated levels have been associated with certain forms of heart disease.[1]
Hypercholesterolaemia	the presence of an abnormally large amount of cholesterol in the blood.[1]
Noncommunicable disease	not capable of being communicated; not transmissible by direct contact[1]
Palatability	agreeable to the palate or taste[1]
Subcutaneous	beneath the skin[1]
Visceral	relating to the viscera – organs of the digestive, respiratory, urogenital, and endocrine systems as well as the spleen, the heart, and great vessels.[1]

CHAPTER 1: LITERATURE REVIEW

1.1 INTRODUCTION

In 2005 there were 1.6 billion adults around the globe that were overweight and approximately 400 million adults that were obese. These figures are estimated to increase to 2.3 billion overweight adults and 700 million obese adults by 2015.[2] Overweight and obesity are related to several chronic conditions and significantly increases morbidity and mortality rates and place a significant economic burden on countries.[3,4] It is important for policy-makers and governments to be aware of the prevalence of overweight and obesity as well as its risk factors in order to focus resources on intervention programs to address this problem. Immigration has been found to exacerbate overweight and obesity, especially when obesity and overweight prevalence in the new country is higher than the country of origin.[5]

1.2 DEFINING OVERWEIGHT AND OBESITY

The World Health Organisation (WHO) defines overweight and obesity as "abnormal or excessive fat accumulation that may impair health".[2] According to the WHO, overweight is defined as a Body Mass Index (BMI) of 25 or more and obesity as a BMI of 30 or more. BMI is calculated as weight in kilograms divided by the square of the height in meters (kg/m^2).[2]

The distribution of body fat affects the extent to which overweight or obesity impacts a person's health.[6] Obese and overweight individuals with excess weight around the abdomen are at an increased risk of developing health problems diabetes and heart disease.[6]

BMI provides an easy measure of overweight and obesity at a population-level. There are other tools available that provide a more accurate and detailed description of the state of overweight or obesity such as underwater weighing, magnetic resonance imaging and doubly labelled water, but these methods are costly and not practical when it comes to research.[6]

It is important to grade the degree of overweight and obesity in order to be able to meaningfully compare the weight status between different populations as well as to identify those at risk of morbidity or mortality. Grading the degree of overweight and

obesity also makes it possible to develop priorities for intervention and provides a way to evaluate interventions.[4,6]

1.3 MEASUREMENTS OF OVERWEIGHT AND OBESITY

1.3.1 Body Mass Index

BMI is a simple measurement to classify individuals as underweight, normal weight, overweight or obese as illustrated in table 1.1.[2,3,6]

Table 1.1: Classification of adult weights according to BMI

Classification	BMI	Risk of comorbidities
Underweight	<18.5	Low (but risk of other clinical problems increased)
Normal range	18.5 – 24.99	Average
Overweight	≥ 25.00	
Pre-obese	25.00 – 29.99	Increased
Obese class 1	30.00 – 34.99	Moderate
Obese class 2	35.00 – 39.99	Severe
Obese class 3	≥ 40.00	Very severe

Source: WHO. 2004.[6]

One limitation of BMI is that it does not distinguish between weight as a result of fat or muscle. Body fat percentage also increases with age up to 60 – 65 years and is, in general, higher in women than men when measured at the same BMI.[6] This should be taken into account when interpreting research data.

1.3.2 Waist Circumference

The abdominal fat mass of individuals with similar BMI measurements can vary substantially. Men tend to have more abdominal fat than premenopausal women. Waist-to-hip ratio used to be widely accepted as the indication of abdominal fat. However, waist circumference values have been shown by recent evidence to be a more practical indication of abdominal fat which does not require a height measurement and correlates with BMI and waist-hip ratio measurements. Waist circumference measurements can be used to identify those individuals at increased risk of developing chronic disease.[6,7]

Waist circumference is a simple measurement that is closely related to BMI and changes in waist circumference provides a good indication of changes in risk factors for cardiovascular disease as well as other chronic diseases as illustrated by table 1.2.[6,7,8]

Table 1.2: Sex-specific waist circumference and risk of metabolic complications associated with obesity in Caucasians

Risk of metabolic complications	Waist circumference (cm)	
	Men	Women
Increased	≥94	≥80
Substantially increased	≥102	≥88

Source: WHO. 2004.[6]

It is not known at this stage how excess abdominal fat leads to cardiovascular disease, but there are a few hypotheses. One hypothesis is that the central nervous system adrenal axis gets activated by environmental stress factors. This activation causes the deposit of adipose tissue in the abdomen which leads to cardiovascular disease.[7] A more recent hypothesis suggests that subcutaneous fat has limited ability to store excessive energy. This leads to chemical energy spreading to intra-abdominal adipose tissue and other sites such as the liver as well as skeletal muscles. This causes these organs to malfunction, which leads to issues such as insulin resistance and dyslipidaemia.[7] Visceral adipose tissue is metabolically more active than subcutaneous adipose tissue. Because visceral adipose tissue is

connected to the liver it may have an enhanced role as the portal circulation delivers free fatty acids to the liver. These free fatty acids impact on the insulin signalling which therefore affects glucose transport into skeletal muscle. This causes insulin resistance.[9] Visceral adipose tissue produces cytokines that contribute to insulin resistance and cardiothoracic disease. These cytokines include interleukin-6 (IL6), tumour necrosis factor-α (TNF α), and plasminogen activator inhibitor-1. IL6 affects insulin and leptin signalling and it also decreases adiponectin secretion. TNF-α inhibits the uptake of glucose and also prevents fatty acid oxidation. The expression of genes involved in de novo synthesis of cholesterol is increased by TNF-α as well. The development of atherosclerosis is accelerated by plasminogen activator inhibitor-1 that inhibits fibrinolysis and TNFα influences insulin signalling and the uptake of glucose.[9] Large fat cells that are associated with obesity do not secrete sufficient insulin sensitising hormone and secrete too much insulin resistance hormone which further contributes to insulin resistance. Large fat cells also secrete less adiponectin which leads to low high density lipoprotein cholesterol levels, high triglyceride levels and insulin resistance.[9]

1.4 THE PREVALENCE OF OVERWEIGHT AND OBESITY

The prevalence of overweight and obesity has been increasing significantly all around the world. This increase is not limited to developed countries and is prevalent in adults and children.[5] It is vital to determine the prevalence and trends in overweight and obesity in order to identify those groups at risk of becoming obese as well as to provide policy-makers with the necessary information in order to apply resources to address the problem. This data is also important for the evaluation of intervention programs.[6]

1.4.1 Obesity Prevalence in the African Region

African countries historically focussed more on underweight and food insecurity. Data regarding overweight and obesity has thus not been widely available. A recent study that was conducted in Mauritius showed that this country experienced a significant increase in the prevalence of obesity in men and women over the last 5 years. Even though Mauritius may not be seen as a typical African country, the study

indicated that rapidly modernising countries experience an increase in obesity which can quickly become a public health problem.[3,6]

In developing African countries those adults living in rural areas and making use of a traditional lifestyle showed limited weight gain with age. The improvement of socio-economic status and urbanisation has led to the rise of obesity in some groups of black African women. These levels of obesity exceed the levels of obesity of populations in developed countries.[3,6]

The following table summarises the overweight and obesity data for the various ethnic groups in South Africa. Asian men and women show the highest percentage of overweight people with white men and African women showing the highest percentage of obese people. South African women showed a higher prevalence of overweight and obesity than South African men.

Table 1.3: Breakdown of the prevalence of measured overweight/obesity by population group and sex in South Africa, 2003

Population group	**Percentage overweight/obesity**	
	Males	
	Overweight	**Obese**
African men	20.4%	7.1%
Men of mixed ancestry	21%	15.6%
Caucasian men	25%	22.6%
Asian men	34.1%	10.7%
TOTAL	**21.1%**	**8.7%**
	Females	
	Overweight	**Obese**
African women	27.8%	28.4%
Women of mixed ancestry	26%	26.6%
Caucasian women	23.5%	13.5%
Asian women	33.8%	23.9%
TOTAL	**29%**	**23.3%**

Source: Adapted from Department of Health. 2003.[10]

1.4.2 Western Pacific Region

Trend data focussing on the prevalence of overweight and obesity in the Western Pacific Region indicated that there has been an increase in overweight and obesity in Australian and Samoan populations. The prevalence of obesity has also increased in male and female Japanese populations. For undetermined reasons Chinese men have experienced an increase in the prevalence of overweight and obesity, but not the women.[3,6]

The Australian data for overweight and obesity is summarised in table 1.4. Australian men and women show much higher rates of overweight compared to the South African Caucasian population. However, Caucasian South African men have a higher rate of obesity compared to Australian men, but Australian women have a slightly higher rate of obesity compared to Caucasian South African women.

The statistics available for South Africa are from 2003 and the Australian statistics are from 2009. The South African situation may have changed between 2003 and 2009.

Table 1.4: The prevalence of overweight/obesity in Australia, 2009

Prevalence of overweight/obesity in Australia	
Males	
Overweight	**Obese**
43%	19%
Females	
Overweight	**Obese**
28%	17%

Source: Adapted from ABS. 2009.[11]

1.5 CAUSES OF OVERWEIGHT AND OBESITY

The simplest way to describe how overweight and obesity develop is that it is caused by an energy imbalance where energy expenditure is exceeded by energy intake over a period of time.[3,6] A number of factors contribute to an energy imbalance. It is important to note that obesity can be the result of a small energy imbalance that causes a gradual increase in body weight over a period of time.[12]

1.5.1 Physiological Regulation of Body Weight

When energy intake exceeds energy expenditure the result is a positive energy balance. This leads to increased energy stores and therefore body weight.[12] Normally energy balance changes from day to day without any lasting increase in body weight. This is the result of many physiological mechanisms in the human body that equate the total energy intake and overall energy expenditure which keeps body weight stable.[12]

The physiological mechanisms that ensure that body weight is regulated are not completely understood. There is evidence that there are signalling mechanisms within the human intestine as well as fat tissue and the brain that pick up when nutrients are consumed. The brain receives afferent signals (nutrient, metabolic, hormonal and neuronal) and integrates these signals. The brain responds by changing food intake, autonomic nervous system activity, hormonal responses and physical activity that occurs spontaneously. The proportion of energy deposited as protein as opposed to fat is then determined. The hormone, Leptin, is one such signalling mechanism which is currently being researched.[12]

Leptin is a cytokine-like hormone that is derived from adipocytes and is said to play a very important role in energy balance regulation. Leptin acts mainly on the central nervous system and activates the cognate receptor. Research has shown that the absence of leptin or its receptor in mice results in obesity, hyperphagia, insulin resistance, hyperglycemia and neuroendocrine dysfunction. The binding of leptin regulates energy intake and expenditure as well as body fat, neuroendocrine systems, autonomic function as well as the balance of insulin and glucose.[13]

Several other substances may be involved in the regulation of body weight as described below.[14,15]

- Ghrelin is a peptide hormone produced by endocrine cells in the gastric fundus. It binds to the secretagogue receptor which is a growth hormone receptor. The secretagogue receptor is highly expressed in the hypothalamus, the pituitary gland and the brainstem. Ghrelin has a stimulatory effect on appetite and food intake. Levels of Ghrelin rise when the body is in the fasting state and falls after eating.

- Peptide YY (PYY) is part of the pancreatic polypeptide family of proteins. Levels of PYY peak after a meal and are low during the fasting state. When PYY is administered peripherally, it leads to a reduction in food intake.

- Oxyntomodulin and GLP-1 are two hormones that are rapidly released after food is ingested. The levels that are released correspond with the amount of calories ingested. Oxyntomodulin and GLP-1 are satiety signals and can influence body weight in the long term. Cholecystokinin (CCK) is distributed in the gastrointestinal tract. The majority is found in the jejunum and duodenum.

- CCK is distributed into circulation and tissues once nutrients enter the gut. It stimulates the release of important digestive enzymes from the pancreas and gallbladder. In addition to this CCK also increases intestinal motility and it slows gastric emptying. CCK leads to satiety by acting on CCK receptors which are widely distributed throughout the central nervous system.

- Gut peptides influence hunger and satiety and therefore energy balance in human beings. It is really important that hunger and satiety signals from the gut and adipose tissue are integrated otherwise energy homeostasis cannot be upheld.

Despite the fact that the body's physiological regulation is extensive, a positive energy balance can still lead to weight gain if it continues for a long period of time. The process of gaining weight can be divided into three phases. The pre-obese static phase occurs when weight remains constant and there is a long-term energy

balance. The dynamic phase is characterised by weight gain by the individual as a result of excess energy intake. The obese static phase is characterised by a restoration of energy balance, but a higher weight than during the pre-obese static phase.[12]

1.5.2 Dietary Factors

1.5.2.1 Fat and energy intake

Experiments have shown that the levels of fat and energy intake are strongly linked to overweight and obesity. Studies have been conducted on animals which indicated that animals consuming low-fat diets show low levels of obesity. As dietary fat increases in animals, so the prevalence of obesity increases. Studies in humans have shown similar trends.[16] Dietary fat is more energy dense than other macronutrients. Many individuals who consume foods high in fat experience the overeating effect. The pleasant feeling that fatty foods cause in the mouth also contribute to the stimulatory effect of high fat foods on energy intake. The overconsumption of energy from eating high fat foods can be dealt with to an extent by the body, but appetite control signals are weak when it comes to fatty foods and therefore leads to rapid intake of energy from high fat foods.[12] These signals are especially overwhelmed when an individual periodically ingests a large amount of fatty foods. Fibre has the opposite effect and allows time for appetite-control signals to function which prevents that an excessive amount of energy is consumed.[12] Protein and carbohydrates can only be stored in small amounts in the body. Only when very large amounts of low fat carbohydrates are consumed is carbohydrates converted into fat. When excessive amounts of carbohydrates are consumed, however, less oxidation of fatty acids is necessary which leads to fat being stored in the body. Fat storage is practically unlimited which means that excess fat is easily stored. It therefore appears that carbohydrate and protein balances are effectively regulated, but the same cannot be said about fat regulation.[12]

1.5.2.2 Food availability and portion size

Food is easily accessible through retail markets in developed countries with oversized portion sizes being widely available which promotes the intake of excessive amounts of food. Fast food chains offer such opportunities to increase the sizes of portions at a very small extra cost. This may seem as better value for money than getting the normal size items which makes this much more attractive to consumers.[4,16]

1.5.2.3 Food palatability

The palatability of food has a positive effect on the consumption of food which can lead to an excessive intake of energy and in turn overweight and obesity. Fat intake of food contributes to its palatability and this has led to the food industry developing foods with higher fat contents in order to increase palatability. Many foods are also sweetened in order to increase the palatability of foods. Sweetened foods with a high fat content is expected to lead to overweight and obesity as both contribute to the palatability of the product and the fat content will suppress the appetite-control signals.[4,16]

1.5.3 Physical Activity

Cross-sectional data frequently shows an inverse relationship between the BMI and physical activity of individuals. This means that obese and overweight individuals are less active than those with a normal weight or who are underweight which leads to an increase in body weight. Energy requirements increase when physical activity is initiated and remains increased while the activity continues. The amount of energy spent depends on the type and intensity of physical activity. Vigorous exercise leads to elevated oxygen consumption even after the activity has ceased. This is called “excess post-exercise consumption.[12]

Technological advancement and modern transport methods has reduced our need for physical activity. Energy-saving developments such as lifts, escalators, automatic doors, mechanisation and computerisation are a few more causes of decreased activity.[9] An increased fascination with television and electronic games has led to a more sedentary lifestyle. Schools do not seem to engage children in physical activity

as much anymore as mandatory physical education has decreased.[16,17] Safety concerns prevent children, women and the elderly from leaving the house which has had an effect on physical activity levels as well.

A decreased level of physical activity requires a decreased amount of energy. If dietary intake is not adapted according to energy expenditure, it will lead to overweight and obesity.[16] It appears that the global increase in obesity and overweight parallels the rise in sedentary behaviour and inactivity.

When an individual exercises regularly, fat stores rather than carbohydrates are used. If exercise is maintained over time it can lead to a significant loss of fat mass. Regular exercise of moderate intensity will allow an individual to consume up to 40% of energy from fat without gaining weight. In other words, regular exercise allows energy balance to be sustained even when a higher fat diet is consumed.[12]

An analysis of over 40 physical activity studies on a national level conducted globally indicated that there is a relationship between the mean BMI of adult men and their physical activity levels (PAL). The higher the PAL value the more active the individual. Table 1.5 indicates the classifications of PAL values.

Table 1.5: Physical Activity Level categories

Physical Activity Level categories (PAL)	
Sedentary	PAL ≥ 1.0 - 1.4
Low active	PAL ≥ 1.4 - 1.6
Active	PAL ≥ 1.6 - 1.9
Very active	PAL ≥ 1.9 - 2.5

Source: Saris.2003.[18]

When a PAL of 1.8 is maintained in the male population, the risk of becoming overweight is significantly reduced. Women require a PAL of 1.6 in order to have the same effect.[12]

Seventy percent of Australians over the age of 15 is classified as sedentary. Sedentary or low activity levels are more prominent in the elderly and less likely to occur in those aged 15 – 24 years. Women are more likely to be sedentary than men.[19] South African statistics indicate that 46.2% of females and 36.7% of men are inactive.[10] Australian statistics indicate that immigrants from Sub-Saharan Africa and Australian citizens tend to show the same likelihood of engaging in physical activity.[20]

1.5.4 Childhood Malnutrition

Childhood obesity increases the risk of developing chronic diseases such as impaired glucose metabolism, insulin resistance, Type 2 diabetes, hypertension, dyslipidaemia, hepatic steatosis, gastrointestinal disturbances, obstructive sleep apnoea and polycystic ovary syndrome.[3,21,22] Studies have shown that obese children are likely to become obese adults. Adults that have been obese since childhood often suffer from psychological disturbances. Adolescents have the greatest risk of incurring psychological disturbances as a result of obesity.[3, 21,22]

A recent systematic review and meta-analysis by Horta et al. showed that the risk of hypertension, high cholesterol, diabetes and overweight/obesity is increased in babies that were not breastfed.[23]

Moreover, studies have indicated that nutritional stunting also causes long lasting changes such as lower energy expenditure, higher susceptibility to the consequences of diets high in fat, lower levels of fat oxidation and impaired food intake regulation.[24]

A fact sheet by the WHO showed that 43 million children under five were overweight and this problem was not only observed in developed countries, but also in developing countries. Approximately 35 million overweight children are from developing countries as opposed to only 8 million that reside in developed countries.[3]

Childhood obesity should be monitored and prevented in order to prevent chronic disease in later life.

1.5.5 Environmental and Societal Influences

1.5.5.1 Modernisation

Adults following a "traditional lifestyle" do not seem to gain a lot of weight as they get older. Hunter-gatherer populations show an absence of obesity when looking at their anthropometric measurements. Most individuals' dietary intakes have been affected by modernisation. Food is more available, but the energy need has decreased with transport availability, mechanisation and computerisation of work places and entertainment such as television. Obesity seems to be the first "disease" to develop when modernisation occurs. Obesity, type 2 diabetes, hypertension, dyslipidaemia and heart disease are very closely related to modernisation. This is part of the so-called "New World Syndrome".[4,12,16]

1.5.5.2 Immigration

The high prevalence of obesity in migrants has become a major public challenge Internationally and in Australia.[5] Research has shown that some immigrants have a tendency towards weight gain while they settle into new cultures. This happens especially where the country that the immigrants relocate to has a higher prevalence of overweight and obesity.[25]

A study regarding Sub-Saharan African migrants in Victoria, Australia indicated that dietary acculturation took place by a few processes: substitution, supplementation and modification of recipes. The study found that the migrants found it difficult to obtain their traditional foods. These traditional foods included African vegetables, unprocessed maize meal, camel milk as well as maize grain. Pizza, breakfast cereal as well as fast foods were foods that the migrants adopted into their diets. Migrants started going out for meals and an important change in their meal pattern was the introduction of breakfast. This particular study concluded that most of the dietary changes that were introduced were not conducive to good health.[26] Tables 1.6 and 1.7 indicate substitutes that were used for traditional foods as well as the factors that influenced food choices.

Table 1.6: Australian substitutes for traditional dishes that are inaccessible or unavailable (n=97)

Traditional food not accessible	Australian substitutes	% Households affected
Camel meat	Lamb	38.1
Maize flour	Semolina/polenta	33
African vegetables	Bok Choy/Chinese	27.8
Camel milk	Cow's milk	20.6
Cocyam/plantain banana/cassava	Potatoes	11.3
Sorghum	Wheat	10.3
Maize grain	Mashed sweet corn/peas	7.2
Thick sorghum porridge/meal	Noodles/pasta	7.2
Fresh water fish	Sea fish	3.1
Plantain banana	Rice	3.1
Tropical fruit	Summer fruit/apple	2.1
Sorghum flour, cassava flour, yam flour	Potato flour	2.1
Liboke	Pork	1
Smoked wild meat/goat meat	Barbecue	1
Fermented thick maize meal	Pizza	1

Source: Renzaho et al. 2006.[26]

Table 1.7: Factors most influencing food choice of Sub-Saharan African immigrants in Victoria, Australia

Variables	Christian (n=71)	Muslims (n=68)	Total (n=139)
Nutritional value	32.4%	2.9%	18.0%
Budget	25.4%	10.3%	18.0%
Health	14.1%	13.2%	13.7%
Palatability	8.5%	0.0%	4.3%
Preference/favourite	8.5%	2.9%	5.8%
Easy to prepare	5.6%	1.5%	3.6%
Cultural/traditional	4.2%	2.9%	3.6%
Availability of ingredients	1.4%	0.0%	0.7%
Religion	0.0%	66.2%	32.4%

Source: Renzaho et al. 2006.[26]

A study comparing the nutritional status of Greek immigrants in Melbourne, Australia to Greeks in Spata, Greece showed that the Greeks in Melbourne were showing the same alarmingly high prevalence of heart disease as the Australian-born population. This is possibly because the Australian diet is much higher in animal products and lower in plant products. Melbourne Greeks also illustrated a much higher prevalence of obesity compared to the Greeks in Spata.[27]

A study conducted in Australia showed that there were a number of food alterations in the Chinese and Greek immigrants in Australia. These alterations are summarised in table 1.8.[28] In general there was a change from lower fat, sugar and energy foods to energy dense, high fat and high sugar foods.

Table 1.8: Acculturation, food cultural analogues and alterations of Chinese and Greek immigrants in Australia

Culture	Item	Food alteration
Chinese	Green leafy vegetables	Increased fatty meat or cooking oil
	Sweet potato/yam	Potato
	Chinese tea	Coca-cola
	Rice (morning)	Breakfast cereal
	Rice (mid-day)	Bread
	Rice (evening)	Potato
	Tofu	Cheese, potato
Greek	Goat	Lamb
	Bread	Breakfast cereal
	Olive oil	Butter
	Wine	Beer
	Water	Beer
	Chick peas	Biscuits

Source: Wahlqvist. 2002.[28]

Numerous studies have indicated that excess weight of immigrants increases with the length of time since immigration. This is the case for males and females.[29,30,31] One explanation for this is that this happens as a result of acculturation which includes the adoption of unhealthy dietary habits.[31]

The above illustrate some of the psychosocial factors such as lack of availability of familiar "comfort" foods that play a role in the weight changes of immigrants. Other factors such as stress and employment changes should be considered when investigating weight changes as a result of immigration.[5,26]

1.5.6 Individual/Biological Susceptibility

1.5.6.1 Genetic susceptibility

Some people are more susceptible than others to become overweight or obese. Genetics have been identified as increasing one's susceptibility to becoming overweight or obese.[12] Human genes have not changed dramatically over the last

few decades and therefore cannot explain the increase in the obesity and overweight prevalence.[16] It is currently believed that the genes that cause weight gain make individuals more susceptible to becoming overweight or obese when the individuals are exposed to adverse environments.[12] The thrifty gene theory surfaced in 1962 and proposed that individuals in harsh environments without food security maximised their survival by maximising the storage of surplus energy. During periods of starvation energy is stored as fat rather than glycogen. This energy storing genotype causes glucose intolerance when there is an abundance of food.[32] An alternative theory suggests that metabolic syndrome is programmed in utero. When intrauterine malnutrition leads to low birth weight the risk of metabolic syndrome later in life is increased.[32] Table 1.9 summarises the genetic factors that are involved in the development of obesity.

Table 1.9: Factors involved in the development of obesity thought to be genetically modulated

Macronutrient-related	Adipose tissue lipolysis
	Adipose tissue and muscle lipoprotein lipase activity
	Muscle composition and oxidative potential
	Free fatty acids and B-receptor activities in adipose tissue
	Capacities for fat and carbohydrate oxidation
	Dietary fat preferences
	Appetite regulation
Energy expenditure	Metabolic rate
	Thermogenic response to food
	Pattern of energy usage
	Propensity for spontaneous physical activity
Hormonal	Insulin sensitivity
	Growth hormone status
	Leptin action

Source: WHO. 2004.[12]

1.5.6.2 Non-genetic biological susceptibility

There are a number of biological factors other than the genetic factors mentioned above that can increase an individual's susceptibility to becoming overweight or obese. Sex is one of these factors. Females have an increased storage of fat compared to males. Females tend to store extra energy into fat storage while males use energy for the synthesis of muscle. Ethnic groups that live in developed countries are very susceptible to becoming overweight or obese. One of the explanations for this is that these groups have a genetic predisposition and when they are exposed to a less traditional lifestyle they tend to gain weight.[12]

1.6 CONSEQUENCES OF OVERWEIGHT AND OBESITY

1.6.1 Obesity as a Risk Factor for Noncommunicable Diseases

Obesity is a a risk factor for many chronic diseases such as type 2 diabetes, coronary heart disease, hypertension and hypercholesterolaemia.[6,3,33,34,35] Table 1.10 illustrates the relative risk of health problems that are associated with obesity. Table 1.11 summarises the types of cancer that are more prevalent in the overweight and obese populations and table 1.12 lists the hormonal imbalances associated with intra-abdominal fat accumulation.

