ASSESSING THE VALIDITY OF A SELF-ADMINISTERED FOOD-FREQUENCY QUESTIONNAIRE (FFQ) IN THE ADULT POPULATION OF NEWFOUNDLAND AND LABRADOR, CANADA

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Assessing the Validity of a Self-administered Food-Frequency Questionnaire (FFQ) in the Adult Population of Newfoundland and Labrador, Canada

by

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ABSTRACT

The Food-Frequency Questionnaire (FFQ) is a dietary assessment tool frequently used in large-scale nutritional epidemiological studies. Investigators have recognized that nutritional data collected through self-administered FFQs are subject to substantial error, both systematic and random. For accurate interpretation of FFQ results that arise from epidemiological studies, it is necessary to determine the relationship between self-reported food intakes using the FFQ and true usual dietary intake. The goal of the thesis is to validate a self-administered version of the Hawaii FFQ modified for use in the Canadian province of Newfoundland and Labrador (NL).

Over a one year period, 195 randomly selected adults completed four 24-hour dietary recalls (24-HDRs) by telephone and one subsequent self-administered FFQ. Estimates of energy and selected nutrients derived from the 24-HDRs and FFQs were compared. Data were analyzed using the cross-classification method, Pearson's correlation coefficients, and Bland–Altman plots. The results suggest that this 169-item FFQ developed specifically for the NL population has moderate relative validity and therefore can be used in studies to assess food consumption in the general adult population of NL. This tool can be used to classify individual energy and nutrient intakes into quartiles, which is useful in examining relationships between diet and chronic disease.

With this valid FFQ, four major food consumption patterns in the general adult population of NL were identified. Additionally, this thesis found significant associations

between some population characteristics (e.g. age, smoking habit) and food consumption patterns.

In summary, this thesis has developed a NL based FFQ which is valid and can be self-administrated. This work may contribute greatly to future epidemiological studies and other nutritional studies in this province; as well, using this validated tool could reveal patterns in dietary intake and thus enhance our conceptual understanding of NL dietary practice, and provide guidance for nutrition intervention and education in this province.

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ABBREVIATIONS

FFQ	Food-Frequency Questionnaire
NL	Newfoundland and Labrador
CRC	Colorectal Cancer
24-HDR	24-Hour Dietary Recall
CHD	Coronary Heart Disease
LDL-cholesterol	Low density lipoprotein-cholesterol
HDL-cholesterol	High density lipoprotein-cholesterol
EPIC	European Prospective Investigation into Cancer and Nutrition
USDA	United States Department of Agriculture
ASA24	Automated Self-Administered 24-hour dietary recall
DLW	Doubly Labeled Water
BMR	Basal Metabolic Rate
HRU	Health Research Unit
SD	Standard Deviation
SPSS	Statistical Package for Social Science
PCA	Principal Components Analysis
BTS	Bartlett's Test of Sphericity
KMO	Kaiser-Meyer-Olkin
ICEHR	Interdisciplinary Committee on Ethics in Human Research

CCHS	Canadian Community Health Survey
OR	Odds ratio
95%CI	95% confidence interval

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Chapter 1: INTRODUCTION

Food-Frequency Questionnaires (FFQs) are designed to assess food consumption patterns by collecting information regarding the frequency with which specific food items are consumed over a specified reference period [1, 2]. This tool has been the most commonly used dietary assessment method in large-scale epidemiological studies and other nutritional research. Compared to other dietary assessment methods, the FFQ is easy to administer, inexpensive to process, and provides a rapid estimate of usual food intake [3]. However, this approach is commonly criticized for imprecise and biased estimates [4, 5], which may contribute to the failure of epidemiologic studies to show significant results of investigations into issues of concern, such as the relationship between diet and disease, the composition of a total diet or changes in the diet, and a comparison of dietary intakes between groups. Therefore, to properly interpret the results of epidemiological studies that use FFQs, it is necessary to know the relationship between reported intakes from the FFQ and true usual intakes [6]. Multiple dietary recalls [6-8], food records [9], and biomarkers [10] are generally considered to be more accurate reference measures of intake, and thus can be used in measuring the validity of FFQs.

FFQs are widely used throughout the world for epidemiologic nutrition surveys. However, due to differences in food supply and dietary habits from one population to another, there is no universally accepted FFQ that can be used for all populations. The Newfoundland and Labrador (NL) diet is known to be different from the diets of other

North American populations. Specifically, as reflected in the name, the province is made up of two geographical parts: Newfoundland, which is an island surrounded by the Atlantic Ocean, and Labrador, which is a large land mass connected to mainland Canada. Since Newfoundland is an island, the population is dependent upon imported foods from other provinces and countries. Some residents, however, grow their own vegetables, pick berries, hunt, and fish to supplement their diet. In addition, most residents of Newfoundland are of European descent which greatly influences the culture and food choices in the province. Overall, due to the geography, economics, culture and population demographics [11-13], Newfoundlanders and Labradorians experience a unique food consumption pattern compared with people in other North American regions.

A self-administrated FFQ, used for assessing the relationship between habitual diet and Colorectal Cancer (CRC) in adult residents of Newfoundland and Labrador, was developed from the well-known Hawaii FFQ [14, 15] and modified by NL researchers. Investigation of CRC in this population is warranted as NL has the highest CRC incidence rate in the country, when compared to other Canadian provinces [16]. It has been suggested that elucidation of diet–disease relationships requires dietary assessment methods which can adequately describe and quantify intakes, minimize systematic errors and provide reasonably precise estimates of variability between individuals and/or groups [17]. Thus, an investigation into the possible relationship between dietary factors and CRC is especially warranted in NL. However, the developed FFQ has not yet been appropriately validated for a NL

population, making some of the findings of the CRC study difficult to interpret. Therefore, the major component of this study is to develop a NL based FFQ which is valid to detect diet-disease associations and can be self-administrated.

Food consumption pattern analysis has recently emerged as an alternative and complementary approach to examine the relationship between diet and the risk of chronic diseases [18]. The analysis of food consumption patterns examines the whole diet and takes into account the combined effects of food and nutrients consumed together [19]. Conceptually, the patterns represent a broader picture of food and nutrient consumption, and may thus be more predictive of disease risk than individual foods or nutrients. Furthermore, the validated FFQ from the first paper was used to evaluate the patterns of food consumption in the general adult population of NL in the second paper.

1.1 Objectives of the Thesis

The specific objectives of this thesis are as follows:

1) To address whether this self-administered FFQ is valid for use with the NL general population by comparing its results with those of multiple 24-hour dietary recalls (24-HDRs).

2) To provide a validated NL based self-administrated FFQ for future use that can be understood and completed by an adult resident of the province with less than a high school education.

3) To contribute to the process for other researchers to follow in validating

dietary intake questionnaires.

4) To evaluate the patterns of food consumption in the general adult population of NL using the validated FFQ and to assess whether these patterns vary according to demographic characteristics.

1.2 Rationale

Community-based nutrition surveys are desirable to study health problems and their nutritional correlates. To date, there have been few studies examining the dietary intake of the NL population. A major reason for this has been the lack of appropriate tools to assess dietary intake of local foods, especially the intake of an individual over a period of weeks or months. It is noteworthy that the use of the FFQ remains the most cost-effective way to collect long-term dietary information in population studies. This study would not only immediately assist with the analysis and interpretation of data collected by the previous CRC study, but contribute greatly to future epidemiological studies and other nutritional studies in NL. It would also be of great practical significance to future NL researchers as there is growing evidence to suggest that environmental factors, such as dietary intake and physical inactivity, are of primary importance in the development of chronic illnesses such as cardiovascular disease, diabetes, and certain cancers. Thus, a valid tool to collect dietary intake data from residents of NL has significant public health implications.

Studying dietary patterns could also have important public health implications because knowing the overall patterns of dietary intake and their possible associations

with states of ill health could guide the NL public to incorporate changes in their diet [20]. For example, it could guide the public health education systems to promote positive changes in diet and thus supporting individuals, families or communities in making modifications to their diet. This work should enhance our conceptual understanding of NL dietary practice, and provide guidance for nutrition intervention and education in this province.

1.3 Organization of the Thesis

This thesis is divided into five chapters. It begins with a short introductory chapter. Chapter 2 is a literature review that introduces diet and health, major dietary assessment instruments used in epidemiological studies, their advantages and disadvantages and validity. Chapter 3 introduces the study design, assessment tools as well as statistical methods employed in this thesis. Chapter 4 includes two results sections. Each section is written in a manuscript format for both this thesis and future publication in peer-reviewed journals, including its own *Introduction, Methods, Results, Discussion, and Conclusion* sections. To make them integrated and readable as separate manuscripts, overlapping contents and sentences are unavoidable. Chapter 5 summaries the key findings and discusses the implications of the study results and future research.

Chapter 2: REVIEW OF THE LITERATURE

Given the broad scope of my thesis, my literature review is confined in the areas that are directly related to my study: 1) Diet and Health; 2) Dietary Measurements; and 3) Validity of Dietary Measurements.

2.1 Diet and Health

Food is of major importance as a determinant of health because it provides the nutrients essential for energy, growth and repair, and regulation of body processes. As promoted by Canada's Food Guide [21], a healthy diet is important to keep the immune system in working order, to maintain a healthy weight and to avoid general ill health.

2.1.1 Diet and Disease

There is a vast literature that describes the effects of various dietary factors on health. Dietary factors affect the cause and prevention of many important diseases, including cancer [22, 23], coronary heart disease (CHD) [24], osteoporosis [25], and cataracts [26]. In some cases, there is incontrovertible evidence of a cause-and-effect relationship between a dietary factor and health, while in many other cases, the link is inconclusive.

2.1.1.1 Energy

The World Health Organization (WHO) has commented that 'energy is the fuel

for the body'; dietary energy is not a nutrient but is required in the body for metabolic processes, physiological functions, muscular activity, heat production, growth and synthesis of new tissues. The main sources of energy are macronutrients which include carbohydrate, protein, and/or fat. A person's energy need (expressed in units of calories and kilocalories) varies due to factors such as genetics, body size, body composition, and daily physical activity. According to Canada's Food Guide, the estimated energy requirement for adults (31-70 y) varies from 2,150 to 2,900 calories per day in men and 1,650 to 2,250 calories per day in women [27].

Total dietary energy has been unequivocally and causally associated with the risk of many prominent age-related diseases [28, 29]. It is widely believed that high-calorie diets result in obesity, and that obesity impairs many systems and makes the body more prone to disease. In a 20-year animal experiment [30], researchers have found that severely restricting calories led to significantly fewer deaths from natural causes as well as fewer cases of diabetes, cancer, cardiovascular disease, and brain shrinkage. It is likely that reducing caloric intake would have the same positive effects in human beings. However, a new released report [31] has concluded that a low-calorie diet may actually impair the immune system's ability to respond to infection, and thus increase the mortality of bowel disease patients. As a result, it is important to intake an adequate and appropriate amount of calories from diet.

2.1.1.2 Protein

Proteins are substantial components of cells, tissues and organs throughout the body. Without protein, our bodies would be unable to heal from injury, stop bleeding

or fight infection. Similar to the total energy, the individual requirement of protein changes depending on personal height, weight, age, and activity level. Health Canada has been recommended daily protein allowance (RDA) for healthy Canadians, which is calculated as 0.80g per kilograms per day for an adult [32].

Although protein is essential for our life, there is a limit as too much or too little dietary protein intake can be problematic. Several studies have shown that excessive protein intake is linked to many health problems, from relatively benign and reversible conditions such as dehydration, constipation and nutritional deficiencies to obesity, heart and kidney diseases, insulin resistance and diabetes, prostate cancer, decreased thyroid function, metabolic acidosis and reduced immune function [33-36]. As a result, a low or moderate protein diet is recommended and used by persons with abnormal kidney or liver function to prevent the worsening of their disease [37]. But on the other hand, too low a level of protein intake may lead to a protein deficiency and subsequently cause malnutrition, starvation or malabsorption. Under these conditions, the body is unable to extract adequate amounts of protein and other nutrients from the diet. In particular, protein-energy malnutrition is a serious disorder and ranks among the top causes of death of children in developing countries [38]. *Kwashiorkor* and *Marasmus* are two common forms of malnutrition resulting from low protein intakes.

2.1.1.3 Carbohydrates

Dietary carbohydrate is necessary to maintain glycemic homeostasis and for gastrointestinal integrity and function. An optimum diet, suggested by Health

Canada's Food Guide [32], should consist of at least 55% of total energy coming from carbohydrate obtained from a variety of food sources. Nevertheless, carbohydrates alone cannot adequately supply all of our energy needs, lesser amounts of our energy needs should be met by proteins and fats [39].

Some epidemiological and clinical studies suggest possible associations between carbohydrate intake and health consequence, such as obesity, non-insulin dependent Diabetes mellitus [40, 41], however no causal associations have been established. In a Joint FAO/WHO Report (1998, Chapter 3) [42], carbohydrates is described to influence human diseases directly by 'affecting physiological and metabolic processes, thereby reducing risk factors for the disease or the disease process itself'; and indirectly by 'displacing other nutrients or facilitating increased intakes of a wide range of other substances frequently found in carbohydrate-containing foods'. It has been suggested that as fat is stored more efficiently than excess carbohydrate, and thus an elevated consumption of high carbohydrate foods is likely to reduce the risk of obesity in the long term [43]. As well, some studies found that increasing carbohydrate intake can assist in the reduction of saturated fat and further reduce the risk of cardiovascular disease [44, 45]. Many carbohydrate staple foods, such as cereals, grains and especially fruits and vegetables, are considered to be possible contributors that protective against some cancers, including breast, prostate and colorectal cancer [46, 47].

2.1.1.4 Dietary Fibre

According to the American Association Of Cereal Chemists' definition [48],

'dietary fibre is the remnants of the edible part of plants and analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the human large intestine. It includes polysaccharides, oligosaccharides, lignin and associated plant substances' (AACC Report *2001: p113*). Adequate dietary fibre is essential for proper functioning of the gut and has also been related to risk reduction for a number of chronic diseases including heart disease, certain cancers and diabetes. As well, in a recent cohort study, Park et.al (2011) suggest that dietary fibre intake is associated with a lower risk of death from these diseases [49]. The protective effects of dietary fibre have been explored and the following have been suggested as its possible mechanisms: (1) improve laxation by increasing bulk and reducing transit time of feces through the bowel; (2) increase excretion of bile acid, estrogen, and fecal procarcinogens and carcinogens by binding to them; (3) lower serum cholesterol levels; (4) slow glucose absorption and improve insulin sensitivity; (5) lower blood pressure; (6) promote weight loss; (7) inhibit lipid peroxidation; and (8) have anti-inflammatory properties [50, 51].

2.1.1.5 Fat

For years, it has been suggested that a low-fat diet is the key to losing weight, managing cholesterol, and preventing health problems. More recently, the types of fat eaten, rather than the amount, have also been shown to be associated with ill health. One common categorization of fats is into monounsaturated, polyunsaturated, saturated, and trans fats. According to Canada's Food Guide [32], for good health, it is

essential to include a small amount of unsaturated fat and limit the amount of saturated and trans fat. Normally, 20% to 35% of total daily calories are recommended to intake from fat for an adult.

Monounsaturated fats and polyunsaturated fats belong to the unsaturated fat category. A newly released meta-analysis of clinical trials suggests that replacing saturated and trans fats for unsaturated fats in a diet may help lower circulating cholesterol levels and reduce the risk of heart disease [52]. Additionally, unsaturated fat provides omega-3 and -6 fatty acids. Omega-3 fatty acids have been shown to have various benefits to physical health, and also play a vital role in cognitive function as well as emotional health [53]. Even though unsaturated fat is good for health, it does provide energy and such inappropriately high levels of intake may be associated with weight gain and lead to health consequences.

Saturated fats are mainly found in animal products such as red meat and whole milk dairy products. Dietary Guidelines for Americans 2010 has recommended Americans to consume less than 10% of calories from saturated fats daily. It has been shown to be associated with elevated levels of low density lipoprotein-cholesterol (LDL-cholesterol) level and chronic disease, specifically CHD [54]. Trans fats, also named trans fatty acids, do exist in nature, such as those found in dairy products, but are also produced during the processing of polyunsaturated fatty acids in food production [55]. It has been suggested that the consumption of trans fat increases circulating levels of LDL-cholesterol and decreases the level of high density lipoprotein-cholesterol (HDL-cholesterol), therefore contributing to the risk of

developing CHD [56, 57]. Also, one experimental study in rats suggested a strong relationship between high levels of dietary trans fat intake and non-alcoholic fatty liver disease [58]. Overall, according to the Dietary Reference Intakes *(*Lupton et.al *2005: p479)*, 'trans fats are not essential and provide no known benefit to human health' [59].

2.1.1.6 Cholesterol

Cholesterol is a waxy substance that occurs naturally both in the body and in certain food. It is a type of lipid and it is critical for the body to make cell membranes, vitamin D and hormones [60]. There are two types of cholesterol: LDL-cholesterol and HDL-cholesterol. The theory of LDL-cholesterol metabolism states that too much LDL-cholesterol promotes the build-up of plaque in artery walls, leads to plaque growth and atherosclerosis, and thus greatly increases the risk of developing CHD or heart attack [61]. On the other hand, HDL-cholesterol may act in a variety of helpful ways that tend to reduce the risk of heart disease, including scavenging and removal of LDL-cholesterol, as well acting as a maintenance crew for the inner walls of blood vessels [62, 63].

In epidemiological studies, experts use LDL-cholesterol [64], HDL-cholesterol [65, 66], LDL/HDL ratio [67], or total cholesterol/HDL-cholesterol [68] as marker/predictors of CHD. For example, a 28-year follow-up study concluded that HDL is a strong predictor of the long term risk of CHD in healthy middle-aged men [66]. It has also been suggested that LDL-cholesterol is linked to Parkinson's disease in seniors [69], and an increased risk of mortality from CHD for men but not for

women [70]. According to Statistics Canada's Canadian Health Measures Survey released in 2010 [71], approximately 41% of Canadian adults have high total cholesterol levels and the level increases with age. Although the levels of different types of cholesterols have not been tested, the fact is worthy of note.

2.1.1.7 Micronutrients

According to the World Health Organization, micronutrients are the 'magic wands that enable the body to produce enzymes and hormones' and are 'essential for proper growth and development' [72]. As tiny as the amounts needed, the consequences of their absence are severe. Micronutrients include minerals such as calcium and sodium, and vitamins such as vitamin A, C, and D. Given the broad scope, this review focuses only on the four micronutrients used in this thesis: vitamin A and its precursor beta-carotene, vitamin D, and calcium.

Vitamin A is a group of fat-soluble retinoids, which is involved in immune function, vision, reproduction, and cellular communication [73]. It is critical for vision as an essential component of rhodopsin and it supports the normal formation and maintenance of the heart, lungs, kidneys, and other organs [74]. The human diet provides both preformed vitamin A and a number of provitamin A carotenoids, where Beta-carotene is the most important provitamin A carotenoid recognized by scientists [74]. Although many studies have examined the association between vitamin A and various types of cancer, the results are inconsistent. For instance, several cohort studies indicated that higher intakes of dietary carotenoids are associated with a lower risk of lung cancer [75, 76]. However, clinical trials have not shown that supplemental

beta-carotene and/or vitamin A helps prevent lung cancer [77]. It has also been suggested that vitamin A may help to prevent age-related macular degeneration theoretically; however, there is no significant epidemiological evidence supporting this issue. An on-going Age-Related Eye Disease Study [78], a large randomized clinical trial with 4,000 subjects, may provide a clearer picture of this relationship in the future.

Vitamin D is a group of fat-soluble pro-hormones, which encourages the absorption and metabolism of calcium and phosphorous [79]. Other functions of vitamin D have been investigated, suggesting its possible roles in the modulation of cell growth, neuromuscular and immune function, and reduction of inflammation [79, 80]. On this basis, emerging epidemiologic data suggest that vitamin D status could affect cancer risk. Results from the Cancer Prevention Study II Nutrition Cohort indicated that vitamin D modestly reduces risk of colon cancer [81], but the data are not as strong for a protective effect against other cancers [82, 83]. There is also a growing body of research suggesting that vitamin D may play some role in the prevention and treatment of other medical conditions such as type 2 diabetes, osteoporosis, as well as lower all-cause mortality [84]. On above basis, in addition to following *Canada's Food Guide*, which recommends that all Canadians consume 600IU vitamin D every day, everyone over the age of 50 should take a daily supplement of 400 IU of vitamin D to prevent osteoporosis. However, the deficiencies can be found in all ethnicities and age groups in worldwide [85, 86], it may due to that very few foods are naturally rich in vitamin D, and the biggest dietary sources of

vitamin D are fortified foods and vitamin supplements. One issue must be kept in mind is that studies of the effects of vitamin D always include calcium, so it is difficult to isolate the effects of each nutrient.

The body stores 99% of calcium in bones and teeth while the remaining 1% is found in the blood which helps control muscle movements, blood clotting and nerve impulses [79]. Laboratory and animal evidence as well as epidemiologic data consistently suggest that supplementation with calcium plus vitamin D is effective in reducing osteoporosis and maintaining bone health [87]. In other diseases, the effect of calcium is controversial. Some studies, but not all, suggest a positive association between supplemental calcium intake and the risk of kidney stones, and these findings were used as the basis for setting the calcium UL in adults [79]. Further, a 2010 meta-analysis [88] pooled the results from 11 studies involving close to 12,000 women and found that women taking calcium supplements (about 1,000 mg/day in most of the studies) had a 27% increased risk of myocardial infarction. Study results are also inconsistent in its protective effects from various cancers [82, 83], hypertension, and weight management [89].

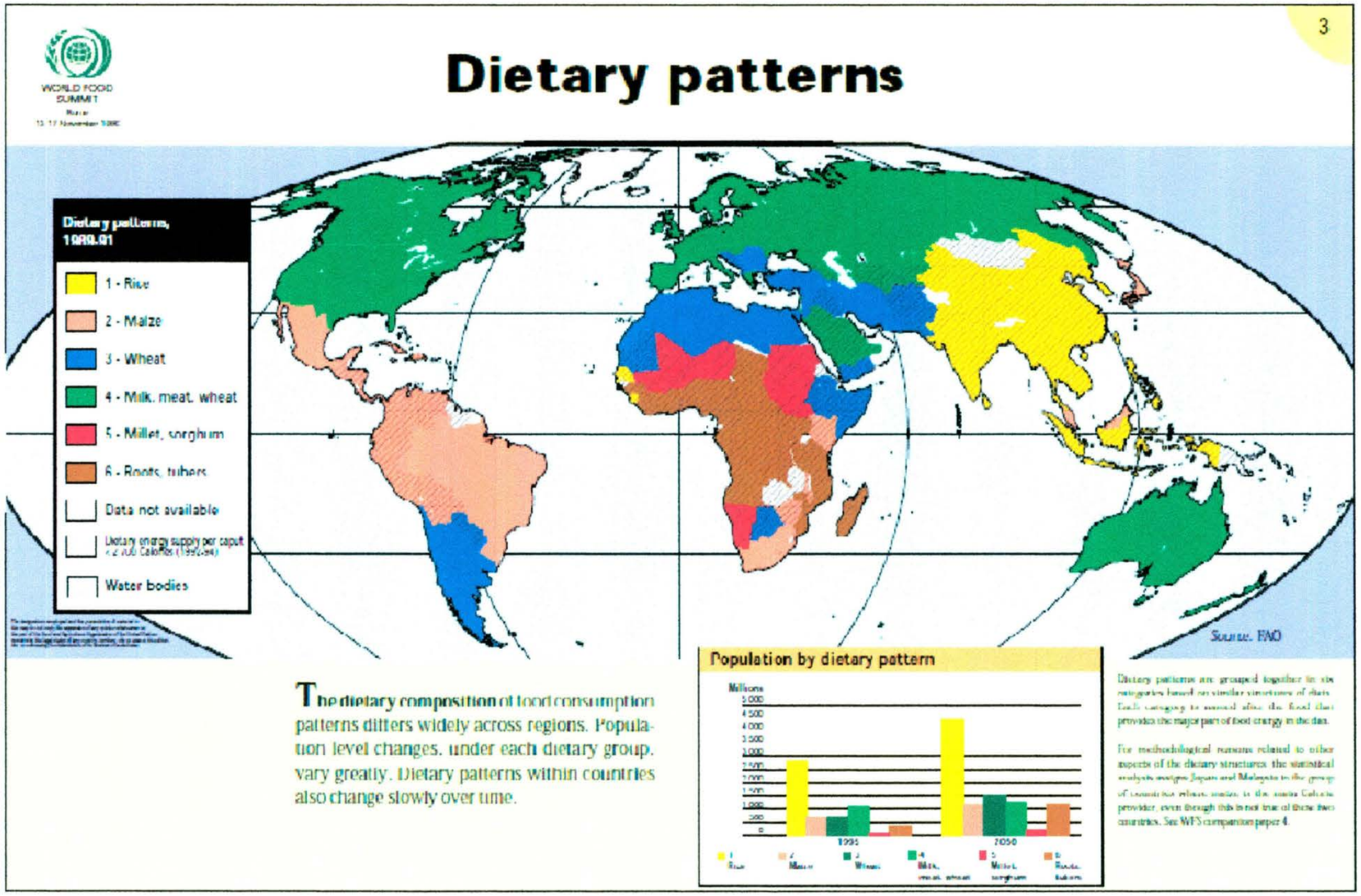
2.1.2 Food Consumption Patterns

Food consumption data provide estimations of the quantity of each prepared food consumed by individuals and their habitual food choices. Only when people make dramatic changes in their circumstances do they make big changes in their diet; this might happen by getting married, emigrating to another country, or being told by the doctor that their diet is having a significant and negative impact on their health. The

food consumption pattern, also known as the dietary pattern, has been used to describe the habitual diet of individuals or populations.

Factors that influence food choices among individuals and populations include income, prices, individual preferences and beliefs, cultural traditions, as well as geographical, environmental, social and economic factors [90, 91]. The complexity of these choices and their interactions make the food consumption patterns evolve over time and differ widely across regions (**Figure 2.1**). Recognizing broad differences in food consumption patterns and exploring their relationships with economic, social, demographic, and health factors could improve our understanding of the causes and consequences of different food consumption patterns, which in turn will help us identify the more healthful food consumption patterns and support their systematic promotion.

Figure 2.1 Food Consumption Patterns across the World



Source: www.fao.org/wfs/final/WFSmaps/Map03-e.pdf

2.1.2.1 Food Consumption Pattern and Disease

Traditional analyses in nutritional epidemiology typically examine the role of single nutrients or foods in relation to disease risk. Although this approach has been quite valuable, it has several conceptual and methodological limitations [18]. For example, surveys of over 200,000 people in different communities around the world have provided compelling evidence that diets high in vitamin E and/or use of vitamin E supplements reduce the risk and the mortality of cardiovascular disease [92, 93]. Disappointingly, the results from several large clinical trials failed to show any protective effect [94]. The reasons may include the complex synergistic interactions among nutrients and the confounding effect of food consumption patterns. As a result, there has been a growing interest in total food consumption pattern analyses rather than single nutrient studies. For analytic reasons, food consumption patterns are desirable to account for the collinearity of dietary variables, to avoid finding chance associations due to analyses with multiple individual nutrients as exposures, and to increase the possibility of detecting significant associations when single nutrient effects are relatively small [95].

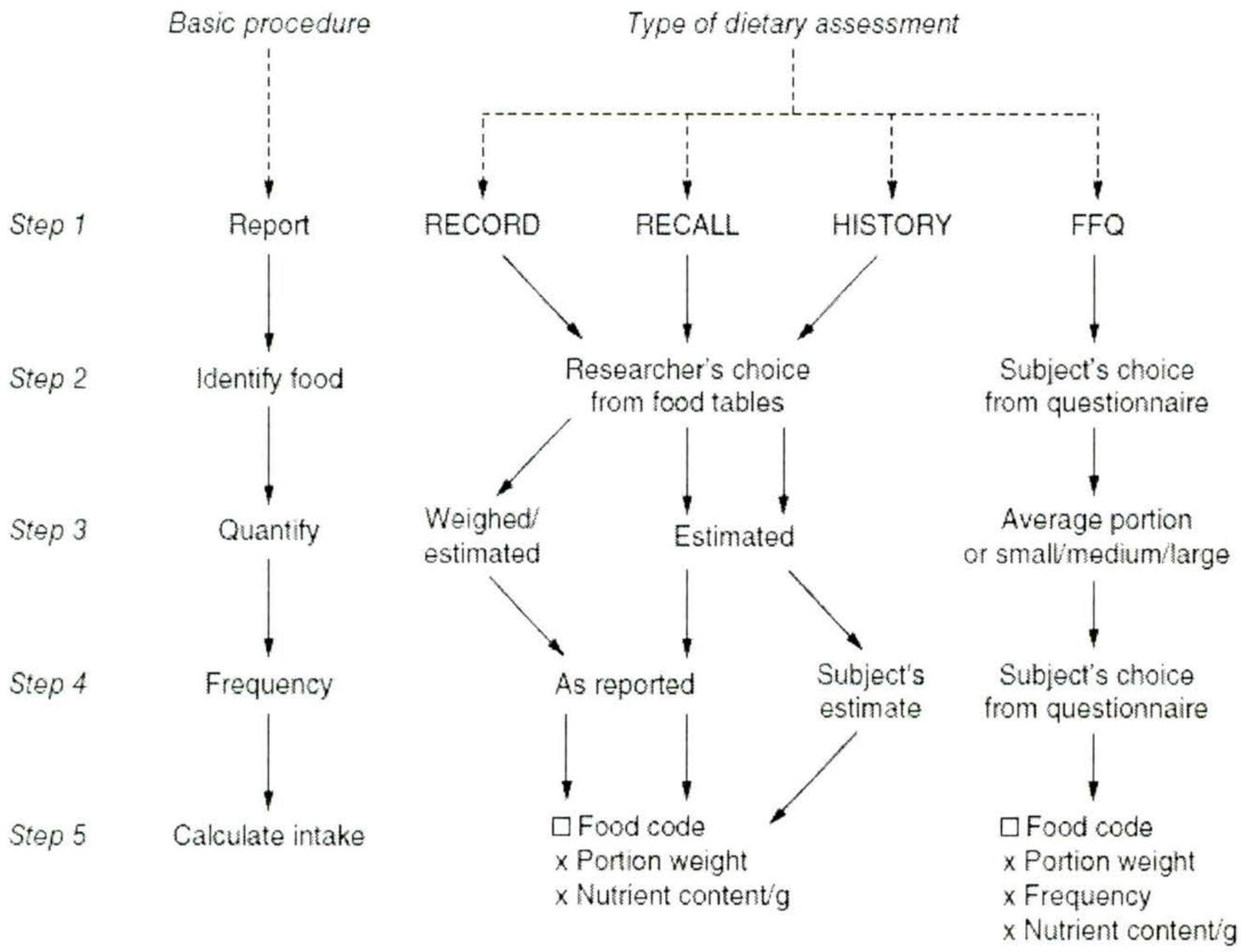
Several studies have suggested that food consumption patterns derived from factor or cluster analysis predict disease risk or mortality. In a representative US cohort, with patterns derived from cluster analysis, a marginally lower risk of all-cause mortality was noted in men reporting diets with higher amounts of fruits and vegetables, whole grains, and lower-fat meats and dairy, but not in women [96]. Food consumption patterns derived from the use of factor or principal components analyses also consistently report lower all-cause risk and mortality in the highest intake category of the prudent, healthy, or traditional diet factors [97-99]. In a newly

released UK study, researchers found that a reduced red and processed meat dietary pattern is associated with lower risks of diabetes and colorectal cancer [100].

2.2 Dietary Measurements

Studying the association between diet and disease requires reliable and valid methodology. Dietary assessment encompasses food consumption at a national level (e.g., food supply and production), a household level (e.g., food accounts and inventories), and a individual level [101]. The appropriate tool for dietary assessment will depend on the purpose for which it is needed. The purpose may be to measure nutrients, foods or eating habits. According to Gibney et.al (2009), the process of dietary assessment is shown in **Figure 2.2** [102].

Figure 2.2 The Five Basic Steps in a Dietary Assessment and the Variations according to Different Methods (Gibney et.al *2009: p235*)



In order to meet our purpose, it is necessary to measure both nutrient and food intake individually to explore eating habits and validate the original FFQ. Thus, this review focuses only on the individual-level food intake assessment. The main methods for assessing present or past diet by individuals include food frequency questionnaires, 24-hour dietary recalls, food records, and diet history [103, 104].

2.2.1 Food-Frequency Questionnaire

The food frequency questionnaire (FFQ) consists of a list of foods and a selection of options relating to the frequency of consumption of each of the foods listed (e.g. times per day, per week, per month) [105]. Respondents indicate the most appropriate frequency option for each of the foods on the list by marking the appropriate column in the questionnaire. The length of the food list can vary depending on the nutrients or foods of interest. If a range of different nutrients and energy values are required, the list of foods may contain up to 200 foods whereas a questionnaire designed to capture the calcium intake may contain only a few items. To estimate relative or absolute nutrient intakes, many FFQs also incorporate portion size questions, or specify portion sizes as part of each question [101]. FFQs are normally self-administered, though interviewer administered and telephone interviews are possible modifications [106]. This is because they were developed primarily as a practical and cost-effective way of collecting long-term dietary intake data from large numbers of respondents.

Many FFQs are available, and many continue to be adapted and developed for different populations and different purposes. There were two famous FFQs designed in the 1980s and remain partially hegemonic in their use: one was developed by Willett et.al (1985) [107] (also known as the Harvard food frequency questionnaire)

and the other was developed by Block et.al (1986) [108] (also known as the Health Habits and History Questionnaire). As the use of FFQs has expanded, many other instruments have been developed for specific populations. Investigators at the University of Hawaii have developed a questionnaire for assessing the diverse diets of Hawaiian, Japanese, Chinese, Filipino, and non-Hispanic white ethnic groups [14, 15]. In Europe, a number of FFQs have been developed within Western European countries for the European Prospective Investigation into Cancer and Nutrition (EPIC) research [10, 109, 110]. Researchers also have developed FFQs for Asian and Hispanic adults [111, 112].

Strengths of the FFQ approach include simpler and quicker administration and processing, and subsequently lower costs as well as the burden for the respondents compared to alternative methods. It can be used to circumvent recent changes in diet (e.g., changes resulting from disease) by asking individuals to recall their diet in a prior time period [101]. As a result, FFQs have become a common way to estimate usual dietary intake in large epidemiological studies. The FFQ method also has limitations. First, it contains a substantial amount of measurement error [4, 5]. For example, the estimation tasks required for an FFQ are complex and difficult; people may have errors in frequency and portion size estimations. Second, due to the social desirability, many people tend to over-report consuming 'healthy' foods (e.g. fruit and vegetables) but under-report the consumption of 'unhealthy' foods (e.g. red and processed meat). Research also suggests that longer food frequency lists may overestimate, whereas shorter lists may underestimate intake of fruits and vegetables [113]. Finally, FFQs may require a minimum level of literacy and can be a difficult cognitive task for some respondents.

2.2.2 24-Hour Dietary Recall

For the 24-hour dietary recall (24-HDR), individuals are asked to recall all the foods consumed in the preceding 24 hours or in the preceding day. The period of recall can be longer than 24 hours but is usually restricted to this length of time because of the difficulties that individuals have in being able to recall, in sufficient detail, what and how much food was eaten over longer periods of time [114]. The recall can be self-administered [115, 116] but typically is conducted by interview, in person or by telephone, either computer assisted or using a paper-and-pencil form [101]. The interviewer often prompts the individual for information on brand names, portion sizes, recipe ingredients, cooking methods, condiments, and beverages. Traditionally, food intake has been reviewed chronologically but more recently a 'multiple pass' technique has been applied which is considered to be an extended and more accurate version of this method [117].

The 24-HDR method has been widely used in large-scale epidemiological studies. For instance, the EPIC used this approach to collect dietary information of approximately 37,000 participants from 10 countries [118]. The current state-of-the-art 24-HDR instrument is the United States Department of Agriculture's (USDA) Automated Multiple Pass Method [119], and it is used in the U.S. National Health and Nutrition Examination Survey, the only nationally representative dietary survey in the United States. Furthermore, along with the technological advances in automated data collection systems, there are increasing surveys conducted via the Internet. The most known one is likely the Automated Self-Administered 24-hour dietary recall (ASA24) developed by the National Cancer Institute of the United States [115, 120]. The goal of the ASA24 is to create a web-based software that respondents can use to complete a dietary recall with the aid of multimedia visual

cues, prompts, and animated characters, versus standard methods that require a trained interviewer. The development of ASA24 began in 2006. Its first version was released in September 2011 and it has been used by more than 169 researchers to collect more than 8,500 recalls [120].

There are many advantages to the 24-HDR. There is relatively little burden on the respondents, as well, because it is interviewer-administered based, a high literacy level of the respondent is not required. Furthermore, compared to other methods, it generally has a higher response rate [114], and can provide more accurate information due to the immediacy of the recall period. The principal disadvantage is that the method cannot provide information on day-to-day variation of food or nutrient intake [121]; repeated 24-HDRs are needed to get population distributions of habitual intake. As well, people are often reluctant to divulge poor dietary habits, especially if the interviewer exhibits any reaction to what the person is saying. Those who consume high quantities of foods often underreport their intake; individuals with low intakes often exaggerate their reports. And thus, it requires interviewers to be highly trained to capture detailed information and to conduct the interview in a non-judgmental manner. Similar to the FFQ, the 24-HDR is prone to reporting errors, including biased or inaccurate recalls of food intake and portion sizes.

2.2.3 Food Records or Diaries

This method asks subjects to record at the time of consumption all foods and beverages consumed for a specified duration, typically one to seven days, in order to quantify intake. Three or seven day food records are the most common. There are several types of food records: menu record, weighed food record, and estimated food record.

2.2.3.1 Menu Record

This type of record only records the types and the frequency of food consumed but does not indicate any portion sizes. It is mainly useful for determining food intake patterns over time and for assessing compliance with dietary advice [114]. Due to the insufficient information about the quantities, it is impossible to use them to derive an estimate of nutrient intake.

2.2.3.2 Weighed Food Record

In a weighed record, all foods and beverages consumed are weighed by the subject or an investigator at the time of consumption. Weighing can be carried out in two different ways: 1) *precise weighing method*: The ingredient used in the preparation of each meal or snack, as well as the individual portions of prepared food, must be weighed. Any food waste occurring during preparation and serving or food not consumed is also weighed; and 2) *weighed inventory method*: record all food and beverage items in the form in which they are consumed, immediately before they are eaten [102].

The first approach is usually carried out by the investigator rather than the respondents themselves, and thus it is very labour intensive, time consuming, and expensive to conduct. It is most appropriate when the food composition tables available contain few data on cooked and mixed dishes. Some researchers have applied this method in small-scale studies [122-124] but it is limited use in population surveys. The second procedure, which is more widely used, has often been taken as an imperfect gold standard against with other less detailed or demanding methods. It was used in the National Diet and Nutrition Surveys of the EPIC project [125], and has been used as the 'reference method' to investigate the validity of other dietary assessment instruments [126].

The strengths of the weighed record are that it provides the most accurate description of the types and amounts of the foods actually consumed and it does not rely on memory. However, it is time-consuming, costly, and requires a high level of motivation and commitment from both the investigator and respondents. The requirements for cooperation can lead to poor response rates, as well as limit the generalizability of the findings to the broader population from which the study sample was drawn [101]. Another disadvantage is that subjects may alter their diet during the survey period, or that some items of food and drink consumed may be omitted from the record.

2.2.3.3 Estimated Food Record

Estimated food record is similar to the weighed food record method except that the quantification of the foods and drink is estimated rather than weighed. Generally, they are described with the aid of pictures or models of foods, rulers, standard household measuring cups and spoons. The investigator converts these estimates into weights that can then be used to calculate food and nutrient intake. Welch et.al *(2001)* used a seven-day estimated food diary with portion sizes being recorded using household measures and colour photographs in the EPIC project [127].

The strengths and limitations of estimated records are similar to those of the weighed record, but this method has a lower respondent burden and thus a higher degree of cooperation [102]. Loss of accuracy may occur during the conversion of household measures to weights, especially if the investigator is not familiar with the utensils used in the household, however, the magnitude of this effect is not well documented [128].

2.2.4 Diet History

The diet history method of assessment is used to evaluate usual intake in an

individual over a long time period. The term "diet history" is used in many ways [101]. As first proposed by Burke in the 1940s [129], the method had several components: 1) An interview to obtain usual diet. Collected information includes detailed descriptions of foods, their frequency of consumption, and usual portion sizes in common household measures; 2) A cross-check of this information by food group, which consists of a FFQ of specific food items. It was used to verify and clarify the information on the kinds and amounts of foods given as the usual intake in the first component; and ultimately 3) a three-day food record using household measures.

Although the original Burke diet history has not often been exactly reproduced, many variations of the Burke method have been developed and used in a variety of settings [130-132]. Some diet history instruments have been automated and adapted for self-administration [130], and thus eliminating the need for an interviewer to ask the questions. Other versions have been automated but still continue to be administered by an interviewer [132]. Many now imprecisely use the term '*dietary history*' to refer to the food frequency method of dietary assessment, while some diet history instruments have been developed to obtain information about usual food intake patterns beyond simple food frequency data [131].

One advantage of this method is that relatively long time periods can be studied and thereby habitual intake for individuals can be estimated. Another advantage is that a low drop-out rate may be obtained if there is a good communication between the interviewer and the respondents. The weaknesses of the approach are the time and skills required by both the interviewer and the respondents, making it unsuitable for large scale surveys. A diet history interview generally takes at least an hour and requires an interviewer with the skills to help respondents recall their intake freely and fully in a non-judgmental atmosphere [114]. The interviewer's skill will directly

impact the quality of the interview. Also, the results obtained are more qualitative than quantitative; the information on the day-to-day variation in food intake is impossible to ascertain.

2.3 Validity of Dietary Measurements

The validity of a dietary measurement may be defined as the degree to which the dietary method measures what it purports to measure [133]. It is almost impossible to observe the true intake: for short-term dietary assessments, such as 24 hours or a few days, direct observation is only feasible in institutional settings or in situations specially set up to allow unobtrusive observation of what people eat; for methods that are designed to obtain information on habitual longer-term intake, such as the diet history or FFQ, nonintrusive observation is impossible [102]. The errors that affect the validity of a dietary method are systematic. Systematic (i.e. non-random) measurement errors represent the tendency of a measurement to produce an average over- or underestimation of what the method is intended to measure.

2.3.1 Measurement of a Relative Validity

2.3.1.1 Dietary Measures

Each dietary assessment method has its advantages and limitations, and none of them measure food intake without errors. Currently, the general model of validation for dietary assessment methods is to compare one method (test method) with another, which is considered more accurate (reference method). The reference method chosen must also be designed to measure similar parameters over the same time frame as the test method. However, good agreement between two dietary methods does not necessarily indicate validity, and may merely indicate similar errors. On the other hand, poor agreement between the two methods suggests that at least one of the

dietary methods is invalid [134].

Several studies indicate that reported energy and protein intakes on dietary records for selected small samples of adults are underestimated in the range of 4% to 37% when compared to energy expenditure as measured by doubly labeled water (DLW) or protein intake as measured by urinary nitrogen [135-137]. Among them, a seven day weighed dietary record is the one with the highest agreement and is always considered to be the best available as the reference method to the other dietary assessment instruments.

The validity of the 24-HDR has been studied by comparing respondents' reports of intake either with intakes unobtrusively recorded/weighed by trained observers or with biological markers. In an early study, Gersovitz et.al (1978) found that mean nutrient estimates from 24-HDRs were similar to those from the seven-day food record, although 24-HDR is prone to over-reporting low intakes and under-reporting high intakes [138]. Studies with biomarkers also have found underreporting, on average, 16% for energy intake and 12% for protein [135].

In terms of FFQ, multiple food recalls or records over a period are often used as the reference method. This approach is the most practical one and has been used in many studies [101, 109-111, 139]. The correlations between the methods for most foods and nutrients are in the range of 0.4 to 0.7. There are also a lot of FFQ validation studies using biomarkers, which are more accurate but much more expensive. There were large under-estimates of self-reported energy intake and some under-estimates of protein intake found in these studies [10, 140-142].

As there is a lack of independent knowledge of an individual's usual long-term intake, the validity of diet history is usually difficult to assess [101]. Nutrient estimates from diet histories have often been found to be higher than nutrient

estimates from tools that measure intakes over short periods, such as recalls or records [143, 144]. However, results for these types of comparisons depend on both the approach used and study characteristics. We have found only one study, with 12 subjects, in which the diet history method was used to determine energy intake while energy expenditure was simultaneously measured using the DLW method [145]. In this study, reported energy intake measured by diet history was 13% lower than measured energy expenditure.

2.3.1.2 Biological Measures

In recent years, biological or biochemical markers have been used as more objective measures that reflect but are independent of food intake. The main reasons are that they do not rely on memory and are free of biases [102]. However, markers are not perfect. There are limitations and some markers are only valid in certain conditions. For example, markers do not exist for all nutrients and food components. And sometimes there is a risk of measuring the nutritional status instead of the dietary intake. Also, it can be very expensive to conduct a test for biomarkers.

The three most widely used measures to assess the validity of dietary intake data are urinary nitrogen to validate protein intake [146, 147], energy expenditure as measured by the DLW method to compare with energy intake in weight stable individuals [136, 137, 146], and the ratio of energy intake (EI) to basal metabolic rate (BMR) to identify "plausible" records of food intake [148]. The EI/BMR ratio is not strictly a laboratory assessment of 'intake' but provides a way of comparing an estimate of intake with an independent but related measure. Detailed reviews of these methods are given in the reference [114, 149].

2.3.2 Validation Studies

It is important and desirable that any new dietary assessment method be

validated against other more established methods. The purpose of such studies is to better understand how the method works in the particular research setting and to use that information to better interpret results from the overall study [101]. The American National Cancer Institute maintains a register of validation/calibration studies and publications on the Web [150].

Validation studies are challenging because of the difficulty and expense in collecting independent dietary information. Domel et.al (1994) once used observational techniques to realize true dietary intake in school-aged children [151], however, none of this type of investigation has been conducted in adults. Others have used biological measures [10, 135, 141, 142, 146], yet the high cost makes it impractical for large-scale population studies. There is much evidence to suggest that the most practical approach is to compare the data collected from two different dietary assessment instruments [110, 111, 116, 139, 143].

Chapter 3: RESEARCH METHODS

3.1 Sample Recruitment

Recruitment of participants and data collection were conducted by the Health Research Unit (HRU) of Memorial University. The HRU has a reputation for quality health research with many years of experience conducting telephone, mail-out, and face-to-face surveys.

3.1.1 Sample Size Calculation

The sample size calculation for this study was based on the means and standard deviations of various nutrient values derived from the FFQ data of the on-going CRC project [152-154] and the generally acceptable correlation coefficient value of 0.6. The minimum sample size that was calculated for this study was 98 participants. This validation study would last one year and each subject would be contacted a minimum of three times. A 30% attrition rate per step was expected. Therefore, an initial random sample of 450 participants from the general population was recruited by telephone.

3.1.2 Inclusion and Exclusion Criteria

With the intention of measuring food and beverage intake for the general NL population, the following inclusion criteria were used. An eligible participant should be:

1) A non-institutionalized adult resident of NL who has lived in NL for at least two years at the time of the study and is not expected to move within the next 12 months;

2) 35-70 years of age (35 and 70 years old included); and

3) Able to speak and read English at a minimum level of grade 8.

For several reasons, we did not exclude people with chronic conditions, such as

diabetes, heart disease, or cancer. Firstly, the NL FFQ is expected to be used for the general population which is comprised of individuals with and without chronic diseases. Secondly, as this study was intended to assess intra-reliability between the FFQ and 24-HDR, inter-variations among individuals are not of primary concern. However, we did not include individuals with cognitive impairment, psychological conditions, or who were pregnant, as information collected from these individuals may not be reliable or may not represent their normal food consumption pattern.

3.2 Data Collection

There were three major components of data collection during this study: (1) a weekday and a weekend 24-HDR conducted during the winter and spring months, (2) a weekday and a weekend 24-HDR conducted during the summer and fall months, and (3) a mailed out FFQ.

The trained HRU telephone interviewers contacted participants using a list of landline telephone numbers purchased from Info Canada [155]. After asking to speak with a member of the household who is between 35 and 70 years of age, the interviewer briefly introduced the objectives of the study and outlined the three components (2 x Winter-Spring 24-HDR, 2 x Summer-Fall 24-HDR and 1 x FFQ) that were required for full participation in the study. Participants were provided with contact information for the study investigators and were given the opportunity to ask questions about the research during the initial telephone interview or at any point during the course of the study.

If a participant indicated his/her willingness to participate in the study, the baseline demographic information was collected. Also, the first 24-HDR was completed at that time. If a participant wanted to complete the 24-HDR at a different

time, an appointment was made to call them back within the next few days. So as to minimize the potential for confounding errors, the exact day of the call back was not specified.

3.2.1 Demographic Information

The demographic information collected included: age, gender, size of the participant's community, marital status, employment status, level of education, and smoking habits.

Respondents were classified into four age groups (35-40, 41-50, 51-60 and 61-70 years). Their residential areas were also classified into 'rural community' (less than 10,000 people in the community) or 'urban community' (more than 10,000 people living in the community).

Education attainment was investigated through the question: "What is the highest level of education that you completed?" and respondents were classified into three education groups (some school but no high school certificate, high school certificate, and post-secondary education).

Questions were asked to determine the marital status of participants: "What is your marital status?" and respondents were classified into four groups: single, separated/divorced, widowed, married/living together.

Current employment status was assessed with the question "Are you currently employed?" and the answer choices included yes and no. If he/she responded "yes", the exact kind of the job (part-time, full-time, or seasonal) was determined. If he/she responded "no", they were asked if he/she was retired. In addition, participants were also asked about their current or past occupation.

Subjects were classified as smoker, former smokers or non-smokers according to the question "Do you currently or ever smoke cigarettes daily?"

3.2.2 24-Hour Dietary Recalls

The 24-HDRs were unannounced and conducted by telephone by trained interviewers. The telephone interviewers randomly selected a day (either a weekday or a weekend day) to phone the participants. Each subject was asked to recall and describe in detail all types and amounts of food and beverages consumed in the previous 24 hours. The 24-hour period specified for the dietary recall was defined as the 24 consecutive hours between midnight on day one and midnight on the following day, and his/her responses were recorded by the telephone interviewer.

At the end of the first 24-HDR the interviewer informed the participant that they would be contacted in approximately 2 weeks for another diet-related interview. This call was made at a different time of the week than the first one. For example, if the participant's first 24-HDR was on a weekday, then the second 24-HDR would be on a weekend day, or vice versa. The exact day of the second telephone call was not specified. Weekend days included Saturday and Sunday to capture food and alcohol consumption patterns which may be different from those on weekdays (Monday to Friday) [8, 156, 157]. Such differences may include increased intake of 'limiting foods', which is defined in Canada's Food Guide [158], and restaurant foods. To assist in estimating portion sizes of consumed foods, respondents were encouraged to view a measuring cup and measuring spoons as they completed their 24-HDR by telephone.

At the end of the second 24-hour recall, the interviewer informed the participant that they would be contacted in approximately 6 months' time to complete another two telephone interviews. The first round of 24-HDRs was conducted from February to April 2011, and the second round which was in the same format as the first one, was conducted from September to November 2011. After the completion of the dietary recalls, the participants were informed that the final phase of the study (i.e. the

mail-out FFQ) would take place in 6 months' time. There were a total of four completed 24-HDRs for each participant at the end of this study.

3.2.3 Food-Frequency Questionnaire

Approximately six months after the completion of the second round of 24-HDRs, specifically, in March 2012, the HRU telephone interviewers called to remind all study participants that a FFQ survey was being sent to them. The mailed package included: an information pamphlet concerning the study, a FFQ, a self-addressed stamped envelope, a thank-you note to the participants, and a sheet of research abstracts pertaining to work which had already been done.

The original Hawaii FFQ was designed to assess the typical food intake of individual males and females in a multi-ethnic Hawaiian/ Southern Californian population [15]; it has been validated and widely used in the United States [159-161]. The FFQ administered in NL was modified to account for the unique food consumption patterns in NL. Food items considered unusual in NL (e.g. tamales, ham hocks) were deleted or altered while some items commonly consumed in NL (e.g. moose meat, salt/pickled meat) were added. This resulted in a list of 169 food and beverage items in the final FFQ tool. The FFQ required participants to recall the number of times each food item was consumed either per day, per week, per month, or rarely/never during the past 12 months. It also required participants to recall how many months of the year the food was consumed to account for seasonal variation in intake. Portion size options were given using standard measuring units (e.g. cups, tablespoons, slices) or by referring to photographs provided representing small, medium, and large portion sizes of certain food items.

If a participant did not return finished questionnaires within 3 weeks of the mailing date, a follow-up telephone call was made to ensure that the study package

had been received. After five unsuccessful attempts to reach a participant had been made, he/she was considered dropped from the study.

3.3 Data Entry

Amounts and specific types/brands of foods and beverages consumed were entered into ESHA Food Processor SQL, version 10.8, nutrient analysis software (ESHA Research Inc, 2010, Salem, Oregon) [162] under the guidance of a registered dietitian. This software contains more than 35,000 food and beverage items. When an exact match was not available between a food consumed and an item offered in the ESHA database, a group decision was made pertaining to the proper categorization of the item in question. The group always included at least two dietetic professionals/students. All data were reviewed for accuracy, consistency, completeness and manipulation.

3.4 Response Rate

During the first round of 24-HDRs, a total of 1834 telephone numbers were initially identified. After screening for eligibility, 683 eligible participants were contacted to retrieve further information. At the end of the first round of 24-HDRs, 400 participants were selected for further telephone interviews and FFQ surveys; of these, 306 (77%) completed the second round 24-HDR and 210 (49%) completed their FFQs (**Figure 3.1**). For the analyses, we excluded participants who had left over 20 continuous items blank on the FFQ or more than one 24-HDR was rated as unreliable, and those who reported energy intakes outside the range of 500-5000 kcal which matches the exclusionary rules for food-frequency questionnaire data used by Willett [1]. After excluding those with unreliable data, 195 subjects (153 females, 42

males) were included in the final analysis.

Table 3.1 presents the demographic information of subjects who had complete data from the first round 24-HDR interview (baseline visit) and FFQs (1-year follow-up visit). Of the baseline population, the majority of participants were 41-50 years of age (29.0%) and 51-60 years of age (36.5%); the average age was 53.5 years. In the subsample, the mean (standard deviation) age was 55.03 (8.75) years of age. There were significantly more females than males who participated in this study; 74.3% were females and 25.7% were males. In addition, individuals with a higher education level and those who were non-smokers were more likely to participate in the study. Approximately half of the participants were employed (53.3%), rural residents (56.9%), and the majority had a post-secondary education (60.5%), were non-smokers (82.6%) and were married (78.5%).

Figure 3.1 Flow Diagram of Sample Selection in the Study

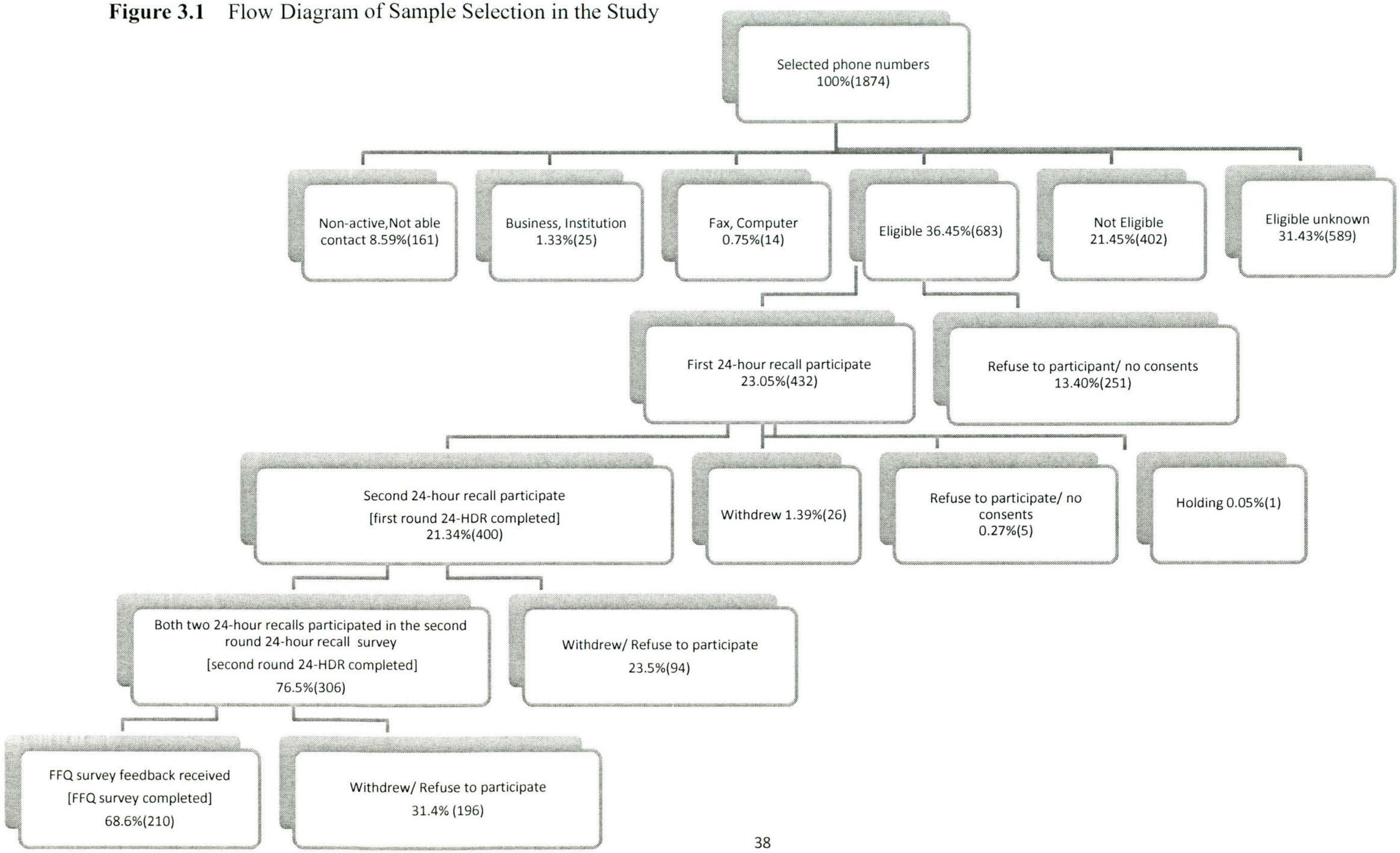


Table 3.1 Demographic Characteristics of the Participants with Completed Dietary Information at Baseline and the 1-year Follow-up Visit

Characteristic	n (%) n=400	n (%) n=195
Age Range (years)		
35-40	50 (12.5)	17 (8.7)
41-50	116 (29.0)	46 (23.6)
51-60	146 (36.5)	81 (41.5)
61-70	88 (22.0)	51 (26.2)
Gender		
Male	103 (25.8)	42 (21.5)
Female	297 (74.3)	153 (78.5)
Residential Area		
Rural area	217 (54.3)	111 (56.9)
Urban area	182 (45.5)	84 (43.1)
No answer provided	1 (0.3)	0 (0)
Education Attainment		
Some school but no high school certificate	57 (14.3)	26 (13.3)
High school certificate	97 (24.3)	51 (26.2)
Post-secondary education	246 (61.5)	118 (60.5)
Marital status		
Single	29 (7.3)	15 (7.7)
Separated/Divorced	41 (10.3)	18 (9.2)
Widowed	16 (4.0)	9 (4.6)
Married/Living together	314 (78.5)	113 (78.5)
Current Employment		
Part-time	29 (7.3)	16 (8.2)
Full-time	162 (40.5)	75 (38.5)
Seasonal	31 (7.8)	13 (6.7)
No	171 (42.8)	88 (45.1)
Retired	115 (27.9)	64 (32.8)
Not retired	52 (12.6)	22 (11.3)
No answer provided	4 (1.0)	2 (1.0)
Unusable data	1 (0.3)	1 (0.5)
Yes	6 (1.5)	2 (1.0)
Current Daily Smoking		
Yes	80 (20)	34 (17.4)
No	320 (80)	161 (82.6)
Pervious Daily Smoking		
Yes	165 (41.3)	85 (43.6)
No	155 (38.8)	76 (39.0)
N/A	80 (20)	34 (17.4)

3.5 Statistical Analysis

3.5.1 Calculation of Nutrient Intake

The nutrient composition of each item was obtained using the ESHA Food Processor software. The nutrient composition data in the ESHA database is compiled from a variety of sources including the USDA Nutrient Database for Standard Reference, the USDA Database for the Continuing Survey of Food Intake by Individuals, the Canadian Nutrient File, manufacturers' nutrient information, and over 1,000 additional sources of data.