Table 1.10: Relative risk of health problems associated with obesity

Greatly increased	Moderately increased	Slightly increased
Type 2 diabetes	Cardiovascular disease	Cancer
Gallbladder disease	Hypertension	Reproductive hormone abnormalities
Dyslipidaemia	Osteoarthritis	Polycystic ovary syndrome
Insulin resistance	Hyperuricaemia and gout	Impaired fertility
Breathlessness		Low back pain
Sleep apnoea		Increased risk of anaesthesia complications
		Foetal defects

Source: WHO. 2004.[30]

Table 1.11: Cancers with a higher reported incidence in obese persons

Hormone-dependent	Gastrointestinal/hepatic/renal
Endometrial	Colorectal
Ovarian	Gallbladder
Breast	Pancreatic
Cervical	Hepatic
Prostate	Renal

Source: WHO. 2004.[34]

Table 1.12: Common hormonal abnormalities associated with intra-abdominal fat accumulation

Insulin resistance and increased insulin secretion
Increased free testosterone and free androstenedione levels associated with decreased sex hormone binding globulin in women
Decreased progesterone levels in women
Decreased testosterone levels in men
Increased cortisol production
Decreased growth hormone levels

Source: WHO. 2004.[34]

1.6.2 Psychological Problems Associated with Obesity

Psychological problems in the obese appear to be worse in those with chronic illnesses. Social bias, prejudice and discrimination are issues that obese individuals have to contend with in addition to body shape dissatisfaction and eating disorders.[28]

1.7 THE COST OF OVERWEIGHT AND OBESITY

It is important for policy-makers as well as health care professionals to understand the cost of overweight and obesity. There have not been many attempts to quantify this burden and limited information is available. There are direct, indirect and opportunity costs that make up the economic burden of overweight and obesity. Direct costs are costs that the individual or health professional incur as a result of treating overweight or obesity. Indirect costs are usually seen as the loss of productivity as a result of overweight and obesity and opportunity cost is the

personal and social costs that an individual incurs as a result of overweight and obesity. This is generally as a result of morbidity or mortality.[34]

The limited number of studies that have looked into the economic impact of obesity are summarised in table 1.13.

Table 1.13: Economic costs of obesity

Country	Year	Study	BMI	Estimated direct costs	National health care costs
Australia	1989 - 1990	National Health and Medical Research Council	>30	464 million Australian dollars	>2%
France	1992	Levy et al.	≥27	12 000 million French Franc	2%
Netherlands	1981 – 1989	Seidell & Deerenberg	>25	1000 million Dutch Gilder	4%
USA	1994	Wolf & Colditz	>29	45 800 million United States dollars	6.8%

Source: WHO. 2004.[34]

Studies conducted in developing countries could not be compared to the studies in the table above, but the World Health Organisation and World Bank have highlighted the fact that developing countries have been experiencing an increased burden as a result of obesity.[34]

International studies have shown that obesity is accounting for 2 – 7% of total health care costs. This is most likely a conservative estimate. Although studies in developing countries cannot be compared to those conducted in developed countries the cost of obesity is likely to exceed the costs incurred by developed countries.[34]

1.8 RESEARCH PROBLEM

Overweight and obesity are global problems that lead to several chronic conditions and high health care costs. Research has shown that some immigrants have a tendency towards weight gain while they settle into new cultures. This happens especially where the country that the immigrants relocate to has a higher prevalence of overweight and obesity than the country of origin.[25]

Research conducted in Atlanta showed that South African immigrants did experience a significant increase in BMI post-immigration. It is, however, known that the United States has a much higher prevalence of obesity and overweight compared to South Africa and Australia.[36] The mentioned study was a cross-sectional study using socio-economic, physical activity, weight change and food frequency questionnaires in order to gather data.

The Australian Immigration Update indicates that the following numbers of South Africans obtained their respective Australian Visas in the period 2005-06[37]:

- 5512 permanent additions
- 5692 temporary entry – students (Sub-Saharan Africa) (June 06)
- 9572 short-term business (June 06)
- 6514 temporary residents present on 30th of June (June 06)
- 5656 temporary business entry (June 06)

It is clear that a large number of South Africans have relocated to Australia. Table 1.14 compares the prevalence of overweight and obesity rates in South Africa and Australia. Caucasian statistics were used for South Africa as the largest proportion of South African immigrants to Australia is Caucasian.

Table 1.14: The comparison of overweight/obesity rates in South Africa and Australia

Comparison of overweight/obesity rates in South Africa and Australia		
	South African Health and Demographic Survey, 2003[10] (Caucasian)	Australian Bureau of Statistics : Health Risk Factors Australia, 2004-5[11]
Overweight	25% (Males)	43% (Males)
	23.5% (Females)	28% (Females)
	24.25% (combined)	**35.5% (combined)**
Obesity	22.6% (Males)	19% (Males)
	13.5% (Females)	17% (Females)
	18.05%(combined)	**18% (combined)**

Source: Adapted from Department of Health and ABS. 2003 and 2009.[10,11]

No studies investigating weight changes have been conducted on the South African immigrants in Australia even though there are such a large number of these immigrants.

Studies investigating interventions aimed at limiting weight gain in immigrants to Australia have shown promising results. A study investigating Asian and European immigrants to Australia indicated that public health policies that focus on lifestyles of immigrants may prevent BMI increases in these groups.[38] Another study looked at a diet and lifestyle intervention aimed at preventing metabolic syndrome in Pakistani immigrants in Melbourne, Australia. This study showed that culturally appropriate diet and lifestyle intervention programs can be successful in this subgroup.[39] The World Health Organisation's document, The Asia-Pacific perspective: Redefining Obesity and its Treatment, indicates that weight management strategies should include modification to diet as well as physical activity and that all weight management strategies should educate patients about healthy eating habits.[3]

Considering the global problem of obesity and overweight and its consequences, the impact of immigration on overweight and obesity and the large number of South African migrants currently residing in Australia it would be valuable to observe the possible changes in BMI, physical activity and dietary intake of these South African

migrants in Australia in order to determine whether intervention programs would be necessary and, if so, which areas should be focused on. Hobart was selected for this study as the investigator lived there at the time that the study was conducted.

CHAPTER 2 METHODOLOGY

2.1 AIM

To determine the changes in overweight and obesity rates and the associated causes in South African immigrants in Hobart, Australia.

2.2 OBJECTIVES

To determine:

- The change in BMI since immigration of South Africans residing in the Greater Hobart Area.
- The usual and current dietary intake of South African immigrants in the Greater Hobart Area and perceived changes since immigration.
- The usual physical activity of South African immigrants in the Greater Hobart Area and perceived changes since immigration.
- Any differences in BMI, dietary intake and physical activity in the various immigrant sub-groups (gender, age, and weight category as applicable).

2.3 HYPOTHESES

Null-hypotheses:

- There is no statistically significant difference between the participants' BMI before and after immigration.
- There are no statistically significant differences between the BMI changes of the male and female participants.
- There are no statistically significant differences between the BMI changes of the participants in the various age categories.
- There are no statistically significant differences between the physical activity changes of the male and female participants

2.4 STUDY PLAN

2.4.1 Study Design

This study had descriptive, cross-sectional as well as analytical components.

2.4.2 Study Population

South African immigrants in the Greater Hobart Area of the island State of Tasmania were included as the investigator resided in the area at the time of the study. The State of Tasmania can be seen at the south-east corner of the mainland of Australia. Tasmania spans roughly 517 kilometres from north to south and 400 kilometres from the eastern to the western coast. Tasmania has a population of 507 626 of which the largest proportion are between the ages of 25 and 64 years. Tasmania has an ageing population with the mean age of the population being 39.9 years.[40] The Greater Hobart Area is located in the Southern part of Tasmania. (Figure 2.1)[41]

Figure 2.1: Map of Australia with Hobart indicated by the arrow[41]

2.4.2.1 Sampling

Both male and female South African immigrants in the Greater Hobart Area were included in this study. Figure 2.2 illustrates the Greater Hobart Area. Greater Hobart has a population of 214 705 people.[40]

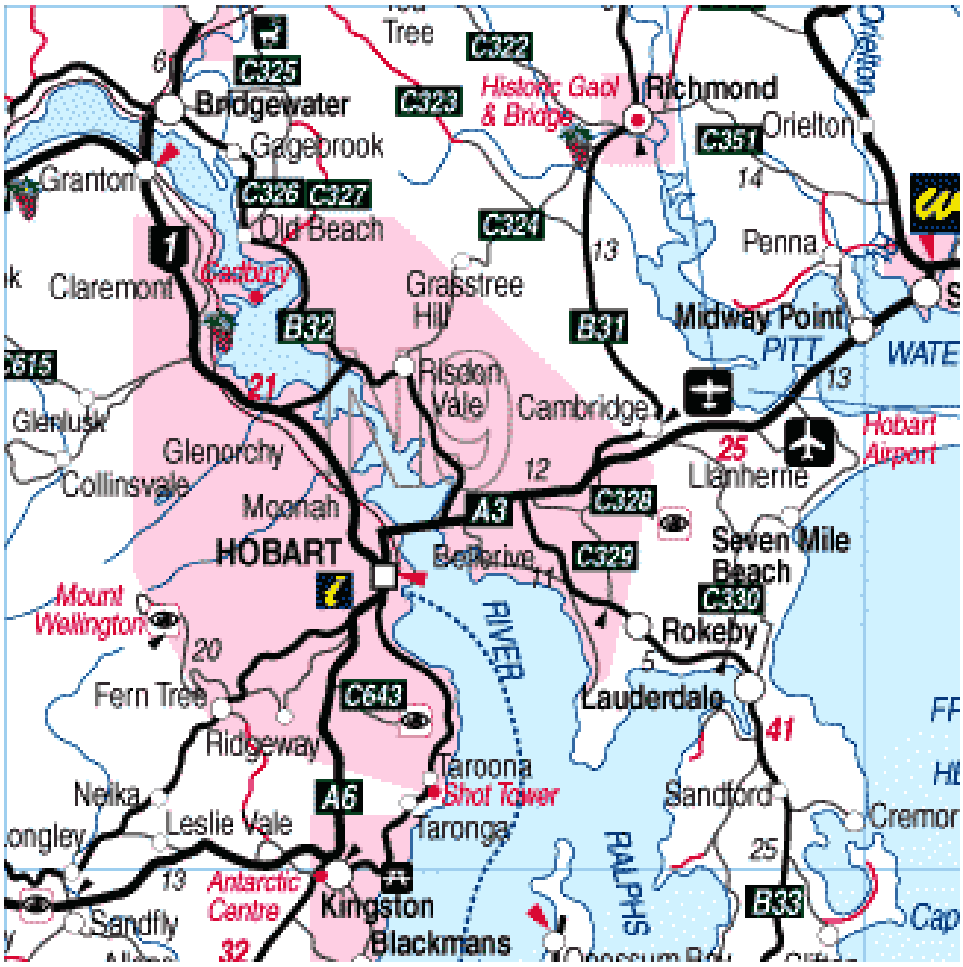


Figure 2.2: The Greater Hobart Area[42]

Participants were recruited by making use of the following methods:

- A notice was posted in the Classified section of The Mercury Newspaper on the 20th and 24th of May 2009 asking willing participants to send their contact details to the researcher.
- Facebook was used to contact South African immigrants known to the researcher.

- The investigator used “Facebook” to set up a group for South African immigrants in Hobart for the purpose of this study. Nine South African migrants joined the group.
- The investigator accessed other Facebook groups for South African immigrants in Tasmania and attempted to contact those living in the Greater Hobart Area.
- An organisation for South African immigrants in Tasmania, SATAZ (South Africans in Tasmania), was discovered and contacted in September 2009. A notice was published in the SATAZ October newsletter regarding the study and all South Africans living in the Greater Hobart Area that were on the SATAZ contact list were contacted via email.
- The Department of Economic Development in Hobart was contacted and an email regarding the study was distributed to all South Africans that were sponsored for visas by this department in the last 5 years.

An information sheet was distributed to eligible participants which contained information about the study as well as the investigator’s and study leaders’ contact details (Appendix 1). An excel database was compiled containing the names and contact information of South African immigrants in Hobart.

2.4.2.2 *Sample size*

According to the Australian Bureau of Statistics around 100 South African immigrants moved to Hobart between 2001 and 2006. The 100 immigrants included all ages. The investigator estimated that there would be around 100 immigrants that migrated between 2004 and 2009, but this number included children and immigrants above the age of 50. The investigator contacted and included as many immigrants possible between May 2009 and April 2010.

2.4.2.3 *Inclusion criteria*

The following South African immigrants were eligible to take part in the study:

- South Africans who have lived in Australia for longer than 6 months and shorter than 5 years.
- South African immigrants who lived in the Greater Hobart Area.
- Immigrants who fell into one of three age groups: 20 – 29, 30 – 39, 40 – 50.
- Immigrants who were willing to answer the questions that formed part of the various questionnaires.
- Participants who were willing to undergo the various anthropometric measurements (weight, height and waist circumference).

2.5 METHODS OF DATA COLLECTION

2.5.1 General

Identified participants were emailed, messaged on Facebook or telephoned and their postal addresses were obtained. Copies of the consent form (Appendix 2) and all the questionnaires (socio-demographic, habitual physical activity, diet record, quantified food frequency questionnaire and weight history questionnaires) were bound and sent to participants. The investigator requested that participants complete all the questionnaires, except for the weight history questionnaire, in their own time and to contact the investigator once they have completed this task. The investigator then contacted the participants to arrange a suitable time to conduct the measurements in the comfort of their own homes. The investigator's safety was ensured by the investigator always having a mobile phone present as well as having a person wait in the car while the measurements were being conducted in participants' homes, as requested by the Tasmania Social Sciences Human Research Ethics Committee. This person was not involved in the study and a non-disclosure agreement was signed by the person in order to ensure confidentiality (Appendix 3).

The following methods were used to collect data:

- Five questionnaires were used to collect the following information (Appendices 4 - 8):
    - Socio-demographic information (self-administered)
    - Weight history (administered by researcher)
    - Habitual physical activity (self-administered)
    - Diet history (two self-administered questionnaires)

2.5.2 Socio-demographic Information (Appendix 4)[38]

The following information was obtained by means of a socio-demographic questionnaire consisting of 8 questions of which 5 were closed and 3 were open:

- Date of birth
- Age
- Sex
- Marital status
- Ethnicity
- Level of education
- Duration of residence in Australia
- Country, zip code

This information was used to determine whether certain changes in BMI, dietary intake and physical activity were restricted to certain demographic sub-groups.

2.5.3 Anthropometrical Data (Appendix 5)[38,43]

A weight history questionnaire similar to the one used in the Atlanta study[43] was used by the investigator during an interview. It was not necessary to adapt the

questionnaire for this study as all relevant information could be captured as confirmed by the pilot study. This questionnaire consisted of 9 questions (8 closed and 1 open) for the participants concerning their own perceptions about their weight and what their weight was on arrival in Australia. The questions addressed weight loss methods and methods of preventing weight gain. The questionnaire had sufficient space to fill in anthropometrical data after measurements were completed.

Anthropometrical measurements included current weight, height and waist circumference. These were conducted in the comfort of the participants' homes in a room that was deemed suitable by the participant. The participants were also asked to provide their weight upon leaving South Africa in order to determine their BMI before migration.

2.5.3.1 *Weight*

A calibrated Tanita BC 532 scale was used to determine weight. The participants were asked to remove all jackets and coats as well as their shoes. The participants stood in the correct spot as marked on the scale without holding on to anything. This was important to improve validity. The participants were measured as far as possible at the same time of the day to avoid fluctuations throughout the day. Measurements were rounded off to the nearest 0.1kg. The weight measurement was conducted twice, to improve reliability, and the average of the two measurements was used for statistical analysis.[44]

2.5.3.2 *Height*

Height was measured in centimeters to the nearest 0.001 m by using a 2m "panamedic" non-stretch measuring tape stuck against a wall. Participants were asked to remove their shoes and all hair bands and other objects that could distort the measurement. This improved maximum validity. Height measurements were done twice and the average of the two measurements was used for statistical analysis. The following method was used:[44]

- The participants were asked to stand up straight against the wall with heels, buttocks, shoulders and head touching the wall.

- Knees were together and their heads were in the Frankfort plane ("a line approximating the base of the skull, passing from the intraorbital ridge to the midline of the occiput, intersecting the superior margin of the external auditory meatus/the skull is in the anatomical position when the base line lies in the horizontal plane and right and left sides are level").[45]

- The measurements were taken at maximum inspiration.[43]

2.5.3.3 Body Mass Index

BMI was calculated as weight (kg) / height $(m)^2$. A change in BMI was determined by measuring the difference between the self-reported weight on arrival in the new country and the weight objectively measured by the researcher between 6 months and 5 years after immigration.

2.5.3.4 Waist circumference[44]

Waist circumference was measured to identify individuals with abdominal obesity which has been associated with an increased risk for diseases of lifestyle.[7,36]

The waist circumference was measured by using a strong non-flexible measuring tape. The measurement was taken at the level of the iliac crest at the point between the highest point of the hip bone on the right side and the lowest rib.[44] The measuring tape was in a horizontal position and the measurement was taken at normal expiration. The investigator repeated the measurement twice to the nearest 0.1 cm and the average of the two measurements was used for statistical analysis.

2.5.4 Habitual Physical Activity

The current habitual physical activity of the research population was considered as physical activity for the purpose of this study. This included three components:

- Physical activity at work

- Sports during leisure time

- Physical activity during leisure time (sports excluded)

A questionnaire by Baecke et al[46] was adapted as described below and used for determining the current activity level and change in habitual physical activity of participants since immigration (Appendix 6).

2.5.4.1 *Description of the questionnaire*[44]

The questionnaire covered three different areas of physical activity. The first 8 questions dealt with physical activity at work. Question 6 was changed to “After work I am physically tired” as opposed to “After work I am tired” to avoid confusion. This change was made before the pilot study commenced.

Question 9 had 6 sub-questions. This included 3 questions on the most frequently played sport and 3 questions on the second most frequently played sport.

Questions 10 - 12 dealt with a leisure time index which excludes sport activities.

Four questions were added to the questionnaire by the investigator consisting of closed questions to determine the perceived changes in physical activity since immigration.

2.5.4.2 *Questionnaire validity*

A validity study was conducted by Philippaerts et al.[47] Three questionnaires were investigated namely the Baecke questionnaire, and the questionnaires used in the Five City Study and Tecumseh Community Health Study. Doubly labeled water was the method used to test the validity of these questionnaires by measuring the Physical Activity Level (PAL). The Baecke questionnaire was found to be the most valid. This was confirmed by another study conducted by Jacobs et al.[47,48]

Although subjects have been found to over- and underestimate the time that they spend on their respective activities, this questionnaire is considered sufficient to assess physical activity in large studies.

Face validity and the content validity of the extra four questions were tested by conducting a pilot study in Melbourne, Australia.

2.5.4.3 Questionnaire reliability

The reliability of the Baecke study was tested by Jacobs et al.[47,48] The following results were obtained:

Table 2.1: Baecke study's age-adjusted, test-retest correlation coefficient

Index	Age-adjusted, test-retest correlation coefficient
Total	0.93
Work	0.87
Sport	0.90
Leisure	0.86

Source: Jacobs. 1993.[48]

The one month reliability was found to be high. As time increases the reliability decreases, but the questionnaire was considered suitable for this study as the investigator was only focusing on the last 6 months. Age-adjustments were done before calculation of the correlation coefficients.[48]

2.5.5 Dietary Intake (Appendix 7)

The investigator determined current dietary intake as well as the perceived changes in dietary intake since arrival in the new country. The following nutrients were of interest in the study:

- Total Energy
- Carbohydrate (CHO)
- Protein
- Fat
- Fibre, Vitamins and Minerals

These nutrients influence BMI in the following ways:

- Total energy: This directly increases or decreases BMI depending on whether it is too high or too low.
- CHO, protein and fat make up total energy and provide extra information on the efficiency of the diet.
- Fibre, vitamins and minerals provide extra information on the quality of the diet.

The participants completed a Quantified Food Frequency Questionnaire (QFFQ) for this purpose. The 88GP questionnaire developed and validated by Harvard[49] served as the basis for the assessment of dietary intake. The 88GP questionnaire was, however, adapted by the researcher to improve its validity in the Australian context. Questions were added in order to determine the current intake as well as the perceived dietary changes since migration to Australia. The Health 2000 FFQ developed by the Cancer Council of Australia[50] was used by the investigator to adapt the wording of the Harvard questionnaire as well as to add some popular Australian food items. (Appendix 9) This resulted in a QFFQ containing 175 questions that was used to obtain the necessary dietary information. As some items were altered on the QFFQ, it was necessary to conduct a three day diet record to test the relative validity of the questionnaire.

A validation study done in Australia showed poor agreement when a widely used Australian FFQ was compared to diet records.[51] This suggested that incorrect conclusions would be made if the intakes collected by using this FFQ were compared to Nutrient Reference Values.[52] This was another factor that the investigator took into account with the decision to use a questionnaire based on the 88GP questionnaire and not the Australian developed QFFQ.

The face validity of the adapted questionnaire was tested by the investigator in a pilot study that was conducted on a sub-sample in Melbourne, Australia.

2.5.5.1 Description of Food Frequency Questionnaire (FFQ)[49]

The questionnaire covered the following areas:

- Section one had 7 questions with their own sub-questions consisting of the following:
    - 18 questions concerning dairy consumption
    - 19 questions concerning fruit
    - 27 questions concerning vegetables
    - Protein foods like eggs and meat were covered in 29 questions
    - Twenty one questions cover breads, cereals and starches
    - Beverages were covered by 11 questions
    - 25 questions covered all sweets, baked goods and miscellaneous items
- Questions 8 – 18 covered fats, sugars, cold breakfast cereals, other foods as well as multi-vitamin and minerals.
- The last section consisted of the added questions and formed questions 19 to 22. This covered all the perceived changes in dietary intake since migration to Australia.
- Most of the questions were closed-ended questions, but there were 5 open-ended questions as well as space to include other foods frequently eaten.

2.5.5.2 *Questionnaire Validity and reliability*

Diet records and 24-hr recalls were used to test the validity and reliability of the questionnaire in America. The studies included men and women from different age groups as well as from different socio-economic backgrounds and ethnic groups. It was found that the Harvard QFFQ is robust and therefore a valid and reliable tool to use in research studies.[53] In this study, a 3-day diet record, including two non-

consecutive weekdays and one weekend day, was conducted by each participant to further test the relative validity of the adapted QFFQ. The face validity of the questionnaire in the Australian setting was tested in a pilot study conducted in Melbourne. The QFFQ captured the intake of participants over the last six months. The completeness of the questionnaires was checked by the investigator during the visit to conduct the measurements. Participants were asked to complete missing data as well as explain unclear data.

Content validity of the QFFQ was determined by sending the questionnaire to a senior member of the Dietetics Association of Australia (DAA) as well as a senior nutrition and dietetics lecturer at Deakin University, Melbourne to comment on the applicability of the questionnaire with regards to Australian dietary habits and foods commonly consumed. The DAA did not respond after several contacts, but a suitable person from Deakin University, recommended by a DAA representative, provided input which was used to alter the questionnaire before it was used in the pilot study. Changes recommended were in line with the changes made by using the Cancer Council questionnaire and it was also recommended that ounces are converted to grams (Appendix 9).

2.6 PILOT STUDY

A pilot study was conducted on a sub-sample of Caucasian South African immigrants in Melbourne, Australia between 9 and 12 June 2009 to test the face validity of the questionnaires. These participants were not included in the main study. Ten sets of questionnaires were sent out to willing participants, but only 8 questionnaires were received back.

An extra questionnaire was created for the sole purpose of the pilot study. This questionnaire contained 4 questions regarding the language used in the questionnaires, time taken to complete the questionnaires, difficulty of questions and suggestions for making the questionnaires easier to complete.

It was found that the QFFQ contains answers such as 1 – 3 times a month. This was difficult to analyse unless a value of 1, 2 or 3 times was selected. It was decided that the average value will be used consistently throughout the study, in other words instead of 1 – 3 times, 2 times would be used for analysis.

All the pilot study participants found the language used in the questionnaires easy to understand and the questions easy to complete.