Estimation of specific nutrient intake was conducted as follows:

1) Within each round of 24-HDRs, each day was weighted appropriately to produce a synthetic week with the following formula:

$$\boldsymbol{Mean\ Daily\ Nutrient\ Estimate} = \frac{(\boldsymbol{Weekend\ Intake} \times \mathbf{2}) + (\boldsymbol{Weekday\ Intake} \times \mathbf{5})}{\mathbf{7}}$$

2) Nutrient estimates from the FFQ data were calculated using the product-sum method [1, 163]. Thus,

$$\boldsymbol{Daily\ nutrient\ intake} = \sum[(\boldsymbol{reported\ consumption\ frequency\ of\ a\ food\ item, converted\ to\ times\ per\ day}) \times (\boldsymbol{portion\ size\ consumed\ of\ that\ food}) \times (\boldsymbol{amount\ of\ that\ nutrient\ in\ a\ standard\ serving\ size\ of\ that\ food})]$$

3.5.2 Validation Study

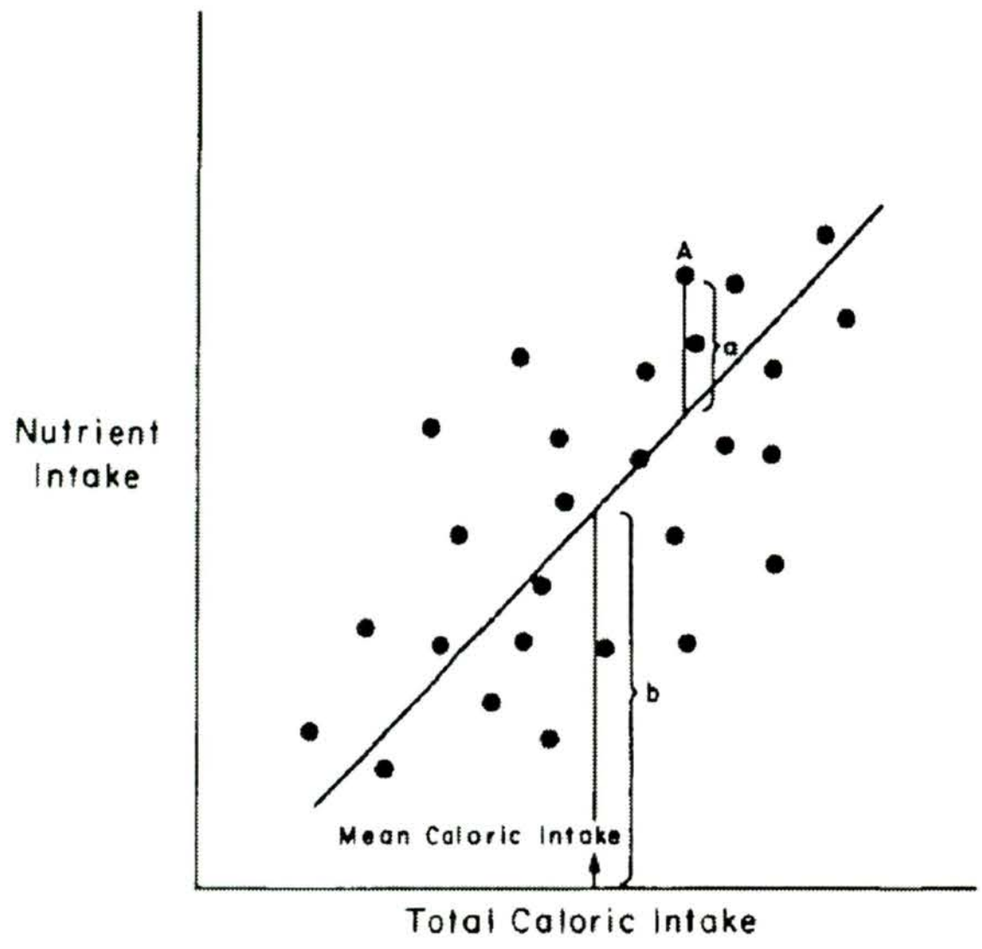
3.5.2.1 *Energy Adjustment*

In epidemiologic studies, even the most carefully collected dietary data can produce misleading conclusions if the data are not carefully analyzed and interpreted. One critical aspect of analysis is accounting appropriately for total energy intake

[164]. Owing to the high inter-correlation of dietary intake with energy, energy adjustment in dietary investigations can reduce the variation in dietary intake resulting from differences in 'body size, metabolic efficiency and physical activity'[165].

According to Willett (1997) [164], a nutrient residual (energy-adjusted) model has been used to 'control for confounding by total energy intake and to remove extraneous variation due to total energy intake' *(*Willett et.al *1997:p1224s)* and this model has been highly recommended for use in validation studies. In this procedure, individuals' actual intakes are computed as the residuals from the regression model with total caloric intake as the independent variable and absolute nutrient intake as the dependent variable. Since residuals have a mean of zero and include negative values, it may therefore be desirable to add a constant (**Figure 3.2**).

Figure 3.2 Nutrient Residual Model (Willett et.al *1997: p1223s*)



The formula of calorie-adjusted nutrient intake is as follows [166]:

$$N_E = a+b$$

N_E is calorie-adjusted nutrient intake; **a** is residual for subject A from the regression model with nutrient intake as the dependent variable and total caloric intake as the

independent variable; and **b** is the expected nutrient intake for a person with mean caloric intake.

Further, the derivative formula is:

$$N_E=N_i-(A\times K_i+B)+A\times K_m+B$$

N_E is calorie-adjusted nutrient intake; N_i is absolute nutrient intake; **A** and **B** are the slope coefficient and intercept of regression model with nutrient intake as the dependent variable and total caloric intake as the independent variable; K_i is individual caloric intake; and K_m is mean caloric intake.

In this study, nutrient intakes were energy-adjusted by using the derivative formula. Because men and women have different caloric intakes, nutrients were adjusted by a different mean caloric intake for each gender.

3.5.2.2 Descriptive Analyses

All analyses were conducted using the SAS statistical software package version 9.2 (SAS Institute Inc., Cary, NC, USA) and Statistical Package for Social Science (SPSS) software version 9.0 (SPSS, Inc., Chicago, IL, USA).

Means and standard deviations (SD) were calculated for nutrient intakes assessed by the 24-HDRs and FFQs. For the purpose of this study, the following nutrient intakes derived from the FFQ and 24-HDRs were compared: energy (kcal), protein, total fat, saturated fat, monounsaturated fat, polyunsaturated fat, carbohydrate (including dietary fibre), cholesterol, carotene (including vitamin A), calcium, and vitamin D. Paired-sample t-tests were used to determine differences between the means for energy and the specified nutrients derived from the two dietary tools. All tests of statistical inference employed a two-sided alpha level of 0.05.

3.5.2.3 Pearson Correlation Coefficients

All nutrient variables were log-transformed to improve normality and reduce

skewness, and then were energy-adjusted to reduce potential bias due to over- or under-reporting of food intakes. The relationship between the nutrient values from FFQ, both the unadjusted and the energy-adjusted nutrient estimates, and averages of the two synthetic weeks of 24-HDRs were estimated using Pearson correlation coefficients. The correlation coefficient **r** is a measure of the linear relationship between two variables. A correlation coefficient gives a value between -1 and +1 as a measure of the relationship between the methods, where 0 demonstrates no relationship and +1 a perfect relationship between the methods. Also, the **r** value is positive when the slope of the regression line is directed upwards and negative if it is directed downwards.

We calculated de-attenuated correlations to remove the within-person variability found in the 24-HDRs [167] by using the following formula:

$$\mathbf{r_t = r_0\sqrt{1 + r/n}}$$

Here $\mathbf{r_t}$ is the corrected correlation between the energy-adjusted nutrient derived from the FFQ and 24-HDRs, $\mathbf{r_0}$ is the observed correlation, **r** is the ratio of the within-person and between-person variance measured from the 24-HDRs, and **n** is the number of replicated recalls (n=4).

3.5.2.4 Classification into Quartiles

We categorized the distribution of energy-adjusted nutrient intakes into quartiles and estimated the percentage of subjects classified into same, adjacent and extreme quartiles [10, 168, 169]. This is a relative validation method.

The Bland–Altman method [170] was also used to assess the agreement between the mean energy and nutrient intake values obtained using the two different dietary instruments. It plotted the difference against the sum of each pair of observations. This makes no assumption about which of the methods yields the better measure and

assesses only the level of agreement.

3.5.3 Food Consumption Patterns Identification

The 169 food items in the FFQ were grouped into 36 predefined categories **(Table 3.2)** according to their nutritional characteristics and the usual frequency of consumption in this population, where several foods (e.g. eggs, beer) comprised their own groups. The median intakes of these food groups were adjusted for total energy intake with the use of the residual method [1] to obtain factors uncorrelated with total energy intake.

Table 3.2 Food Groupings Used in the Food Consumption Pattern Analysis

	Food groups	Items
1	High-fat dairy products	whole milk(1);2% milk(2); cheese(26-29); cream (31), regular yogurt (34, 36)
2	Low-fat dairy products	1% milk (3); milk shake(4); light yogurt(5, 35, 37), cottage cheese (30); coffee whitener(33); light cream(32)
3	Coffee	decaffeinated or not decaffeinated (6,7)
4	Tea	herbal or not herbal (8,9)
5	Sweets, Miscellaneous sugary food	sugar in tea or coffee(10); sugar on cereal (112); cakes(140); pies and tarts(141); donuts and sweet rolls(142); cookies(143); ice cream(144); pudding (146); jello(147); popsicles(148); freezies(149); chocolate bar and chocolate candy(150);candy (151); jam, jelly, honey, syrup (163); chocolate or strawberry syrup (165); chocolate spreads (166)
6	Low fat sweets	light or diet ice cream and pudding(145, 147)
7	Soft drinks	cola, dietetic, and other soft drinks (11-13)
8	Juices	fruit juices, fruit drinks, iced tea, vegetable juices (14-19)
9	Beer	beer or ale(20)
10	Alcohol	white wine, red wine, sherry, port, liquor (21-23)
11	Eggs	egg (boiled, poached)(24); egg (fried, scrambled, omelette) (25)
12	Rice, Pasta vege	pasta with tomato sauce (42); macaroni, spaghetti, noodles (plain)(122); rice (123)
13	Soups	soups (non-creamed)(39); pea soup(40)
14	Potatoes	potatoes (mashed, boiled, baked etc) (48); french fries or fried potatoes(49)
15	Cruciferous Vegetables	broccoli (51); cabbage, coleslaw (52); cauliflower (53); asparagus; brussel sprouts (70)
16	Leafy Greens	spinach and other green leafy vegs (58); green salad (59)
17	Pickled Vegetables	pickles, radish (72)
18	Tomato, Tomato Sauce	fresh tomatoes (61); canned tomatoes /tomato sauce (62); ketchup (153)
19	Other Vegetables	corn (54); cucumber (60); onion (63); zucchini, eggplant (68); sweet pepper (69); avocado (73); other vegs (74)
20	Legumes	peas, lima beans (55); green/ yellow beans (56); beans/ lentils (57); bean sprouts (71); tofu, tempeh (152)
21	Dark yellow vegetables	carrots (50); beets (64); turnips or rutabagas(65); other root vegs (66); yellow squash (67)

22	Red meat	beef (75-79), pork (80-81), baked ham(82); bacon(83); veal(84); lamb(85); hot dog or wiener(86); sausage(87); corned beef(88); coldcuts(89); liver(90)
23	Mixed dishes	creamed soup(38); pasta with meat sauce (41); meat stew (46); chili with meat (47); mixed dishes(43); pizza (44,45)
24	Game meat	sea-birds, seal (103); caribou, moose (104); other wild birds (105)
25	Cured/processed meat	baked ham (82); bacon (83); hot dog (86); sausage (87); corned beef (88); cold cuts (89); fried chicken(91); salted meat (94); pickled meat (95)
26	Poultry	fried chicken (91); roasted or stewed chicken or turkey (92); skin removed chicken (93)
27	Fish	shellfish(96); fried fish (97); fish(98-102)
28	Processed fish	fried fish(97); canned fish(99); smoked fish(100); salted /dried fish(101); picked fish(102)
29	Ready to eat cereals	cereals(106-111)
30	Whole grains	whole grain bread(113, 114); whole wheat rolls (117), wheat bran and germ (168,169)
31	White bread and refined grains	white bread(115, 116); muffin, pancakes, waffles(119-121)
32	Snacks	crisp snacks (124); crackers (118)
33	Fruits	fruits (125-136, 139)
34	Processed fruit	dried and canned fruit (137,138)
35	Add fat high in saturated fat	mayonnaise/ miracle whip(154,155); salad dressing(156); oil(157); butter and margarine(158,159);gravy(164); sauces (white, cream, mornay) (167)
36	Nuts	peanut butter(160); peanuts and other nuts(161,162)

3.5.3.1 Factor Analysis

As food consumption patterns cannot be measured directly, one must rely on statistical methods to characterize dietary patterns using collected dietary information [18]. The methodology for defining food consumption patterns is relatively new and is still in development. However, the most common approach is the Principal Components Analysis (PCA). PCA, a form of factor analysis, creates sequential linear combinations of foods or food groups to explain the maximal amount of variance in a correlation matrix. Weights are assigned to each food or food group to describe their correlation with the overall inter-correlation of foods in the matrix [171].

The Bartlett's Test of Sphericity (BTS) and the Kaiser-Meyer-Olkin (KMO) measurement of sample adequacy were applied to verify the appropriateness of using factor analysis. The number for the components that best represented the data was chosen on the basis of the following criteria: eigenvalue>1.25, identification of a break point in the scree plot and the interpretability of the factors [172]. Then, PCA with varimax rotation was performed on the 36 food groups. Varimax rotation redistributed the explained variance for the individual components, thereby achieving a simpler structure, increasing the number of larger and smaller loadings [172].

Items were considered to load on a factor if they have a correlation of greater than 0.3 with that factor [173] and were deemed to be the most informative in describing the food consumption patterns. We also retained food groups that have negative correlations ($\leqslant$-0.2) to incorporate the valuable information concerning infrequently consumed foods within each factor [174].

3.5.3.2 Relation to Demographic Variables

Univariate analyses and Multivariable Linear Regression Models were

performed to assess the relationship between participants' food consumption patterns and demographic variables, with factor scores being the dependent variable. The characteristics used in the analyses were: Age, Gender, Residential Area, Education Attainment, Marital Status, and Current Daily Smoking. The variables of Previous Daily Smoking and Current Employment were not included in the analysis because there were unusable values in these two categories.

Chapter 4: RESULTS

4.1 Paper 1. Assessing the Validity of a Self-administered Food-Frequency Questionnaire (FFQ) in the Adult Population of Newfoundland and Labrador, Canada

4.1.1 Introduction

Food- Frequency Questionnaires (FFQs) are designed to assess habitual diet by asking about the frequency with which specific food items are consumed over a reference period [1, 2]. This tool has been the most frequently used dietary assessment method in large-scale epidemiological studies and other nutritional research. Compared to other dietary assessment methods, the FFQ is easy to administer, has relatively low cost, and provides a rapid estimate of usual food intake [3]. However, investigators have recognized that nutritional values reported from FFQ data are subject to substantial error, both systematic and random [4, 5]. Therefore, to properly interpret the results of epidemiological studies that use FFQs, it is necessary to know the relationship between reported intakes from the FFQ and true usual intakes [6]. Multiple dietary recalls [6-8], food records [9], and biomarkers [10] are generally considered to be more accurate reference measures of nutrient intake, and thus can be used in measuring the validity of FFQs. Validation correlations vary depending upon the nutrient, but typically range from 0.40 to 0.70 [8, 175, 176].

FFQs are widely used throughout the world for epidemiologic nutrition surveys. However, due to differences in food supply and dietary habits from one population to another, there is no universally accepted FFQ that can be used for all populations. A

self-administrated FFQ, used for assessing the relationship between habitual diet and Colorectal Cancer (CRC) in adult residents of Newfoundland and Labrador (NL), was developed from the well-known Hawaii FFQ [14, 15] and modified by NL researchers. Investigation of CRC in this population is warranted as NL has the highest CRC incidence rate in the country, when compared to other Canadian provinces [16]. The diets of residents of this province have been described as 'unique' due to the geography, economics, culture and population demographics [11], and thus an investigation into the possible relationship between dietary factors and CRC is especially warranted in NL. It has been suggested that elucidation of diet–disease relationships requires dietary assessment methods which can adequately describe and quantify intakes, minimize systematic errors and provide reasonably precise estimates of variability between individuals and/or groups [17]. However, the developed FFQ has not yet been appropriately validated for a NL population which makes some of the findings of the CRC study difficult to interpret.

Thus, the objective of the present study is twofold - to address whether this self-administered FFQ is valid in the NL general adult population by comparison with the results of multiple 24-hour dietary recalls (24-HDRs) and to provide a validated NL based self-administrated FFQ for future use.

4.1.2 Methods

4.1.2.1 Sample Recruitment and Study Design

Based on the information (means and standard deviations for various nutrients) derived from the FFQ data of the on-going CRC project [152-154] and the generally acceptable correlation coefficient value of 0.6, the minimum sample size for this study was determined to be 98 participants. The validation study lasted approximately one

year and each subject was contacted a minimum of three times. A 30% attrition rate per step was expected. Therefore, an initial sample size of 450 subjects was required.

During February 2011, experienced telephone interviewers recruited a random population-based sample of NL adults, aged 35-70 years, using a list of land-line telephone numbers purchased from Info Canada [155]. After excluding non-residential telephone numbers, 683 potential subjects were identified as eligible and 432 (63%) initially agreed to participate in the study. Eligibility criteria included non-institutionalized adult resident of NL for at least two years with no intent to move in the next 12 months; aged 35-70 years inclusive at the time of the intended interviews; able to speak and read English at a grade 8 level; and with no specific identified medical conditions (cognitive impairment, psychological conditions, or pregnancy).

We collected dietary intake data by telephone through a set of two variably timed 24-HDRs (one weekday and one weekend day) from each participant, which then was duplicated approximately six months later. This procedure aimed to obtain two sets of recalls (a total of four 24-HDRs) in different seasons from each subject. An FFQ survey was mailed out to all study participants in early 2012, six months after the completion of the second pair of 24-HDRs. Reminder phone calls were used to prompt participants to complete and return the FFQs.

Demographic information, including: age, gender, size of their community, marital status, employment status, level of education, and smoking habits, was collected by telephone interview. This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Interdisciplinary Committee on Ethics in Human Research (ICEHR) [177], Memorial University (No.2010/11-057-ME). Verbal

informed consent was obtained from all subjects.

4.1.2.2 Dietary Assessment

4.1.2.2.1 The Food-Frequency Questionnaire

The original Hawaii FFQ was designed to assess the typical food intake of individual males and females in a multi-ethnic Hawaiian/ Southern Californian population [15]; it has been validated and widely used in the United States [159-161]. The FFQ administered in NL was modified to account for the unique food consumption habits in NL. Food items considered unusual in NL (e.g. tamales, ham hocks) were deleted or altered while some items commonly consumed in NL (e.g. moose meat, pickled meat) were added. This resulted in a list of 169 food and beverage items in the final instrument.

The FFQ required participants to recall the number of times each food item was consumed per day, per week, per month, or rarely/never during the past 12 months. It also required participants to recall how many months of the year the food was consumed to account for seasonal variation in intake. Portion size options were given using standard measuring units (e.g. cups, tablespoons, slices) or by referring to photographs provided representing small, medium, and large portion sizes of some food items.

4.1.2.2.2 The 24-Hour Dietary Recalls

The 24-HDRs were unannounced and conducted by telephone by trained interviewers. During the 24-HDR, each subject recalled and described in detail, all types and amounts of foods and beverages consumed in the previous 24 hours on two separate occasions, a weekday and a weekend day. Weekend days included Saturday and Sunday to capture food and alcohol consumption patterns which may be different from those on weekdays (Monday to Friday) [8, 156, 157]. The 24-hour period

specified for the dietary recall was defined as the 24 consecutive hours between midnight on day one and midnight on the following day. To assist in estimating portion sizes of consumed foods, respondents were encouraged to view a measuring cup and measuring spoons as they completed their 24-HDR by telephone. At the end of this study, there were a total of four completed 24-HDRs for each participant.

4.1.2.3 Statistical Analysis

Data analyses attempted to (1) assess completeness of the responses and (2) examine potential errors/outliers. Both are directly related to overall validity assessment.

4.1.2.3.1 Data Entry

Amounts and specific types/brands of foods consumed were entered into ESHA Food Processor SQL, version 10.8, nutrient analysis software (ESHA Research Inc, 2010, Salem, Oregon) [162] under the guidance of a professional Registered Dietitian and/or dietetic graduate students. This software contains more than 35,000 food and beverage items. When an exact match was not available between a food consumed and an item offered in the ESHA database, a group decision was made pertaining to the proper categorization of the food item in question. The group always included at least two dietetic professionals/students. For instance, homemade bread, which is not offered in the database, is known to be denser than the equivalent commercial bread. Nutrient information from one slice of homemade bread was calculated as following:

$$\boldsymbol{Nutrient\ estimate\ from\ one\ piece\ of\ homemade\ bread}$$

$$= \mathbf{1.25} \times \boldsymbol{Nutrient\ estimate\ from\ one\ piece\ of\ commercial\ bread}$$

4.1.2.3.2 Calculation of Nutrient Intake

The nutrient composition of each item was obtained using the ESHA Food Processor. The nutrient composition data in the ESHA database is compiled from a

variety of sources including the USDA Nutrient Database for Standard Reference, the USDA Database for the Continuing Survey of Food Intake by Individuals, the Canadian Nutrient File, manufacturers' nutrient information, and over 1,000 additional sources of data.

Estimation of intake for a specific nutrient was conducted as following:

1) Within each round of 24-HDRs, each day was weighted appropriately to produce a synthetic week with the following formula:

$$\textbf{\textit{Mean Daily Nutrient Estimate}} = \frac{(\textbf{\textit{Weekend Intake}} \times \mathbf{2}) + (\textbf{\textit{Weekday Intake}} \times \mathbf{5})}{\mathbf{7}}$$

2) Nutrient estimates from FFQ data were calculated using the product-sum method [1, 163]. Thus,

$$\textbf{\textit{Daily nutrient intake}} = \sum [(\textbf{\textit{reported consumption frequency of a food item, converted to times per day}}) \times (\textbf{\textit{portion size consumed of that food}}) \times (\textbf{\textit{amount of that nutrient in a standard serving size of that food}})]$$

4.1.2.3.3 Validation Study

Subjects were excluded if total energy intake from the FFQ fell outside the range of 500-5,000 kcal per day [1] (n=4) or if more than one 24-HDR (n=2) was rated as unreliable. We also excluded subjects with missing information (n=4) from the analyses.

Means and standard deviations (SD) were calculated for nutrient intakes assessed by the 24-HDRs and FFQs. For the purpose of this study, the following nutrient intakes derived from the FFQ and 24-HDRs were compared: energy (kcal), protein, total fat, saturated fat, monounsaturated fat, polyunsaturated fat, carbohydrate, dietary

fibre, cholesterol, carotene, calcium, vitamin A, and vitamin D. Paired-sample t-tests were used to determine differences between the means for energy and nutrients derived from the two dietary tools. All nutrient variables were log-transformed to improve normality and reduce skewness, and then were energy-adjusted using the residual method [166].

The relationship between the nutrient values from the FFQ, both the unadjusted and the energy-adjusted nutrient estimates, and averages of the two synthetic weeks of recalls were estimated using Pearson correlation coefficients. We also calculated de-attenuated correlations to remove the within-person variability found in the recalls [167] by using the following formula:

$$\mathbf{r_t = r_0\sqrt{1 + r/n}}$$

Here $\mathbf{r_t}$ is the corrected correlation between the energy-adjusted nutrient derived from the FFQ and 24-HDRs, $\mathbf{r_0}$ is the observed correlation, **r** is the ratio of the within- and between-person variance measured from the 24HDRs, and **n** is the number of replicated recalls (n=4).

Furthermore, we categorized the distribution of energy-adjusted nutrient intakes into quartiles, and estimated the percentage of subjects classified into same, adjacent and extreme quartiles [10, 168, 169]. The Bland–Altman method [170] was also used to assess the agreement between the mean energy and nutrient intake values obtained using the two different instruments. We plotted the difference in intake between the two methods (FFQ-24HDR) against the mean intake of the two measures ((FFQ+ 24HDR)/2). The overall mean difference indicated whether one method tends to overestimate or underestimate, and the limits of agreements (mean ±1.96SD) were used to show how well the two administrations agree.

All analyses were conducted using the SAS statistical software package version

9.2 (SAS Institute Inc., Cary, NC, USA) and Statistical Package for Social Science (SPSS) software version 9.0 (SPSS, Inc., Chicago, IL, USA).

4.1.3 Results

Out of the 432 participants who agreed to participate in this study, 400 (93%) completed the first two dietary recalls; of these, 306 (77%) completed the second round of 24-HDRs and 210 (49%) completed the FFQ (**Figure 4.1.1**). After excluding those with unreliable data (n=15), 195 subjects (153 females, 42 males) were included in the present analysis. The mean (SD) age of the 195 participants was 55.03 (8.75) years. Over half of the participants were employed (53.3%), were rural residents (56.9%), and the majority had completed post-secondary education (60.5%), were non-smokers (82.6%), and were married (78.5%). When comparing the demographic characteristics of the participants at baseline and the 1-year follow-up visit, no significant differences were observed.

Table 4.1.1 presents the means and respective standard deviations for energy and nutrients, derived from the FFQ and 24-HDRs. Values for energy and nutrients estimated by the FFQ were higher than those obtained using the dietary recalls, except for protein in men. Evaluation of the differences between these means showed significant differences ($p<0.05$) for all the nutrients in women and some nutrient estimates in men (dietary fibre, vitamin A, vitamin D, and calcium).

Correlations between nutrient intakes derived from the FFQs and the 24-HDRs are shown in **Table 4.1.2** for men and women. The Pearson correlation coefficient for crude data varied from 0.17 (carbohydrate) to 0.40 (carotene) in women and 0.07(protein) to 0.56 (carbohydrate) in men. In both genders, adjusting for total energy intake improved the correlations in some nutrients (e.g. protein) but decreased

the values in the others (e.g. polyunsaturated fat). However, adjustment for residual measurement error (de-attenuation) increased all correlations, ranging from 0.20 (polyunsaturated fat) to 0.52 (dietary fibre) in women and 0.13 (protein) to 0.61 (carbohydrate, dietary fibre) in men, with a median correlation value of 0.38 in women and 0.42 in men. Except for that of protein in men, all correlations were statistically significant with $p<0.05$.

Data for energy-adjusted nutrient intakes estimated from the FFQs and 24-HDRs were distributed into quartiles of intakes and cross-classified. A subject would be correctly classified if his/her energy or nutrient intakes were ranked into the same or an adjacent quartile by both methods. **Table 4.1.3** presents the summary of cross-classification analysis. For women, classification of subjects into the same and adjacent quartiles ranged from 66.7% (polyunsaturated fat) to 79.1% (dietary fibre), while grossly misclassified individuals varied from 3.3% (carbohydrate, dietary fibre) to 9.1% (polyunsaturated fat). For men, the mean proportion of individuals correctly classified was 78.0%, while on average only 5.85% fell into the extreme quartile. Bland–Altman plots showed no serious systematic bias between the administration of the two instruments over the range of mean intakes (**Figure 4.1.2**).

4.1.4 Discussion

A valid, comprehensive tool to measure nutrient intakes is essential to health research involving humans, especially when it is aimed at investigating the relationship between diet and diseases [178, 179]. The present study demonstrated that a previously developed 169-item self-administered FFQ is reasonably valid for dietary assessment in the general adult population of NL. We observed high agreement between the two methods investigated in quartile categorization, as more

than 74% women and 78% men were correctly classified into the same or adjacent quartiles for energy and twelve nutrients. Bland-Altman plots also indicated acceptable level of agreement between the two methods.

A major component of the validation process is the selection of an appropriate reference method to test the target instrument; however no gold standard exists for dietary intake measurements. It is crucial for the errors of both the methods used in the current study to be as independent of each other as possible [180]. In a review on the validation of FFQs, Cade et.al *(2002)* found that 75% of the studies validated FFQs against repeated 24-HDRs [3]. The FFQ and the 24-HDRs have some similar error sources, such as the reliance on memory and the perception of portion sizes [1, 3]; however, the FFQ stresses long-term memory whereas the 24-HDR relies on short-term memory. In addition, the 24-HDR method was interviewer-based using open-ended questions, whereas the FFQ was self-administered with close-ended questions. Such differences let us assume that the errors are sufficiently independent and that the 24-HDR method is an adequate comparison method for this target instrument [181].

As expected, the absolute nutrient values derived from the FFQ tended to be higher than those derived from the 24-HDRs, which is a common issue reported in previous research [17, 163, 178, 182]. A possible explanation is that people tend to overestimate their actual intake when they are asked to recall the frequency of a large number of foods consumed in an FFQ [1, 163]. According to nutrient intakes of NL adults estimated in 2004 by the Canadian Community Health Survey (CCHS Cycle 2.2) [183] , all nutrient intakes estimated by the current study were within the acceptable range ($\pm$20%) of the mean values.