2.7 DATA ANALYSIS

2.7.1 Analysis of Outcome Data

2.7.1.1 *Weight change questionnaire and anthropometrical data*

The BMI's of participants before and after immigration were calculated and the participants were classified using the following cut-off points[44]:

- Grade 3 chronic energy deficiency: <16
- Grade 2 chronic energy deficiency: 16 – 16.9
- Grade 1 chronic energy deficiency: 17 – 18.5
- Normal BMI: 18.5 – 24.9
- Pre-obese: 25 - 30
- Obese class 1: 30 – 34.9
- Obese class 2: 35 – 39.9
- Obese class 3: >40

Waist circumference was classified as follows[44]:

Table 2.2: Waist circumference classifications

Gender	Waist Circumference	Classification
Female	>80 cm	Action level 1
Male	>94 cm	Action level 1/High risk
Female	>88 cm	Action level 2
Male	>102 cm	Action level 2/High risk

Source: WHO. 2004.[6]

Data was entered onto an Excel spreadsheet which was used for further statistical analysis.

2.7.1.2 *Physical activity questionnaire*[46]

Work Index

The following formula was used to calculate the work index:

- [(6-(point for sitting) + SUM(points for 7 other parameters)]/8

One to five points was awarded depending on the level of activity, five being the most active.

Sport Index

The sport index was calculated by using the following formula:

- [SUM(points for all 4 parameters)] / 4

Leisure Index

Leisure time index was calculated by using the following formula:

- [6 (points for television watching) + SUM(points for remaining 3 items)] / 4

Total Activity Index

The total activity index was calculated as follows:

- [Work index + sport index + leisure time index]

These indices were then used to describe occupational and non-occupational activity levels as well as overall physical activity level (PAL), as described below.

Work index was classified as light, moderate or heavy occupational activity levels as illustrated in table 2.3. Leisure and sports index were summed and classified as non-active or moderately active non-occupational activity level as illustrated by table 2.4. The PAL could then be determined by using table 2.5 as described by Saris et al.[18]

Table 2.3: Conversion of work index to occupational activity level

Work index	Occupational Activity Level
0 – 2	Light
>2 – 3	Moderate
>3 – 5	Heavy

Source: Saris et al. 2003.[18]

Table 2.4: Conversion of leisure and sport index to non-occupational activity level

Leisure and sport index	Non-Occupational Activity Level
<5	Non-Active
5 – 10	Moderately active

Source: Saris et al. 2003.[18]

Table 2.5: Conversion of non-occupational and occupational activity to PAL

Non-Occupational Activity Level	Occupational Activity					
	Light		Moderate		Heavy	
	Male	Female	Male	Female	Male	Female
Non-Active	1.4	1.4	1.6	1.5	1.7	1.5
Moderately Active	1.5	1.5	1.7	1.6	1.8	1.6

Source: Saris et al. 2003.[18]

PAL levels were classified as sedentary, low active, active and very active as illustrated in table 2.6.

Table 2.6: Classification of PAL

Physical Activity Level categories (PAL)	
Sedentary	PAL ≥ 1.0 - < 1.4
Low active	PAL ≥ 1.4 - < 1.6
Active	PAL ≥ 1.6 - < 1.9
Very active	PAL ≥ 1.9 - < 2.5

Source: Saris et al. 2003.[18]

Data was entered into a spreadsheet for further analysis.

2.7.1.3 *Quantified Food Frequency Questionnaire and Diet Record data*

Data from the QFFQ was converted into grams. This was done by using the averages of the frequency of times consumed (e.g. if a participant selected 2 - 4 times, 3 times was used to convert the value into grams. All data was entered onto a spreadsheet where after FoodWorks nutrient analysis software by Xyris (2009 professional edition, version 6.0) was used to determine the dietary intake of the study population. The values were then compared to the Nutrient Reference Values (NRV's) for Australia and New Zealand which is similar to the Dietary Reference Intakes (DRI's) used in South Africa, Canada and the United States.[52]

The data gathered from the 30 sets of diet records, which included two week days and 1 weekend day, was also analysed with FoodWorks. An average of the three days was used and compared to NRV recommendations.

Supplement use was not included in the analyses of Diet Records and QFFQ as the researcher was interested in the quality of the food intake of participants.

Data from the QFFQ and diet records were statistically compared after it was analysed by using FoodWorks. Appropriate analysis of variance (ANOVA) were used with a $p < 0.05$ indicating a significant difference. Variability analysis could not be completed as a result of the small study population.

2.7.2 Statistical Analysis

Descriptive as well as inferential statistics were used to analyse the data. This was done with the help of a statistician appointed by Stellenbosch University.

The following was analysed by means of descriptive statistics:

- BMI before migration and BMI post-immigration.
- The current dietary intake of South African immigrants in the Greater Hobart Area as well as the change in dietary intake since immigration.
- The current physical activity of South African immigrants in the Hobart Metro Area as well as the change in physical activity since immigration.
- Current waist circumference
- The comparison between the current and usual dietary intake of immigrants and the Nutrients Reference Values.

The following were analysed by means of inferential statistics:

- The comparison between BMI pre- and BMI post-immigration.
- The differences between the results of male and female participants.
- The comparison between data obtained from QFFQ and diet records.

MS Excel was used to capture the data and STATISTICA version 9 (StatSoft Inc. (2009) STATISTICA (data analysis software system, www.statsoft.com.) was used to analyse the data.

Summary statistics were used to describe the variables. Distributions of variables were presented with histograms and or frequency tables. Means were used as the measures of central location for ordinal and continuous responses and standard deviations as indicators of spread.

Relationships between two continuous variables were analysed with regression analysis and the strength of the relationship measured with Pearson correlation or

Spearman correlation if the continuous variables were not normally distributed. If one continuous response variable was to be related to several other continuous input variables, multiple regression analysis was used and the strength of the relationship measured with multiple correlation.

The relationships between continuous response variables and nominal input variables (like different diets) were analysed using appropriate analysis of variance (ANOVA) and appropriate repeated measures analysis of variance (RMANOVA) when responses were measured at specific time intervals.

When ordinal response variables were compared versus a nominal input variable, non-parametric ANOVA methods were used. For completely randomized designs the Mann-Whitney test or the Kruskal-Wallis test was used and for repeated measures designs the Wilcoxon- or Friedman tests were used.

The relation between nominal variables was investigated with contingency tables and appropriate chi-square tests like the likelihood ratio chi-square test or the McNemar test.

A p-value of $p < 0.05$ represented statistical significance in hypothesis testing and 95% confidence intervals were used to describe the estimation of unknown parameters.

2.8 ETHICS AND LEGAL ASPECTS

The Health Research Ethics Committee, Faculty of Health Sciences, Stellenbosch University approved the research protocol on 29 January 2008 (Reference number N08/01/004). Ethics approval was also obtained from the Tasmania Social Sciences Human Research Ethics Committee on the 20th of May 2009 after extensive changes were made to the research protocol. The privacy of the participants was ensured by using participant identification numbers and not the names on the various questionnaires. All information was kept anonymous and confidential. All participants signed a consent form (Appendix 2) before commencement of the study. There were no risks involved for participants and no incentives were offered. All participants took part in the study voluntarily.

CHAPTER 3 RESULTS

3.1 SOCIO-DEMOGRAPHIC INFORMATION

A total of 30 eligible subjects were included in the study. Table 3.1 indicates the various recruitment methods used by the researcher over a period of 12 months. Five South Africans who initially indicated that they would be interested in participating in the study never made contact with the investigator after the questionnaires were sent out and four South Africans withdrew from the study as a result of lack of time. Eight South Africans were interested in participating in the study, but were not eligible as a result of age or length of stay in Australia. Therefore 47 potential participants were identified of which 30 met the inclusion criteria and were willing to complete all the required questionnaires and measurements.

Table 3.1: Recruitment methods used in this study

Recruitment Method	Number of participants recruited
SATAZ (South Africans in Tasmania) contact list	27
Facebook page set up by researcher	4
Facebook site for South Africans in Tasmania	6
Word-of-mouth	10

The socio-demographic characteristics of the participants are described in table 3.2. The majority of subjects were females, married, in the older age group (40-50 years) and in possession of a tertiary qualification. All the participants were Caucasian. The mean age of the study population was 37.17 (7.8) [21-47] years. The mean age of the male participants was 38.23 (7.56) [25-47] years and the mean age of the female participants was 36.35(8.1) [21-46] years. The mean number of years that the study population had lived in Australia is 2.6 (1.03) [1-5].

Table 3.2:

Socio-demographic characteristics of the study population (n=30)

Demographic Factor	Number of subjects	Percentage (%)
Gender		
Male	13	43
Female	17	57
Age		
20 – 29	6	20
30 – 39	9	30
40 - 50	15	50
Marital Status		
Married	24	80
Single	2	7
De Facto	2	7
Divorced	1	3
Other	1	3
Highest education level		
High school	5	17
Tertiary (Undergraduate)	14	47
Post graduate	11	37

Significance testing with regards to the weight classification and age category sub-groups within the different gender groups were not included in this study as these sub-groups were too small for meaningful statistical analysis.

3.2 ANTHROPOMETRIC MEASUREMENTS

Pre-immigration weight was self-reported and post-immigration weight was objectively measured by the investigator. In conjunction with the objectively measured height of participants, pre-and post-immigration BMI was calculated.

3.2.1 Pre- and Post-immigration BMI

Mean pre-immigration BMI of the sample population was 24.91 kg/m^2 (4.42 kg/m^2) [17.93 – 38.24 kg/m^2] and the mean post-immigration BMI of the sample population was 25.5 kg/m^2 (4.36 kg/m^2) [17.93 – 35.1 kg/m^2].

The mean pre-immigration BMI of female participants was 23.44 kg/m^2 (4.76 kg/m^2) [17.93 – 38.24 kg/m^2] and the post-immigration BMI of the female participants was 24.18 kg/m^2 (4.9 kg/m^2) [17.93 – 35.1 kg/m^2].

The mean pre-immigration BMI of male participants was 26.85 kg/m^2 (3.13 kg/m^2) [22.78 – 33.46 kg/m^2] and the mean post-immigration BMI of the male participants was 27.24 kg/m^2 (2.83 kg/m^2) [23.28 – 33.69 kg/m^2].

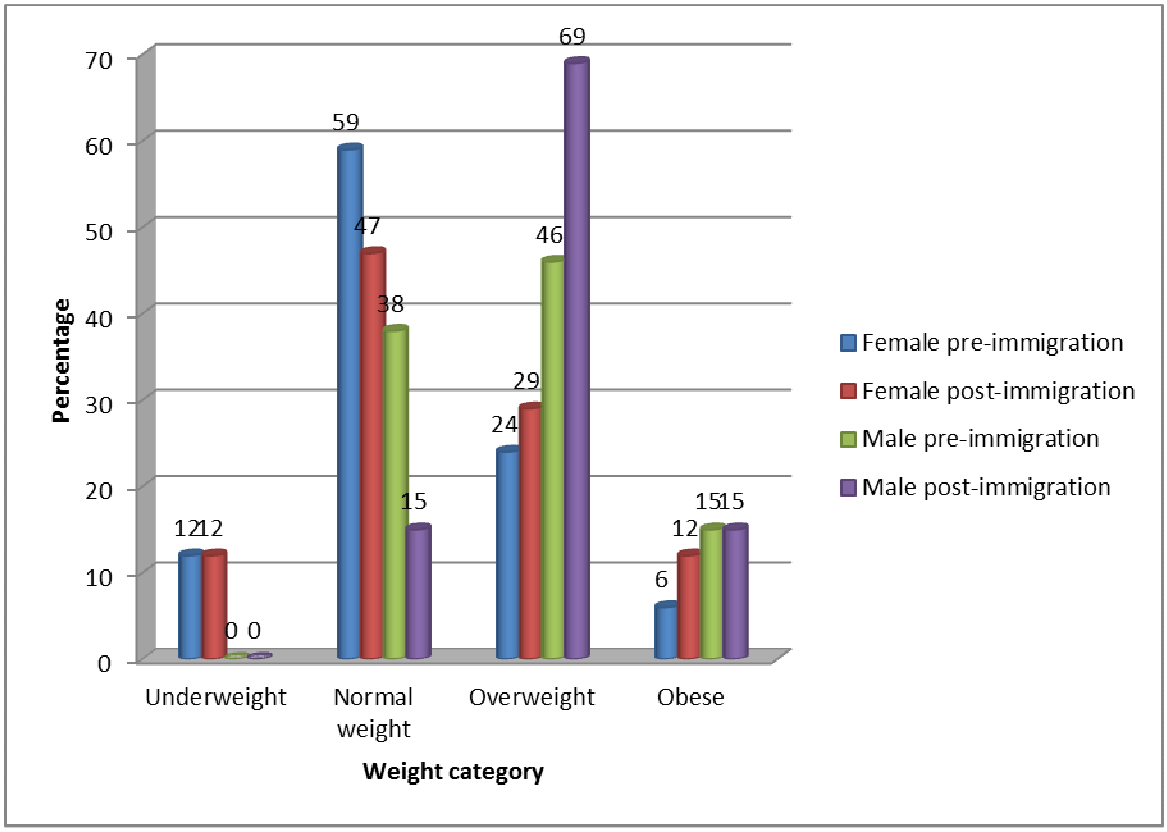
Although there was a trend towards increasing BMI after immigration, the Wilcoxon Matched Pairs Test indicated that the difference between the pre-immigration BMI and post-immigration BMI of participants was not significant ($p=0.06$).

Table 3.3 illustrates the pre- and post-immigration BMI values for participants in the various age categories.

Table 3.3: Mean pre- and post-immigration BMI values of the various age categories

	20 – 29 year participants (n=6) (SD;range)	**30 – 39 year participants (n=9) (SD;range)**	**40 – 50 year participants (n=15) (SD;range)**
Pre-immigration mean BMI values (kg/m^2)	22.7 (3.57) [17.93-27.14]	23.34 (3.17) [18.17-29.21]	26.74 (4.78) [19.53-38.24]
Post-immigration mean BMI values (kg/m^2)	21.74 (3.53) [17.93-25.88]	24.76 (4.2) [19.02-31.68]	27.45 (3.78) [19.93-35.1]
P-value	0.1489	0.0122	0.0933

Figure 3.1 illustrates the weight classifications of the male and female participants before and after immigration. There was an increase in the percentage of overweight and obese female participants post-immigration and an increase in the percentage of overweight men post-immigration with the percentage of obese male participants remaining the same post-immigration.



Changes are not significant (p=0.05577)

Figure 3.1: Weight classifications of male (n=13) and female (n=17) participants pre- and post-immigration

3.2.2 Waist Circumference

The mean waist circumference of female participants was 86.76 cm (13.89 cm) [70 – 121 cm]. The mean waist circumference of male participants was 95.73 cm (12.01 cm) [69.5 - 112 cm]. Table 3.4 provides information regarding the waist circumference classifications of male and female participants. From Table 3.4 it is clear that about two thirds of males and females had waist circumference values above the normal range.

Table 3.4: Waist circumference classifications of male and female participants

	No additional risk	Action Level 1	Action Level 2
Females (N=17)	35% (n=6)	24% (n=4)	41% (n=7)
Males (N=13)	38% (n=5)	31% (n=4)	31% (n=4)

3.2.3 Participants' Perceptions of their Weight

Figure 3.2 illustrates the results of the weight history questionnaire's questions to participants which aimed at determining participants' opinions about their weight measurements. Figure 3.3 summarises the weight loss methods attempted by participants. The majority of participants (70%) indicated that they would like to weigh less and 60% of participants perceived themselves to be overweight. Exercise and a decrease in overall food intake were the two most popular methods named by participants for losing weight.

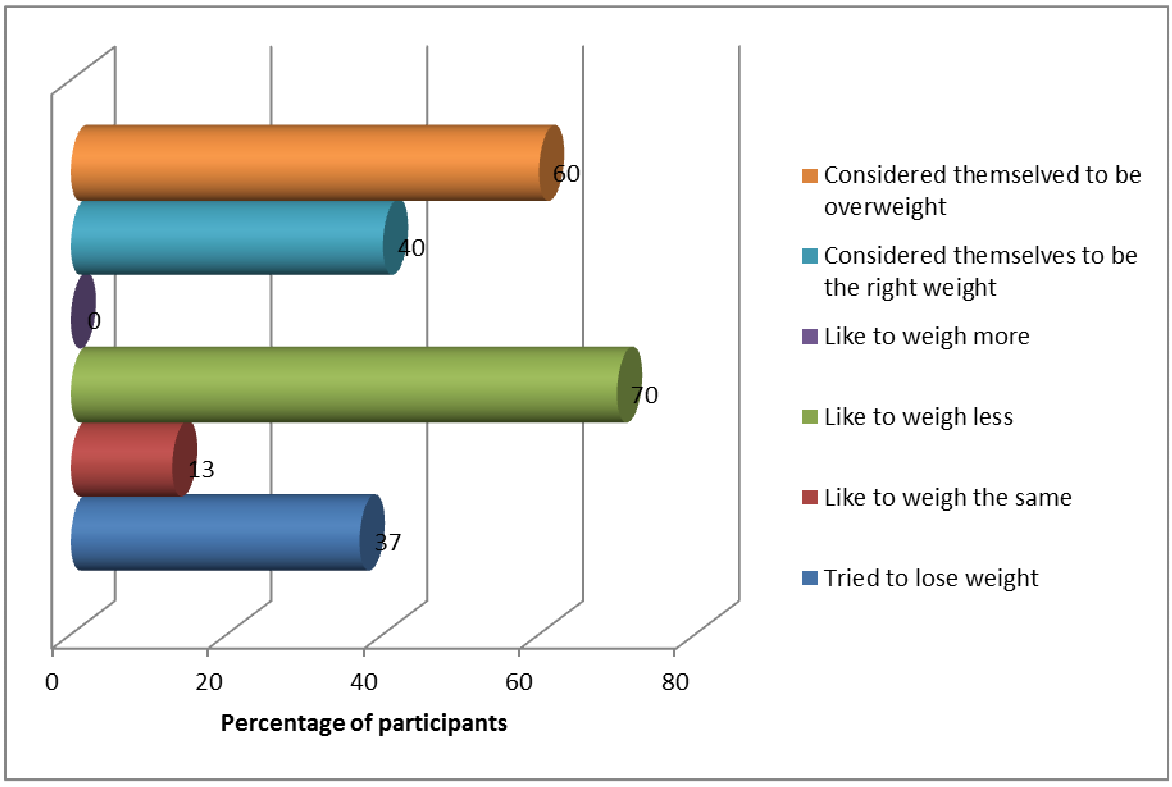


Figure 3.2: Participants' perceptions of their weight (n=30)

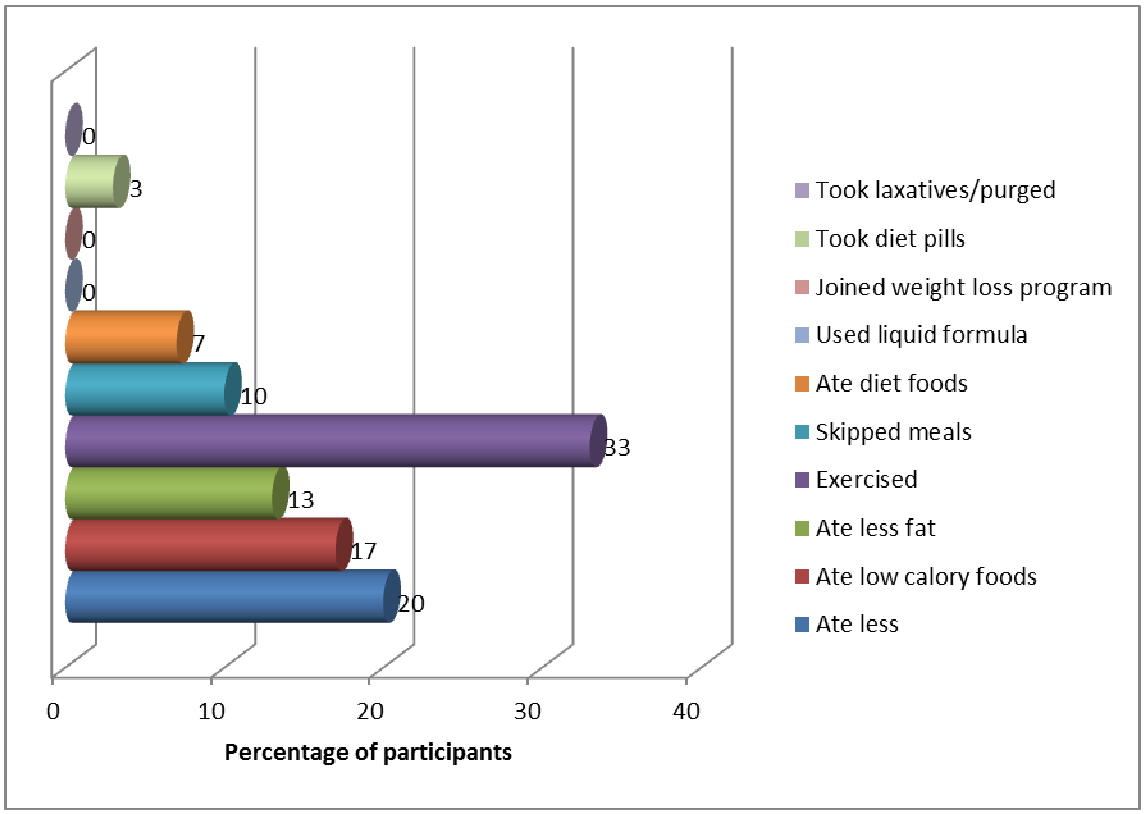


Figure 3.3: Participants' reported methods for attempting weight loss over the last 12 months (n=21)

3.3 MACRONUTRIENT INTAKE

Usual dietary intake during the last 6 months was determined by means of the QFFQ. In addition, 3-day diet records were completed by the participants to determine current dietary intake. Variation adjustment could not be used as the sample size was smaller than 36. [54]

Table 3.5 summarises macronutrient intake values for male and female participants as captured by the QFFQ and diet records. Energy intakes of males and females as indicated by the QFFQ and diet record did not differ significantly. The mean energy intake of males was higher than the mean energy intake of female participants (QFFQ and diet records). There was a significant difference between the protein intakes of male and female participants as indicated by the diet records. There were no significant differences between the remaining macronutrient intakes of male and female participants for both the QFFQ and diet records. There were significant differences between the protein, energy, fat and saturated fat intakes of females as indicated by the diet records compared to the QFFQ. There were no significant

differences between the intakes of male participants as calculated from QFFQ compared to the diet records.

Table 3.6 illustrates the macronutrient intakes as percentages of total energy intake and a comparison of these values to the NRV recommendations. The mean saturated fat intakes of males and females as measured by the QFFQ and diet record were higher than the NRV recommendation. The mean total fat intakes of male and female participants as measured by the QFFQ and diet record were at the higher end of the normal range. The same was true for protein intake. Mean carbohydrate intakes of female and male participants as measured by the QFFQ and diet records were all lower than the NRV recommendation. This is likely because the mean protein and fat intakes were at the higher ends of the normal ranges. Mean fibre intakes of male and female participants as determined by the QFFQ and diet record were lower than the NRV recommendation.

Table 3.7 indicates the energy requirements of participants as determined by the Schofield equation[53] and the PAL values as reported by participants. The energy requirements of participants when using a PAL of 1.2 are also indicated in the table and all participants that are not consuming energy values sufficient to meet these needs were seen as underreporters. Fifty percent of participants (n=15) likely underreported their energy intakes when they completed the QFFQ and 70% (n=21) of participants likely underreported their energy intakes when they completed their diet records.

Figures 3.4, 3.5, 3.6 and 3.7 illustrate the prevalence of inadequate or increased macronutrient intakes of male and female participants when compared to NRV recommendations. A large proportion of participants consumed inadequate amounts of carbohydrates as recommended by the NRV. A large proportion of participants consumed excessive amounts of saturated fat and a large proportion of participants did not consume adequate amounts of fibre.

Table 3.5 Daily Macronutrient intake of participants (Means, SD, range)								
	QFFQ			Diet Record (mean values)			Difference between QFFQ and Diet Record	
Macronutrients	**Males (n=13)**	**Females (n=17)**	**P-Value**	**Males (n=13)**	**Females (n=17)**	**P-Value**	**P-value females**	**P-value males**
Energy (KJ)	8276 (2402) [5692 – 13 904]	7951 (1721) [5060 – 12 280]	0.67	8367 (3654) [3348 – 17 873]	6522 (1831) [3396 – 9615]	0.67	**0.02***	0.93
Protein (g)	108 (30) [72 – 157]	105 (21) [56 – 138]	0.67	108 (46) [17 – 208]	80 (30) [37 – 140]	**0.05***	**0.01***	0.99
Carbohydrates g)	181 (62) [112 – 349]	192 (58) [97 – 307]	0.62	199 (120) [26 – 490]	170 (55) [92 – 293]	0.38	0.23	0.61
Fat (g)	72 (23) [51 – 131]	71 (23) [27 – 130]	0.92	64 (31) [26 – 490]	54 (20) [21 – 92]	0.29	**0.01***	0.2
Saturated fat (g)	29 (12) [18 – 61]	30 (10) [17 – 56]	0.93	26 (13) [6 – 50]	21 (8) [9 – 39]	0.17	**0.005***	0.2
Fibre (g)	21 (6) [14 – 33]	22 (8) [12 – 35]	0.67	20 (7) [3 – 31]	20 (8) [8 – 36]	0.98	0.28	0.33

* Significant differences as determined by the Wilcoxon and T-test.

Table 3.6 Macronutrient distribution compared to NRV recommendations (Means, SD, range)							
		QFFQ			Diet Record		
Macronutrients	**NRV Recommenda-tions**	**Males (n=13)**	**Females (n=17)**	**P-value**	**Males (n=13)**	**Females (n=17)**	**P-value**
Protein (%)	15 – 25%	23 (5) [16 – 31]	23 (4) [18 – 32]	0.85	23 (5) [14 – 30]	22 (5) [13 – 30]	0.45
Carbohydrates (%)	45 – 65%	35 (6) [26 – 48]	40 (7) [25 – 52]	**0.05**	40 (8) [26 – 52]	43 (6) [32 – 56]	0.28
Fat (%)	20 – 35%	33 (5) [20 – 41]	33 (6) [16 – 44]	0.87	29 (8) [15 – 41]	30 (6) [19 – 40]	0.68
Saturated fat (%)	10%	13 (3) [8 – 18]	14 (3) [7 – 18]	0.69	12 (4) [7 – 19]	12 (3) [7 – 17]	0.6
Fibre intake	25g Females 30 g Males	21 (6) [14 – 33]	22 (8) [12 – 35]	0.67	20 (7) [3 – 31]	20 (8) [8 – 36]	0.98

* Significant differences as determined by the Mann-Whitney test.

Table 3.7 Energy intake compared to energy needs as determined by the Schofielf equation[55]					
Participant	**Basal Metabolic Rate**	**Basal Metabolic Rate times PAL**	**Basal Metabolic Rate times 1.2**	**Energy intake as per QFFQ**	**Energy intake as per diet records**
1	6224	9958	7469	9860	**5594**
2	5446	8169	6535	8440	6891
3	7781	13228	9337	**5933**	**7598**
4	5607	8972	6728	8174	**6542**
5	5874	8811	7049	9730	8863
6	7891	12626	9469	**7742**	12651
7	8062	14512	8674	**5692**	**5372**
8	5558	8336	6670	**6351**	8285
9	8068	13716	9682	**6608**	**3348**
10	5316	7443	6379	6474	**4875**
11	5496	8794	6595	7080	**6082**
12	5622	8433	6746	8084	**5185**
13	7373	13271	8848	**7151**	**6803**
14	7421	12616	8905	**8765**	**8316**
15	7234	12297	8681	**8186**	8731
16	8693	15647	10432	12331	**6113**
17	6020	9030	7224	9330	**6754**
18	8203	13946	9844	13904	**9256**
19	5864	8796	7037	7230	**3396**
20	8002	14403	9602	**6649**	**6121**
21	7404	11846	8885	**6313**	9615
22	9327	16788	11192	**7246**	**9569**
23	7613	11420	9136	**8289**	**7019**
24	8371	13394	10045	**9090**	17873

Participant	Basal Metabolic Rate	Basal Metabolic Rate times PAL	Basal Metabolic Rate times 1.2	Energy intake as per QFFQ	Energy intake as per diet records
25	6193	9909	7432	**6765**	**7272**
26	5793	9269	6952	7834	**3979**
27	5714	8571	6857	12280	8066
28	5476	8214	6571	7340	**4967**
29	5850	9360	7020	8828	9138
30	5408	8112	6490	**5060**	**5379**

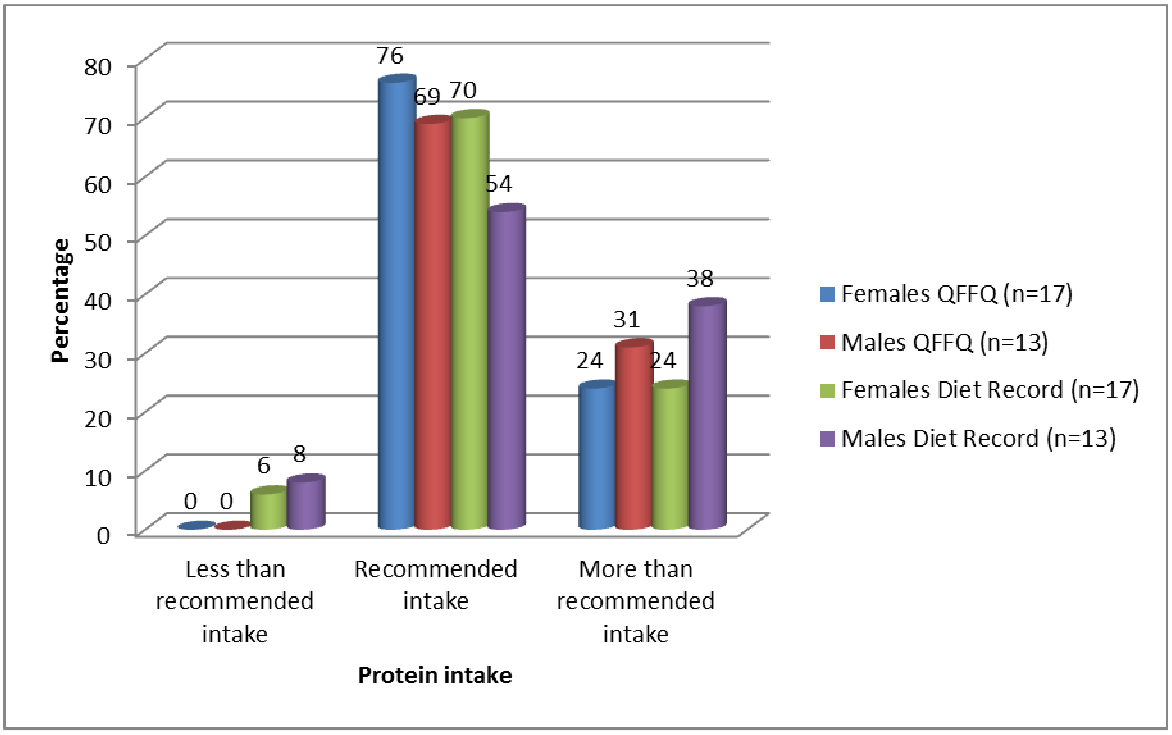


Figure 3.4: Protein intakes of male and female participants respectively compared to Nutrient Reference Values recommendations

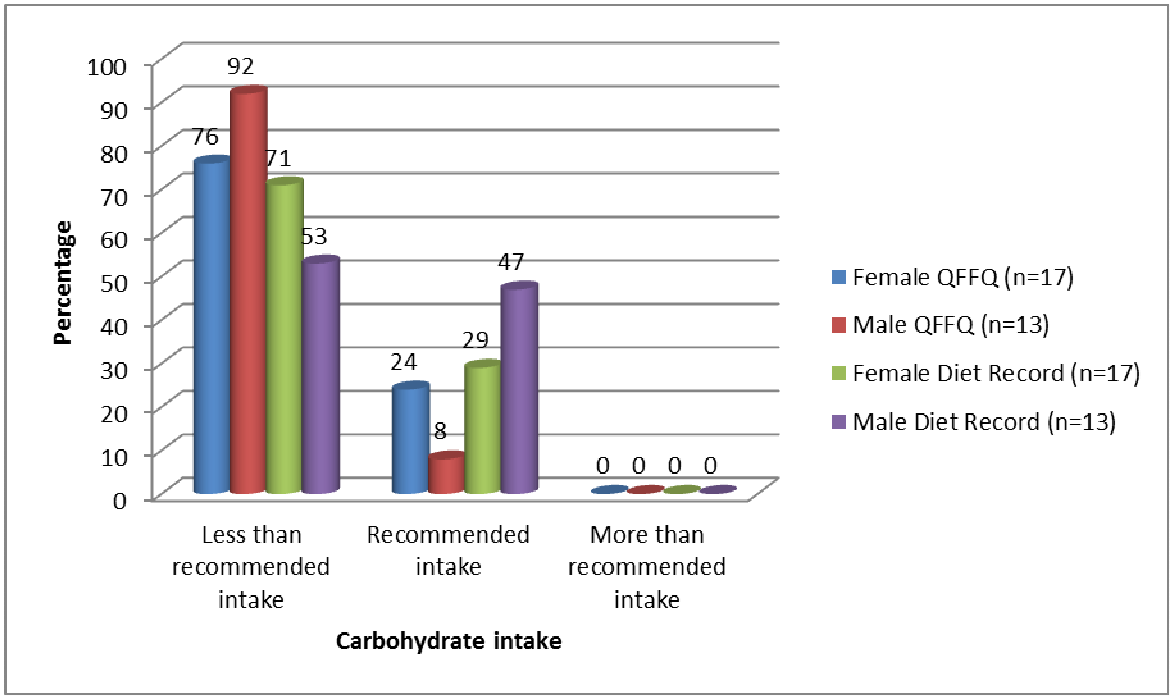


Figure 3.5: Carbohydrate intakes of male and female participants respectively compared to Nutrient Reference Values recommendations

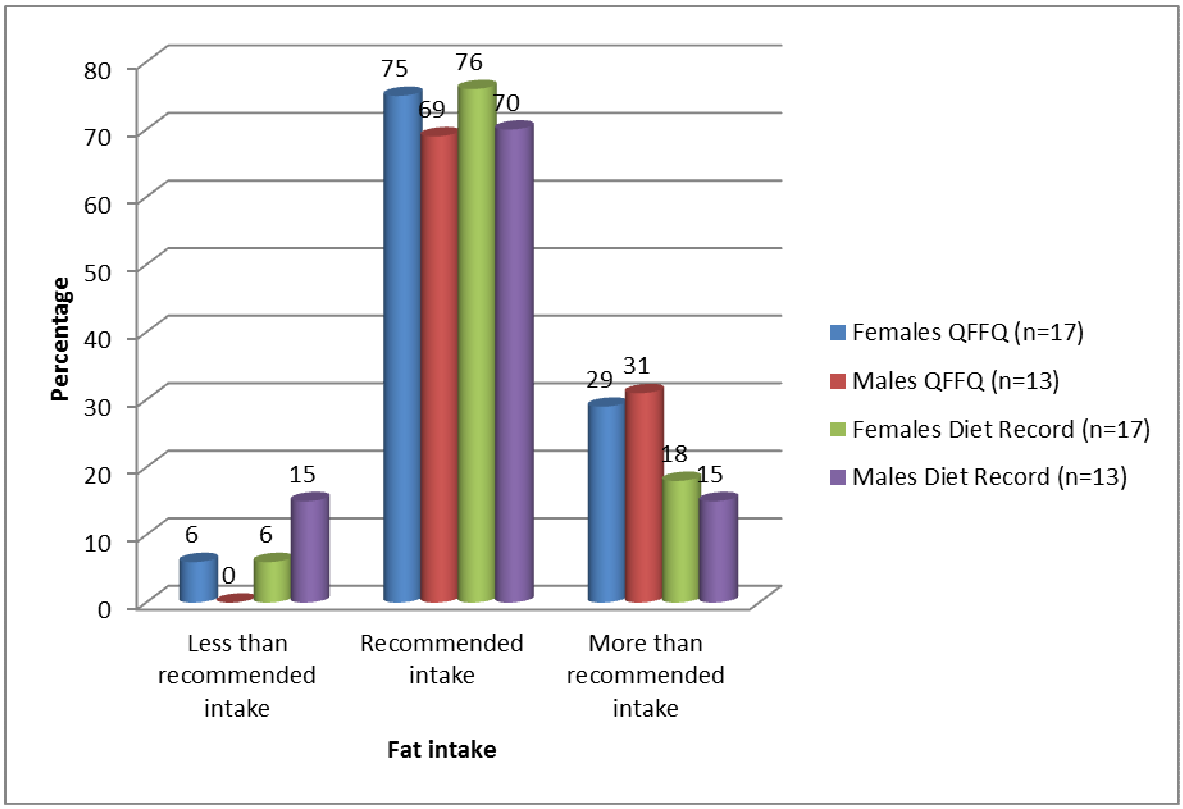


Figure 3.6: Fat intakes of male and female participants respectively compared to Nutrient Reference Values recommendations

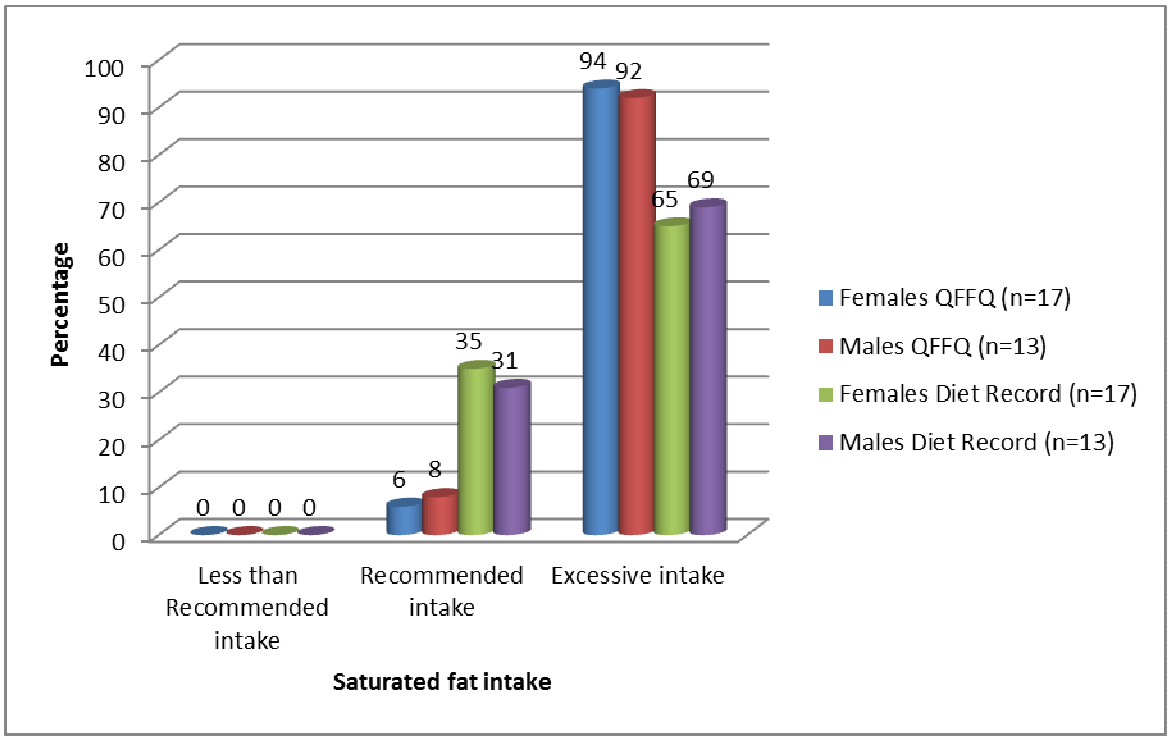


Figure 3.7: Saturated fat intakes of male and female participants respectively compared to Nutrient Reference Values recommendations

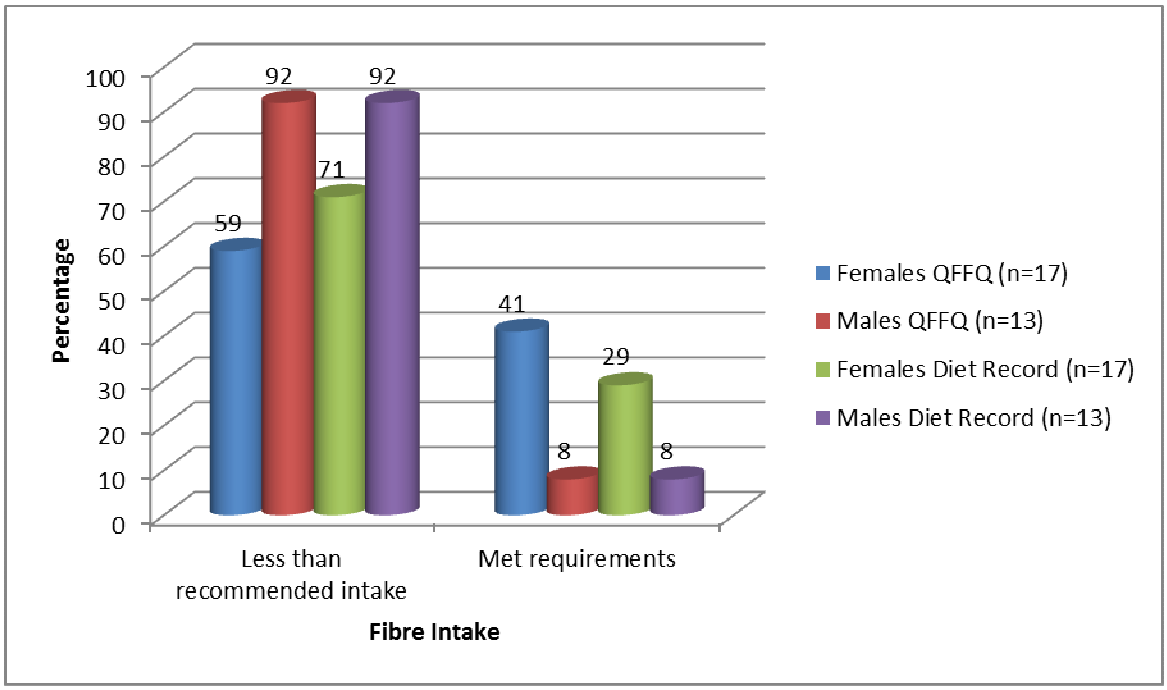


Figure 3.8: Fibre intakes of male and female participants respectively compared to Nutrient Reference Values recommendations

3.4 MICRONUTRIENT INTAKE

Table 3.7 summarises the micronutrient intake as indicated by the QFFQ and diet records and indicates the NRV recommendations for the various micronutrients. There were no significant differences between the micronutrient intakes of male and female participants as indicated by the QFFQ. There were significant differences between the sodium intakes of male and female participants as indicated by the diet record. For vitamin A and folate the differences between males and females approached borderline significance. With the exception of vitamin C there were no significant differences between the micronutrient intakes of males as indicated by the QFFQ compared to the diet records. There were significant differences between the vitamin A, vitamin C, calcium and potassium intakes of female participants as indicated by the QFFQ compared to the diet records respectively.

Table 3.8 Daily Micronutrient intake of participants (Mean, SD, range)									
		QFFQ			Diet Record (mean values)			Difference between QFFQ and Diet Record	
Micronutrients	**NRV[1] Recommen-dations (EAR[2]; UL[3]) unless otherwise indicated)**	**Males (n=13)**	**Females (n=17)**	**P-value**	**Males (n=13)**	**Females (n=17)**	**P-value**	**P-value females**	**P-value males**
Vitamin A (ug)	Females 500; 3000 Males 625; 3000	1572 (1714) [376 – 6887]	1141(372) [596 – 1801]	0.32	1033 (700) [302 – 2435]	659 (221) [236 – 994]	0.05	**0.00**	0.2
Vitamin C (mg)	All 30; None	129 (56) [52 – 227]	144 (64) [58 – 277]	0.49	77 (39) [14 – 146]	80 (58) [6 – 202]	0.91	**0.00**	**0.01**
Folate (ug)	All 320; 1000	411 (162) [141 – 699]	319 (103) [161 – 565]	0.07	380 (151) [89 – 690]	291 (89) [148 – 425]	0.05	0.34	0.44
Calcium (mg)	All 840; 2500	921 (573) [362 – 2419]	964 (376) [339 – 1529]	0.81	791 (308) [351 – 1290]	638 (228) [198 – 1020]	0.13	**0.01**	0.43
Phosphorus (mg)	All 580; 4000	1693 (574) [1145 – 3128]	1604 (454) [400 -2167]	0.64	1702 (546) [975 – 2620]	1388 (440) [720 – 2197]	0.09	0.13	0.96

[1] Nutrient Reference Values
[2] Estimated Average Requirement
[3] Upper Limit

*Significance indicated by the Mann-Whitney test

		QFFQ			Diet Record			Difference between QFFQ and Diet Record	
Micronutrients	**NRV[4] Recommen-dations (EAR[5]; UL[6]) unless otherwise indicated)**	**Males (n=13)**	**Females (n=17)**	**P-value**	**Males (n=13)**	**Females (n=17)**	**P-value**	**P-value females**	**P-value males**
Magnesium (mg)	Females 265; 350 Males 350; 350	338 (102) [190 – 547]	512 (837) [121 – 3743]	0.46	332 (93) [160 – 554]	392 (374) [188 – 1785]	0.57	0.33	0.84
Potassium (mg)	Females 2800; None Males 3800; None	3473 (1144) [2003 – 6152]	3412 (1012) [1447 – 5118]	0.88	3163 (955) [1203 – 4568]	2673 (1005) [1513 – 5026]	0.19	**0.02**	0.3
Iron (mg)	Females 8; 45 Males 6; 45	12 (3) [8 – 17]	11 (3) [4 – 16]	0.63	13 (5) [5 – 22]	12 (5) [6 – 24]	0.48	0.57	0.36
Zinc (mg)	Females 6; 40 Males 12; 40	13 (3) [9 – 20]	13 (4) [3 – 18]	0.79	15 (6) [6 – 31]	12 (5) [4 – 20]	0.12	0.25	0.4
Sodium (mg)	All Adequate Intakes of 460 – 920 Upper Limit 2300	2512 (988) [1482 – 4541]	2485 (1254) [278 – 4584]	0.95	2797 (1036) [1421 – 4468]	1952 (967) [664 – 4750]	**0.03**	0.21	0.36
Cholesterol (mmol)	No recommendation	331 (82) [222 – 536]	295 (101) [15 – 450]	0.2	418 (132) [231 – 671]	311 (159) [100 – 766]	0.06	0.62	0.53

*Significance indicated by Mann-Whitney test

[4] Nutrient Reference Values
[5] Estimated Average Requirement
[6] Upper Limit

The mean micronutrient intakes differed as follows from the Estimated Average Requirement (EAR) and Upper Limits of the NRV:

- Mean folate intake of females were lower (QFFQ and diet records)
- Mean calcium intakes of males and females participants were lower (diet records)
- Mean magnesium intake of females were above the Upper Limit (QFFQ and diet records)
- Mean potassium intake of males were lower (QFFQ and diet records)
- Mean potassium intake of females were lower (diet records)
- Mean sodium intake of males were above the UL (QFFQ and diet records)
- Mean sodium intake of females were above the UL (QFFQ)

Figures 3.9 to 3.18 compare the individual micronutrient intakes of male and female participants to the NRV recommendations. These figures indicated that there were a large percentage of participants that were probably consuming less than the required daily amounts of folate, calcium, magnesium and potassium. It was also likely that a large percentage of participants were probably consuming daily amounts of sodium above the recommended UL.