Correlation coefficients were used to assess the association between FFQ and

24-HDRs as well as to measure the relative validity. For both genders, energy adjustment improved the correlations for the majority of nutrients. According to Willett [166], energy adjustment increases correlation coefficients when the variability of nutrient consumption is related to energy intake, but decreases correlation coefficients when the variability depends on systematic errors of overestimation and underestimation. In the present study, the lower correlation values found in some categories may indicate that the FFQ to some extent systemically over-/under-estimated intake of these nutrients, however, error in over/under estimation by the FFQ is expected. Likewise, Dehghan et.al *(2012)*, Wang et.al *(2008)*, and Cardoso et.al *(2010)* found energy adjustment did not improve the crude correlation in their studies [184-186].

Due to correction for the day-to-day variation in intakes, the de-attenuated energy-adjusted correlations were usually higher than their original values. On average, the correlation values were approximately 0.40 when genders were combined. These values are lower than some reported by previous validation studies [6, 10, 15] but comparable to others [8, 175, 187-189]. In regards to energy, lower concordance coefficients have been reported in the Willett FFQ (0.16 for women and 0.18 for men) and the Block FFQ (0.37 for women and 0.41 for men) [175] as compared with 0.26 (women) and 0.44 (men) derived from our study. It was particularly noticeable that our correlations for protein were unfavourable, especially in men (0.13), however, our findings were similar to those obtained from a Brazilian cohort (0.20) [186]. For carbohydrate in women, our study yielded a coefficient of 0.38, which compares favourably with the Jackson Heart Study (0.32) [187]. Our low correlations for polyunsaturated fat (0.20 for women and 0.26 for men) were very similar to the results of most other FFQs [175, 187-189]. This could be associated in part with the

irregular distribution of oils used in food preparation. In terms of micronutrients, it has been suggested that the number of days which must be monitored to allow a true estimation of average daily intake is greater for micronutrients than for macronutrients and exceeds the four days investigated in this study [190]. Although our correlations for vitamin A in women (0.38) and carotene in men (0.28) were low, they were significant with *p-value* <0.05, suggesting reasonably good agreement between the two instruments. Other studies have also reported poor correlations for micronutrients [6, 185, 186], including vitamin A and carotene.

The use of correlation analysis for assessing validity has often been questioned on the basis that it does not measure agreement but only measures the strength of association between two variables [107, 191]. Cross-classification into quartiles of intake and Bland–Altman plots were therefore used to achieve a measure of the agreement between the two methods. In terms of total energy and all nutrients analyzed, this FFQ shows a relatively high proportion of subjects being correctly classified (into same or adjacent category) and only a small number of grossly misclassified individuals (less than 10%). As a result, we demonstrated stronger between-method agreement than other studies [192, 193]. This may reflect a high sensitivity for this instrument. Bland–Altman plots performed showed that the difference between the two methods was the same across the range of intakes, as well as that the extent of agreement did not differ for low intakes compared with high intakes. Therefore, we might conclude that these results could be acceptable as well as very satisfactory for the assessment of individual intake.

Several limitations of this study must be considered. First, we did not administer an FFQ at the onset of the study, thus cannot assess the reproducibility of the instrument. Future work needs to be done to evaluate the reproducibility (reliability)

of this FFQ. Furthermore, relevant information pertaining to the use of dietary supplements was not collected during the 24-HDRs. Therefore, we do not know the true nutrient intakes of this population. Finally, as in most research, the general limitations of dietary assessment instruments cannot be ignored. Both the FFQ and 24-HDR methods rely on memory and may be biased due to under- or over-estimation. It has been suggested by others that multiple reference methods, including dietary methods and biochemical analyses, be used in validation studies [3, 179] to increase the accuracy of the results. Future studies may benefit from including biomarker reference methods such as urinary nitrogen and doubly labeled water; however, using a biomarker will certainly add to the participant burden and costs associated with the study. As well, it is noteworthy that use of the FFQ remains the most cost-effective way to collect usual nutrient intakes in population studies.

4.1.5 Conclusion

In conclusion, this 169-item FFQ developed specifically for the NL population had moderate relative validity and therefore can be used in studies to assess food consumption in the NL general population. In addition, this FFQ is capable of classifying an individual's intake into quartiles, which is useful in examining the relationships between diet and chronic disease including CRC. Such a validation not only immediately assists the analyses and interpretation of data collected during the CRC study, but also contributes greatly to future epidemiological studies and other nutritional studies in NL. Further efforts should be made to evaluate the reproducibility of the present FFQ.

Figure 4.1.1 Flow Diagram of Sample Selection

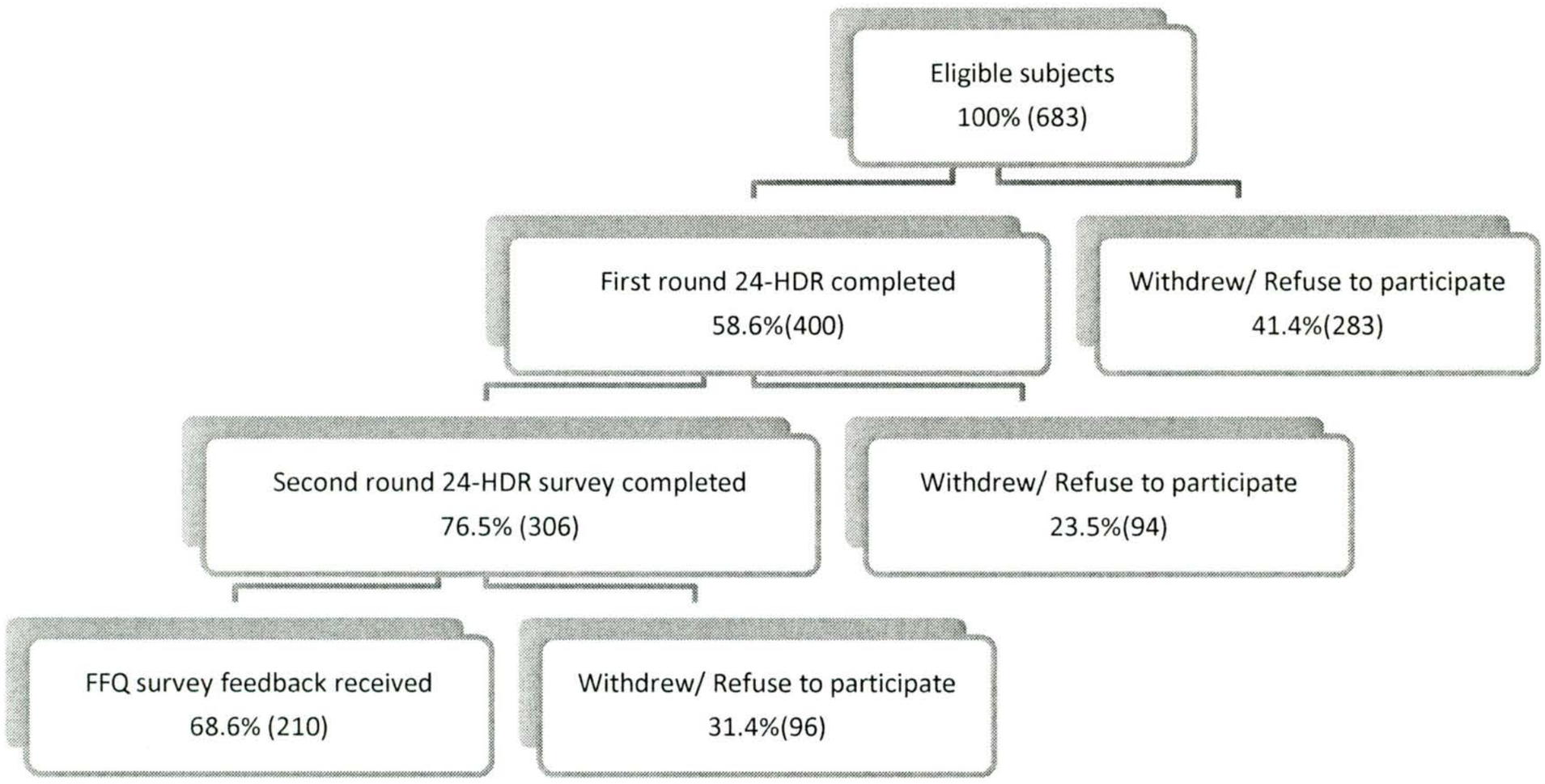
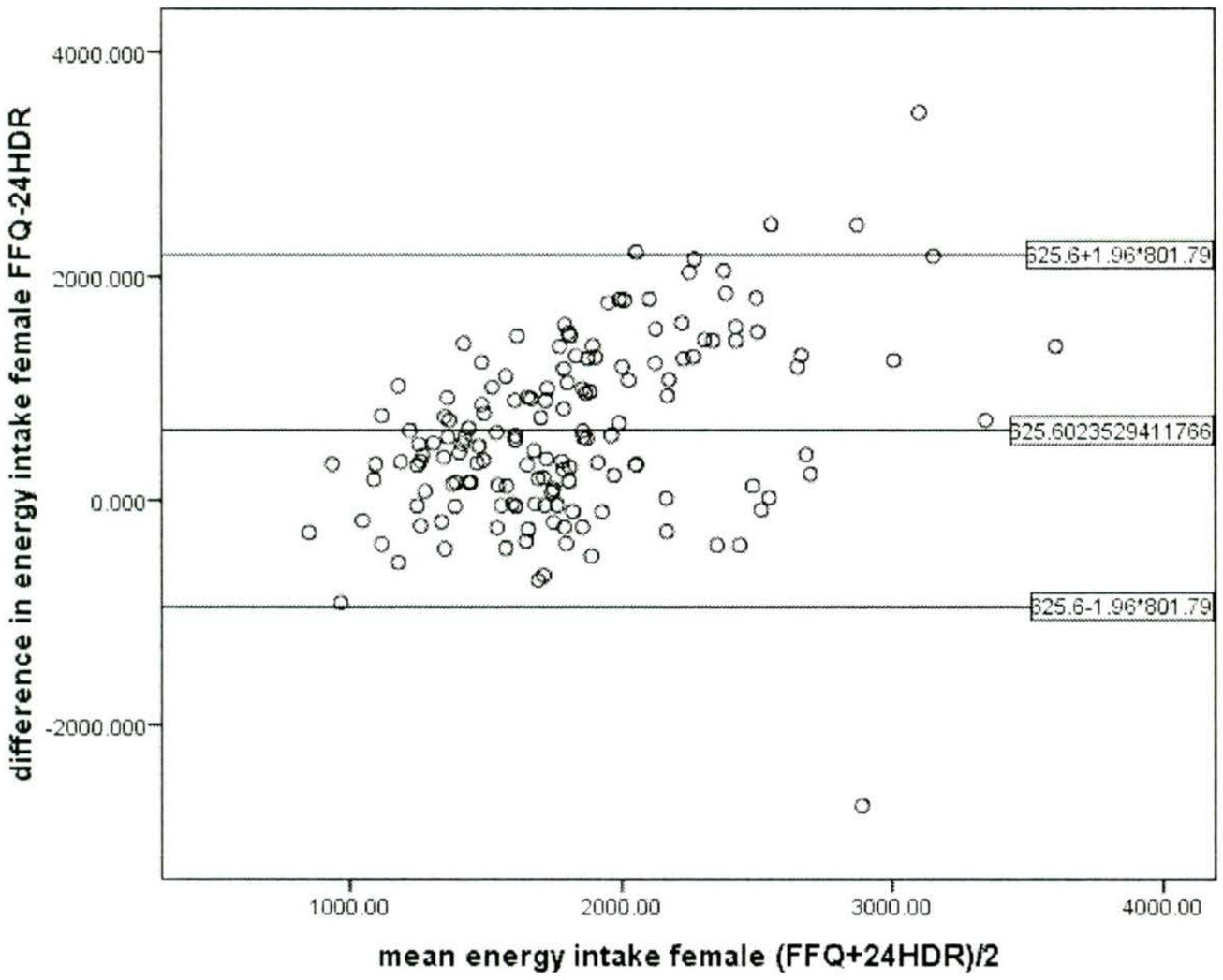
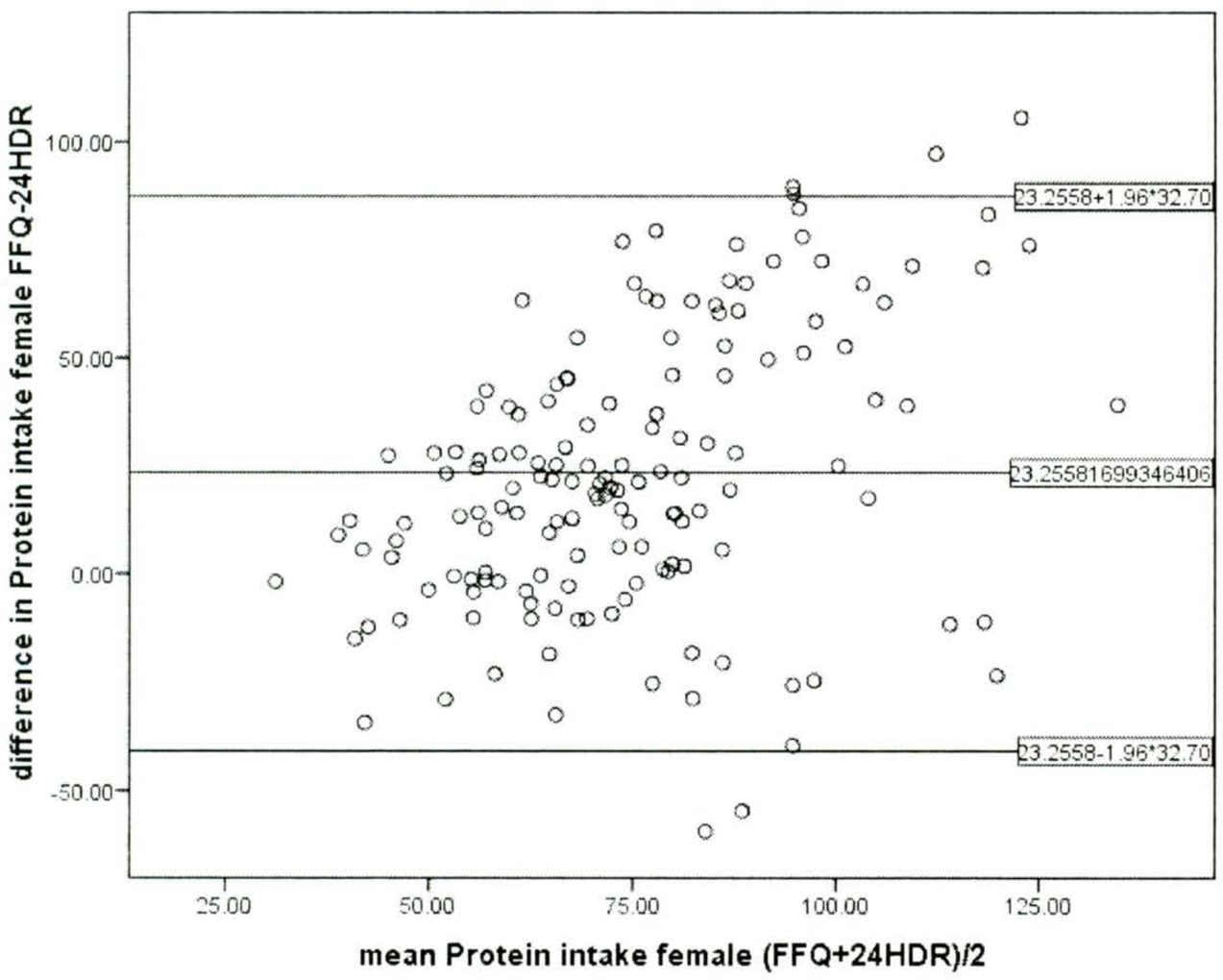


Figure 4.1.2 Bland-Altman Plots for Nutrient Intakes with the Mean Difference and Limits of Agreements between the food frequency questionnaire (FFQ) and 24-hour dietary recall(24-HDR)

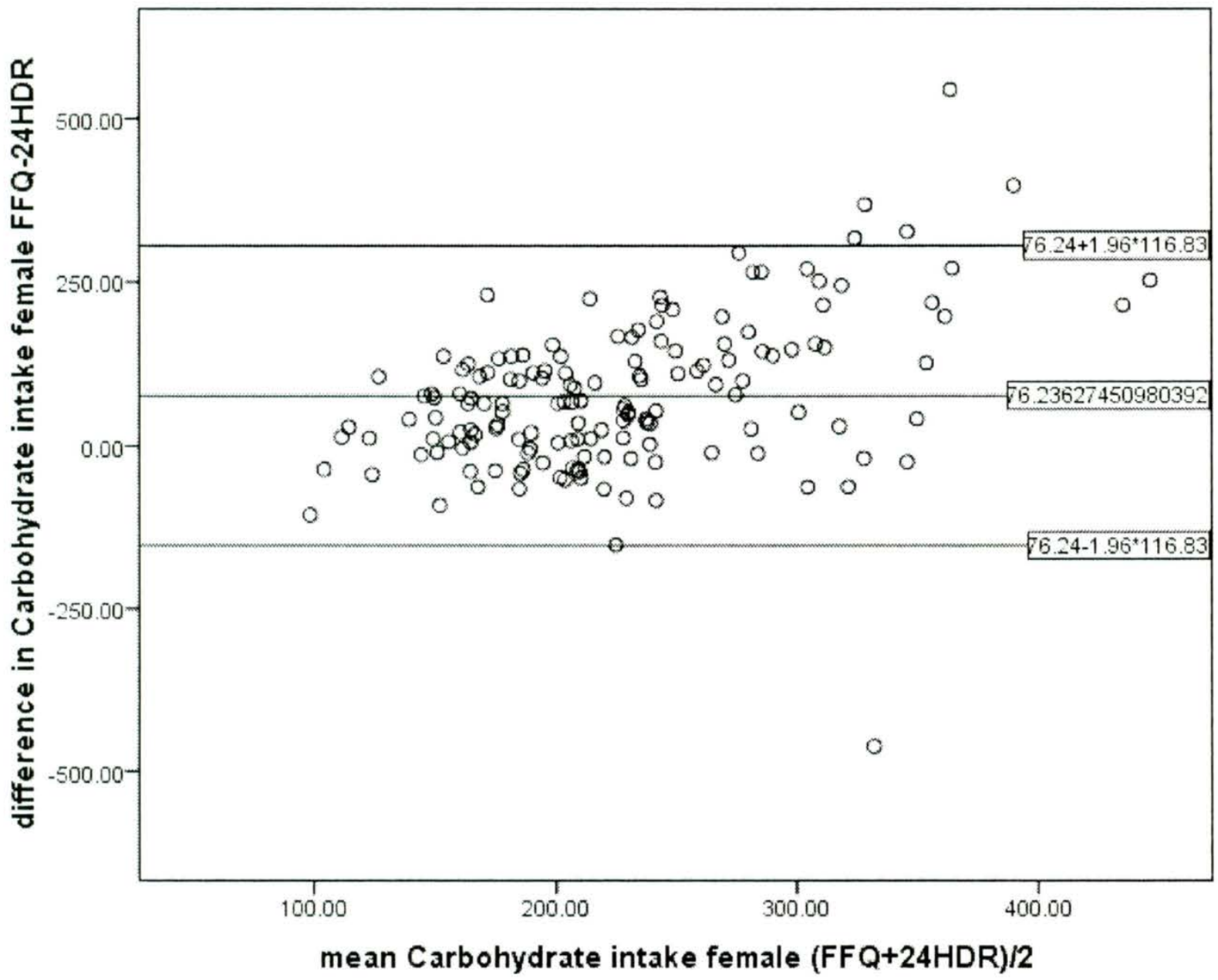
Bland-Altman Plot for Total Energy Intake in Female



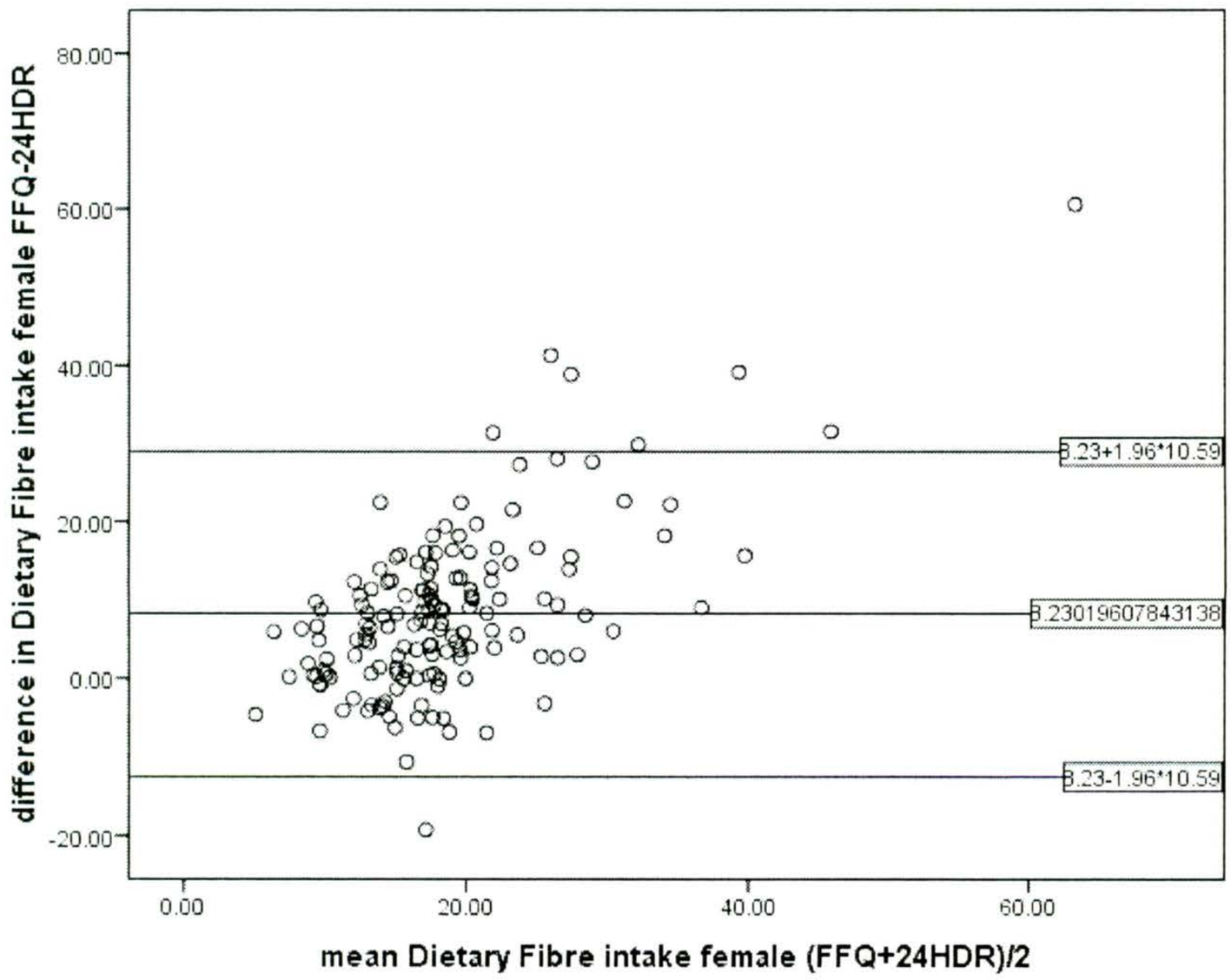
Bland-Altman Plot for Protein Intake in Female



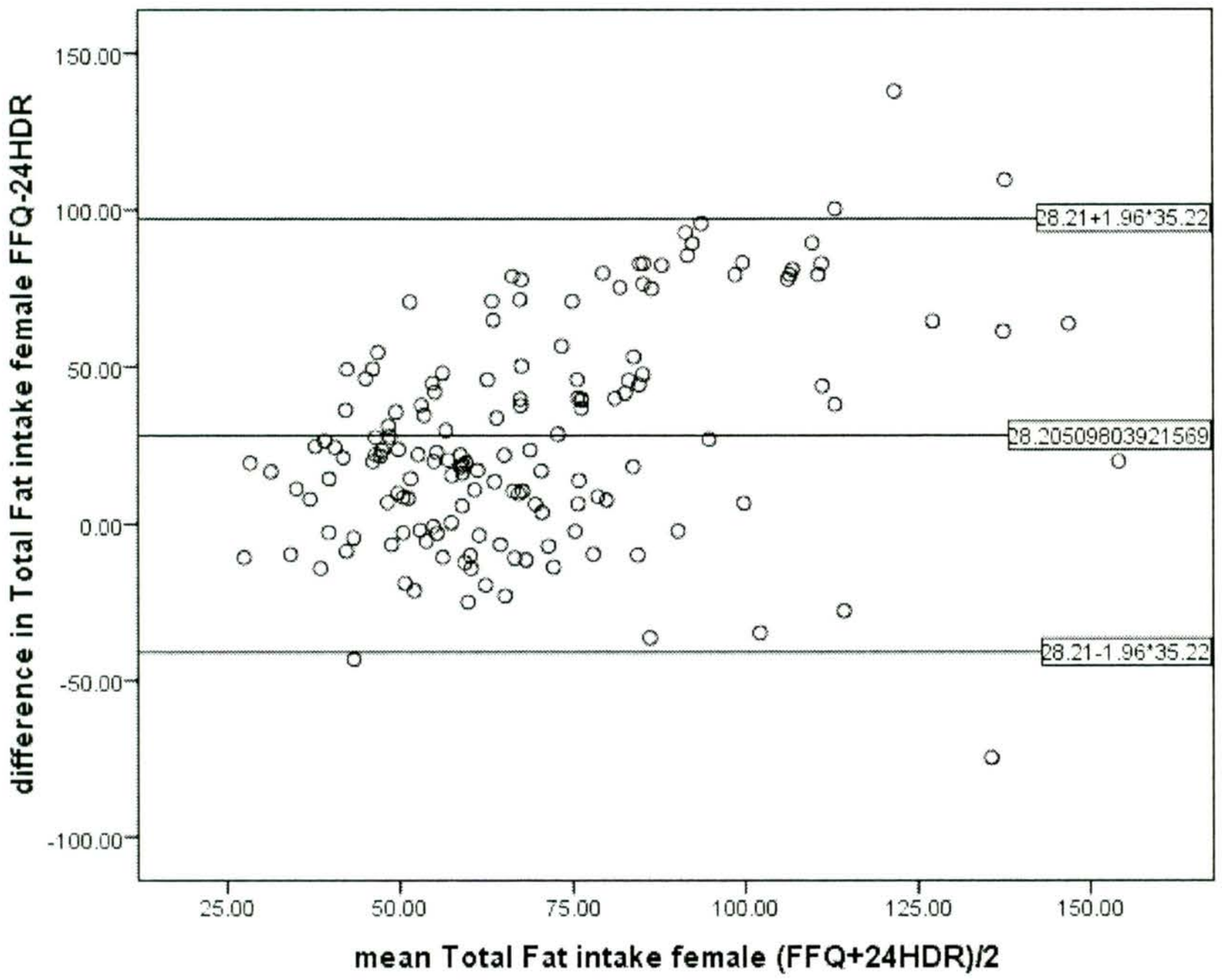
Bland-Altman Plot for Carbohydrate Intake in Female



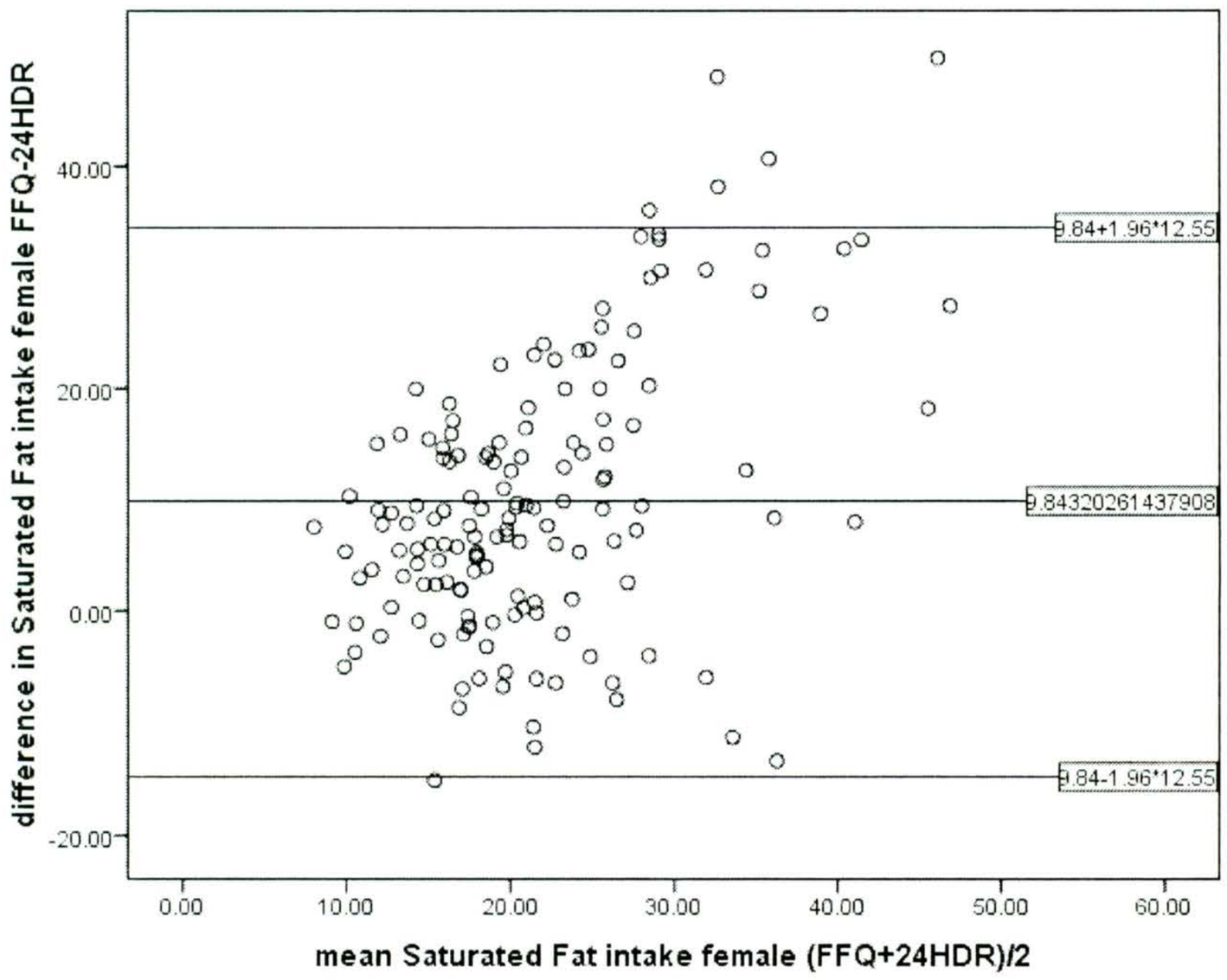
Bland-Altman Plot for Dietary Fibre Intake in Female