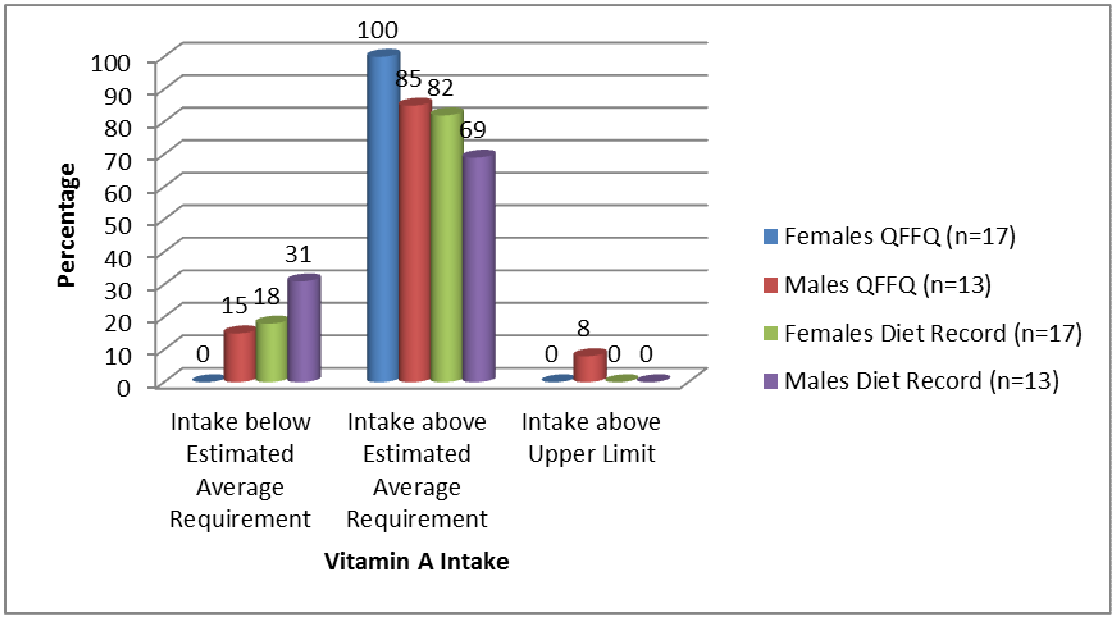


Figure 3.9 Vitamin A intakes of male and female participants compared to Nutrient Reference Values recommendations

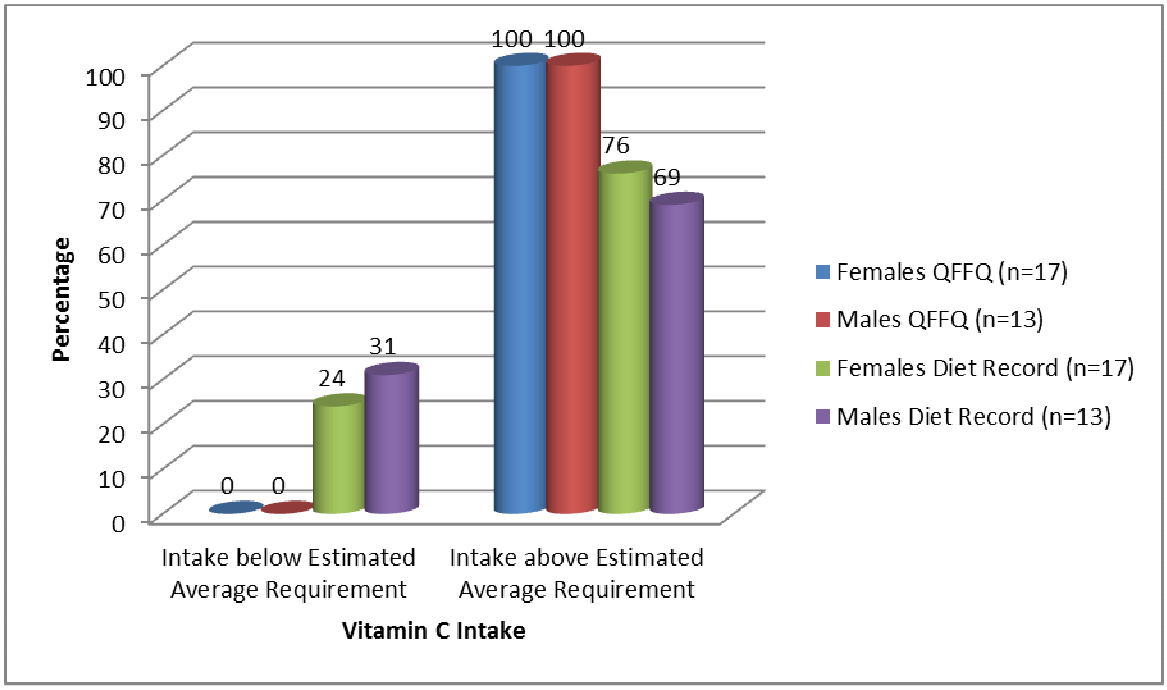


Figure 3.10 Vitamin C intakes of male and female participants compared to Nutrient Reference Values recommendations

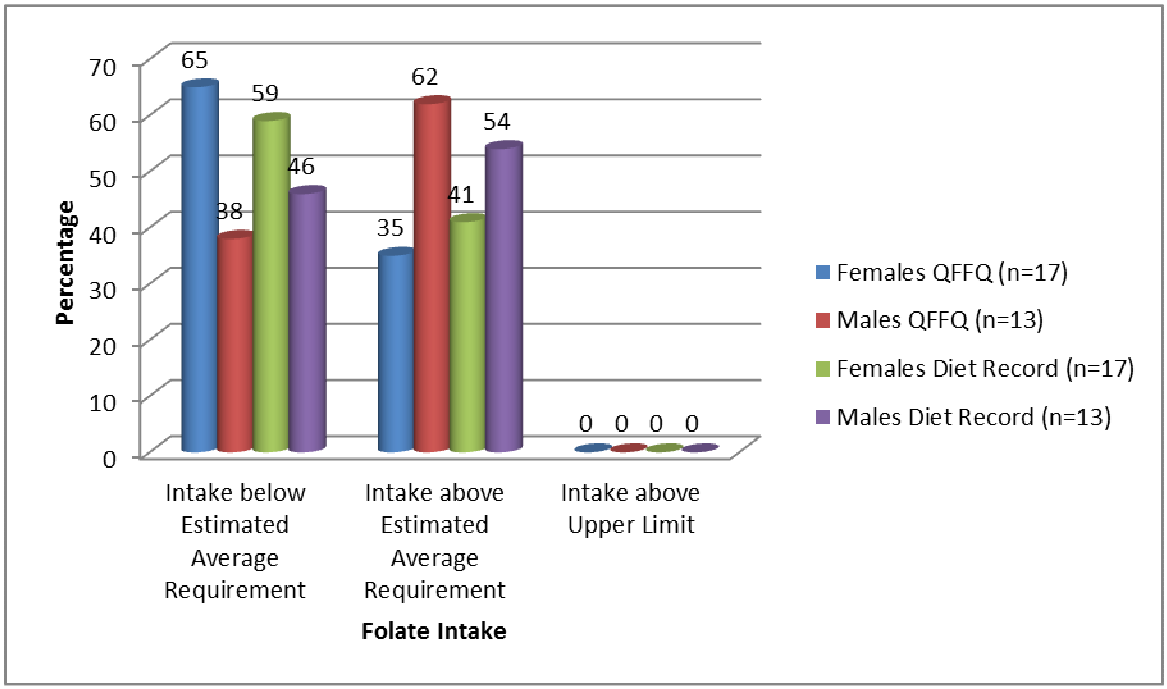


Figure 3.11 Folate intakes of male and female participants compared to Nutrient Reference Values recommendations

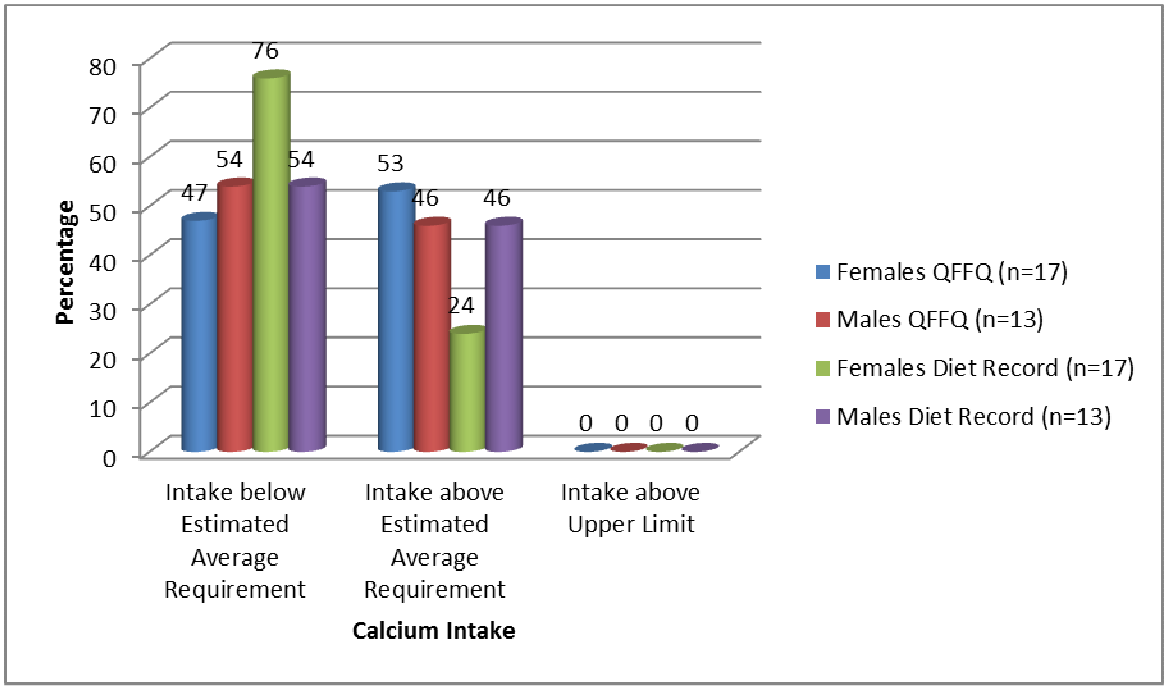


Figure 3.12 Calcium intakes of male and female participants compared to Nutrient Reference Values recommendations

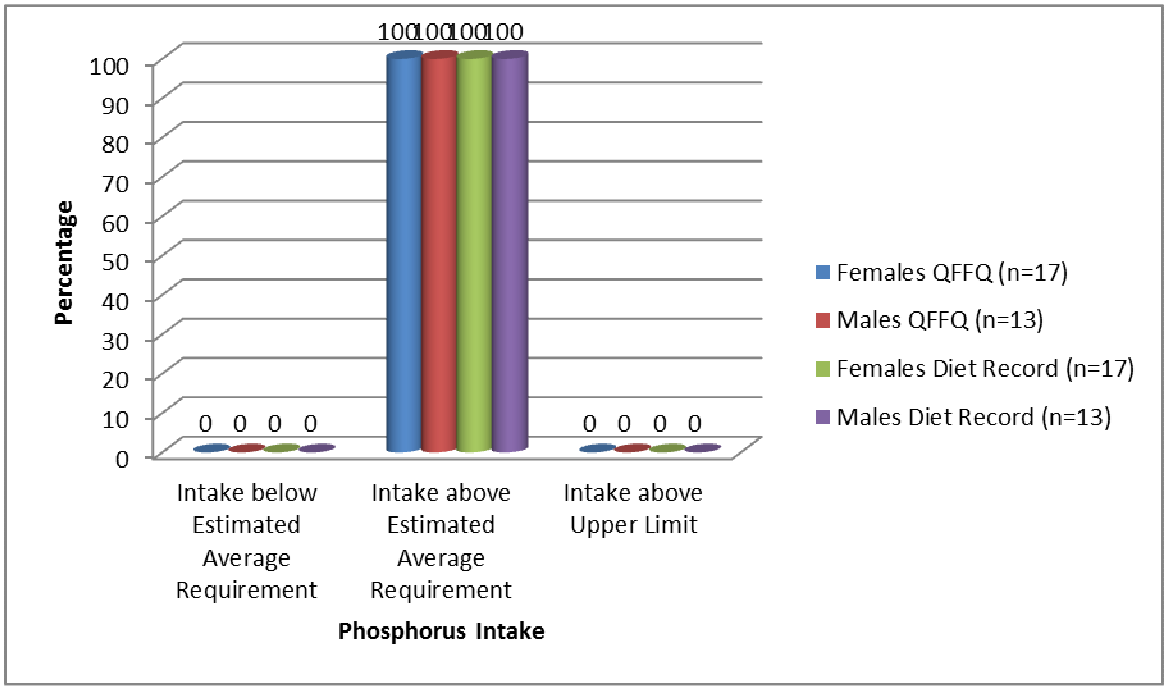


Figure 3.13 Phosphorus intakes of male and female participants compared to NRV recommendations

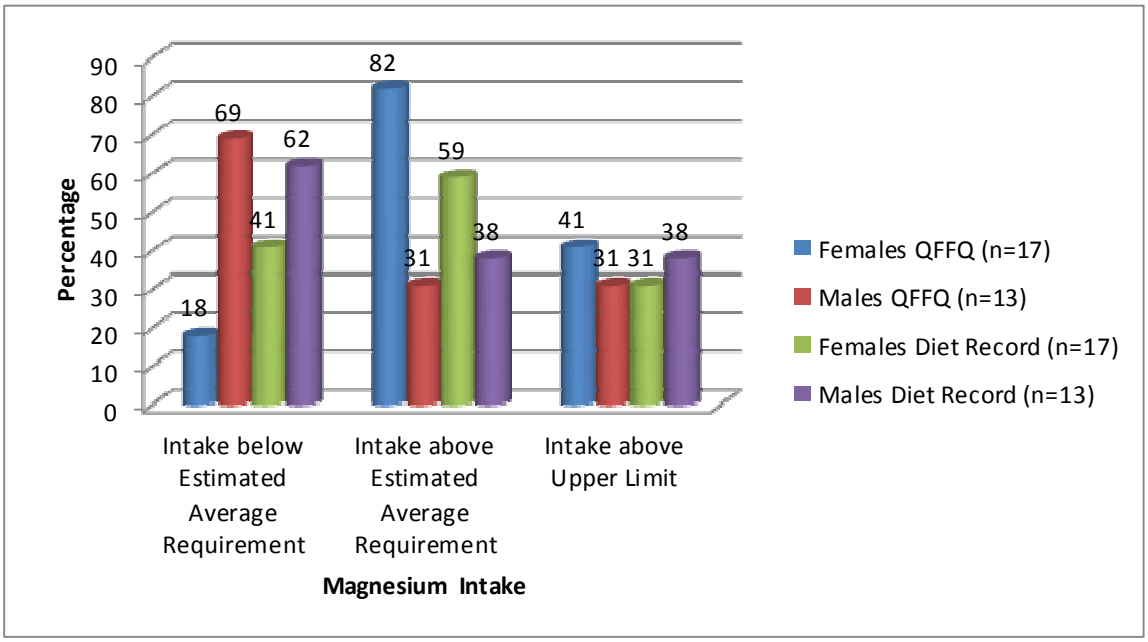


Figure 3.14 Magnesium intakes of male and female participants compared to Nutrient Reference Values recommendations

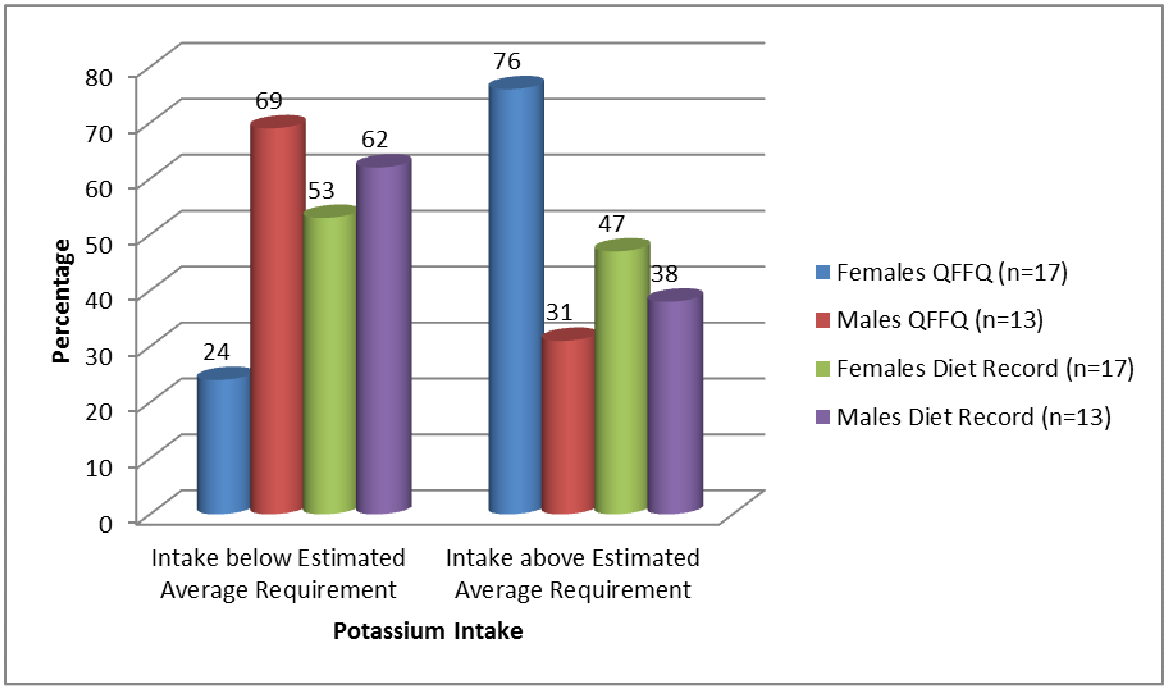


Figure 3.15 Potassium intakes of male and female participants compared to Nutrient Reference Values recommendations

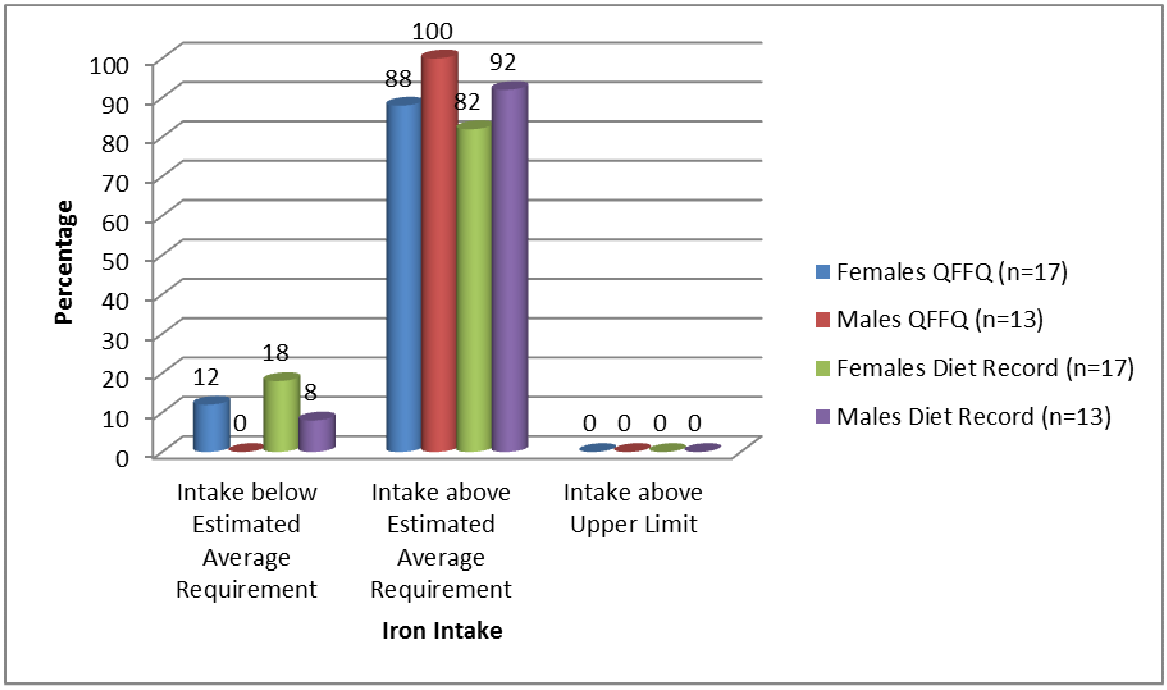


Figure 3.16 Iron intakes of male and female participants compared to Nutrient Reference Values recommendations

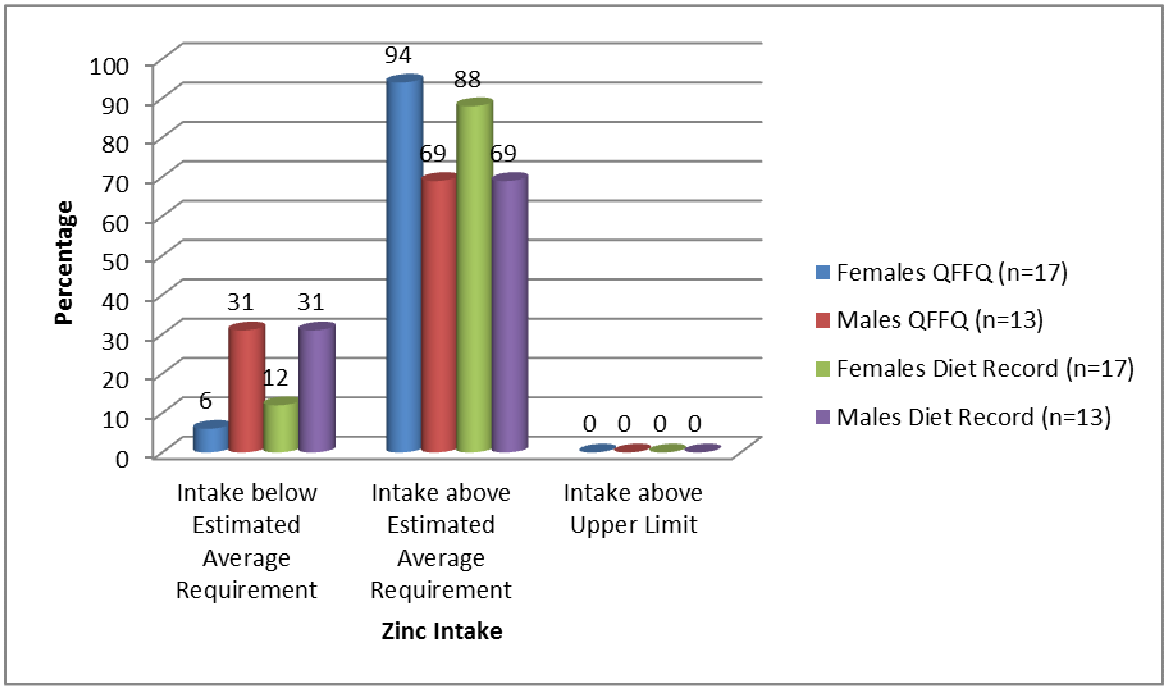


Figure 3.17 Zinc intakes of male and female participants compared to Nutrient Reference Values recommendations

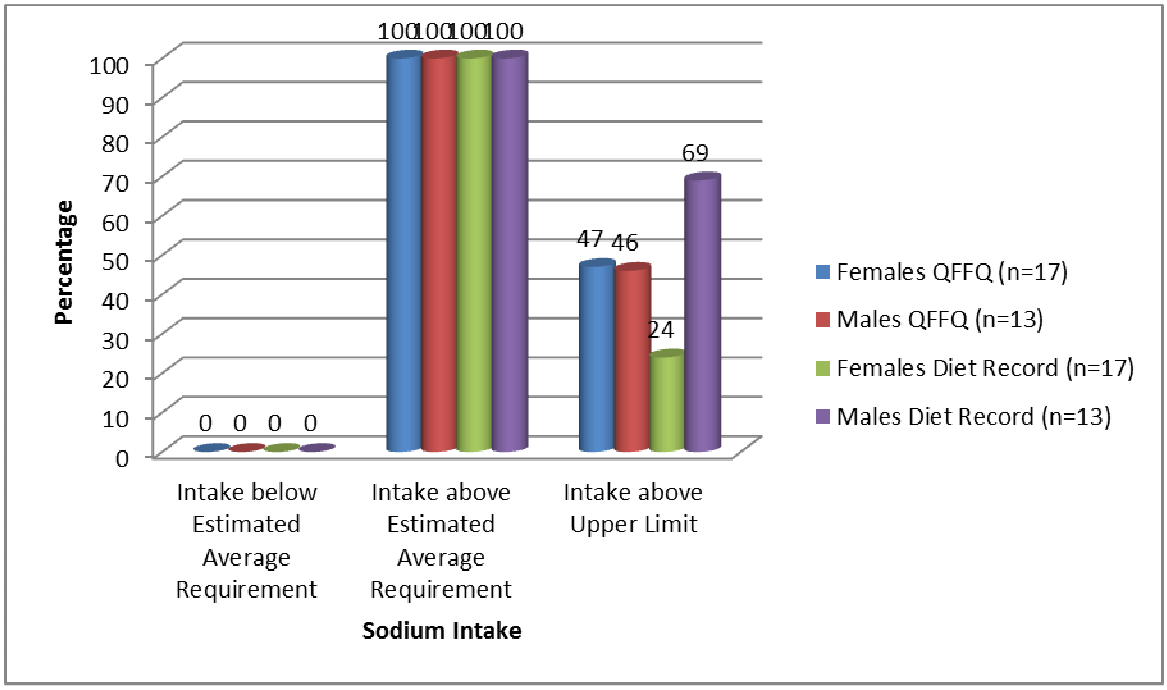


Figure 3.18 Sodium intakes of male and female participants compared to NRV recommendations

3.5 DIETARY CHANGES SINCE IMMIGRATION

Figures 3.19 and 3.20 summarise the participants' perceived reasons for changes in dietary intake and the dietary changes that they reported. Lack of time for food preparation was reported by a large percentage of participants as the reason for changes in dietary intake. Money was not reported as a reason for changes in dietary intake by many participants. Twenty percent of participants reported that take-out/take away food intake increased post-immigration. Thirty three percent of participants reported an increase in meat and egg intake and 37% reported and increased overall food intake. Forty three percent of participants reported a decrease in vegetable intake.

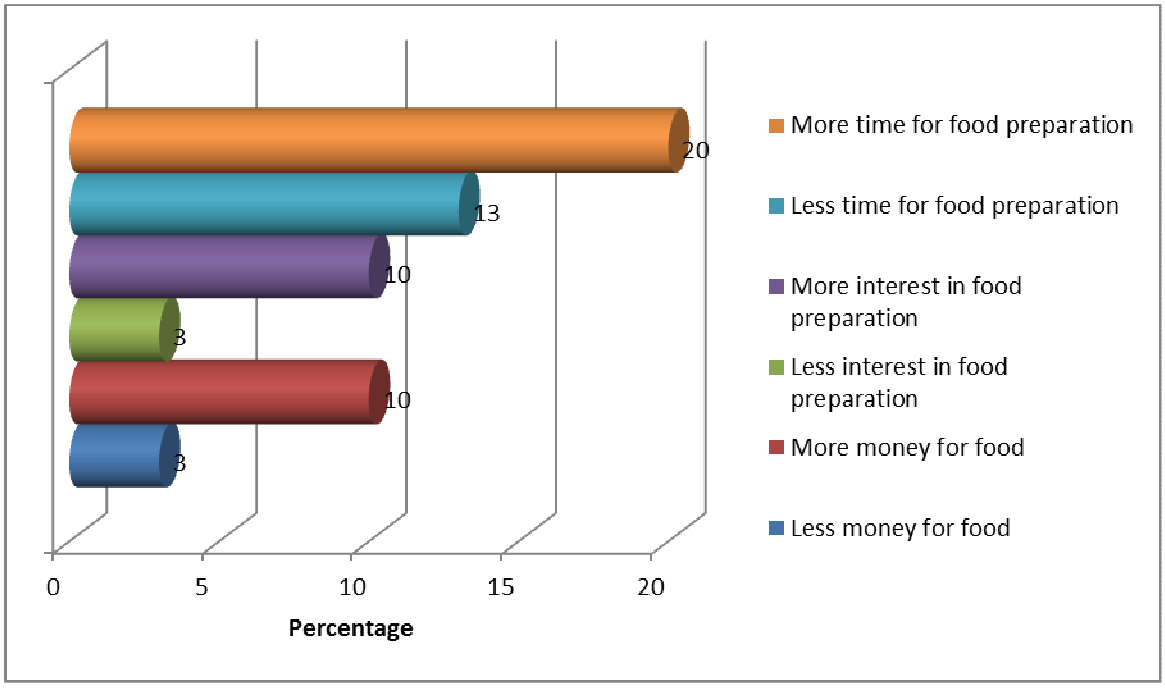


Figure 3.19: Participants' perceived reasons for change in dietary intake post-immigration (n=30)

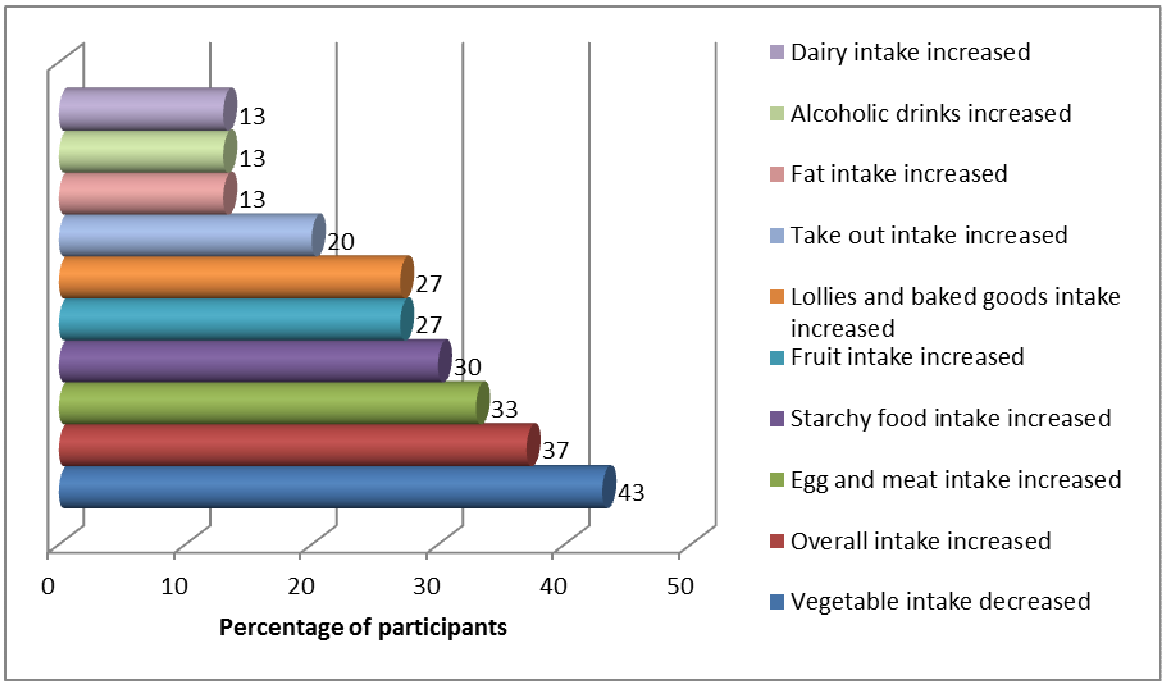


Figure 3.20: Participants' perceived changes in dietary intake post-immigration (n=30)

3.6 PHYSICAL ACTIVITY

3.6.1 Physical Activity Index Values

The results from the Physical Activity questionnaires are summarized in Table 3.8. There were no significant differences between the male and female mean index values.

Table 3.9: Mean physical activity index values of male and female participants

	Female (SD;range) N=17	Male (SD;range) N=13	P-value
Mean Work Index	2.69 (0.90) [1.875-4.75]	3.01 (0.93) [1.5-4.125]	0.33
Mean Sport Index	2.41 (0.71) [1.5-3.25]	2.62 (0.7) [1.5-4]	0.52
Mean Leisure Index	2.66 (0.43) [2-3.75]	2.88 (0.47) [2-4]	0.13
Mean Total Activity Index	7.76 (1.2) [5.875-10]	8.5 (1.17) [6.625-10.5]	0.12

3.6.2 Physical Activity Levels

Participants with a PAL greater than 1.4 up to 1.6 was classified as “low active” and participants with a PAL greater than 1.6 was classified as “active”. Figure 3.22 compares the percentages of male and female participants with low active and active classifications respectively.

The female participants had a mean Physical Activity Level (PAL) of 1.54 (0.06) and the male participants had a mean PAL of 1.71 (0.1). The females showed a significantly lower mean PAL compared to the males with the Mann-Whitney test indicating a p-value of less than 0.01.

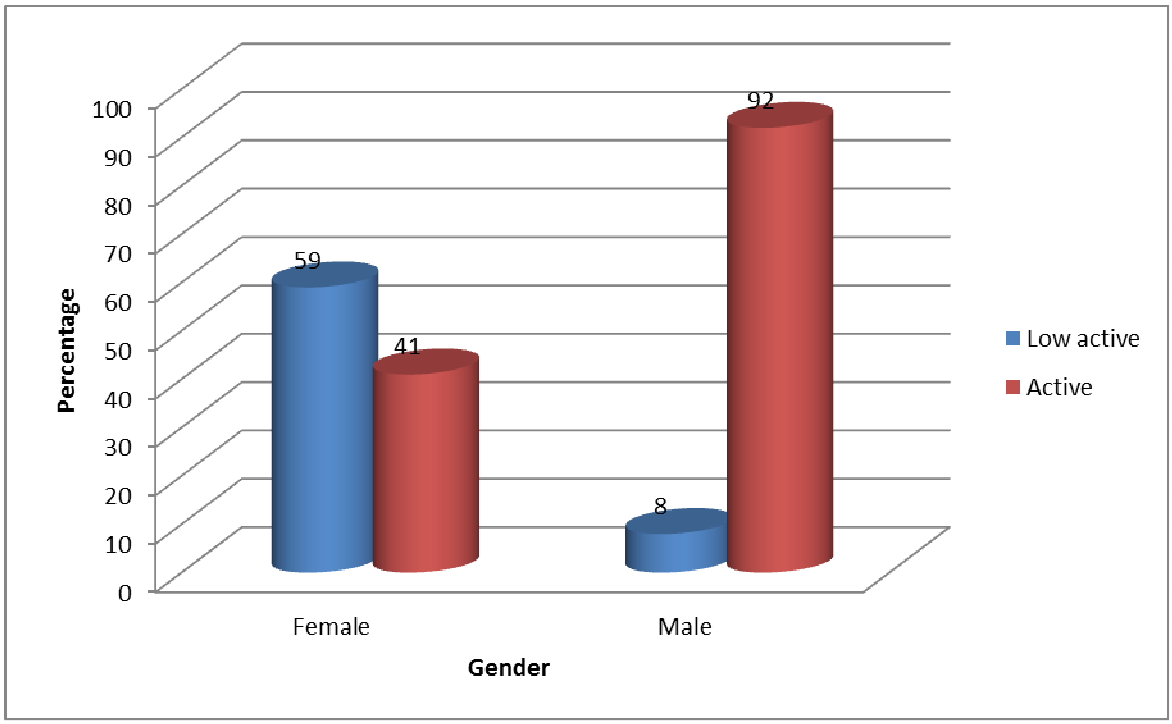


Figure 3.21: Activity levels of (n=13) and female (n=17) participants

Figures 3.22 and 3.23 summarise the participants' responses to questions regarding physical activity. Seventy seven percent of participants planned to increase their physical activity and 67% reported an increase in their physical activity since immigration. More access to facilities was the most reported reason provided by participants for a change in their physical activity levels.

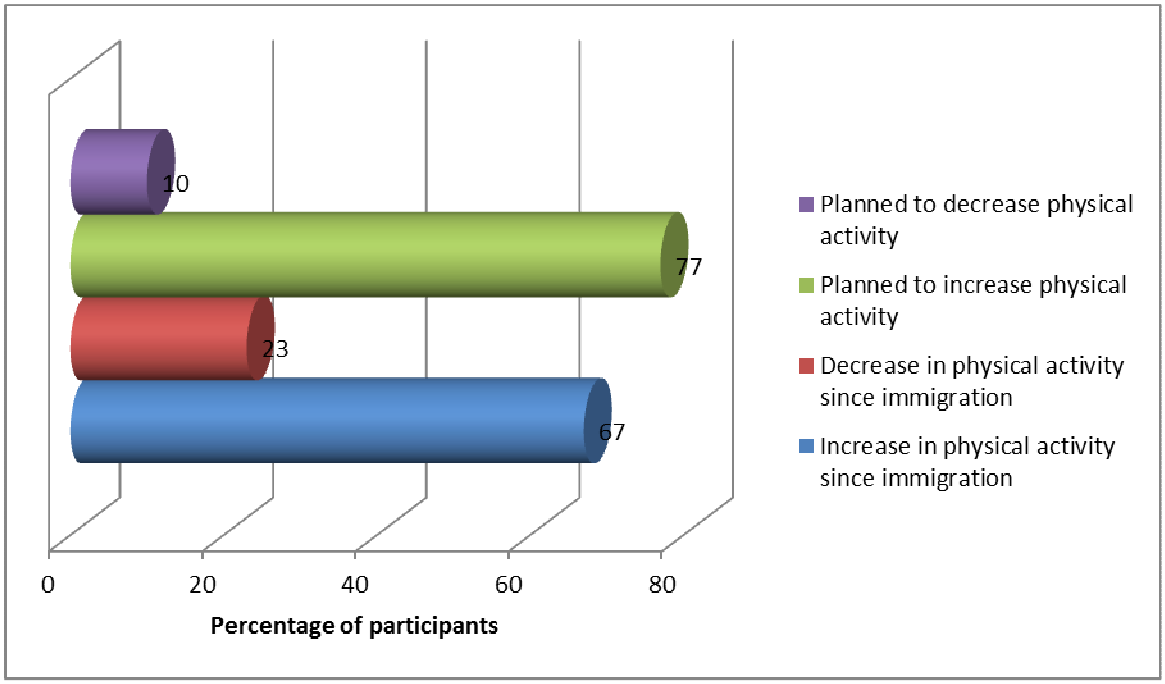


Figure 3.22: Participants' perceived and planned changes in physical (n=30)

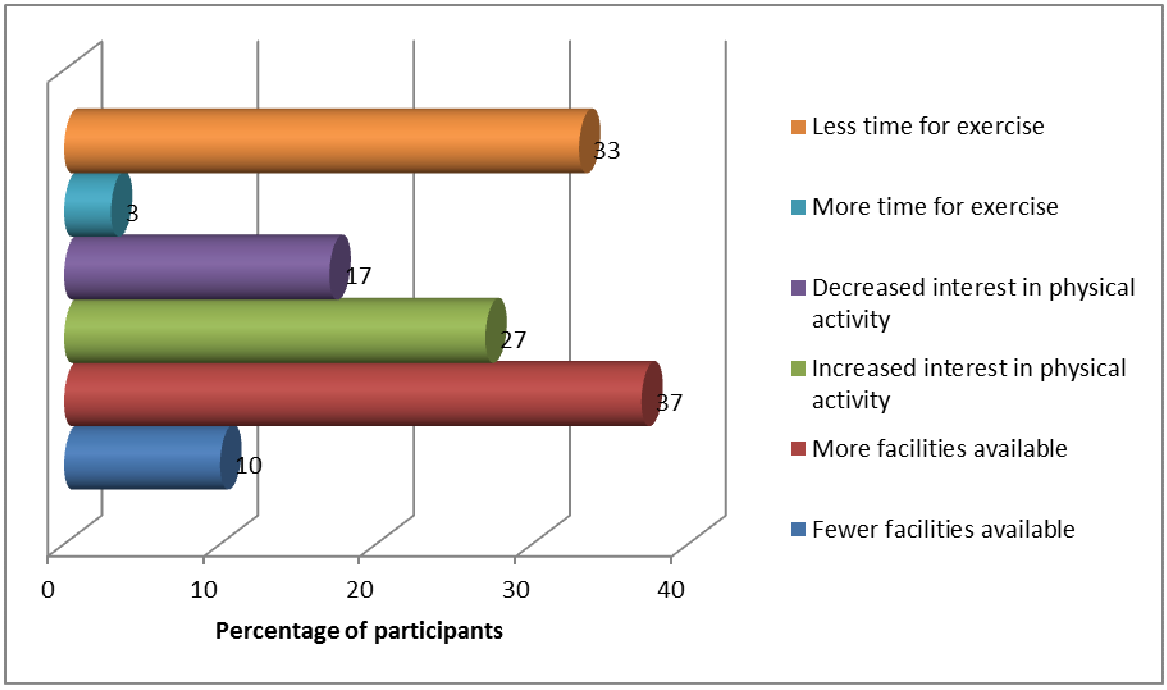


Figure 3.23: Participants' perceived reasons for changes in physical activity (n=27)

CHAPTER 4 DISCUSSION

This study was the first cross-sectional study involving South African immigrants in the Greater Hobart Area.

4.1 ANTHROPOMETRICAL MEASUREMENTS

Although statistical analysis indicated that the difference between the mean BMI values of participants pre- and post-immigration was not significant, both female and male participants showed a trend of an increase in BMI post-immigration. The percentages of overweight and obese female participants and overweigh male participants increased. The percentages of males that were overweight or obese pre- and post-immigration were lower than the Australian statistics,[11] but higher than the South African statistics.[10] The percentage of overweight females before immigration was similar to the South African statistic[10], but lower than the Australian statistic.[11] This percentage was higher than the South African statistic[10] post-immigration, but still lower than the Australian statistic.[11] The percentages of females that were obese pre- and post-immigration were lower than the Australian[11] and South African statistics.[10] This corresponds with literature regarding the effect of immigration on BMI, overweight and obesity.[25] This was not surprising as the prevalence of overweight in Australia is higher than South Africa for males and females.[10,11] However, the small sample size needs to be considered when looking at these statistics. Men appeared to be at higher risk of becoming overweight post-immigration, but it should be noted that men may have underestimated their actual weight pre-immigration. It must be taken into account that participants were asked to recall weight up to five years previously. Participants' weights may have increased as a result of ageing whether they immigrated or not (refer to table 3.3) and this should be taken into account when considering the results.

The mean waist circumference values of male and female participants were classified as action level 1. This means that, as a group, they were at an increased risk of developing chronic disease.[6,7] The waist circumference values of a large percentage of male and female participants were classified as action level 2 which meant that they were at a high risk of developing chronic disease. This was not surprising as the percentages of male and female participants who had waist circumference values that were classified as action level 2 corresponded roughly

with the percentages of male and female participants that were classified as overweight and obese post-immigration.

Sixty percent of participants considered themselves to be overweight which corresponded with the 60% of participants classified as overweight or obese post-immigration. None of the participants considered themselves to be underweight even though a small percentage of participants was classified as underweight post-immigration. Even though 60% of the study population was classified as overweight or obese and 60% of participants perceived themselves as overweight, only 37% attempted to lose weight over the 12 months prior to the data collection. Most of those who did try to lose weight did so by exercising, eating less, eating lower KJ foods and eating less fat. This indicated that immigrants had a good understanding of BMI classifications and were aware of their weight classifications, but this did not necessarily lead to intervention. Those who did attempt weight loss seemed to implement good weight loss strategies.[56,57]

4.2 DIETARY INTAKE

It was interesting to note that the male participants did not consume significantly more energy than the female participants as one would expect. There were a few significant differences between macronutrient intake values as indicated by the QFFQ and diet records. It was also interesting to note that the males showed more agreement between QFFQ and food records than the female participants. Underreporting of dietary intake has been consistently observed in food consumption surveys such as 24 hour recalls with participants consuming less when required to document their intake.[58,59] Underreporting appeared to be a big problem for participants of this study when completing dietary intake information with the diet records posing the biggest problem for underreporting.

The mean fat intakes of male and female participants as indicated by the QFFQ and diet records were at the higher end of the normal range. This was still within the optimal range for minimisation of the risk of obesity, coronary heart disease and diabetes.[52]

The mean saturated fat intakes of male and female participants were above the NRV recommendation as indicated by both the QFFQ and diet records. A large

percentage of male and female participants consumed excessive amounts of saturated fat compared to the NRV recommendation. Regression analysis has illustrated that serum Low Density Lipoprotein (LDL) cholesterol increases for each 1% increase in energy intake from saturated fats.[52] There is a positive relationship between serum total and LDL cholesterol concentration and cardiovascular disease.[50] A study conducted by Phillips et al.[60] demonstrated that Metabolic Syndrome risk was increased by a genetic variant which caused impaired insulin sensitivity, insulin resistance, increased abdominal obesity as well as hypertension. High saturated fat intake heightened the effects of this genetic variant on Metabolic Syndrome risk. The increased egg and meat intake as reported by the participants could be responsible in part for the high saturated fat intake. A report by Food Standards Australia New Zealand claimed that 15% of Australians' total energy intake is made up of saturated and trans-fatty acids.[61] Studies have shown that Sub-Saharan African and Greek immigrants showed an increase in high fat foods post-immigration to Australia.[26,27] This may explain the high saturated fat intake of the study participants.

The mean protein intakes of male and female participants as indicated by the QFFQ and diet records were at the higher end of the normal range. High protein intakes have been studied in relation to cancer, renal disease, obesity, coronary artery disease and osteoporosis. Studies investigating the role of high protein diets in the development of cancer have shown inconsistent results.[52] Studies have indicated conflicting results in relation to breast cancer. Some studies have found an adverse effect of high protein intake on breast cancer development, but others could not identify any association.[50] No relationship between high protein intake and lung, oral, pharynx, oesophageal and non-Hodgkin lymphoma had been found.[51] High protein intake has been found to increase the risk for upper digestive tract and kidney cancer.[52] Adverse renal outcomes have been investigated in relation to high protein intakes. There is no published evidence to show that a diet with up to 2.8 g protein/kg/day affects kidney metabolism negatively. Studies have not been able to show an association between protein intake and progressive renal insufficiency.[52] Protein intake has been found to be detrimental to bone health in some instances. This is as a result of urinary calcium loss. Increased protein intake is, however, also associated with an increased calcium intake and is therefore not always detrimental

to bone health.[52] There is no evidence that high protein diets lead to hyperlipidaemia in humans.[52] The above indicates a lack of consistent data regarding protein intake and chronic disease. Recent evidence has shown that higher protein diets can promote weight loss.[62,63] This is interesting as the study population appeared to have gained weight even though the mean protein intake of the study population was above 25% of total energy intake. There is limited information regarding the long-term consequences of diets in which protein provides greater than 25% of total energy.[52] It would therefore be advisable for the study population to address the high protein intake. The higher protein intake of the study population could be attributed to the increased meat and egg intake reported by participants. As mentioned before, studies have shown that Sub-Saharan African and Greek immigrants showed an increase in high fat foods post-immigration.[26,27] This study was much smaller with only 30 participants, but it is worth noting the results of the above mentioned study as it supports the reported increased meat and egg intake of the participants in this study. It should be noted that details regarding the type of meat that was increasingly consumed were not obtained. The increased meat intake therefore could have referred to an increased fish intake which may have led to a favourable dietary fat profile.

Male and female participants showed mean carbohydrate and fibre intakes that were lower than the NRV recommendations. The majority of the male and female participants had carbohydrate and fibre intakes that were lower than the NRV recommendations. The low fibre intakes of the study participants increased the risk of overweight and obesity as well as colon cancer.[52,64] Fibre forms such as methylcellulose and cellulose have been frequently used as satiety agents. Guar and other high fibre, high carbohydrate diets have been used for weight loss.[52] The British Nutrition Foundation released a report in 1990 stating that foods that are rich in non-starch polysaccharide are useful for weight loss as a result of the satiation effect and that diets high in fibre are usually lower in fat and energy. It may also take longer to chew these foods which could influence meal size.[52] Dietary fibre has also been linked to reduced risk of coronary heart disease as a result of its effect on plasma cholesterol. Pectin can lead to a 10% reduction of serum cholesterol if ingested in large amounts and bran and oatmeal products can lead to reductions of up to 23%. There are three biological mechanisms that have been suggested to

explain the cholesterol lowering effect. These are the prevention of re-absorption of bile salt from the small intestine which leads to increased faecal bile salt excretion, reduced glycemic response which leads to insulin stimulation of cholesterol synthesis in the liver and the effects of the fermentation products of non-soluble fibre.[65] A 1% serum cholesterol reduction is said to translate to a 2% reduction in coronary heart disease. Studies have indicated an inverse association between fibre rich diets and the regional prevalence of diabetes.[52] This is potentially as a result of the positive effect on weight as well as its smoothing effect on blood glucose response after food intake.[52] There has been a lot of experimental data in relation to the protective effects of fibre on colon cancer, but some studies have failed to show any benefit of high fibre intakes and risk of colon cancer. Nearly all studies have, however, found that fruits and vegetables decreases risk of colon cancer.[50] The low fibre intakes of male and female participants could be attributed to the decreased fruit and vegetable intake and the low carbohydrate intakes. A paper published by the Australian Bureau of Statistics in 2008 indicated that only 6% of Australian Adults consumed the recommended daily amount of fruit and vegetables.[62] The decrease in fruit and vegetable intake, as reported by the participants, is therefore not surprising.

Micronutrient intake was measured to indicate the quality of the participants' dietary intakes. There were many significant differences between the mean micronutrient intakes as indicated by the QFFQ and diet records and results therefore need to be interpreted with caution. There were a large proportion of participants that possibly consumed inadequate daily amounts of folate, calcium and potassium as recommended by the EAR. The reported decreased fruit and vegetable intake could be responsible for this.

A large percentage of the study population consumed less than the EAR recommendation of folate which meant that they were potentially at a higher risk of developing disease.[64,67] Studies have suggested that hyperhomocysteinemia leads to occlusive arterial vascular disease and venous thromboembolism.[68,69,70] Homocysteine causes oxidative stress and damages endothelium. Thrombogenicity is also enhanced. This makes it a risk factor for cardiovascular disease.[71] Folate is a cofactor in the metabolism of homocysteine. Low folate intake leads to higher levels of homocysteine in the blood which is a risk factor for cardiovascular disease and

stroke.[69,70,72,73] Vitamin B_6 and vitamin B_{12} are also cofactors in the metabolism of homocysteine, but was unfortunately not indicated in the FoodWorks analyses of the study population. A study conducted by the Heart Outcomes Prevention Evaluation (HOPE) 2 investigators showed that supplements containing folic acid and vitamins B_6 and B_{12} did not reduce the risk of cardiovascular events in patients that have vascular disease.[71] Supplementation with these vitamins therefore does not seem to decrease the risk. Adequate Folate intake is very important for women of childbearing age for the prevention of neural tube defects.[74]

Studies have suggested that high intakes of calcium, magnesium and potassium could reduce the risk of cardiovascular disease.[75] A study by Bolland et al. (2010) found that calcium supplementation without vitamin D supplementation led to increased risk of myocardial infarction.[76] A study by Iso Hiroyasu et al. (1999) found that low intakes of calcium and possibly potassium could increase the risk of ischemic stroke in middle-aged American women.[73] The reason for this is that calcium and potassium have been known to inversely affect blood pressure or risk of hypertension with potassium having the strongest hypotensive effect. Potassium blunts the effect of sodium chloride on blood pressure and mitigates salt sensitivity.[52] As hypertension is a risk factor for stroke, these micronutrients also inversely affect stroke risk.[65] A study by Umesawa et al. (2008) also found that dietary calcium intake, especially from dairy products, was associated with a reduced stroke incidence in middle-aged Japanese people.[77] Study participants showed mostly adequate intakes of magnesium, but calcium and potassium seemed to be consumed in less than the EAR.

It is difficult to accurately assess sodium intake without conducting urinary analysis. Sodium intake can be estimated by assessing dietary intake, but added salt is generally not accounted for and different brands of the same food can have different sodium contents.[52] Sodium intake appeared to be high for female and male participants even with these limitations. Sodium is related to elevated blood pressure in salt-sensitive subjects and studies have identified that sodium increases the risk of death from stroke.[52,78] The NRV recommendations suggest that the risk of stroke and heart disease could be further reduced by limiting sodium intake to 1600 mg/day. The male and female participants consumed mean sodium amounts much

greater than this recommendation. The study population could therefore be at an increased risk of stroke and heart disease as a result of their excessive sodium intake. The high sodium intake could possibly be attributed to the perceived increased take away food intake as well as increased meat and egg intake which likely was consumed in dishes such as casseroles and curries with was likely high in sodium. Urinary analysis studies conducted in Australia have indicated that Australians are consuming much more than 5.5 g of salt per day (2200 mg sodium) which indicates that they are likely to consume sodium amounts higher than the NRV recommendation and it is therefore not surprising that the study participants showed high sodium intakes.[79]

It should be taken into account that micronutrient supplementation was not included in the dietary intake analyses for this study. This means that participants could have had higher micronutrient intakes if they consumed micronutrient supplementation.