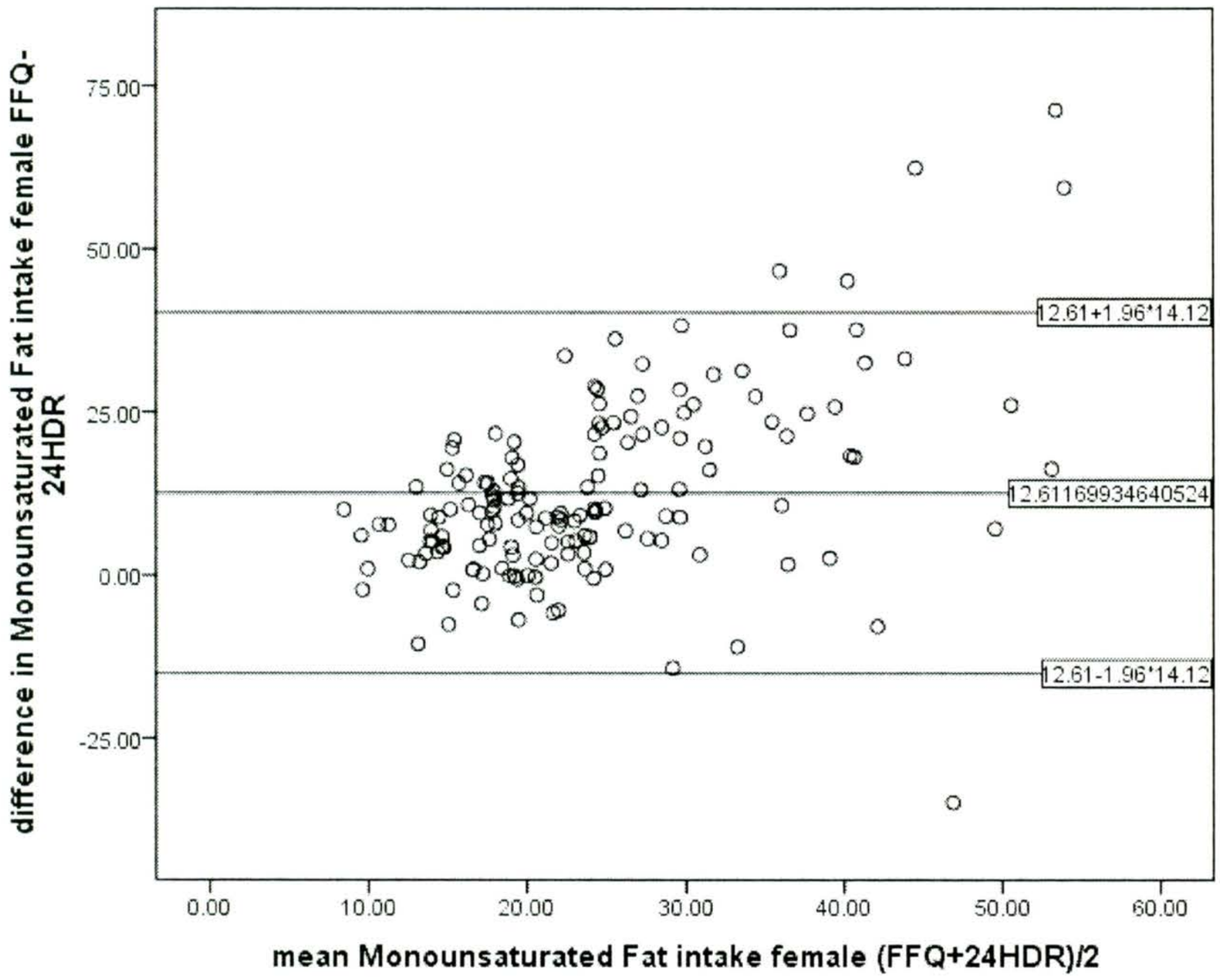
Bland-Altman Plot for Total Fat Intake in Female



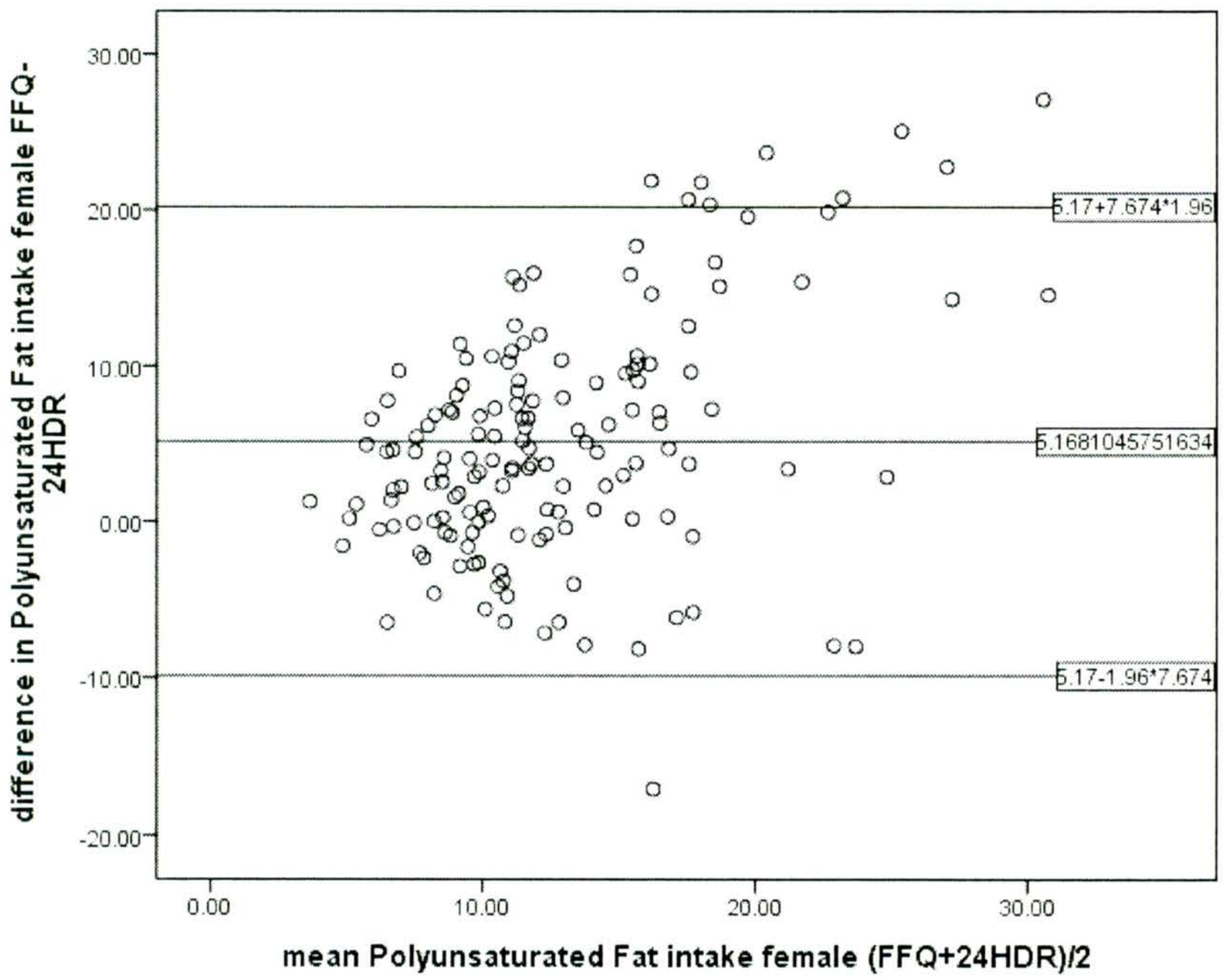
Bland-Altman Plot for Saturated Fat Intake in Female



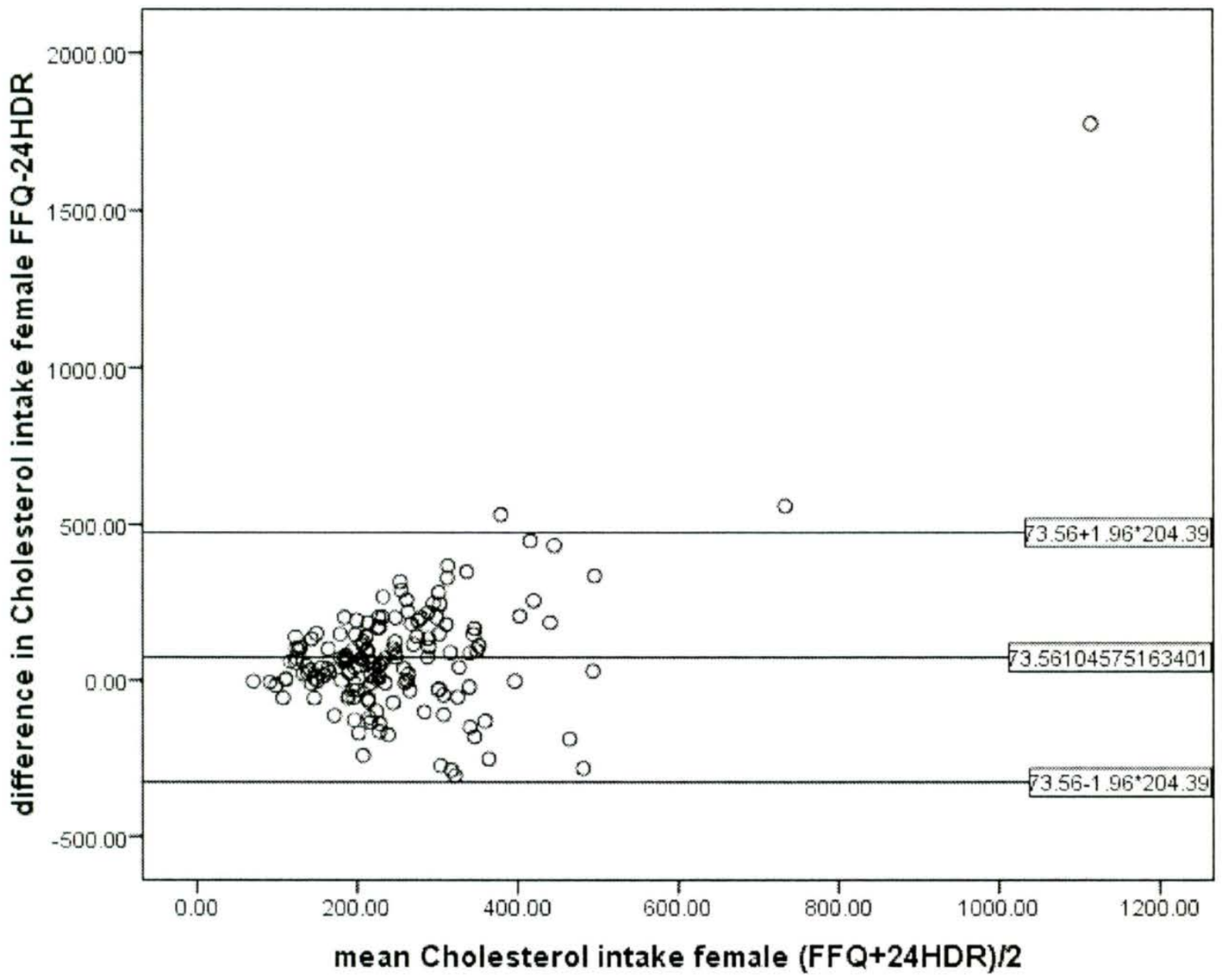
Bland-Altman Plot for Monounsaturated Fat Intake in Female



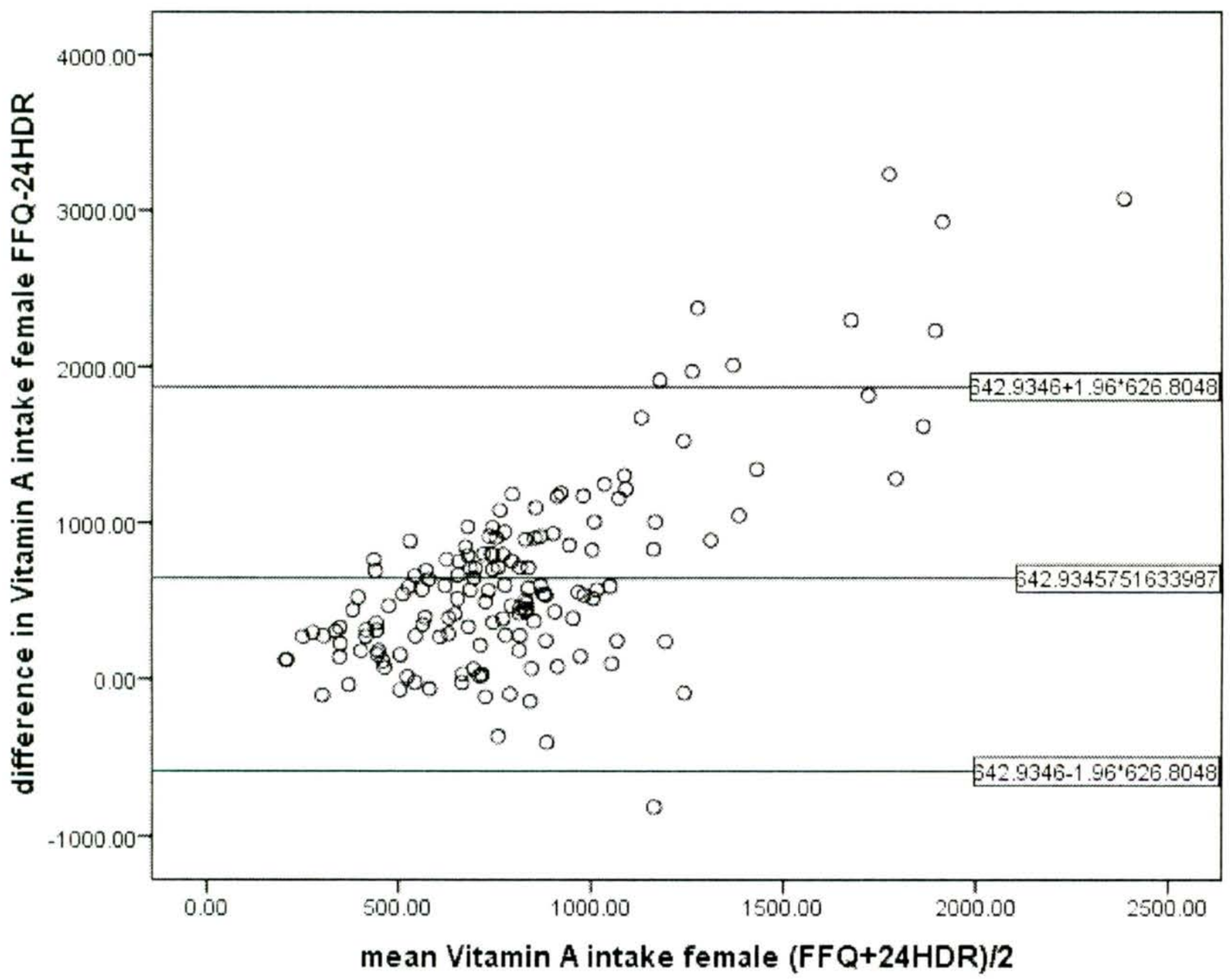
Bland-Altman Plot for Polyunsaturated Fat Intake in Female



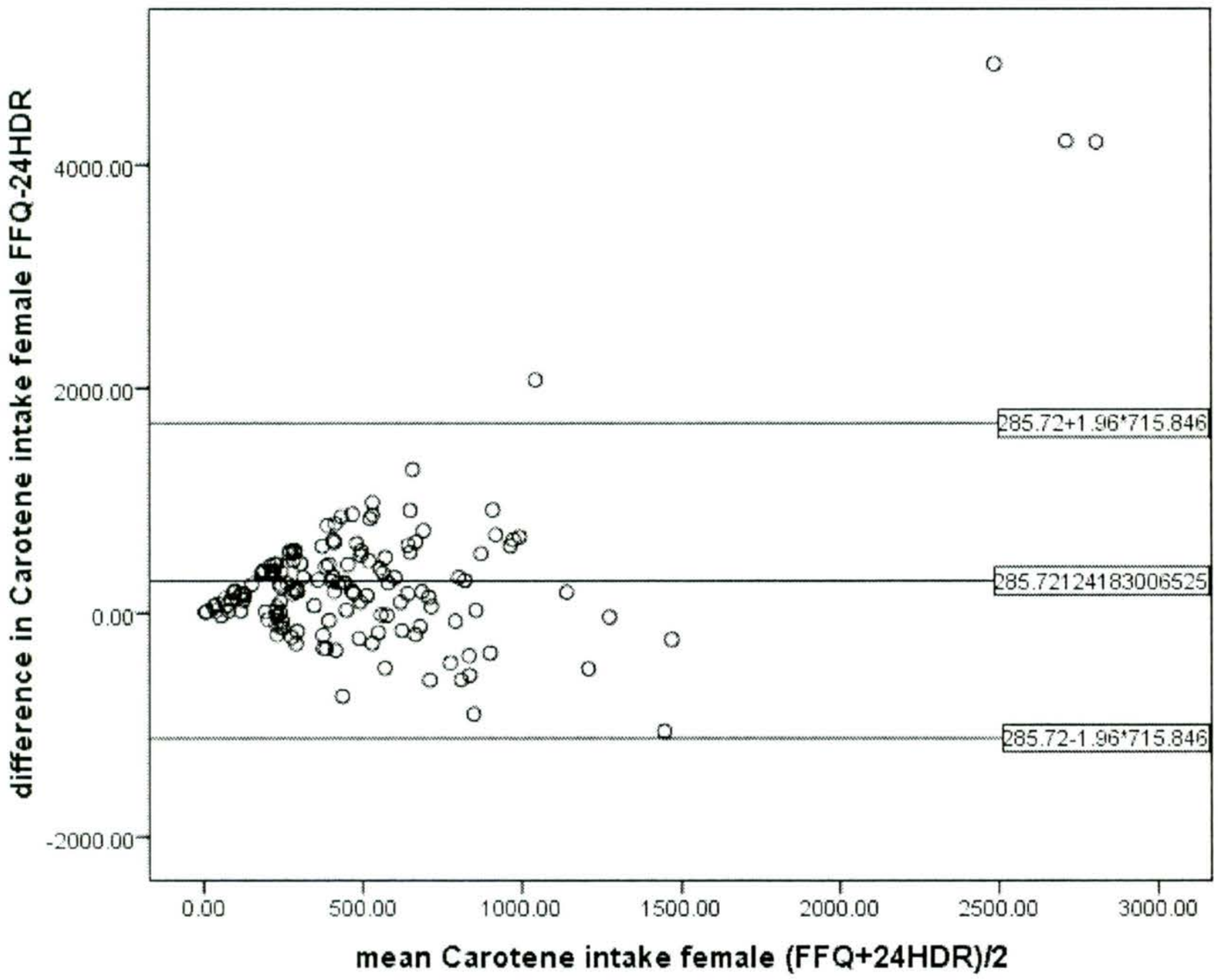
Bland-Altman Plot for Cholesterol Intake in Female



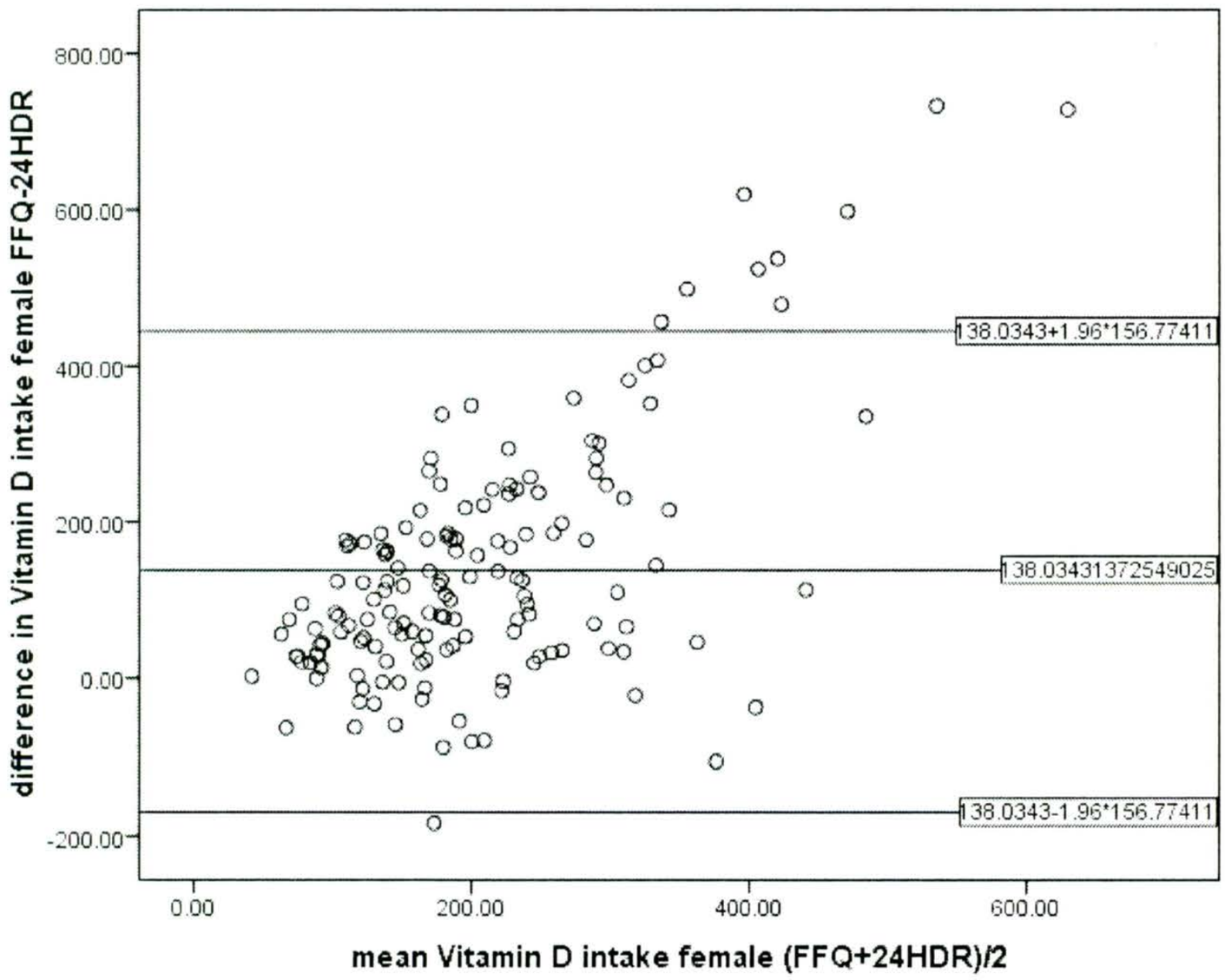
Bland-Altman Plot for Vitamin A Intake in Female



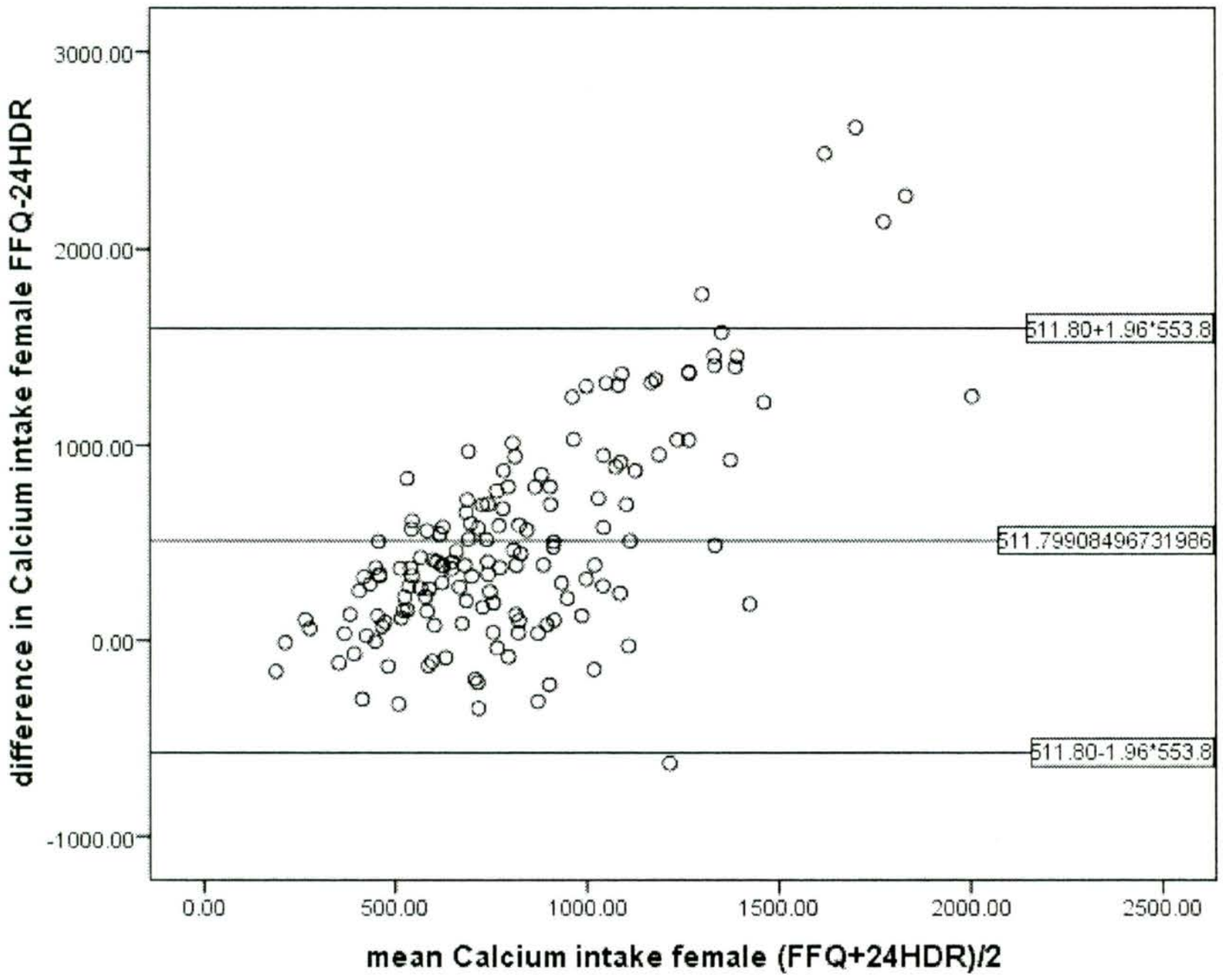
Bland-Altman Plot for Carotene Intake in Female



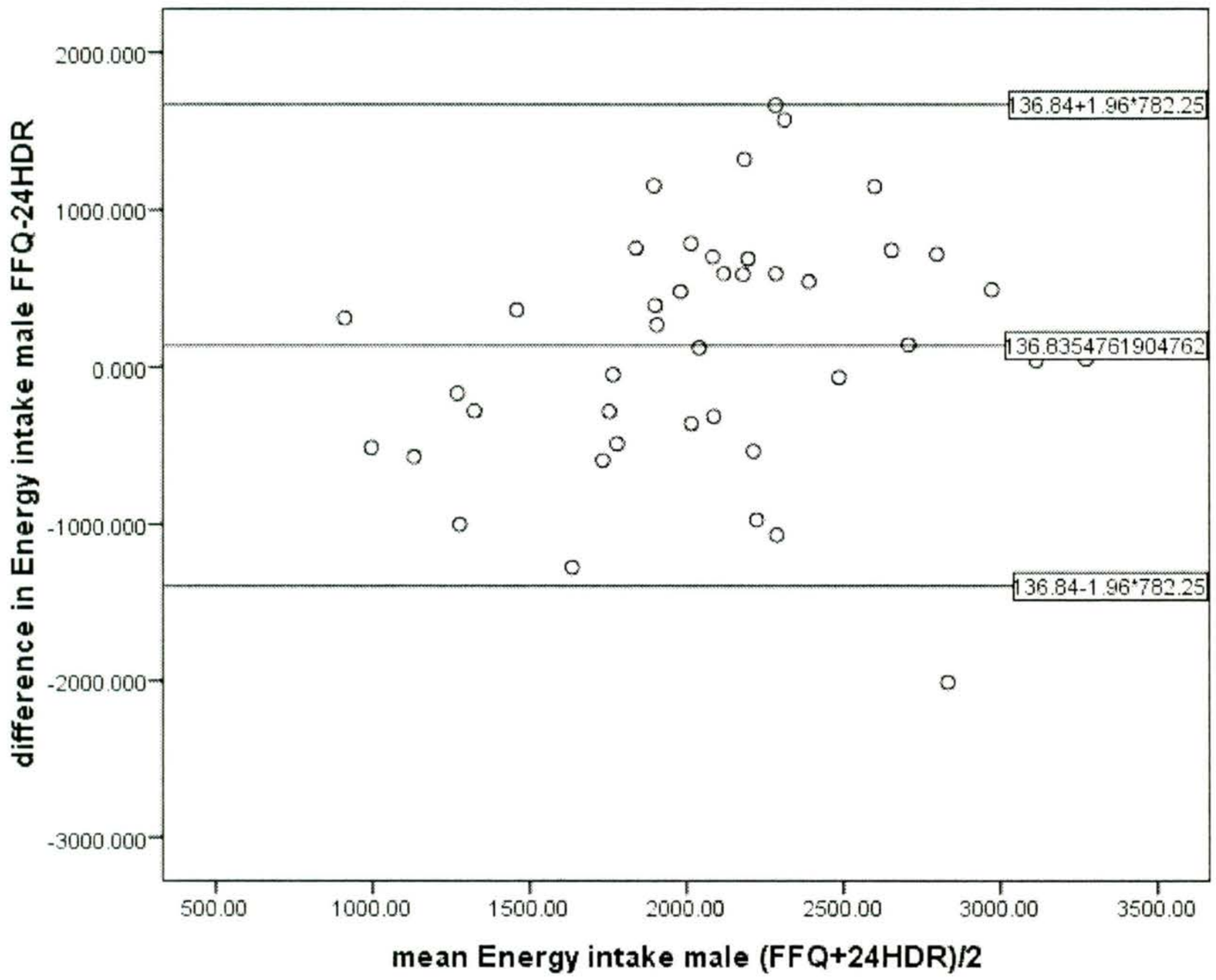
Bland-Altman Plot for Vitamin D Intake in Female



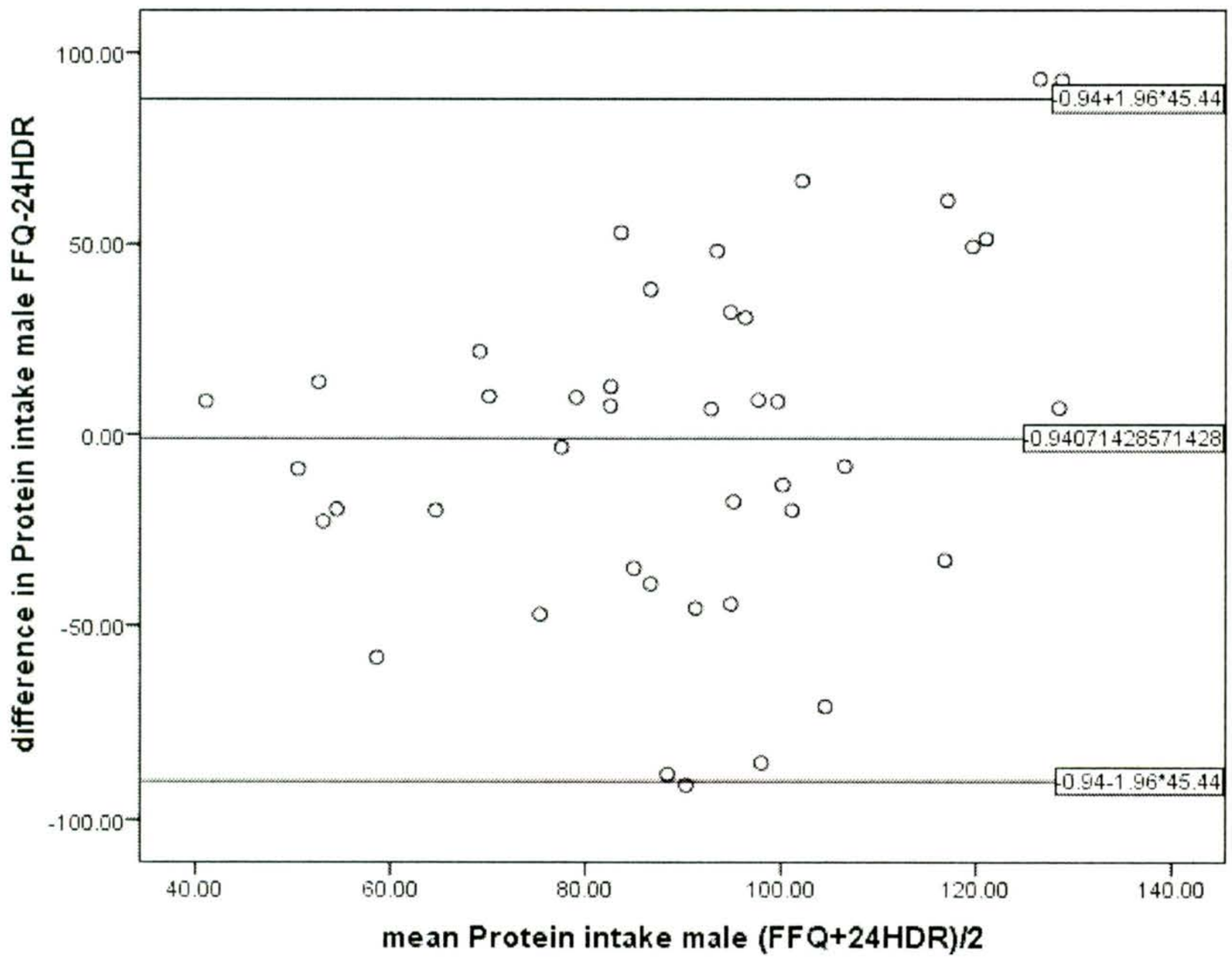
Bland-Altman Plot for Calcium Intake in Female



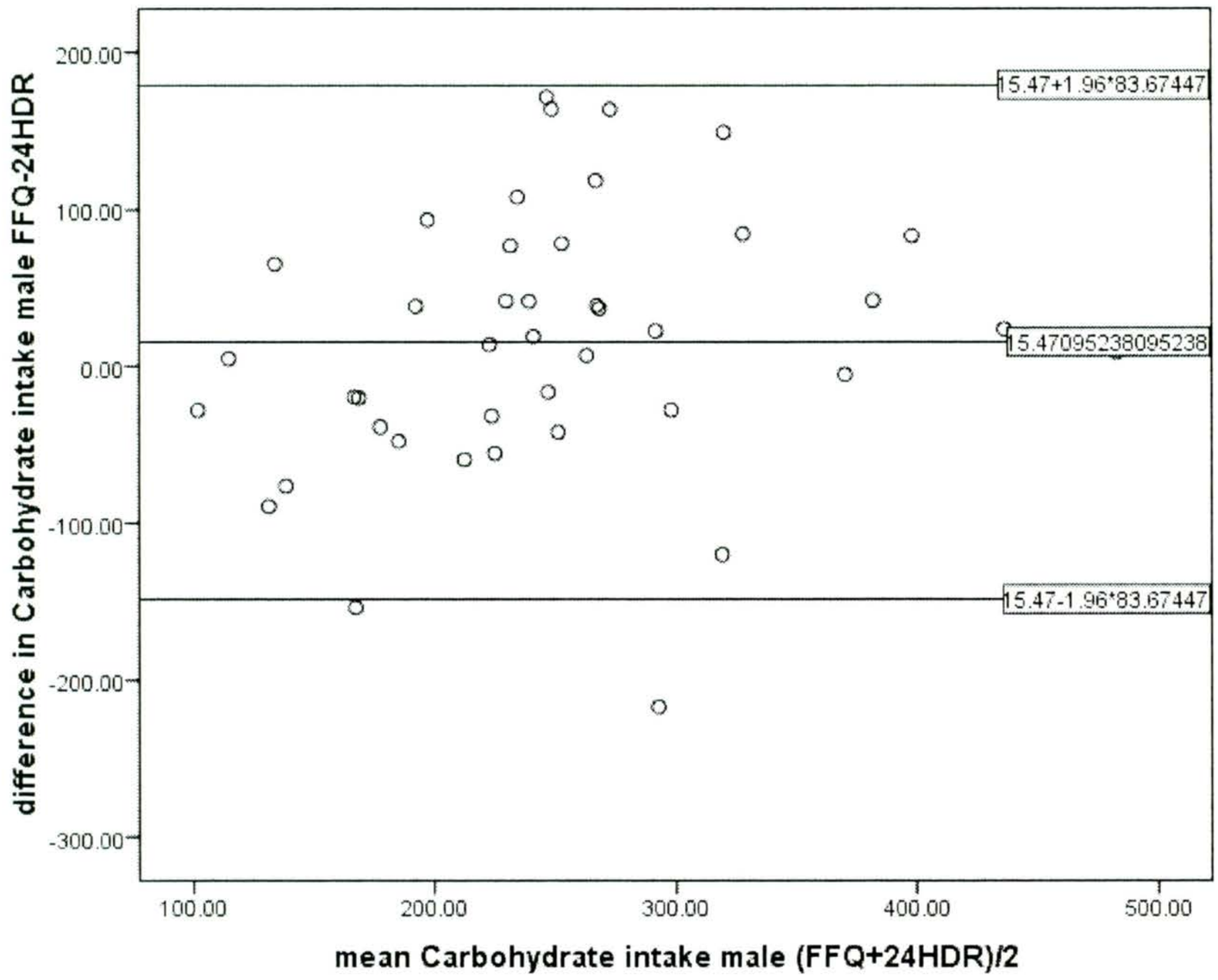
Bland-Altman Plot for Total Energy Intake in Men



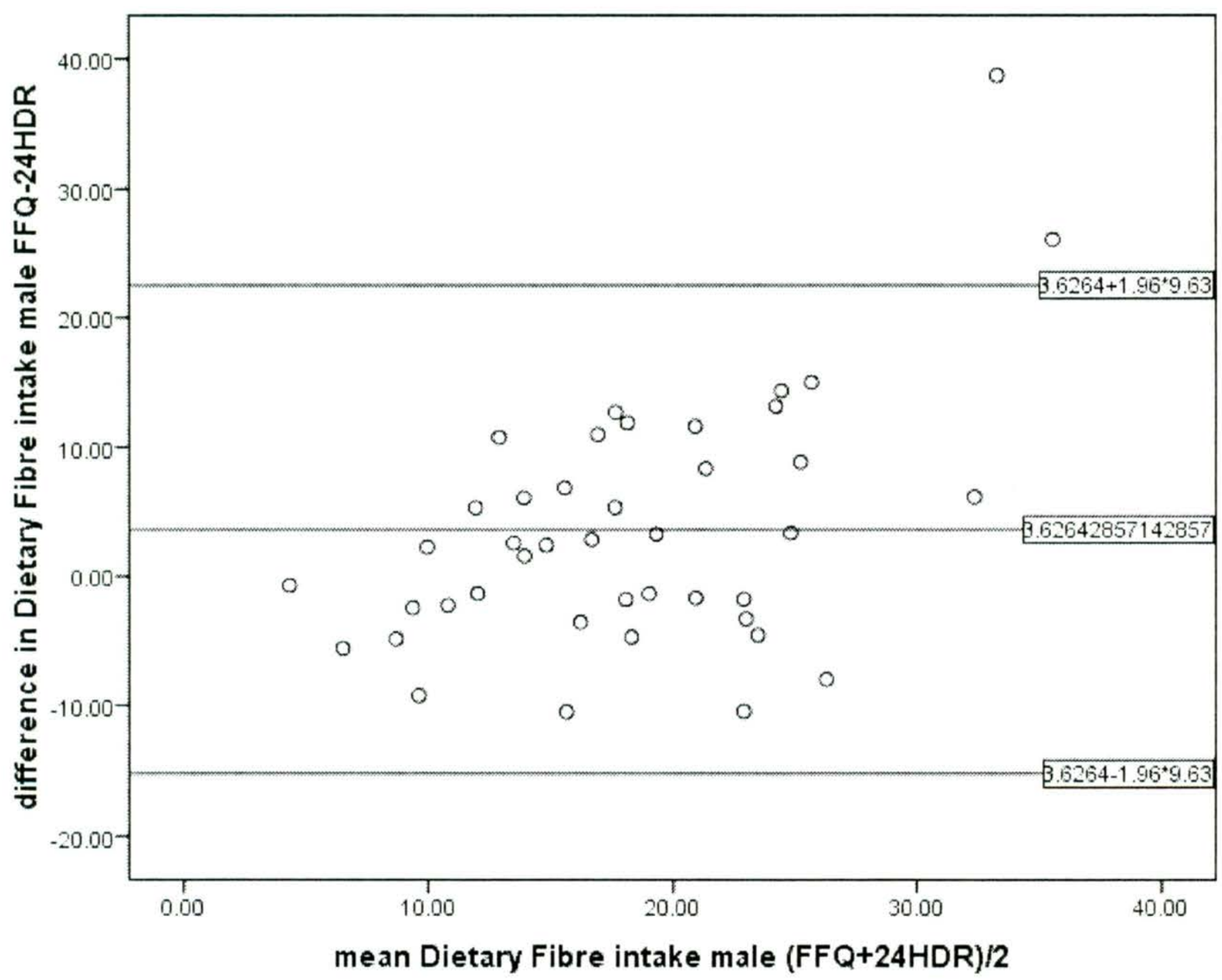
Bland-Altman Plot for Protein Intake in Men



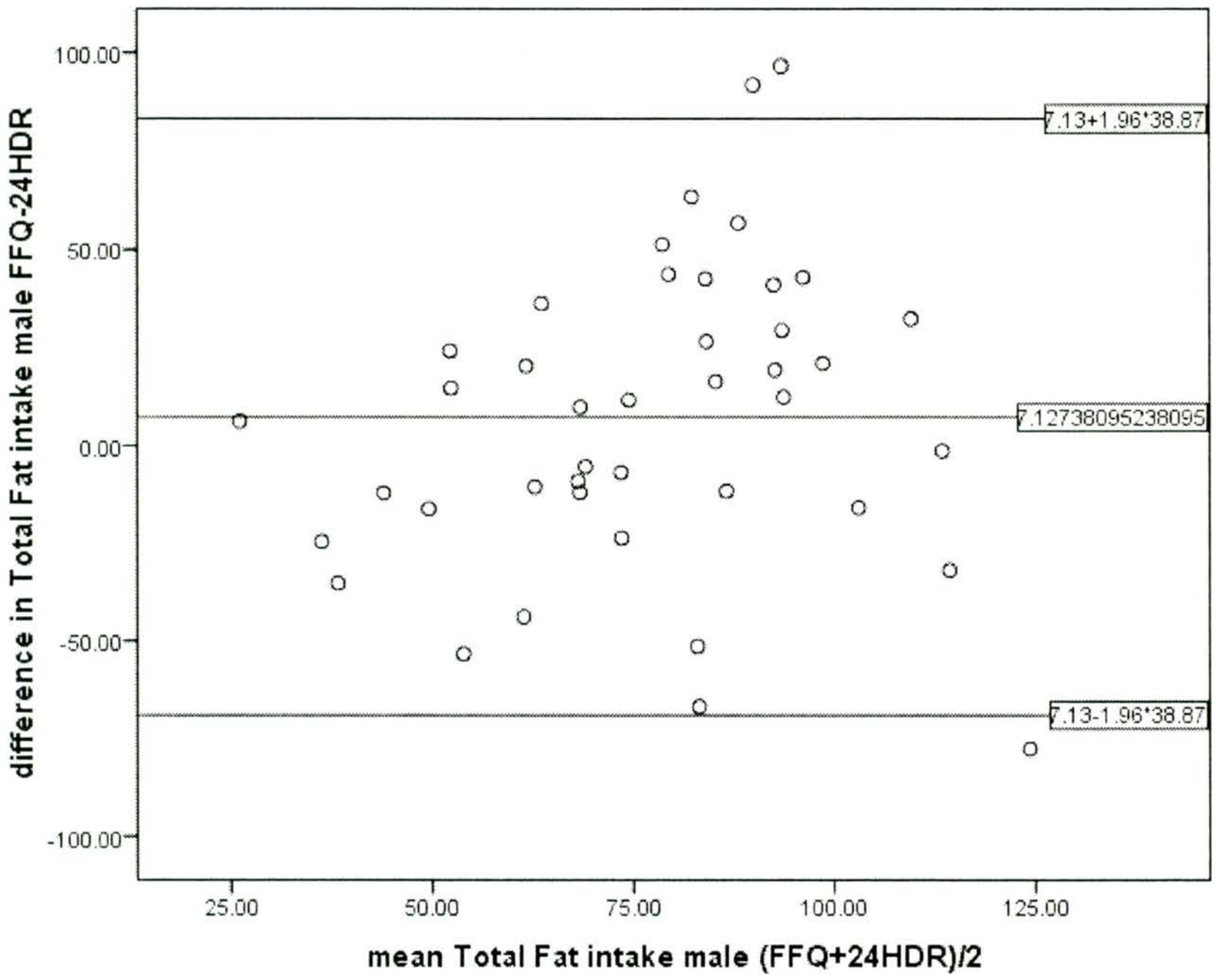
Bland-Altman Plot for Carbohydrate Intake in Men



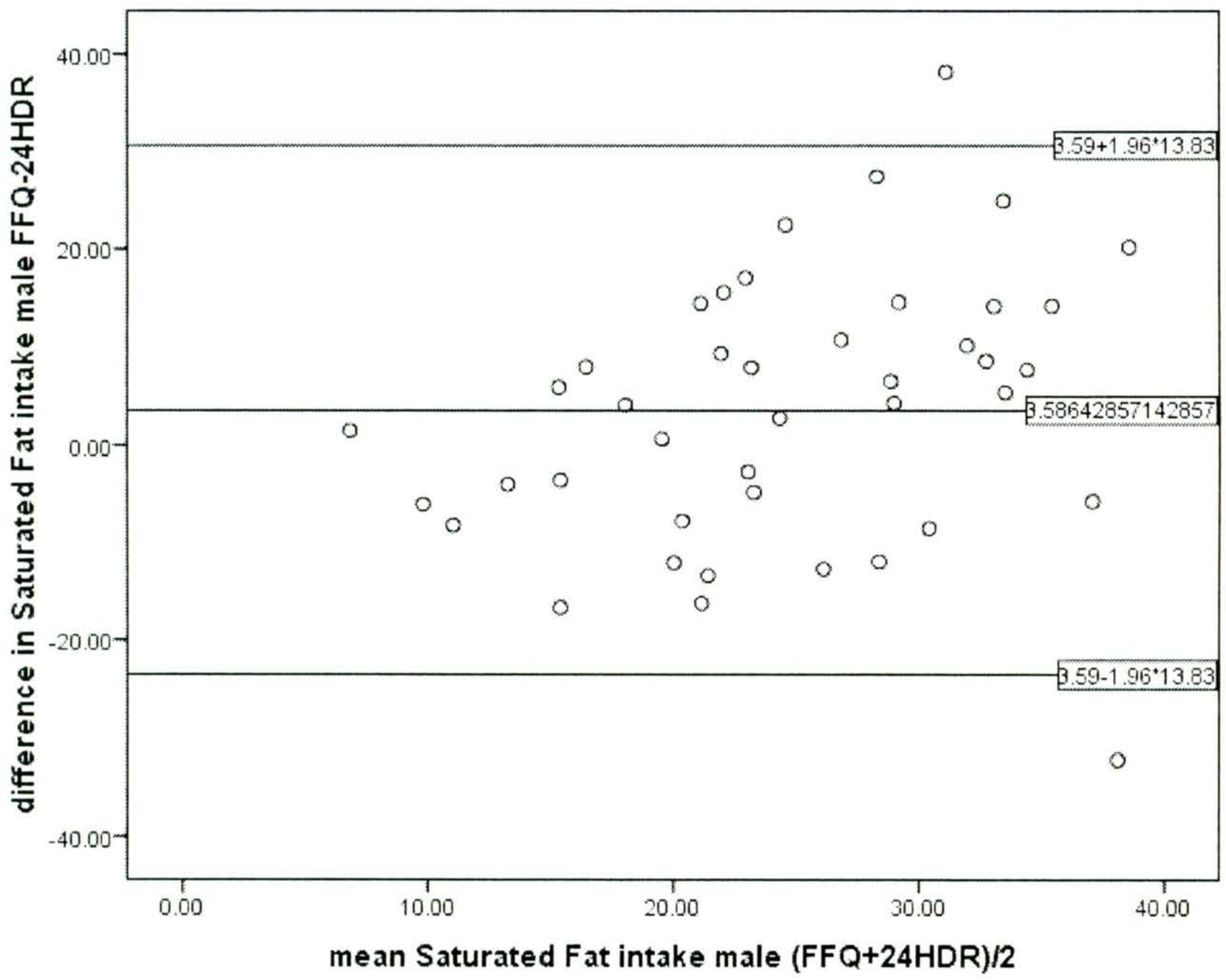
Bland-Altman Plot for Dietary Fibre Intake in Men



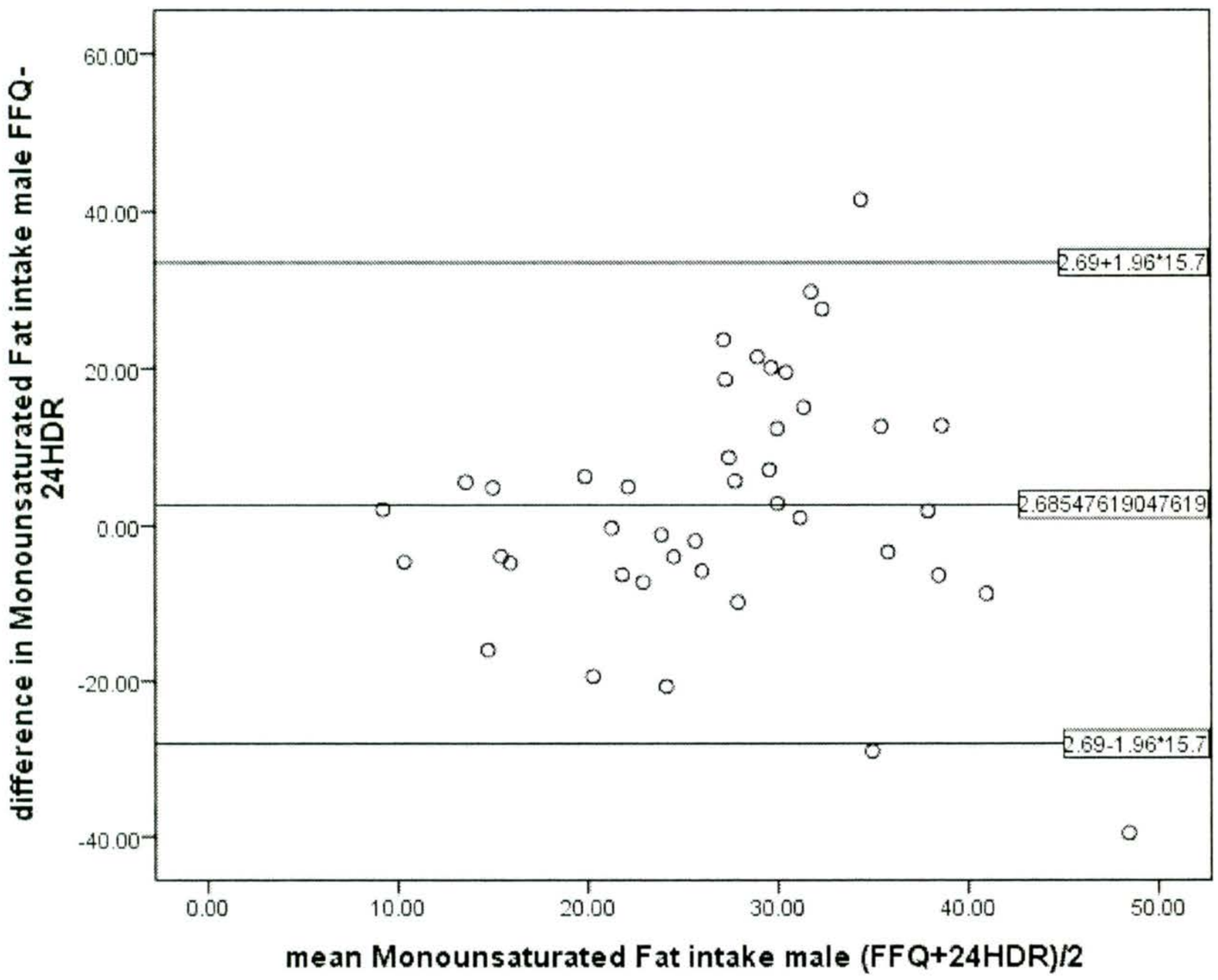
Bland-Altman Plot for Total Fat Intake in Men



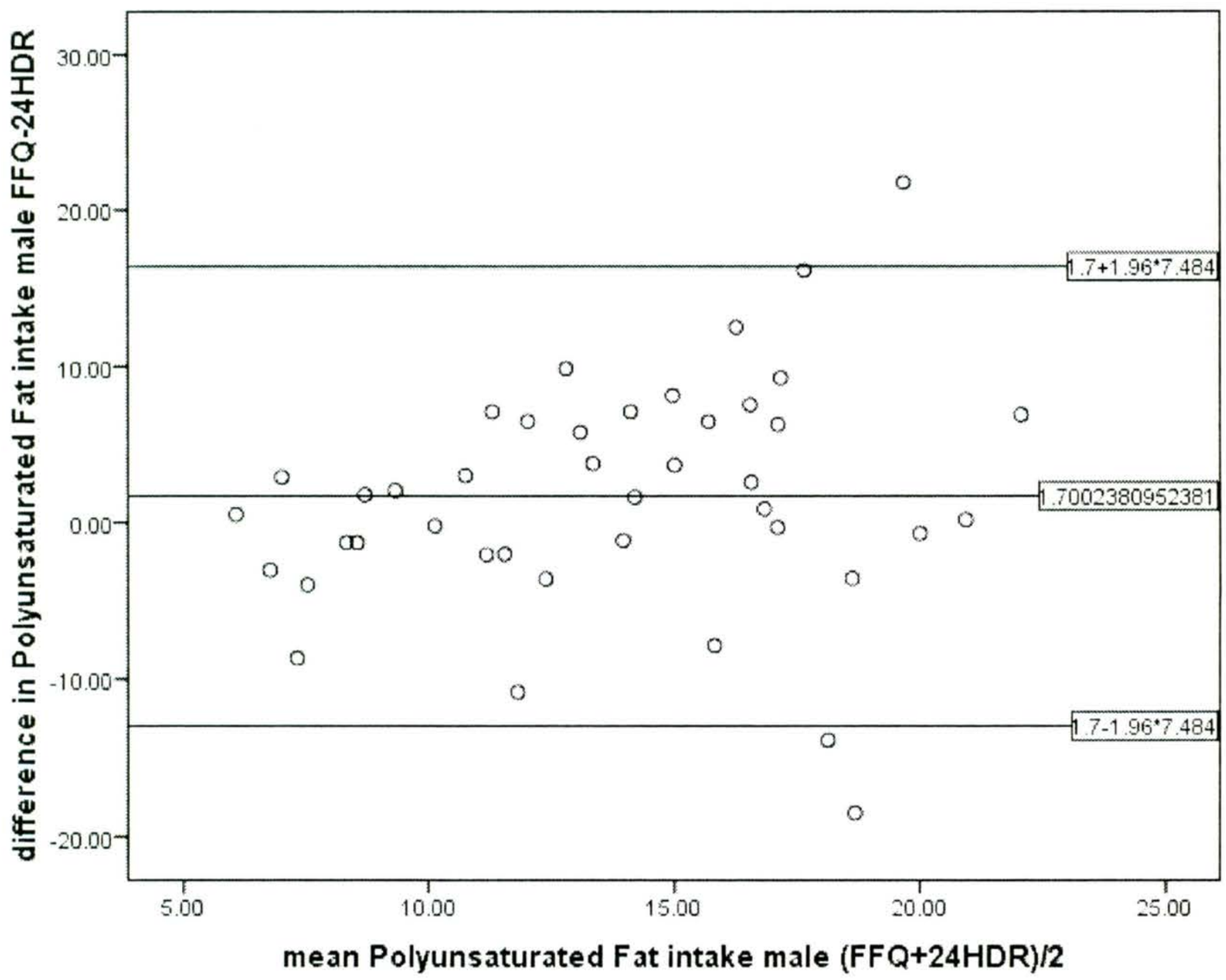
Bland-Altman Plot for Saturated Fat Intake in Men



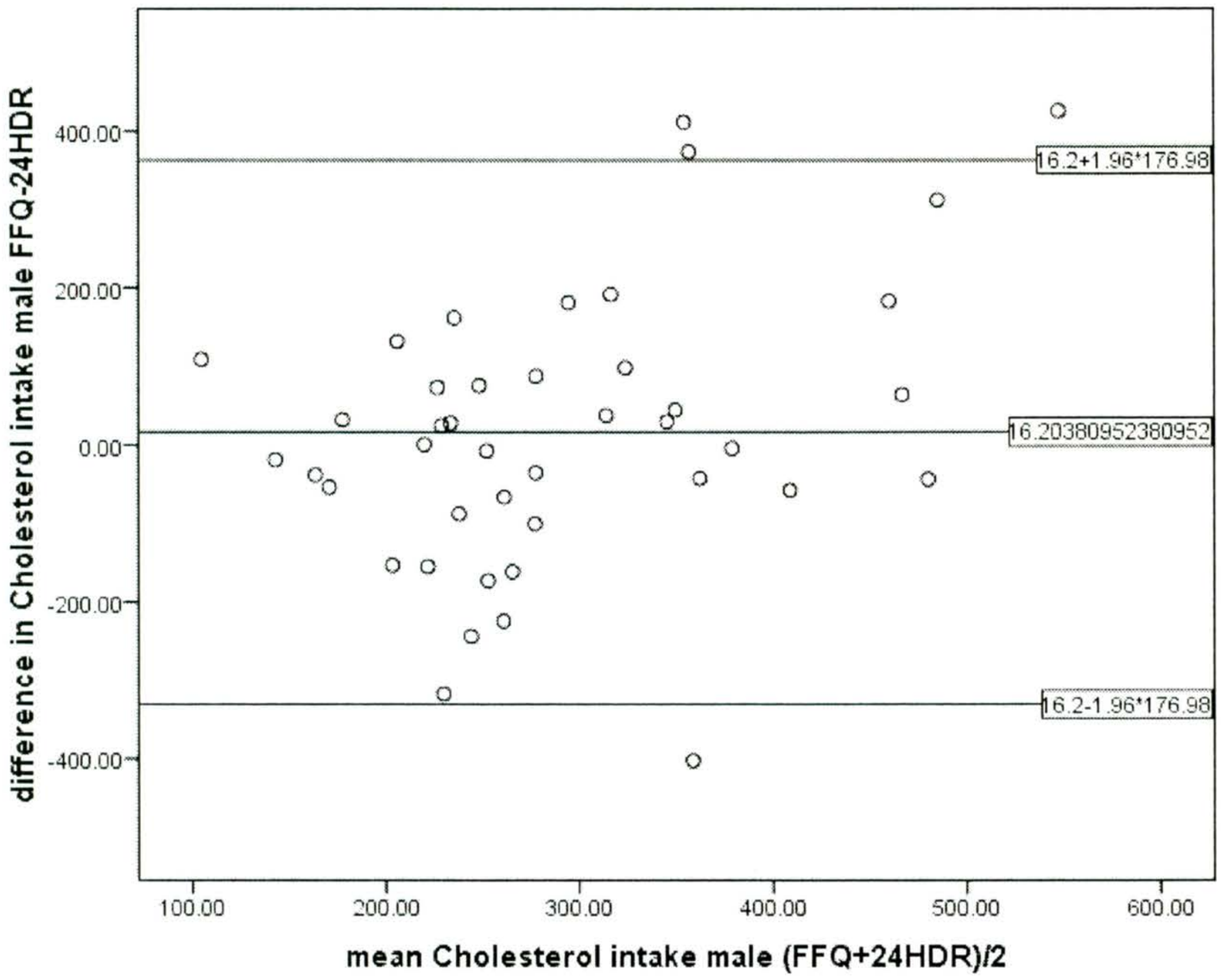
Bland-Altman Plot for Monounsaturated Fat Intake in Men