A large percentage of participants indicated an increased total food intake, meat and egg intake, starchy food intake, lollies and baked goods intake as well as take-out food intake post-immigration. A very large percentage of participants also indicated a decrease in vegetable intake. These changes correspond with the increase in body mass index post-immigration. A study regarding Sub-Saharan African migrants in Victoria indicated an increase in energy dense, high fat and sugar food post-immigration. This was mostly because of difficulty obtaining foods consumed in their home countries which is unlikely to be the case in this study population.[26] A study investigating the nutritional status of Greek immigrants in Melbourne, Australia showed that these Greeks showed a dietary intake much higher in animal products and lower in plant products than Greeks living in Greece. The Melbourne Greeks also showed a higher prevalence of obesity.[27] As mentioned before, the Australian Bureau of Statistics have indicated that only 6% of Australian Adults consumed the recommended daily amount of fruit and vegetables.[66] The decrease in vegetable intake post-immigration is therefore not surprising.

4.3 ACTIVITY LEVELS

There was a significant difference between the PAL of male and female participants. This corresponds with Australian statistics that indicate that females are more likely

to be sedentary than men.[12] The majority of the male participants were classified as active compared to the female participants. Most of the participants reported that they anticipated increasing their physical activity levels. A large proportion of participants reported an increase in physical activity since immigration. This correlates with Australian Bureau of Statistics findings that 66.6% of Sub-Saharan African immigrants take part in physical activity in Australia. Australia also has a slightly lower prevalence of inactivity compared to South Africa, which could be a contributing factor.[19,20] Increased availability of facilities, desire to lose weight and an increased interest in physical activity were the two most reported reasons for increased activity. Physical inactivity is a modifiable risk factor for a large range of chronic diseases including cardiovascular disease. Physical activity has been shown to have the following beneficial effects that affect chronic disease risk:[80]

- Improved body composition (reduced abdominal adiposity and improved weight control)
- Enhanced lipid lipoprotein profiles (reduced triglyceride levels, increased high density lipoprotein cholesterol levels and improved low density lipoprotein to high density lipoprotein ratios)
- Improved glucose homeostasis and insulin sensitivity
- Reduced systemic inflammation
- Increased coronary blood flow
- Augmented cardiac function
- Enhanced endothelial function

The increased physical activity reported by study participants may therefore lower their risk of developing chronic disease.

Participants are likely in the preparation or action stages of the behaviour change modification model which would likely make intervention programs and the promotion of physical activity opportunities more successful.[81]

4.4 STUDY LIMITATIONS

There are a number of limitations that need to be considered when interpreting the results of this study.

4.4.1 Size of Study Population

The small number of study participants may lead to large variability of data. Various strategies were implemented in order to recruit as many participants as possible, but only 30 eligible participants could be included. The small sample size in turn meant that not many socio-demographic subgroups within the study population could be explored as there were not enough participants in each sub-group. In addition, the physical activity questionnaire was valid for medium to large study populations. Since this study population was small, results should be interpreted with caution. Lastly, variability of dietary intake could not be tested as a result of the small number of study participants.[53] Methods to recruit participants, such as Facebook, may have introduced bias as different methods may have led to different types of people responding. In addition, non-response rates were high which impacted on the generalizability of the study findings.

4.4.2 Dietary intake limitations

It should be taken into account that questions from the original QFFQ were altered in order to make it more suitable for the South African immigrant population in Hobart. The QFFQ and diet records did not explore details around take-away use which should be noted as a limitation. FoodWorks analyses did not indicate all micronutrients and it would have been valuable to obtain information regarding micronutrients such as omega-3 fatty acids and iodine. Micronutrient supplements were not taken into account when dietary intake was assessed. The micronutrient intakes of participants may therefore have been higher than what is reflected.

4.4.3 Self-administered Questionnaires

Most of the questionnaires were self-administered by the participants. The accuracy of the reported answers depended on the ability of participants to recall dietary, physical activity and weight information and under-reporting by the overweight and obese population was a factor. Physical activity information could have been improved by using pedometers and keeping physical activity diaries kept.

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

This study investigated the changes in BMI, dietary intake and physical activity of South African immigrants in Hobart, Australia. The study is important as a large number of South African's immigrate to Australia on an annual basis and overweight and obesity appears to be a problem in immigrants in Australia as well as the rest of the world.

There was no significant difference between the BMIs of participants pre- and post-immigration, but the percentage of overweight male and female participants increased according to the Australian statistics[11] and the percentage of obese female participants increased as well. There were no statistically significant differences between the male and female participants' BMIs before and after immigration. There were no statistically significant differences between the BMI changes of the participants in the various age categories. The two null hypotheses were therefore accepted. There was a statistically significant difference between the PAL values of the male and female participants and the null hypothesis was therefore rejected.

The high saturated fat intake and low fibre intake of the study population indicated an increased risk of becoming overweight or obese. The study participants were also at risk of folate, potassium and calcium deficiencies, which could further increase the risk of developing chronic diseases. The high sodium intake of study participants is another risk of chronic disease. Participants reported dietary changes post-immigration that were consistent with studies investigating Greek immigrants in Melbourne and Sub-Saharan African immigrants in Australia.

The majority of South African immigrants reported an increase in physical activity post-immigration. Most participants also anticipated a further increase in physical activity. This was possibly as a result of a large percentage of South African immigrants that reported that they were trying to lose weight and the majority of those participants used physical activity as a tool for weight loss.

Recommendations

Interventions at individual and community level that are aimed at decreasing the risk of South African immigrants in Hobart becoming overweight or obese should be aimed at dietary intake and especially at saturated fat, carbohydrate and fibre intake

and variation that would improve micronutrient intake. Physical activity should be encouraged further as participants appear to be ready for change. These recommendations regarding dietary intake and physical activity could be directed to the Dietitians Association of Australia for actioning. The Department of Immigration could be approached to distribute the findings and recommendations of this study to prospective South African immigrants. The Dietitians Association of Australia also has plenty of very useful healthy nutrition guidelines and information available which could be distributed to prospective immigrants. Informal organisations such as SATAZ should make information regarding existing physical activity programs available in the area available to new immigrants. Health Promoting Schools is a very successful program in Australia and schools should be made aware of the findings of this study in order for them to ensure that South African immigrants attending their schools receive healthy eating information which can be passed on to their parents as well. Ethnographic studies are required to truly understand the factors leading to changes in dietary intake and physical activity in order for effective interventions to be developed.

Using social networking sites, such as Facebook, is a very helpful way of identifying potential participants. A number of participants were recruited this way for this study. Researchers should ensure that they are aware of social networking tools that can be used effectively for the recruitment of participants.

LIST OF REFERENCES

1. The Merriam-Webster online dictionary. [Cited 2010 November 3] Available at: http://www.merriam-webster.com/

2. World Health Organisation. Fact sheet number 311. Geneva. 2008. [Cited 2010 November 3] Available at: http://www.who.int/mediacentre/factsheets/fs311/en/

3. World Health Organisation. The Asia-Pacific perspective: Redefining obesity and its treatment. Geneva. 2000. [Cited 2010 November 3] Available at: http://www.who.int/nutrition/publications/obesity/09577082_1_1/en/

4. Swinburn BA, Caterson I, Seidell JC, James WPT. Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutr*. 2004; 7(1A):123–146.

5. Renzaho AMN, Swinburn B, Burns C. Maintenance of traditional cultural orientation is associated with lower rates of obesity and sedentary behaviours among African migrant children to Australia. *Int J Obes.* 2008; 32:594-600.

6. WHO Technical Report Series. The problem of overweight and obesity: preventing and managing the global epidemic. Part 1. Report of a WHO Consultation. Geneva, World Health Organisation. 2004

7. Klein S, Allison DB, Heymsfield SB, Kelley DE, Leibel RL, Nonas C, Kahn R. Waist circumference and cardiometabolic risk: a consensus statement from Shaping America's Health: Association for Weight Management and Obesity Prevention; NAASO, The Obesity Society; the American Society for Nutrition; and the American Diabetes Association. *Am J Clin Nutr*. 2007; 85:1197–1202.

8. Christian AH, Mochari H, Mosca LJ. Waist Circumference, Body Mass Index, and their association with cardiometabolic and global risk. *J Cardiometab Syndr*. 2009; 4(1):12–19.

9. Grossniklaus DA, Gary RA, Higgins MK, Dunbar SB. Biobehavioral and psychological differences between overweight adults with and without waist circumference risk. *Res in Nurs Health.* 2010; 33:539-551.

10. Department of Health. South African Demographic and Health Survey. Pretoria, Department of Health. 2003.[Updated December 2004 , cited 3 November 2010] Available from: http://www.doh.gov.za/facts/sadhs2003/main.html

11. Australian Bureau of Statistics (ABS). National Health Survey: Summary of Results, Australia, 2007-08. ABS, Canberra. 2009. [Cited 2010 November 3] Available at: http://abs.gov.au/AUSSTATS/abs@.nsf/mf/4364.0/

12. WHO Technical Report Series. The problem of overweight and obesity: preventing and managing the global epidemic. Part 3. Report of a WHO Consultation. Geneva, World Health Organisation. 2004

13. Bjorbaek C. Central Leptin receptor action and resistance in obesity. *J Investig Med*. 2009; 56(7):789-794.

14. Hameed S, Dhillo WS, Bloom SR. Gut hormones and appetite control. *Oral Dis*. 2009; 15:18-26.

15. Wynne K, Stanley S, Bloom S. The gut and regulation of body weight. *J Clin Endocrinol Metab.* 2004; 89(6):2576-2582.

16. Hill JO, Peters JC. Environmental contributors to the obesity epidemic. *Sci*. 1998; 280:1371-4.

17. Burke V, Beilin LJ, Durkin K, Stritzke WGK, Houghton S, Cameron CA. Television computer use, physical activity, diet and fatness in Australian adolescents. *Int J Pediatr Obes.* 2006; 1(4): 248 – 255.

18. Saris WHM and the STORM study group. Sibutramine trial of obesity reduction and maintenance lifestyle and diet during the 6 month run-in phase. University of Maastricht, Maastricht, The Netherlands. 2003.

19. Australian Bureau of Statistics [Home Page on the Internet] Physical Activity in Australia: A Snapshot, Australia, 2004-2005. [Updated 2007 Feb, cited 2010 Feb 10] Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4812.02001?OpenDocument.

20. Australian Bureau of Statistics. Migrants and participation in sport and physical activity. ABS, Canberra. 2006. [Cited 2010 November 3] Available from: www.ausport.gov.au/ .../ABS_-_migrants_participation_sport_physical_activity.pdf

21. Biro FM, Wien M. Childhood obesity and adult morbidities. *Am J Clin Nutr*. 2010; 91(suppl):1499S-1505S.

22. Freedman DS, Khan LK. Relationship of childhood obesity to coronary heart disease risk factors in adulthood: the Bogalusa Heart Study. *Pediatr*. 2001; 108:712-718.

23. Horta BL, Bahl R et al. Evidence of the long-term effects of breastfeeding: systematic reviews and meta-analyses. Geneva, World Health Organisation. 2007 [Cited 2011 October 31] Available at: http://www.who.int/child_adolescent_health/documents/9241595230/en/

24. Sawaya AL, Roberts S. Stunting and future risk of obesity: principal physiological mechanisms. *Cad Saude Publica*. 2003; 19(1):S1-8.

25. Cairney J. Time since immigration and excess body weight. Canadian *J Pub Health*. 1999;90(2):120-124.

26. Renzaho A.M.N., Burns C. Post-migration food habits of sub-saharan African migrants in Victoria: a cross-sectional study. *Nutr Diet.* 2006; 63(2):91.

27. Kouris-Blazos A, Wahlqvist ML, Trichopoulou A, Polychronopoulos E, Trichopoulos D. Health and nutritional status of elderly Greek migrants to Melbourne, Australia. *Age Aging*. 1996; 25:177-189.

28. Wahlqvist ML. Asian migration to Australia: food and health consequences. *Asia Pacific J Clin Nutr*. 2002; 11:562-568.

29. Sanchez-Vaznaugh E.V, Kawachi I, Subramanian S.V, Sanchez B.N, Acevedo-Garcia D. Differential effect of birthplace and length of residence on body mass index (BMI) by education, gender and race/ethnicity. *Soc Sci Med*. 2008; 1-11.

30. Goel MS, McCarthy EP, Phillips RS, Wee CC. Obesity among US immigrant subgroups by duration of residence. *J Am Med Ass*. 2004; 292(23):2860-2867.

31. Kaplan, MS, Huguet, MA, Newsom JT, McFarland BH. The association between length of residence and obesity among Hispanic immigrants. *AJPM*. 2004; 27(4): 323-326.

32. Groop L, Orho-Melander M. The dysmetabolic syndrome. *J Intern Med*. 2001; 250(2):105-120.

33. Wilborn C, Beckham J, et al. Obesity: prevalence, theories, medical consequences, management, and research directions. *J Int Soc Sports Nutr.*. 2005; 2(2):4-31.

34. WHO Technical Report Series. The problem of overweight and obesity: preventing and managing the global epidemic. Part 4. Report of a WHO Consultation. Geneva, World Health Organisation. 2004

35. Cameron AJ, Dunstan DW, et al. Health and mortality consequences of abdominal obesity: evidence from the AusDiab study. *MJA*. 2009; 191(4):202-208.

36. Viljoen I., Labadarios D, Herselman MG. *BMI changes, dietary intake and physical activity of immigrants in the USA: an investigation of a South African population in the greater Atlanta area*. *[dissertation]*. University of Stellenbosch. 2004.

37. Department of Immigration and Multicultural Affairs. Research and Statistics Section. [Updated 2005-2006, cited 2010 Nov 3]. Available from: http://www.immi.gov.au/media/publications/pdf/update_june06.pdf

38. Hauck K, Hollingsworth B, et al. BMI differences in 1st and 2nd generation immigrants of Asian and European origin to Australia. *Health Place*. 2010; 17(1):78-85.

39. Kousar R, Burns C, et al. A culturally appropriate diet and lifestyle intervention can successfully treat the components of metabolic syndrome in female Pakistani immigrants residing in Melbourne, Australia. *Metabolism*. 2008; 57(11):1502-8.

40. Australian Bureau of Statistics. Tasmania at a glance. [Cited 2011 July] Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/1305.62011?OpenDocument

41. Reference Wiki. [Homepage on the Internet] Map/Australia. [Cited 2011 April] Available from: http://en.18dao.net/Map/Australia

42. Australian rail maps. [Homepage on the Internet] Melbourne rail map. [Updated 2006 Sept, Cited 2007 Feb] Available from: http://www.railmaps.com.au/melbourne.htm.

43. Weight History Questionnaire. Center for Disease Control. National Center for Health Statistics. [homepage on the internet] National Statistics Section. [Updated 2007 April, Cited 2007 April] Available from: http://www.cdc.gov/nchs/data/nhanes/nhanes_05_06/sp_whq_d.pdf

44. Lee RD, Nieman DC. Chapter 7. *Nutritional Assessment*. 3rd ed. McGraw-Hill. 2003. p. 214.

45. *Stedman's Medical Dictionary*. 27th ed. Lippincott Williams & Wilkins; 2000; p. 1391.

46. Baecke JAH, Burema J, Frijters JER. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *Am J Clin Nutr*. 1982; 36:936-942.

47. Philippaerts RM, Westerterp KR, Lefevre J. Doubly labeled water validation of three physical activity questionnaires. *Int J Sports Med*. 1999; 20:284-289.

48. Jacobs DR, Ainsworth BE, Hartman TJ, Leon AS. A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Med Sci Sports Exerc*. 1993; 25(1):81-91.

49. Harvard School of Public Health. [homepage on the Internet] Department of Human Nutrition. Adult Food Frequency Questionnaire. 88GP. [cited 2007 Feb] Available from: http://www.hsph.harvard.edu/Academics/nutr/department/Nurses%20Study.html.

50. Ireland P, Jolley D, Giles G et al. Development of the Melbourne FFQ: a food frequency questionnaire for use in an Australian prospective study involving an ethnically diverse cohort. *Asia Pacific J Clin Nutr* 1994; 3:19-31.

51. Ambrosini GL, Mackerras D, de Klerk NH, Musk AW. Comparison of an Australian food-frequency questionnaire with diet records: implications for nutrition surveillance. *Public Health Nutr*. 2003 Jun; 6(4):415-22.

52. Department of Health and Ageing. Nutrient Reference Values for Australia and New Zealand. Commonwealth of Australia. 2006.

53. Willet WC, Sampson L, Stampfer MJ, et al. Reproducibility and validity of a semiquantitative food frequency questionnaire. *Am J. Epidemiol*. 1985; 122: 51-65

54. Dietitians Pocket Book. School of Public Health. Curtin University of Technology. 2006; 57

55. Barr SI, Murphy SP, et al. Interpreting and using the Dietary References Intakes in dietary assessment of individuals and groups. *JADA*. 2002; 102(6):780-788

56. Washington RL, Bernhardt DT, et al. Promotion of healthy weight-control practices in young athletes. *Paediatr*. 2005; 116(6):1557-1564

57. O'Gorman DJ, Krook A. Exercise and the treatment of diabetes and obesity.Endocrinology and Metabolism. *Clin North Am*. 2008; 37(4):887-890

58. Harrison GG, Galal OM, et al. Underreporting of food intake by dietary recall is not universal: a comparison of data from Egyptian and American women. *J Nutr.* 2000; 130(8):2049-54

59. Poslusnak K, Ruprich J, et al. Misreporting of energy and micronutrient intake estimated by food record and 24 hr recalls, control and adjustment methods in practice. *Br J Nutr.* 2009; 101(2):573-85

60. Phillips CM, Goumidi L, et al. Dietary saturated fat, gender and genetic variation at the TCF7LZ locus predict the development of metabolic syndrome. J.Nutr Biochem. 2011 [Epub ahead of print]

61. Food Standards Australia New Zealand. FSANZ Advisory: Trans fatty acids and saturated fats. [Cited 2010 November 3] Available at: http://www.foodstandards.gov.au/scienceandeducation/mediacentre/mediarelease/mediareleases2009/mediaadvisorytransfa4562.cfm.

62. Wycherley TP, Noakes M, et al. A high-protein diet with resistance exercise training improves weight loss and body composition in overweight and obese patients with type 2 diabetes. *Diabetes Care*. 2010; 33(5):969-76.

63. Meckling KA, Sherfey R. A randomized trial of a hypocaloric high-protein diet, with and without exercise, on weight loss, fitness, and markers of the Metabolic Syndrome in overweight and obese women. *Appl Physiol Nutr Metab*. 2007; 32(4):743-52.

64. WHO Technical Report Series. The problem of overweight and obesity: preventing and managing the global epidemic. Report of a WHO Consultation. Geneva, World Health Organisation. 2004.

65. Gunness P, Gidley MJ. Mechanisms underlying the cholesterol-lowering properties of soluble dietary fibre polysaccharides. Food Funct. 2010; 1(2):149-155.

66. Australian Bureau of Statistics [Home Page on the Internet] Overweight and Obesity in Adults in Australia: A Snapshot 2007-2008. [Updated 2011 May, cited 2011 August 26] Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Products/36A5AA4EB83E5F69CA25789C0023DB9C?opendocument

67. Robert HF, Fairfield KM. Vitamins for chronic disease prevention in adults. JAMA. 2002; 287(23):3127-3129

68. Cantu C, Alonso E, et al. Hyperhomocysteinemia, low folate and vitamin B12 concentrations, and methylene tetrahydrofolate redcutase mutation in cerebral venous thrombosis. *Stroke.* 2004; 35:1790-1794.

69. Bazzano LA, He J, et al. Dietary intake of folate and risk of stroke in US men and women: NHANES 1 epidemiologic follow-up study. *Stroke*. 2002; 33:1183-1189.

70. Van Guelpen B, Hultdin J, et al. Folate, vitamin B12, and risk of ischemic and hemorrhagic stroke: a prospective, nested case-referent study of plasma concentrations and dietary intake. *Stroke*. *2005*; 36:1426-1431.

71. The Hearth Outcomes Prevention Evaluation (HOPE) 2 Investigators. Homocysteine lowering with folic acid and B vitamins in vascular diseases. N Eng J Med. 2006; 354:1567-1577

72. Cui R, Iso I, Date, C, et al. Dietary folate and vitamin B6 and B12 intake in relation to mortality from cardiovascular diseases: Japan Collaborative Cohort Study. *Stroke.* 2010; 41:1285-1289.

73. Weng L, Yeh W, et al. Is ischemic stroke risk related to folate status or other nutrients correlated with folate intake? *Stroke*. 2008; 39:3152-3158.

74. Pitken RM. Folate and neural tube defects. Am J Clin Nutr. 2007; 85(1):2855-2885.

75. Iso H, Stampfer MJ, et al. Prospective study of calcium, potassium, and magnesium intake and risk of stroke in women. *Stroke*. 1999; 30:1772-1779.

76. Bolland MJ, Avenell A, et al. Effect of calcium supplements on risk of myocardial infarction and cardiovascular events: meta-analysis. BMJ. 2010; 341:c3691.

77. Umesawa M, Iso H, et al. Dietary calcium intake and risks of stroke, its subtypes, and coronary heart disease in Japanese: the JPHC study cohort 1. Stroke. 2008; 39:2449-2456.

78. Nagata C, Takatsuka N, et al. Sodium intake and risk of death from stroke in Japanese men and women. *Stroke*. 2004; 35:1543-1547.

79. Australian Division of World Action on Salt and Health (AWASH). Statement on Australian Salt Intakes.[Cited 2011 August 26] Available from: http://www.awash.org.au/documents/AWASH-Statement-on-Australian-Salt-Intakes.pdf

80. Warburton DER, Nicol CW, et al. Health benefits of physical activity: the evidence. *CMAJ*. 2006; 174(6):801.

81. Zimmerman GL, Olsen CG, et al. A “stages of change” approach to helping patients change behavior. *Am Fam Physician*. 2000; 61:1409-16

APPENDIX 1

CHANGES IN BODY MASS INDEX, DIETARY INTAKE AND PHYSICAL ACTIVITY OF SOUTH AFRICAN IMMIGRANTS IN HOBART, AUSTRALIA

Dear Participant,

Thank you once again for your willingness to participate in this study. All the relevant questionnaires are in this folder for you. You can fill out all the questionnaires in your own time except for the weight history questionnaire which I will complete during the visit to weigh and measure you.

Please let me know once you have completed all the questionnaires so that I can organise a visit at a suitable time in order to complete the measurements. The visit will only take 10 minutes of your time.

If you have any further questions, please don't hesitate to contact me.

Kind regards

Marcy

Ph: 0415986928
Email: marcy.stanton@y7mail.com

APPENDIX 2

FACULTY OF HEALTH SCIENCES

STELLENBOSCH UNIVERSITY

PARTICIPANT INFORMATION SHEET

Changed in Body Mass Index, physical activity and dietary intake of South African immigrants in Hobart, Australia

Invitation

You are invited to participate in a research study into the effects that immigration to Hobart has on the weight, physical activity and dietary intake of South Africans.

This study is being conducted by:

Prof. Marietjie Herselman
Associate Professor and Acting Head
Division of Human Nutrition
Stellenbosch University

Mrs. Janicke Visser
Senior Lecturer
Division of Human Nutrition
Stellenbosch University

Mrs. Marcy Stanton
Master of Nutrition Student
Division of Human Nutrition
Stellenbosch University

Before you decide whether or not you wish to participate in this study, it is important for you to understand why the research is being done and what it will involve. Please take the time to read the following information carefully and discuss it with others if you wish.

1. 'What is the purpose of this study?'

The aim of this study is to investigate the changes in body weight as well as changes in dietary intake and physical activity of South Africans after immigrating to Hobart, Australia.

2. 'Why have I been invited to participate in this study?'

You have been invited to participate in this study as you are a South African immigrant who has lived in Australia for longer than 6 months but shorter than 5 years.

3. 'What does this study involve?'

If you agree to participate in this study, you will be asked to sign the Participant Consent Form.

You will be asked to complete the questionnaires. The socio-demographic and dietary intake questionnaires can be completed in your own time and the physical activity and weight change questionnaires will be completed when the researcher pays you a visit.

The researcher will take your weight, height and waist circumference measurements in the comfort of your own home. This will be done by using a measuring tape and scales.

4. 'What are the risks associated with this procedure?'

There are no physical risks involved in this study. You may feel uncomfortable disclosing information regarding your body weight and having the researcher take your weight, height and waist circumference measurements.

5. 'Will I benefit from this study?'

There will be no personal benefits to you from taking part in this study. This study will however provide information on change in weight status of immigrants that could be useful to health care workers in future.

6. 'What happens if I don't want to take part in the study?'

Participation in this study is voluntary. It is completely up to you whether or not you participate. You are free to withdraw from this research study at any stage and your information can be withdrawn from this study if this is requested before September 2009.

7. 'How will my confidentiality be protected?'

Your information will not be linked to your name or any personal details. Only those conducting and monitoring the study will have access to your results.

We plan to discuss/publish the findings in peer-reviewed journals and at professional forums and conferences. In any publication, information will be provided in such a way that you cannot be identified.

This study's findings will be provided to you, if you wish.

8. 'How is this study being paid for?'

The study is being sponsored by Stellenbosch University.

9. 'What should I do if I want to discuss this study further before I decide?'

When you have read this information, the researcher, Marcy Stanton, will discuss it with you and any queries you may have. If you would like to know more at any stage, please do not hesitate to contact her on +61 415 986 928 or marcy.stanton@y7mail.com.