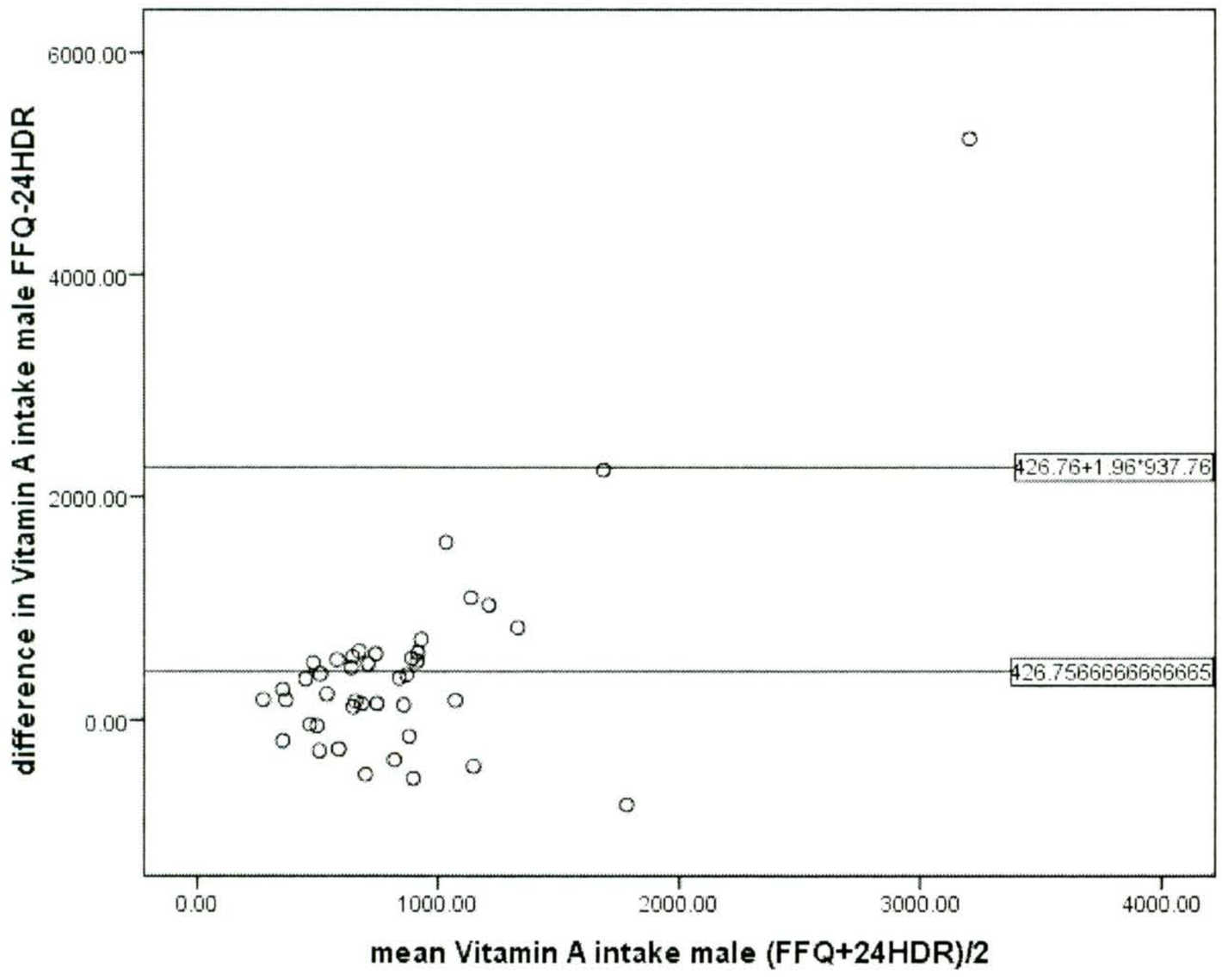
Bland-Altman Plot for Polyunsaturated Fat Intake in Men



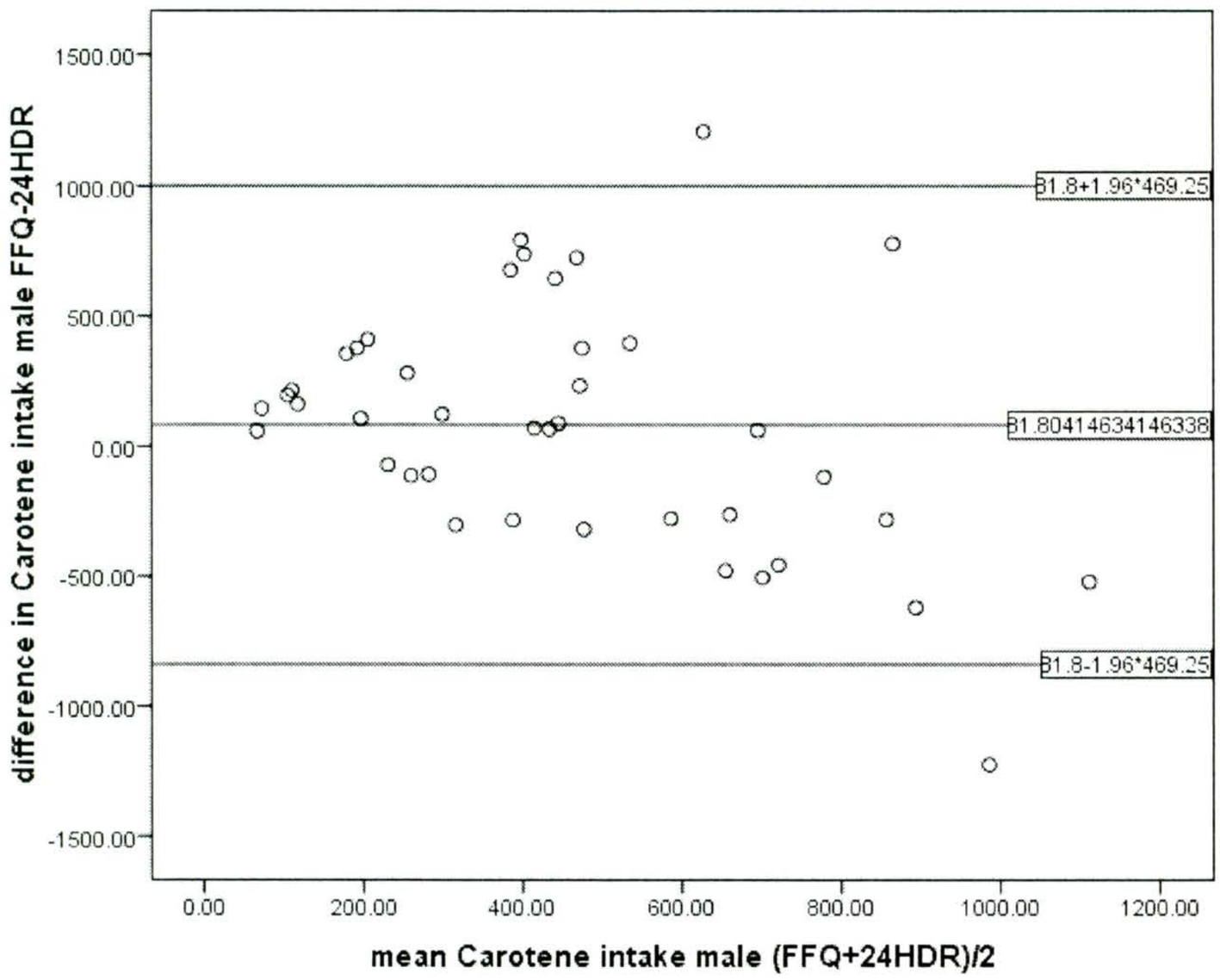
Bland-Altman Plot for Cholesterol Intake in Men



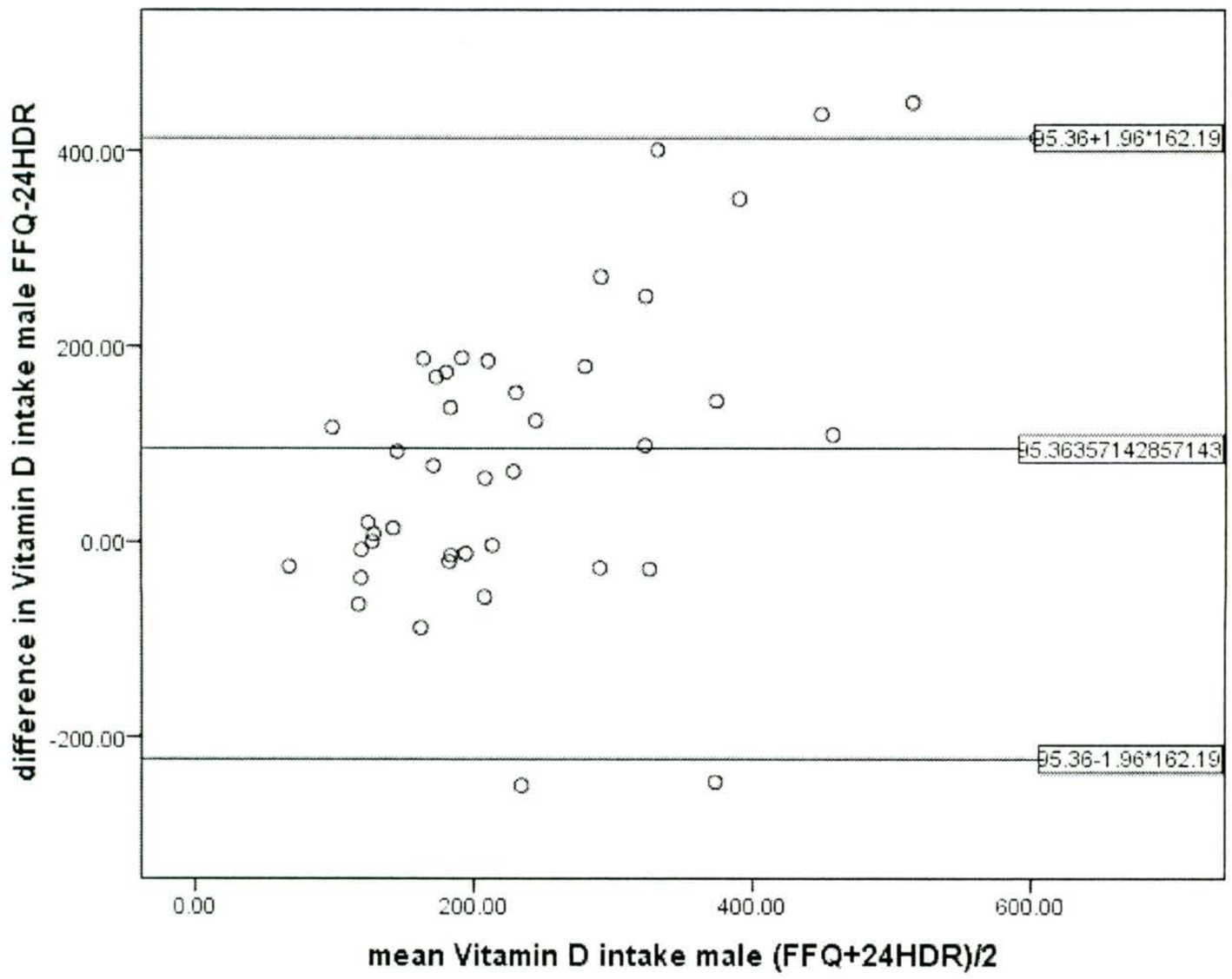
Bland-Altman Plot for Vitamin A Intake in Men



Bland-Altman Plot for Carotene Intake in Men



Bland-Altman Plot for Vitamin D Intake in Men



Bland-Altman Plot for Calcium Intake in Men

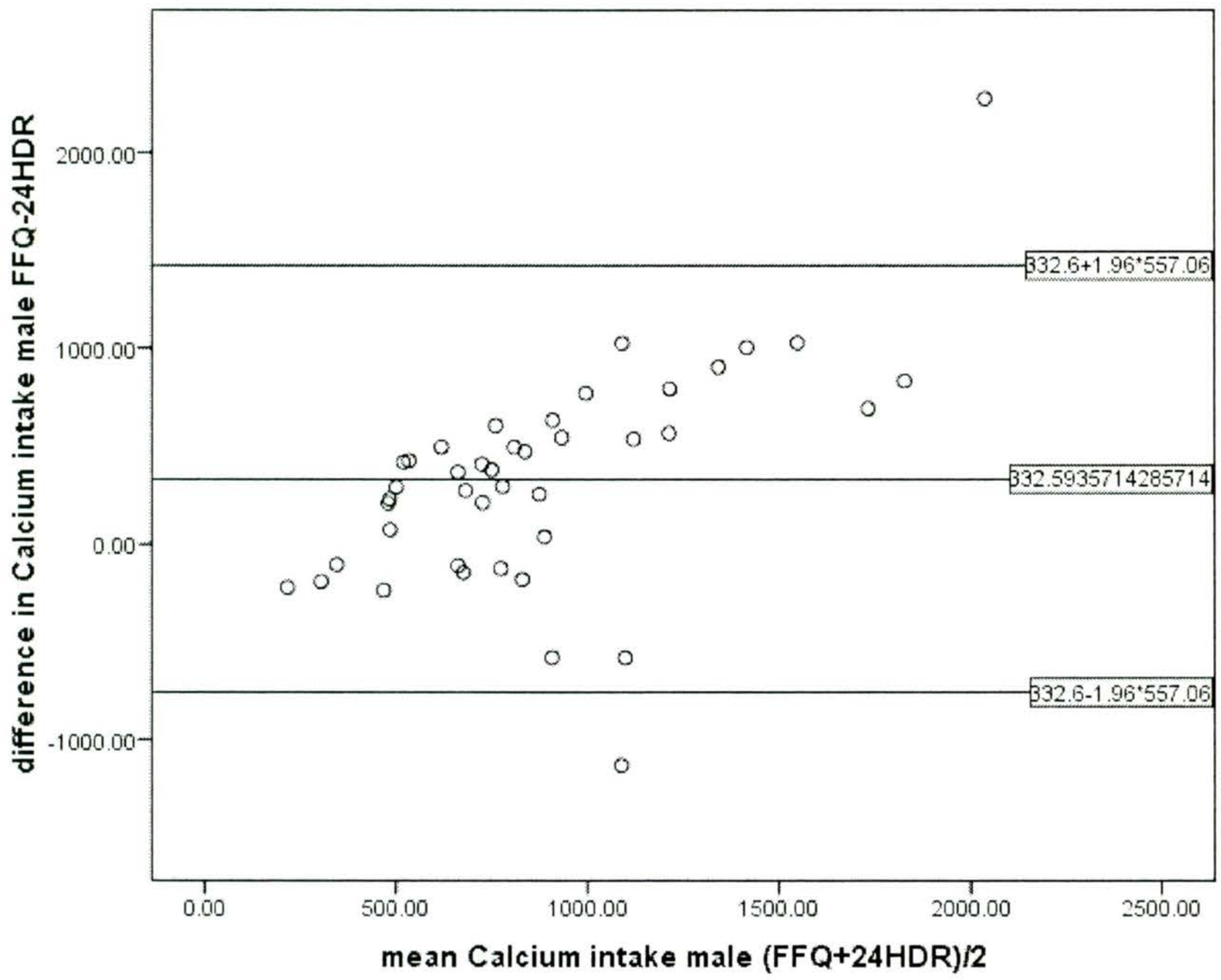


Table 4.1.1 Comparison of Nutrient Intakes per day by Food Frequency Questionnaire (FFQ) and 24-Hour Recall (24-HDR)

	FFQ	**24-HDRs[a]**	***p-value***	**FFQ**	**24-HDRs[a]**	***p-value***
Energy (kcal)	2130.93 (751.47)[b]	1505.33 (496.50)	0.00*	2138.52 (737.47)	2001.68 (604.74)	0.26
Protein (g)	86.83 (30.81)	63.58 (19.81)	0.00*	89.01 (36.35)	89.95 (26.13)	0.89
Carbohydrate (g)	265.12 (106.35)	188.88 (66.55)	0.00*	256.27 (100.97)	240.80 (85.38)	0.24
Dietary Fibre (g)	22.56 (11.68)	14.33 (5.93)	0.00*	20.12 (10.39)	16.49(6.14)	0.02*
Total Fat (g)	83.62 (35.79)	55.42 (23.84)	0.00*	80.87 (31.71)	73.74 (26.98)	0.24
Saturated Fat (g)	26.75 (12.25)	16.91 (8.15)	0.00*	26.48 (11.85)	22.90 (9.05)	0.10
Monounsaturate -d Fat (g)	30.52 (14.39)	17.91 (8.76)	0.00*	28.34 (11.90)	25.65 (11.30)	0.27
Polyunsaturated Fat (g)	15.26 (7.64)	10.09 (4.86)	0.00*	14.59 (6.20)	12.89 (5.06)	0.15
Cholesterol(mg)	288.00 (193.69)	214.44 (104.62)	0.00*	299.12 (155.72)	282.91 (105.23)	0.56
Vitamin A(RAE)	1133.14 (622.12)	490.21 (260.20)	0.00*	1050.41 (897.80)	623.66 (357.54)	0.01*
Carotene (RE)	624.33 (699.23)	338.61 (354.25)	0.00*	499.81 (272.40)	416.53 (417.71)	0.27
Vitamin D(IU)	275.42 (162.57)	137.39 (79.26)	0.00*	287.69 (178.28)	192.32 (100.24)	0.00*
Calcium (mg)	1073.17 (561.17)	561.37 (240.67)	0.00*	1043.57 (615.55)	710.97 (328.90)	0.00*

[a] Average of two round of weighted 24-HDRs

[b] Values are given as Mean (Standard Deviation)

*Significance of the difference between mean 24-HDR and FFQ estimates (p-value<0.05)

Table 4.1.2 Pearson Correlations between Food Frequency Questionnaire (FFQ) Estimates and Weighted 24-Hour Recall (24-HDR) Estimates

Nutrient[a]	**Women**			**Men**		
	Unadjusted	Adjusted[b]	De-attenuated	Unadjusted	Adjusted[b]	De-attenuated
Energy (kcal)	0.23	—	0.26*	0.39	—	0.44*
Protein (g)	0.25	0.30	0.36*	0.07	0.11	0.13
Carbohydrate (g)	0.17	0.34	0.38*	0.56	0.54	0.61*
Dietary Fibre (g)	0.32	0.47	0.52*	0.55	0.54	0.61*
Total Fat (g)	0.33	0.32	0.37*	0.24	0.32	0.38*
Saturated Fat (g)	0.27	0.28	0.33*	0.28	0.26	0.31*
Monounsaturated Fat (g)	0.36	0.29	0.34*	0.23	0.41	0.51*
Polyunsaturated Fat (g)	0.29	0.17	0.20*	0.23	0.20	0.26*
Cholesterol (mg)	0.25	0.34	0.44*	0.10	0.33	0.42*
Vitamin A(RAE)	0.26	0.32	0.38*	0.23	0.35	0.42*
Carotene (RE)	0.40	0.38	0.50*	0.13	0.19	0.28*
Vitamin D (IU)	0.32	0.37	0.45*	0.41	0.45	0.55*
Calcium (mg)	0.32	0.43	0.50*	0.50	0.45	0.51*

[a] All nutrients were log-transformed to improve normality.

[b] Nutrient intakes were adjusted for total energy intake by residual method.

*Correlations of 0.16 and higher have a p-value less than 0.05

Table 4.1.3 Percentage for Cross-Classification of Energy-Adjusted Nutrient Intakes into Quartiles Estimated from the Food Frequency Questionnaire (FFQ) and 24-Hour Recalls (24-HDRs)

Nutrient[a]	Women				Men			
	Same quartile (%)	Adjacent quartile (%)	One quartile apart (%)	Grossly misclassified (%)	Same quartile (%)	Adjacent quartile (%)	One quartile apart (%)	Grossly misclassified (%)
Energy (kcal)	24.8	43.1	24.2	7.8	40.5	33.3	21.4	4.8
Protein (g)	33.3	41.2	18.3	7.2	23.8	45.2	23.8	7.1
Carbohydrate (g)	32.7	45.1	19.0	3.3	40.5	45.2	12.0	2.3
Dietary Fibre (g)	40.5	38.6	17.6	3.3	38.1	42.9	19.0	0.0
Total Fat (g)	34.6	35.3	23.5	6.5	31.0	42.9	16.6	9.5
Saturated Fat (g)	32.7	42.5	17.6	7.2	28.6	50.0	14.3	7.1
Monounsaturated Fat (g)	37.9	33.3	20.3	8.5	38.1	45.2	9.5	7.1

[a] Classification was performed using log-transformed nutrient values.

Table 4.1.3 Percentage for Cross-Classification of Energy-Adjusted Nutrient Intakes into Quartiles Estimated from the Food Frequency Questionnaire (FFQ) and 24-Hour Recalls (24-HDRs) _ ***Continued...***

Nutrient[a]	Women				Men			
	Same quartile (%)	Adjacent quartile (%)	One quartile apart (%)	Grossly misclassified (%)	Same quartile (%)	Adjacent quartile (%)	One quartile apart (%)	Grossly misclassified (%)
Polyunsaturated Fat (g)	34.0	32.7	24.2	9.1	33.3	42.9	14.3	9.5
Cholesterol (mg)	32.7	36.6	24.2	6.5	40.5	40.5	11.9	7.1
Vitamin A(RAE)	30.1	42.5	20.3	7.2	26.2	47.6	21.4	4.8
Carotene (RE)	37.9	39.2	16.3	6.5	31.0	40.5	21.4	7.1
Vitamin D (IU)	38.6	39.2	18.3	3.9	23.8	57.1	14.3	4.8
Calcium (mg)	31.4	45.8	19.0	3.9	33.3	52.4	9.5	4.8

[a] Classification was performed using log-transformed nutrient values.

4.2 Paper 2: Food Consumption Patterns in the General Adult Population of Newfoundland and Labrador, Canada

4.2.1 Introduction

In the past, nutritional epidemiology has focused predominantly on the relationship between diseases and intakes of specific nutrients or foods. However, over the past few decades, an increasing number of researchers have used food consumption patterns to characterize the population's diet and to examine its relation to health [194-197]. The analysis of food consumption patterns examines the whole diet and takes account of the combined effects of food and nutrients consumed together [19]. Therefore, this analysis may provide a more accurate description of actual dietary exposure. In addition, several studies have indicated that a modern 'Western' dietary pattern, characterized by high intakes of meat, highly processed foods, and sweets, is associated with an increased risk of obesity [198, 199], heart disease [200] and metabolic disease [95, 201]. In contrast, a 'Healthy or Prudent' pattern, characterized by higher intakes of fruits, vegetables, legumes, whole grains, poultry, and fish have been associated with significant but modest risk reduction (15%-30%) for all-cause mortality and coronary heart disease [95].

Despite the well-known dietary and cultural differences between Newfoundland and Labrador (NL) and the rest of Canada [11], there has been limited nutritional epidemiological research conducted in the NL population. Dietary nutrient intakes could be estimated by analyzing the 2004 Canadian Community Health Survey (CCHS Cycle 2.2, Nutrition Focus) [183]. Unfortunately, this survey cannot be considered accurate, as the CCHS did not contain certain foods commonly found in the NL diet (such as pickled meat, bakeapples) and did not have a good representation

of this population. In summary, there is a need to know more about current food consumption patterns of NL adults.

The objectives of the study are to (1) evaluate the patterns of food consumption in the general adult population of Newfoundland and Labrador and (2) to assess whether these patterns vary according to demographic characteristics.

4.2.2 Methods:

This study is part of a broader food-frequency questionnaire (FFQ) validation project addressing the food consumption patterns, nutrition conditions, and the association between colorectal cancer and dietary intake in the general NL adult population. The original study was carried out in the province of Newfoundland and Labrador, Canada between February 2011 and May 2012.

4.2.2.1 Sampling Design and Sample Size

According to the 2011 Census Information and Statistic[202], the population of NL is about 514,536 with over 57% of the residents living in rural communities. Based on the information (means and standard deviation for various nutrients) derived from the FFQ data of the on-going CRC project [153, 203-205] and the generally acceptable correlation coefficient value of 0.6 [206], the minimum sample size for this study was 98 participants [207]. A stratified random digit dialing [208] with proportional allocation sampling methodology was adopted for this study. Geographically, the survey covered the whole of NL, both the urban and rural areas.

With the intention of measuring food intakes for the general NL population, the following inclusion criteria were used. An eligible participant should be:

1) A non-institutionalized adult resident of NL who has lived in NL for at least two years at the time of the study;

2) 35-70 years of age;

3) Able to speak and read English at a grade 8 level; and

4) Be without the following conditions at the time of the study: cognitive impairment, psychological conditions, or pregnancy.

Therefore, using a residential telephone number list provided by Info Canada [145], an initial random sample of 450 participants from the general population were recruited by telephone. A total of 306 persons were identified as eligible respondents and were sent the survey packages. 205 individuals participated in the survey, giving a response rate of 67.00%. This research was approved by the Interdisciplinary Committee on Ethics in Human Research (ICEHR) [177], at Memorial University.

4.2.2.2 Food Consumption Assessment Method

A self-administered food-frequency questionnaire (FFQ) was used to determine the food consumption pattern of the NL adult population. The original Hawaii FFQ was designed to assess the typical food intake of individual males and females in a multi-ethnic Hawaiian/ Southern Californian population [15]; it has been validated and widely used in the United States [159-161]. The FFQ administered in NL was modified to account for the unique food consumption habits in NL. Food items considered unusual in NL (e.g. tamales, ham hocks) were deleted or altered while some items commonly consumed in NL (e.g. moose meat, salt/pickled meat) were added. The NL FFQ consisted of a list of 169 food items and included a number of composite dishes that may contain multiple ingredients. The foods and beverages were categorized into nine major groups, including: (1) beverages, (2) dairy products, (3) mixed dishes, (4) vegetables, (5) meat & fish, (6) cereals & grains, (7) fruits, (8) desserts & sweets, and (9) miscellaneous.

Participants were required to recall how often they usually consumed each item,

choosing only from the following options for each food: (1) per day, (2) per week, (3) per month or (4) rarely or never. Subjects were also requested to respond to the number of habitual servings consumed when they ate the food. A reference portion, expressed in household measures or grams, was specified for each food item in the FFQ. For those whose portion size was different than the reference, they were given the option to choose smaller or larger portion sizes. Smaller than the average is considered to be a portion that is approximately 25% less than the reference portion size, while a larger than average portion is considered to be approximately 25% more than the reference size.

If a food item was consumed on a seasonal basis, the individual was asked to estimate the number of times per day, per week, per month, or never/rarely that they would consume the food during its season, and then also indicate the length of the particular food's season (i.e. consuming bakeapples 2 times per week for 3 months only).

Additional information collected and used in the present paper pertains to age, gender, size of their community, marital status, employment status, level of education, and smoking habits.

4.2.2.3 Data Analysis

The 169 food items in the FFQ were grouped into 36 predefined categories according to their nutritional characteristics and the usual frequency of consumption in this population; several foods (e.g. eggs, beer) comprised their own groups. The median intakes of these food groups were adjusted for total energy intake with the use of the residual method [1] to obtain factors uncorrelated with total energy intake. Nutrient intakes for individuals were calculated using the ESHA Food Processor database software [162]. If a participant reported consuming a food that was not

present in the database, the most appropriate alternative was chosen through a discussion with the research team or by consultation with experts in the field.

Exploratory factor analysis of the reported number of servings of the various food groups was used to define the patterns of food consumption within the population. The Bartlett's Test of Sphericity (BTS) and the Kaiser-Meyer-Olkin (KMO) measurement of sample adequacy were used to verify the appropriateness of using factor analysis. The principal component analysis (PCA) was used for factor extraction; factors were also orthogonally rotated (Varimax option) to achieve simpler structure with greater interpretability. Factors were retained based on the following criteria: eigenvalue>1.25, identification of a break point in the scree plot and the interpretability of the factors [172]. To describe the food consumption pattern within each component, a component matrix was generated. Items were considered to load on a factor if they have a correlation of greater than 0.3 with that factor [173]. We also retained food groups that have negative correlations ($\leqslant$-0.2) to incorporate the valuable information concerning infrequently consumed foods within each factor [174].

Univariate analyses and Multivariable Linear Regression Models were used to assess the relationship between participants' food consumption patterns and demographic variables, with factor scores being the dependent variable. Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS, version 10.5) software. Differences with p-value <0.05 were considered to be statistically significant.

4.2.3 Results

4.2.3.1 Demographic Information

Out of a total of 205 questionnaires received by June 2012, we excluded participants who had left over 20 continuous items blank on the FFQ (n=5) and those who reported energy intakes outside the range of 500-5000 kcal which matches the exclusionary rules for food-frequency questionnaire data used by Willett [1] (n=8). As a result, the remaining 192 respondents were involved in all further analyses.

Table 4.2.1 presents the social and demographic characteristics of the study sample. The sample consisted of 43 men and 149 women, aged 35 to 70 years, with a mean age of 54.99 ± 8.74 years. Most participants were females (77.6%), were non-smokers (82.8%), and had a high education level (59.4%). There were no significant differences according to demographic characteristics between respondents and non-respondents (data not shown).