10. 'Who should I contact if I have concerns about the conduct of this study?'

This study has been approved by the Tasmanian Social Science Human Research Ethics Committee. If you have concerns or complaints about the conduct of this

study, you may contact the Executive Officer of the Human Research Ethics Committee (Tasmania) Network on 62267479 or human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number H10372.

Alternatively you can contact the Committee for Human Research at Stellenbosch University at +27 (0)21 938 9207 if you have any concerns or complaints that have not been adequately addressed by the researcher. You will receive a copy of this information and consent form for your own records.

Thank you for taking the time to consider this study.

If you wish to take part in it, please sign the attached consent form.

This information sheet is for you to keep.

CONSENT FORM

Changes in Body Mass Index, physical activity and dietary intake of South African immigrants in Hobart, Australia

1. I acknowledge that the nature, purpose and contemplated effects of the project so far as it affects me, have been fully explained to my satisfaction by the research worker and my consent is given voluntarily.

2. The details of the procedure proposed have also been explained to me, including the anticipated length of time it will take, the frequency with which the procedure will be performed, and an indication of any discomfort, which may be expected. I understand that my involvement means:

    - Completing 4 questionnaires as well as being weighed and measured by the researcher.

3. I understand that there are the following risks or possible discomfort:

    - I may feel uncomfortable being weighed and measured and answering questions relating to my body weight.

4. Although I understand that the purpose of this research project is to improve the quality of medical care, it has also been explained that my involvement may not be of any benefit to me.

5. I have been given the opportunity to have a member of my family or friend present while the project was explained to me.

6. I am informed that no information will be divulged and the results will not be published so as to reveal my identity.

7. I understand that I am free to withdraw from the project at any stage and any of my data that have been collected.

8. I understand that I will be given a signed copy of this patient information sheet and consent form. I am not giving up my legal rights by signing this consent form.

9. I understand that the research will be conducted in accordance with the latest versions of the *National Statement on Ethical Conduct in Human Research 2007* and applicable privacy laws.

Name of participant _____

Signature of participant _____ Date _____

10. I have explained this project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

Name of investigator _____

Signature of investigator _____ Date _____

APPENDIX 3

CHANGES IN BODY MASS INDEX, PHYSICAL ACTIVITY AND DIETARY INTAKE OF SOUTH AFRICAN IMMIGRANTS IN HOBART, AUSTRALIA

University of Tasmania Ethics Ref no. H10372

Non-Disclosure Declaration

I understand that the Chief Investigator (CI) of this research project is Prof Marietjie Herselman, Associate Professor and Acting Head, Division of Human Nutrition, Stellenbosch University.

I confirm that I will not disclose to anyone, other than the CI, any information to which I may become privy about the participants in this research project or about the contents of the questionnaires for this research project.

Name:

Signature:

Date:

APPENDIX 4

SOCIO-DEMOGRAPHIC QUESTIONNAIRE

Subject number: | | | |

Date: | D | D | M | M | Y | Y |

Age: _____

Date of arrival in Australia | M | M | Y | Y |

Address _____
City State Zip

Please mark the appropriate box with a cross (X) in the grey area

Age:

1	2	3
20 – 29	30 – 39	40 – 50

Gender:

1	2
Male	Female

Ethnicity:

1	2	3	4	5
Black	Caucasian	Coloured	Indian	Other - Specify

Marital status:

1	2	3	4	5	6	7
Un-married	Married	Divorced	Separated	Widowed	Living together	Other – Specify

Highest level of education:

1	2	3	4
High school	Tertiary education	Post graduate education	Other – specify

APPENDIX 5

WEIGHT HISTORY QUESTIONNAIRE

Subject number ☐☐☐

1. Current weight, Height and Waist circumference

Weight ☐☐☐, ☐Kg ☐☐☐, ☐lb

Height ☐, ☐☐m ☐, ☐☐feet

Waist circumference ☐☐☐, ☐cm

Please mark the appropriate box with a cross (x) in the grey area

2. Do you consider yourself now to be...

1	2	3
Overweight	Underweight	About the right weight

3. Would you like to weigh...

1	2	3
More	Less	Stay about the same

4. How much did you weigh on arrival in Australia?

☐☐☐, ☐Kg

Or

☐☐☐, ☐lb

For office use only

[Current weight] – [Weight on arrival] =

☐☐☐,☐

1	2	3
Weight loss	No change	Weight gain

If weight loss (-) ≥ 10lb/4.55kg → Answer 5
If weight gain (+) → Answer 4a
No change → Answer 8

If your weight has **stayed the same** since arrival, proceed to **question 8**
If you have **lost weight** since arrival in Australia, proceed to **question 5**
If you have **gained weight** since arrival, proceed to **question 4a**

4a. How much weight did you gain?

1	2	3
0 – 10lb/0 – 5kg	10 – 20lb/5 – 10kg	>20lb/>10kg

5. Was the change between your current weight and weight on arrival intentional?

1	2
Yes	No

6. During the past 12 months have you tried to lose weight?

1	2
Yes	No

7. How did you try to lose weight? [Mark all applicable options with a cross (x)]

Ate less food (amount)	
Switch to foods with lower calories	
Ate less fat	
Exercised	
Skipped meals	
Ate 'diet' foods or products	
Used a liquid diet formula such as Slimfast	
Joined a weight loss program such as weight watchers, Jenny Craig, Tops, or overeaters anonymous?	
Took diet pills prescribed by a doctor	
Took other pills, medicines, herbs, or supplements not needing a prescription	
Took laxatives or vomited	

8. During the past 12 months, have you done anything to keep you from gaining weight?

1	2
Yes	No

9. What did you do to keep from gaining weight? [Mark all applicable options with a cross (x)]

Ate less food (amount)	
Switch to foods with lower calories	
Ate less fat	
Exercised	
Skipped meals	
Ate 'diet' foods or products	
Used a liquid diet formula such as Slimfast	
Joined a weight loss program such as weight watchers, Jenny Craig, Tops, or overeaters anonymous?	
Took diet pills prescribed by a doctor	
Took other pills, medicines, herbs, or supplements not needing a prescription	
Took laxatives or vomited	

APPENDIX 6

HABITUAL PHYSICAL ACTIVITY QUESTIONNAIRE

Subject number ☐☐☐

Please answer the following questions by making a cross (x) in the column on the right, next to the answer that most accurately describes your activity at work. (Grey area is for office use only)

WORK INDEX			X
1. What is your main occupation?	Clerical work, driving, shop keeping, teaching, studying, housework, medical practice, any occupation requiring a university education	1	
	Factory work, plumbing, carpentry, and farming	3	
	Dock work, construction work and professional sport	5	
2. At work I sit	Never	1	
	Seldom	2	
	Sometimes	3	
	Often	4	
	Always	5	
3. At work I stand	Never	1	
	Seldom	2	
	Sometimes	3	
	Often	4	
	Always	5	
4. At work I walk	Never	1	
	Seldom	2	
	Sometimes	3	
	Often	4	
	Always	5	
5. At work I lift heavy loads	Never	1	
	Seldom	2	
	Sometimes	3	
	Often	4	
	Always	5	
6. After work I'm tired (physically)	Very often	5	
	Often	4	
	Sometimes	3	
	Seldom	2	
	Never	1	
7. At work I sweat	Very often	5	
	Often	4	
	Sometimes	3	

	Seldom	2	
	Never	1	
8. In comparison to others of my own age I think my work is physically	Much heavier	5	
	Heavier	4	
	As heavy	3	
	Lighter	2	
	Much lighter	1	

FOR OFFICE USE ONLY	
Calculate Work Index	[(6 – (points for sitting) + Σ(point for other 7 parameters)]/8

Please answer the following questions by making a cross (x) in the column on the right, next to the answer that most accurately describes your sport activities. (Grey area is for office use only)

SPORT INDEX				
9. Do you play any sports	Yes			
	No			
If yes, please answer the following questions by making a cross (x) in the column on the right, next to the answer that most accurately describes your sport activity. If no, go directly to **question 10**.				**X**
a) What sport do you play most frequently?	Billiards, bowling, sailing, golf, walking	LI	0.76	
	Cycling, dancing, swimming, tennis, running, aerobic exercises, downhill skiing	MI	1.26	
	Boxing, basketball, football, rugby, rowing, cross-country ski	HI	1.76	
	Other:			
b) How many hours do you play a week?	< 1 hour	0.5		
	1 – 2 hours	1.5		
	2 – 3 hours	2.5		
	3 – 4 hours	3.5		
	> 4 hours	4.5		
c) How many months do you play in a year?	< 1 month	0.04		
	1 – 3 months	0.17		
	4 – 6 months	0.42		
	7 – 9 months	0.67		
	> 9 months	0.92		
d) What sport do you play second most frequently?	Billiards, bowling, sailing, golf	LI	0.76	
	Cycling, dancing, swimming, tennis	MI	1.26	
	Boxing, basketball,	HI	1.76	

	football, rugby, rowing			
	Other			
e) How many hours do you a play a week?	< 1 hour	0.5		
	1 – 2 hours	1.5		
	2 – 3 hours	2.5		
	3 – 4 hours	3.5		
	> 4 hours	4.5		
f) How many months do you play in a year?	< 1 months	0.04		
	1 – 3 months	0.17		
	4 – 6 months	0.42		
	7 – 9 months	0.67		
	> 9 months	0.92		

FOR OFFICE USE ONLY			
Calculate simple sport score	[(a) x (b) x (c) x (d) x (e) x (f)]		
Simple Sport Score (9)	Sport score >/= 12	5	
	Sport score 8 to < 12	4	
	Sport score 4 to < 8	3	
	Sport score 0.1 to < 4	2	
	Sport score = 0	1	
	No	1	

LEISURE TIME INDEX			
10. In comparison with others I think my physical activity during leisure time is	Much more	5	
	More	4	
	The same	3	
	Less	2	
	Much less	1	
11. During leisure time I sweat	Very often	5	
	Often	4	
	Sometimes	3	
	Seldom	2	
	Never	1	
12. During leisure time I play sports	Never	1	
	Seldom	2	
	Sometimes	3	
	Often	4	
	Very often	5	
13. During leisure time I watch television	Never	1	
	Seldom	2	
	Sometimes	3	
	Often	4	
	Very often	5	
14. During leisure time I walk	Never	1	
	Seldom	2	
	Sometimes	3	

	Often	4	
	Very often	5	
15. During leisure time I cycle	Never	1	
	Seldom	2	
	Sometimes	3	
	Often	4	
	Very often	5	
16. How many minutes do you walk and/or cycle per day to and from work, school or shopping	< 5 minutes	1	
	5-15 minutes	2	
	15-30 minutes	3	
	30-45 minutes	4	
	>45 minutes	5	

FOR OFFICE USE ONLY		
Calculate Sport Index	[Σ(Points for all 4 parameters)]/4	

FOR OFFICE USE ONLY		
Calculate Leisure Index	[(6 – points for TV watching)+ Σ(remaining 3 items)]/4	

FOR OFFICE USE ONLY	
Work Index	
Sport Index	
Leisure Index	
Total Index	

CHANGE IN PHYSICAL ACTIVITY SINCE IMMIGRATION		
a) Has your physical activity increased or decreased since immigration to Australia?	Increased	1
	Decreased	2
b) How much has your physical activity increased or decreased?	1 hour/week	1
	2 hours/week	2
	3 hours/week	3
	4 hours/week	4
	5 hours & more/week	5
c) How would you explain your change in physical activity?	More/less time	1
	Lack/gain of interest	2
	More/fewer facilities available	3 4
d) Do you foresee your amount of physical activity increasing in future?	Yes	1
	No	2

APPENDIX 7

FOOD FREQUENCY QUESTIONNAIRE

Please answer the following questions with regards to your dietary intake over the past 6 months by making a cross ("X") in the appropriate block.

Participant number: ☐☐☐

	AVERAGE USE LAST 6 MONTHS								
	Never	1-3x per month	1x a week	2-4x per wk	5-6x per wk	1x per day	2-3x per day	4-5x per day	6+ per day
1. DAIRY FOODS									
Skim or low fat milk (One 250ml glass)									
Whole milk (One 250ml glass)									
Cream, coffee, whipped etc. (Tbs)									
Sour cream (Tbs)									
Non-dairy coffee whitener (tsp)									
Sherbet or ice milk (1/2 cup)									
Yoghurt (1 cup)									
Cottage or ricotta cheese (1/2 cup)									
Cream cheese (1 Tbs)									
Cheddar cheese (1 slice)									
Hard grating (Parmesan) cheese (1 slice)									
Low fat, low cholesterol cheese (1 slice)									
Fetta cheese (matchbox size)									
Custard (1/2 cup)									
Ice cream (1 scoop)									
Margarine, added to food or bread; exclude use in cooking (1 tsp)									
Butter, added to food or bread; exclude use in cooking (1 tsp)									

	AVERAGE USE LAST 6 MONTHS								
	Never	1-3x per month	1x a week	2-4x per wk	5-6x per wk	1x per day	2-3x per day	4-5x per day	6+ per day
2. FRUIT									
Raisins or grapes (small pack)									
Prunes (1/2 cup)									
Other dried fruit (1/2 cup)									
Bananas (1)									
Cantaloupe, honeydew melon (1/4 melon)									
Watermelon (1 slice)									
Fresh apples or pears (1)									
Apple juice or cider (small glass)									
Oranges (1)									
Orange juice (small glass)									
Grapefruit (1/2)									
Grapefruit juice (small glass)									
Other fruit juices (small glass)									
Strawberries, fresh, frozen or canned (1/2 cup)									
Blueberries, fresh, frozen or canned (1/2 cup)									
Peaches, apricots or plums (1 fresh or ½ cup canned)									
Figs (1)									
Pineapple (1 ring)									
Fruit salad (1/2 cup)									

	AVERAGE USE LAST 6 MONTHS								
	Never	1-3x per month	1x a week	2-4x per wk	5-6x per wk	1x per day	2-3x per day	4-5x per day	6+ per day
3. VEGETABLES									
Tomatoes (1)									
Tomato juice (small glass)									
Tomato sauce (1/2 cup) e.g. spaghetti sauce									
Tofu or soybeans (1/2 cup)									
Broccoli (1/2 cup)									
Cabbage or coleslaw (1/2 cup)									
Cauliflower (1/2 cup)									
Brussels sprouts (1/2 cup)									
Carrots, raw (1/2 carrot or 2-4 sticks)									
Carrots, cooked (1/2 cup)									
Corn (1 ear or ½ cup frozen or canned)									
Peas (1/2 cup fresh, frozen, canned)									
Mixed vegetables (1/2 cup)									
Green beans or lentils, baked or dried (1/2 cup)									
Eggplant or zucchini (1/2 cup)									
Sweet potatoes (1/2 cup)									
Spinach, raw as in salad									
Spinach, cooked (1/2 cup)									
Lettuce (serving)									
Celery (4 sticks)									
Beetroot (1/2 cup)									
Garlic, fresh or powdered (1 clove or shake)									
Pumpkin (1/2 cup)									
Capsicum (1/2 cup)									
Cucumber (1/2 cup)									
Mushrooms (1/2 cup)									
Onion or leeks (1/2)									

	AVERAGE USE LAST 6 MONTHS								
	Never	1-3x per month	1x a week	2-4x per wk	5-6x per wk	1x per day	2-3x per day	4-5x per day	6+ per day
4. EGGS, MEAT, ETC.									
Eggs, boiled or poached (1)									
Eggs, fried or scrambled (1)									
Mixed dishes with egg (1 serving)									
Veal or beef schnitzel									
Beef or veal, roast									
Beef steak									
Rissoles or meatloaf									
Mixed dishes with beef (inc. stews, curry and meat sauce)									
Chicken, roast or fried (inc. schnitzel)									
Chicken, boiled or steamed									
Mixed dishes with chicken (e.g. casseroles, stir fry)									
Lamb, chops or roast									
Mixed dishes with lamb									
Pork, chops or roast									
Rabbit, or other game									
Liver (inc. Liverwurst & pate)									
Other offal meats									
Salami or continental sausages									
Sausages or frankfurters									
Bacon									
Ham (inc. prosciutto)									
Corned beef (silver side)									
Manufactured luncheon mates (inc. mortadella)									
Fish, steamed, grilled or baked									
Fish, fried (inc. take away)									
Fish, smoked									
Canned fish (inc tuna, salmon and sardines)									
Seafood (other than fish)									

	AVERAGE USE LAST 6 MONTHS								
	Never	1-3x per month	1x a week	2-4x per wk	5-6x per wk	1x per day	2-3x per day	4-5x per day	6+ per day
5. BREADS, CEREALS, STARCHES									
Cold breakfast cereal (1 cup)									
Cooked oatmeal (1 cup)									
Other cooked breakfast cereal (1 cup)									
White bread (slice), including pita bread									
Dark bread (slice)									
English muffins, bagels, or rolls (1)									
Muffins or biscuits (1)									
Brown rice (1 cup)									
White rice (1 cup)									
Pasta, e.g. spaghetti, noodles, etc (1 cup)									
Pancakes or waffles (serving)									
French fries (1 cup)									
Potatoes, baked, boiled (1) or mashed (1 cup)									
Potato chips or corn chips (small bag)									
Crumpets (1)									
Pizza (2 slices)									
Couscous (1 cup)									
Crumpets (1)									
Dim Sims/spring rolls (2)									
Crackers or crisp bread (2)									
Pies/savoury pastries (1)									

	AVERAGE USE LAST 6 MONTHS								
	Never	1-3x per month	1x a week	2-4x per wk	5-6x per wk	1x per day	2-3x per day	4-5x per day	6+ per day
6. BEVERAGES (1 glass, bottle or can)									
Diet soft drink (inc. flavoured mineral water)									
Soft drink									
Water (inc. soda and plain mineral)									
Herbal tea									
Coffee									
Coffee substitute									
Tea (1 cup), not herbal teas									
Beer (1 glass, bottle, can)									
Red wine (1 glass)									
White wine (1 glass)									
Spirits, e.g. whiskey, gin, etc. (1 drink or shot)									

	AVERAGE USE LAST 6 MONTHS								
	Never	1-3x per month	1x a week	2-4x per wk	5-6x per wk	1x per day	2-3x per day	4-5x per day	6+ per day
7. SWEETS, BAKED GOODS, MISCELLANEOUS									
Chocolate (bars or pieces) e.g. M & M's									
Lollies (handful)									
Cookies, home baked (1)									
Cookies, ready make (1)									
Brownies (1)									
Doughnuts (1)									
Cake, home baked (slice)									
Cake, ready made (slice)									
Pie, homemade (slice)									
Pie, ready made (slice)									
Jams, syrup or honey (1 Tbs)									
Peanut butter (Tbs)									
Popcorn (1 cup)									
Nuts (small packet)									
Bran, added to food (1 Tbs)									
Cream soup (1 cup)									
Oil and vinegar dressing, e.g. Italian (1 Tbs)									
Mayonnaise or other creamy salad dressing (1 Tbs)									
Mustard, dry or prepared (1tsp)									
Pepper (1 shake)									
Salt (1 shake)									
Dips (1Tbs)									
Vegemite, Marmite or Promite (tsp)									
Olives (handful)									
Avocado (Tsp)									

8. How much of the visible fat on your meats do you remove before eating?

Remove all visible fat ○
Remove majority ○
Remove small part of fat ○
Remove none ○
Don't eat meat ○

9. What kind of fat do you usually use for frying and sautéing? (Exclude "Pam"-type spray)

Real butter ○
Regular Margarine ○
Light margarine ○
Vegetable oil ○
Canola ○
Olive oil ○

10. What kind of fat do you usually use for baking?

Real butter ○
Regular Margarine ○
Light margarine ○
Vegetable oil ○
Canola ○
Olive oil ○

11. What form of margarine do you usually use?

None ○
Light tub ○
Very light tub ○
Regular tub ○
Block/hard ○

12. How often do you eat food that is fried at home? (Exclude the use of "Pam"-type spray)

Daily ○
1-3 times per week ○
4-6 times per week ○
Less than once a week ○

13. How often do you eat fried food away from home? (e.g. French fries, fried chicken, fried fish)

Daily ○
1-3 times per week ○
4-6 times per week ○
Less than once a week ○

14. How many teaspoons of sugar do you add to your beverages or food every day? _____tsp.

15. What type of cooking oil do you usually use? _____(type and brand)

16. What kind of cold breakfast cereal do you usually use? _____(type and brand)

17. Are there any other foods that you usually eat at least once per week?

Other foods that you usually use at least once per week	Usual serving size	Servings per week
a)		
b)		
c)		
d)		
e)		
f)		
g)		
h)		
i)		
j)		

18. Do you use any multivitamin and mineral supplements at the moment?

Yes ○
No ○

If yes, name them and indicate how often you use it.

Multiple vitamin and mineral supplements	Dosage	How often do you take it?
a)		
b)		
c)		
d)		

19. Do you feel that your dietary intake has changed since migrating to Australia?

Yes ○
No ○

If your answer is yes, please answer the following questions.

20. Do you feel that your overall intake has increased or decreased since immigration?

Increased ○
Decreased ○

21. Please indicate how intake has changed:

a) Fruit
Increased ○
Decreased ○

b) Vegetables
Increased ○
Decreased ○

c) Bread, cereals, starches
Increased ○
Decreased ○

d) Eggs, meat etc.
Increased ○
Decreased ○

e) Dairy products
Increased ○
Decreased ○

f) Non-alcoholic beverages
Increased ○
Decreased ○

g) Alcoholic beverages
Increased ○
Decreased ○

h) Lollies, baked goods, miscellaneous

Increased ○

Decreased ○

i) Fats (margarine, butter etc.)

Increased ○

Decreased ○

j) Take-out foods (Fast-foods)

Increased ○

Decreased ○

22. Why do you feel that these changes have taken place? (Mark the appropriate answer with a cross ("X").

Less/more time for preparation of food	
Less/more interest in preparing food	
More/less money to buy food	

APPENDIX 8

3 DAY FOOD RECORD

Participant Number ☐☐☐

INSTRUCTIONS

Please fill in the following forms concerning your dietary intake. Please include 2 non-consecutive week days and 1 weekend day. The following table should be used as a guide on how to give the appropriate information. Please give as much detail as possible.

Time of day/meal	Food	Amount	Preparation
Specify time of day Morning/ Afternoon/ Evening/ Breakfast/ Lunch/ Dinner/ Snack	(Specify the type) Dairy (Type – yoghurt, milk, ice-cream etc. Also mention the brand)	Specify the amount as accurately as possible Please use household measures such as cups/glasses/scoops etc.	Describe preparation methods in detail Home-made Commercial Sweetened or not
	Meat, poultry, fish, eggs (Include the cut of meat, chicken etc.)	If known please give the raw amount in grams. If cooked indicate the length, width and thickness of the cut. With or without bone and/or skin if relevant.	Boiled Fried Baked Grilled Barbequed With skin/without skin Fat cut off or not Flour-dipped Batter-dipped Gravy/no gravy
	Vegetables (What types)	Please give amounts in household measurements such as cups/ladels etc.	Grated Raw Steamed Boiled Grilled Peeled With butter/margarine/oil Added sugar Sauces
	Fruit (What types)	Please give amounts in household measures such as cups or the number of fruits. If whole fruits were eaten please	Stewed Raw Peeled

		indicate whether it was small, medium or large.	
	Bread, starch, cereals (What type/brand)	Please give amounts in household measures such as cups/bowls or indicate how many slices etc.	Cooked Home-made Commercial Toasted Butter/margarine – thin or thick Sugar added
	Sweets, baked goods, miscellaneous (Type/brand)	Indicate the amount such as number of slices, a small packet etc.	Home-made Commercial Icing Filling
	Beverages (Type/brand)	Glasses, bottles	Sweetened

DAY 1 (Week day)

Time of day/Meal	Type of food	Amount	Preparation

DAY 2 (Week day)

Time of day/Meal	Type of food	Amount	Preparation

DAY 3 (Weekend day)

Time of day/Meal	Type of food	Amount	Preparation

APPENDIX 9

CHANGES MADE TO QFFQ

Originally	Change
Whole questionnaire	
Ounces	Grams
Dairy	
	No changes
Fruit	
	No changes
Vegetables	
String beans	Removed from questionnaire
Yellow squash	Removed from questionnaire
Summer squash	Removed from questionnaire
Kale, mustard or chard greens	Removed from questionnaire
Romaine or leaf lettuce	Lettuce
Beets	Beetroot
Eggs, meat, etc	
	Replaced with section from Australian FFQ
Breads, cereals, starches	
Other grains, e.g. bulgar, kasha, couscous, etc.	Couscous
Chips or French Fries	French Fries
Crackers, Triskets, Wheat Thins or crispbread	Crackers or Crispbread
Beverages	
Low calorie cola, low calorie caffeine-free cola and other low calorie carbonated beverage	Diet soft drink
Caffeine free Coke, Pepsi, or other cola with sugar; Other carbonated beverage with sugar; Lemonade, or other non-carbonated fruit drinks	Soft drink
	Added herbal tea
	Added coffee substitute
Liquor	Spirits
Sweets, baked goods, miscellaneous	
Candy/lollies without chocolate	Lollies
Candy bars	Removed from questionnaire
	Added dips
	Added Vegemite, Marmite and Promite
	Added olives
	Added avocado