4.2.3.2 Factor Analysis

The observed KMO was 0.602; therefore the sample was considered to be adequate for factor analysis. The BTS was significant ($p<0.001$) indicating homogeneity of variance by the consumption of food. **Figure 4.2.1** shows the scree plot of eigenvalues for each component. The first eigenvalue (4.11), the second (3.03), and the third (2.12) dropped substantially. After the fourth factor (1.84), the results remained more consistent (1.73 for the fifth and 1.63 for the sixth factor). As a result, a 4-factor solution was selected. These four components accounted for 31% of the variability of food consumption within the sample. Some studies have found that factor solutions differ by gender [174, 209]; therefore, we conducted factor analyses separately for men and women. We found that there was no difference in deciding the number of food consumption patterns between genders (data not shown).

The factor loadings of foods for the four identified food consumption patterns are shown in **Table 4.2.2**, which were labeled 'vegetables', 'red meat', 'fish' and 'whole grains'. We named the first pattern Vegetables, as it has an emphasis on foods of vegetable groups, fruits, nuts, poultry, and added fat rather than on cured/processed meat. The Red Meat pattern was characterized by a high consumption of red meat, cured/processed meat, soft drinks, added fat (vegetable oil), poultry and mixed dishes with high energy but by a low consumption of dark yellow vegetables or legumes. The Fish pattern had a preference for fish, processed fish, tea, game meat (such as moose, sea-birds meat), low-fat sweets, soups, potatoes, pickled vegetables, some vegetables (legumes and dark yellow vegetables), refined grains — but not coffee, soft drinks, and alcohol. The final pattern was labeled Whole Grains because of the high positive loadings in whole grains, cereals, low-fat dairy products, and fruits, but negative loadings in the groups of refined grains/white bread, beer, sweets, potatoes and game meat.

4.2.3.3 Univariate and Regression Analysis

Univariate analysis with factor loading scores, as seen in **Table 4.2.3**, reveals some differences in food consumption patterns associated with demographic characteristics. The variables Previous Smoking Daily and Current Employment were not included in the analysis because there were unusable values in these two categories. Compared to those senior participants (61-70 age-group), participants aged 51 to 60 years had significantly lower scores for the Vegetable and Fish pattern. People aged 41-50 years had higher scores for the Red Meat pattern but lower scores for the Fish pattern. Men had significantly higher scores for the Fish pattern while women scored higher for the Whole Grain pattern. Regarding the difference in living area, there were no significant differences observed. However, a trend was observed

that urban residents have scored higher in the patterns Vegetable and Whole Grains, while rural residents were likely to have higher scores in the other two patterns. The only observable difference regarding education level was that people who indicated a lower education level had significantly higher scores for the Fish pattern than those with higher levels of post-secondary education. In addition, current daily smokers had significantly higher scores for the Red Meat pattern but lower scores for the remaining patterns (not significant).

The results from the regression analyses can be seen in **Table 4.2.4**. The overall model was significant for the Vegetable, Fish, and Whole Grains patterns. Current daily smoking habit was associated with higher factor scores in the Red Meat pattern but lower factor scores in the Whole Grains pattern. For the Fish pattern, significantly increased scores were observed with increasing age. The rest factors were not related to the scores for any pattern.

4.2.4 Discussion

Our present study identified four major food consumption patterns in a representative sample of the adult population in NL and showed associations with selected demographic factors. Independent of other demographic factors, scores for those in the Red Meat pattern were positively associated with smoking habits, while the opposite was found for the Whole Grains pattern. There was a strong positive association between the scores of the Fish pattern and participants' ages.

The first pattern identified in this study titled Vegetable is most similar to the Prudent or Vegetable/fruit patterns described in other studies [98, 210, 211]. This is classified as a high consumption of vegetables, fruits, poultry, nuts, and whole grains. Studies usually label this pattern as the most desirable or healthy pattern in a

population, as it has shown a decrease risk in coronary heart disease [212], type 2 diabetes [98], colorectal cancer [213], and mortality for all subjects who follow this dietary pattern. The second pattern identified in this study, Red Meat, is similar to the set of food items that has been labeled the Western pattern in many previous research studies [98, 214]. This is characterized by a consumption of high fat foods, red meat, processed/cured meat and soft drinks. This pattern has been associated with adverse outcomes such as cancer [215], cardiovascular diseases [216, 217], and obesity [198]. The Fish pattern is characterized by a high consumption of fish/processed fish and some foods common to the traditional NL diet including game meat and pickled vegetables. This pattern seems to be unique to the NL population and is unlike any patterns described in other research. Since the present study is cross-sectional, further follow-up data is needed to assess its impact on health. The final Whole Grains pattern shares common elements with the 'cereals' or 'cereal-based' patterns described in several articles [218, 219].

Age was found to have a negative relationship with the western diet and a positive association with vegetable-based patterns in some research [210, 218]. In the present study, a similar trend was observed (not significant). For example, seniors (>60 y) tended to have higher scores for the Vegetable pattern than those who are younger. This suggests that the older generations may have some healthier dietary practices than those who are younger. Previous studies have reported that women and urban residents tend to have generally higher loadings on healthfulness dietary patterns [210, 217, 218]. Similarly, although not significant, our results suggested that women and participants living in urban area may have higher scores for the Vegetable and Whole Grains patterns and lower scores for the Red Meat or Fish patterns. The factor of education attainment played a small role; the only difference was observed

for the Fish pattern, where people less educated have higher scores than those with post-secondary education. However, Park et.al *(2005)* [210] suggest that individuals with higher scores for a healthy dietary pattern tend to be more educated than those scoring lower. Although there was a hypothesis that patterns may be influenced by marital status [220], no significant results have been found in the present study. Current daily smoking was a strong factor that was positively associated with the Red Meat pattern in our study as well as other studies [210, 218]. In addition, we found an inverse association between the Whole Grains pattern and current daily smoking.

Strengths of this study include detailed dietary and socio-demographic data, sampling from the general population, and the concern of gender difference in extracting patterns. The FFQ used in the study has been validated in our broader project. As food consumption patterns reflect current dietary habits in a specific population, they are expected to differ by population. However, the Vegetable, Red Meat, and Whole Grains patterns identified seem to be reasonably reproducible among populations in various countries [209, 211-213].

There are some limitations in the present study that need to be considered. Our derived food consumption patterns explain 31% of the variance in dietary intake, which is less than the values reported in some studies [174], but similar in magnitude to that observed in others [221]. This low explained variance of food intake may further lead to inappropriately measured nutrient intake, and thus, additional analyses on the minor patterns may demonstrate more associations between food consumption patterns and demographic variables. Another potential limitation is that the use of PCA requires some arbitrary decision making regarding the consolidation of food items into various food groups, the number of retained factors, the method of rotation, and the labels of components [222]. Therefore, a sensitivity analysis is required to

examine if these decisions affected the identified food consumption patterns. Finally, due to the design of a cross-sectional study, we do not know how well the patterns identified in this study reflect the dietary habits of the population in the past or its stability in the future. Longitudinal data may be helpful in addressing this issue.

4.2.5 Conclusion

In summary, we derived four major food consumption patterns that were strongly linked to the age and smoking habits of the general NL adult population. Our findings may contribute to the development of public health interventions through dietary modifications for the NL population.

Table 4.2.1 Demographic Characteristics of the Participants (n=192)

Characteristics	n (%)
Age Range (years)	
35-40	17 (8.9%)
41-50	45 (23.4%)
51-60	81 (42.2%)
61-70	49 (25.5%)
Gender	
Males	43 (22.4%)
Females	149 (77.6%)
Living Area	
Rural area	111 (57.8%)
Urban area	81 (42.2%)
Education Attainment	
Some school but no high school certificate	27 (14.1%)
High school certificate	51 (26.6%)
Post-secondary education	114 (59.4%)
Marital Status	
Single	15 (7.8%)
Separated/Divorced	18 (9.4%)
Widowed	8 (4.2%)
Married/Living together	151 (78.6%)
Current Employment	
Part-time	16 (8.3%)
Full-time	74 (38.5%)
Seasonal	15 (7.8%)
No	84 (43.8%)
Retired	*61 (31.8%)*
Not retired	*21(11.0%)*
No answer provided	*2(1%)*
Unusable data	1 (0.5%)
Yes	2 (1%)
Current Daily Smoking	
Smoker	33 (17.2%)
No	159 (82.8%)
Previous Daily Smoking	
Yes	84 (43.8%)
No	75 (39.1%)
N/A	33 (17.2%)

Figure 4.2.1 Scree Plot Test in Factor Exaction of Data (Factor Analysis)

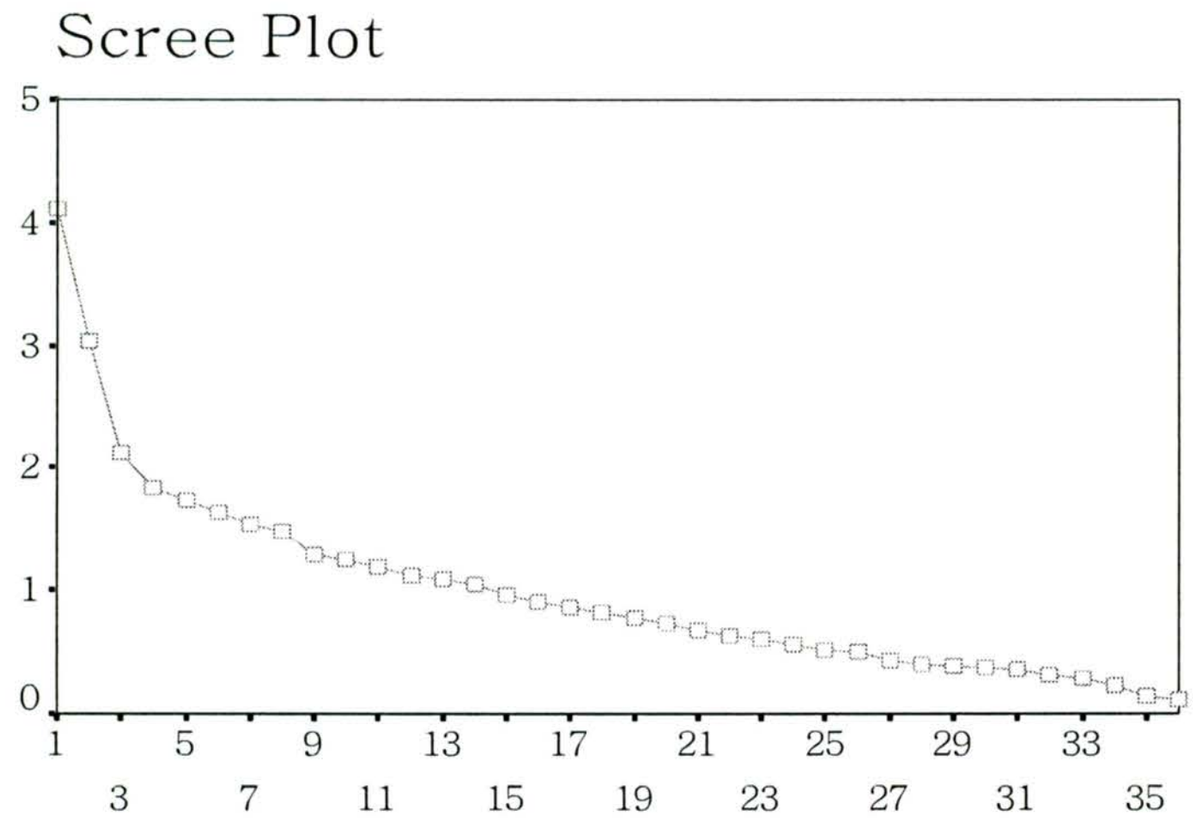


Table 4.2.2 Factor-Loading Matrix for the Food Consumption Patterns Identified in an Adult NL Population [a]

Food Groups		Servings/week (mean ± standard deviation)	Factor loading			
			Vegetables	Red Meat	Fish	Whole Grains
High-fat products	**dairy**	10.62±11.04	—	—	—	—
Low-fat products	**dairy**	9.47±10.41	—	—	—	**0.38**
Coffee		9.80±11.56	0.26	—	-0.26	—
Tea		10.89±11.94	—	—	**0.36**	—
Sweets, Miscellaneous sugary food		19.13±19.14	—	—	0.22	**-0.36**
Low fat sweets		0.32±0.73	—	—	**0.31**	**0.31**
Soft drinks		5.12±8.14	—	**0.61**	-0.24	—
Juices		6.74±11.42	—	—	—	0.29
Beer		0.75±2.12	—	—	—	**-0.41**
Alcohol		1.96±3.65	0.21	—	-0.23	—
Eggs		3.34±5.29	—	—	0.26	—
Rice, Pasta (vegetable)		2.54±2.76	—	0.25	—	0.20
Soups（no cream）		1.28±1.46	—	—	**0.43**	—
Potatoes		4.51±3.07	—	0.21	**0.33**	-0.27
Cruciferous Vegetables		3.28±4.11	**0.47**	—	—	—
Leafy Greens		3.14±4.75	**0.71**	—	—	—
Pickled Vegetables		0.67±1.41	—	—	**0.31**	—
Tomato, Tomato Sauce		4.98±4.02	**0.62**	**0.35**	—	—
Other Vegetables		8.06±6.48	**0.81**	—	—	—

[a] Absolute values less than 0.2 were excluded and those above 0.3 indicated in bold to visually emphasize strength of association.

Table 4.2.2 Factor-Loading Matrix for the Food Consumption Patterns Identified in an Adult NL Population [a]_ ***Continued...***

Food Groups	Servings/week (mean ± standard deviation)	Factor loading			
		Vegetables	Red Meat	Fish	Whole Grains
Legumes	1.95±2.15	**0.49**	-0.21	**0.32**	—
Dark yellow vegetables	6.00±5.88	**0.55**	-0.24	**0.35**	—
Red meat	6.49±4.13	—	**0.75**	0.25	—
Mixed dishes	2.55±2.02	—	**0.51**	—	—
Game meat	0.53±0.87	—	—	**0.35**	-0.29
Cured/processed meat	3.23±2.80	-0.20	**0.73**	—	—
Poultry	2.11±1.44	**0.34**	**0.39**	—	—
Fish	1.91±1.68	—	—	**0.68**	—
Processed fish	1.22±1.11	—	—	**0.70**	—
Ready to eat cereals	5.59±5.31	—	—	0.28	**0.51**
Whole grains	6.45±8.10	0.24	—	—	**0.62**
White bread and refined grains	5.87±6.92	—	—	**0.35**	**-0.59**
Snacks	4.17±7.79	—	—	—	—
Fruits	15.44±10.71	**0.36**	—	0.28	**0.30**
Processed fruit	1.70±3.44	**0.39**	—	—	—
Add fat high in saturated fat	19.28±13.17	**0.36**	**0.45**	—	—
Nuts	3.21±4.04	**0.39**	—	—	0.29

[a] Absolute values less than 0.2 were excluded and those above 0.3 indicated in bold to visually emphasize strength of association.

Table 4.2.3 Univariate Comparison of Mean Food Consumption Scores by Selected Demographic Characteristics in an Adult NL Population

		Vegetables	Red Meat	Fish	Whole Grains
Age groups					
35-40	**mean score**	-0.222	0.250	-0.469	0.073
	OR (95%CI)	0.069 (-0.041, 1.059)	0.092 (-1.021, 0.078)	0.004 (0.257, 1.347)	0.882 (-0.516, 0.600)
41-50	**mean score**	0.036	0.263	-0.102	-0.064
	OR (95%CI)	0.221 (-0.152, 0.654)	**0.019 (-0.888, -0.082)***	**0.033 (0.035, 0.835)***	0.389 (-0.230, 0.589)
51-60	**mean score**	-0.147	-0.064	-0.047	-0.049
	OR (95%CI)	**0.016 (0.081, 0.788)***	0.380 (-0.511, 0.196)	**0.034 (0.029, 0.730)***	0.367 (-0.194, 0.523)
61-70	**mean score**	0.287	-0.222	0.333	0.115
	OR (95%CI)	1.00	1.00	1.00	1.00
Gender					
Males	**mean score**	-0.200	0.143	0.346	-0.321
	OR (95%CI)	0.257 (-0.083, 0.598)	0.290 (-0.525, 0.158)	**0.010 (-0.783, -0.110)***	**0.017 (0.076, 0.750)***
Females	**mean score**	0.058	-0.041	-0.100	0.093
	OR (95%CI)	1.00	1.00	1.00	1.00

*Significant different from reference category, $p < 0.05$

Table 4.2.3 Univariate Comparison of Mean Food Consumption Scores by Selected Demographic Characteristics in an Adult NL Population_ ***Continued...***

		Vegetables	Red Meat	Fish	Whole Grains
Living area					
Rural area	**mean score**	-0.108	0.003	0.067	-0.028
	OR (95%CI)	0.256 (-0.031, 0.543)	0.964 (-0.296, 0.282)	0.275 (-0.448, 0.128)	0.651 (-0.223, 0.355)
Urban area	**mean score**	0.148	-0.004	-0.092	0.038
	OR (95%CI)	1.00	1.00	1.00	1.00
Education attainment					
Some school but no high school certificate	**mean score**	-0.097	-0.040	0.332	0.188
	OR (95%CI)	0.2 (-0.221, 0.621)	0.766 (-0.360, 0.488)	**0.041 (-0.857, -0.018)***	0.403 (-0.602, 0.243)
High school certificate	**mean score**	-0.179	-0.034	0.059	-0.118
	OR (95%CI)	0.281 (-0.050, 0.613)	0.731 (-0.276, 0.392)	0.329 (-0.494, 0.167)	0.454 (-0.206, 0.459)
Post-secondary education	**mean score**	0.103	0.024	-0.105	0.008
	OR (95%CI)	1.00	1.00	1.00	1.00
Current Daily Smoking					
Smoker	**mean score**	-0.216	0.362	-0.082	-0.583
	OR (95%CI)	0.174 (-0.116, 0.637)	**0.022 (-0.811, -0.064)***	0.606 (-0.279, 0.477)	0.000 (0.339, 1.068)
No	**mean score**	0.045	-0.075	0.017	0.121
	OR (95%CI)	1.00	1.00	1.00	1.00

*Significant different from reference category, $p < 0.05$

Table 4.2.3 Univariate Comparison of Mean Food Consumption Scores by Selected Demographic Characteristics in an Adult NL Population_ ***Continued...***

		Vegetables	Red Meat	Fish	Whole Grains
Marital status					
Single	**mean score**	-0.283	0.492	0.204	0.904
	OR (95%CI)	0.194 (-0.181, 0.886)	0.056 (-1.048, 0.013)	0.376 (-0.777, 0.295)	0.000 (-1.553, -0.526)
Separated / Divorced	**mean score**	-0.246	0.014	0.013	0.210
	OR (95%CI)	0.207 (-0.176, 0.807)	0.873 (-0.528, 0.449)	0.839 (-0.545, 0.443)	0.152 (-0.818, 0.129)
Widowed	**mean score**	-0.221	-0.471	0.296	0.381
	OR (95%CI)	0.424 (-0.425, 1.005)	0.218 (-0.266, 1.156)	0.362 (-1.051, 0.385)	0.141 (-1.204, 0.173)
Married/ Living together	**mean score**	0.069	-0.026	-0.037	-0.135
	OR (95%CI)	1.00	1.00	1.00	1.00

*Significant different from reference category, $p < 0.05$

Table 4.2.4 Association *(p-value)* between Factor Scores and Selected Demographic Characteristics in an Adult NL Population

	Vegetables	Red meat	Fish	Whole Grains
Overall	**0.027***	0.170	**0.026***	**0.000***
Age group	0.081	0.073	**0.019***	0.775
Gender	0.080	0.964	0.275	0.651
Education attainment	0.214	0.920	0.110	0.435
Marital status	0.334	0.138	0.677	0.086
Current Daily Smoking	0.174	**0.022***	0.606	**0.000***

*p value<0.05

Chapter 5: SUMMARIES

5.1 Suggestions for Change to the Existing Food Frequency Questionnaire

Although we have demonstrated acceptable validity of the existing FFQ, some work has been conducted to revise this instrument in order to make it more suitable for the NL population. First, those items that were rarely consumed (<5%) by the sample were removed, including veal (#84), smoked fish/lox (#100), papaya (#135), and tofu/tempeh (#152). Next, the basic list was appropriately extended to improve the comprehensiveness of the questionnaire. Popular food items that had been reported more than 20 times in the 24-HDRs were added into the food list of the FFQ. In particular, light beer, light cream cheese, homemade soup, celery, mushroom, extra lean ground beef, short-ribs, homemade bread, biscuits, dumplings, whole wheat noodles, bagels, pineapple, artificial sweeteners (such as saccharin and splenda), candies (such as toffees and mints), low fat salad dressing, and bread stuffing were added to the food list. Furthermore, some items in the list were too general and contained numerous foods with significant different nutrient compositions. These needed to be more specific whereas others made up of foods with very similar nutrient compositions needed to be combined. For instance, cantaloupe, watermelon, and honeydew are conceptually similar foods in the sense that they have similar nutrient content, are all served in the same manner, and are scored by item in the FFQ. As a result, they would be under the same category of melons after revision. Conversely, whole grain cereals (such as Shredded Wheat and multigrain Cherrios), sugar coated ready-to-eat cereals (such as Honey Nut Cherrios and Lucky Charms), and non-sugar

coated ready-to-eat cereals (such as Special K) are conceptually dissimilar foods despite their nearly identical nutrient content. Finally, in order to clarify the confusion in some specific categories, accurate descriptions and additional notes were identified. For example, "Tea (not herbal)" (#8) was changed to "Tea (black)" and #69, "SWEET PEPPER", is now referred to as "SWEET/HOT PEPPER (green, red, yellow)".

5.2 Summary of the Findings

The work presented in this thesis was designed to develop a Newfoundland and Labrador based Food Frequency Questionnaire which is valid and can be self-administrated. Further, the validated FFQ was used to evaluate the patterns of food consumption in the general adult population of NL.

The test FFQ is a modified version of well-known Hawaii FFQ [14, 15], which has been designed to account for the unique food consumption patterns in NL. Through the comparison with the results of multiple 24-HDRs, we found that the de-attenuated energy-adjusted correlations ranged from 0.20 (polyunsaturated fat) to 0.52 (dietary fibre) in women and 0.13 (protein) to 0.61 (carbohydrate, dietary fibre) in men, with a median value of 0.38 in women and 0.42 in men. These values are lower than some reported by previous validation studies [6, 10, 15] but comparable to others [8, 175, 187-189]. This result suggests that the test 169-item FFQ has moderate relative validity and therefore can be used in studies to assess food consumption in the NL general population.

Cross-classification into quartiles of intake and Bland–Altman plots were used to measure the agreement between FFQ and 24-HDR methods. It is desirable to find that the test FFQ shows a relatively high proportion of subjects being correctly classified (into same or adjacent category) and only a small number of grossly misclassified

individuals (less than 10%). Bland-Altman plots also indicate an acceptable level of agreement between the two methods. As a result, this 169-item FFQ is capable of classifying an individual's intake into quartiles, which is useful in examining the relationships between diet and chronic disease including CRC.

Furthermore, with the valid FFQ, four major food consumption patterns were identified, which were labeled 'Vegetables', 'Red Meat', 'Fish' and 'Whole Grains'. The first pattern is named Vegetables, as it has an emphasis on vegetables, fruits, nuts, and poultry rather than on cured/processed meat. The Red Meat pattern is characterized by a high consumption of red meat, cured/processed meat, soft drinks, high energy food but by a low consumption of vegetables. The Fish pattern has a preference for fish/processed fish and some foods common to the traditional NL diet including game meat (such as moose, sea-birds meat) and pickled vegetables. It should be mentioned that the Fish pattern seems to be unique to the NL population and is unlike any patterns described in other research. The final pattern is labeled Whole Grains because of its high consumption of whole grains, cereals, and low-fat dairy products.

Independent associations between selected population characteristics and food consumption patterns were examined. Although consistent results for most factors were observed, significant associations were only found in current smoking habits and age. Current smokers showed a positive association with the Red Meat pattern and inverse associations with the Whole Grains pattern. Meanwhile, there was a strong positive association between the scores of the Fish pattern and participants' ages. These findings support the hypothesis that 'dietary patterns are influenced by interrelated sociocultural, demographic, and other lifestyle factors' (Park et.al *2005:p848*) which has been stated in previous publications [210].

5.3 Implications of the Study

Consideration should be given to the potential limitations in the present study that have been discussed in the *results* section. However, this study has a number of strengths as well which add to the existing literature in many respects. First, there has been limited nutritional epidemiological research conducted among the NL population. Probably the only two credible sources of dietary intake data in NL are the provincial survey conducted in 1996-1997, Nutrition Newfoundland and Labrador [223], and from the CCHS Cycle 2.2 of 2004 [183]. Second, the methods used in our study, including selection of population, sample size, data collection, and statistical approaches, were consistent with commonly accepted practices. All the processes to obtain a validated FFQ were recorded in detail and discussed with dietetic professionals, and thus can be used as a relative 'standardized' process which can be followed in validating dietary intake questionnaires by other researchers. Also, having this valid instrument will provide future researchers with greater flexibility in research design and expand the diet association investigative capabilities within epidemiological studies focusing on NL populations. Third, we have shown that particular demographic groups may be at risk of consuming a poor diet. For instance, unfavourable food consumption pattern, as defined by the consumption of processed meat and red meat, was associated with smoking behaviour and younger adults. As suggested by van Dam et.al (2003), information on existing food consumption patterns, their change over time, and associations with socio-demographic and lifestyle factors can be useful for public health efforts to improve diet [222]. Health promotion programs and policies may utilize the information provided by this work on specific demographic groups. Also, decision makers, including policy and program

developers can use this surveillance data to enhance and target public health programming.

5.4 Future Research

A dietary assessment tool used in examining the relationships between diet and diseases should be both validated and reliable. This study only demonstrated the validity of the test FFQ. Future work needs to be done to evaluate the reproducibility (reliability) of the instrument. Despite that, with this valid instrument, further effort can be made to develop novel approaches to test hypotheses in epidemiological studies dealing with the relationship of diet to chronic diseases, such as CRC.

The current study identifies four major food consumption patterns, which takes into account the combined effects of foods and nutrients, and may be a more meaningful way of assessing dietary exposure than considering individual nutrients. Conducting and reproducing research of this nature on a more frequent basis is essential to better understand how we can improve the health of the population. Sharing such results in a format/medium that not only the academic community can understand is also very important. Future research should examine the stability of these patterns, and if they can be used to promote healthier diets with appropriate nutritional guidance. In addition, the relationships between chronic diseases and specific food consumption patterns will be tested in a future study.

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Appendices

Appendix A Telephone Recruiting Script

Hello, my name is _____. I am calling for Memorial University Medical School about a study looking at the type of foods we eat. We would like to speak to a person in the household who is over 19 years of age. Is there anyone in your household that fits this description?

If someone says no

Thank you for your time. Goodbye

If someone says yes

Yes, person you are talking to is 19 or over.
Go **to *Telephone Consent Form***

Yes, one person but this is NOT the person you are talking to: *Could you ask her/him to come to the telephone?*
If unavailable: *When would be a good time to call her/him*
If available: *Hello my name is* _____ **Go to *Telephone Consent Form***

FOLLOW-UP/REMINDER CALL:
Hi <insert name>, this is <insert your name> about the Nutrition study. Just touching base with you to remind you that it's time to complete the second 24-hour recall.

IF YOU FEEL THE PERSON WOULD NOT BE ABLE TO COMPLETE THE TASK:
Thank you for your willingness to participate in our study.

Appendix B Telephone Consent Form

We are conducting a study to test an instrument called the Food Frequency Questionnaire. A food frequency questionnaire is a useful instrument when you want to examine a person's diet. Food frequency questionnaires are most often health studies such as the Colorectal Cancer Study. However, because the way people eat differs from one population to the next there is no one food frequency questionnaire that is right for everyone. The Newfoundland and Labrador (NL) diet is known to be different from other North American populations. So, it's really important that we have an instrument that can be used on the Newfoundland and Labrador population. A food frequency questionnaire has been developed by people at MUN for the Newfoundland and Labrador population. But we don't know it really captures the Newfoundland and Labrador diet, so we'd like to test it.

If you agree to help us out, here's what we'll be asking you to do:

- At two different times of the year, roughly 6 months apart, we'll call you twice within a 7-day period.
    - During those two calls we'll ask you what you ate in the previous 24-hours.
- Then, one year after the first phone call, we'll send you a copy of the food frequency questionnaire to complete and send back to us.
- The total time commitment on your part is about 3 hours over the course of one year.

Would you be willing to participate in this study?

Yes

↳ Go to PARTICIPANT INFO

No

↳ Go to CLOSE

PARTICIPANT INFO:

Thank you very much for agreeing to participate in this study. Before we continue, there are just a few points that I would like to bring to your attention.

- You will be asked for some demographic information later in the study
- You may decide NOT to answer any questions
- You may withdraw from the study at any time without consequences

I have one more thing to ask of you before we conclude today. Because this survey consists of mail-out and telephone surveys, I will need to have your full name and mailing address.

I can assure you that any information you send us will be kept confidential. After you complete the telephone and mail-out surveys, your responses will be kept in locked filling cabinets and password-protected computer files accessible only to the researchers involved in this study. All data will be reported in aggregate form only, and no information identifying you as an individual will be used.

Name:	
Mailing Address:	

The proposal for this research has received ethical approval.

Do you have any questions?

CLOSE:
Thank you again. Goodbye.

Some possible FAQ's:

1. ***Why do you need to do two 24-hour recalls?***
   The Newfoundland and Labrador diet is known to change at different times of the year. So, we want to make sure that our food frequency questionnaire will capture all the possibilities of the NL diet.

2. ***So, you'll be looking at my diet, right?***
   Not quite. Yes, we'll be analyzing your diet but not in terms of telling if it's a good diet or not. Rather, we'll look at your nutritional intake as noted in the 24-hour recalls and then looking at your nutritional intake as noted on the food frequency questionnaire you complete. Hopefully, want you say in the phone call and indicate on the survey will tell us same thing. That way we'll know if our survey is valid.

3. ***Can I have a copy of the final report?***
   Sure. I can send it to your mailing or email address.

Name: _____

Mailing address: *See above.*

Email: _____

4. ***Can I have more information about the ethical approval of this study?***

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at (709) 864-2861.

Appendix C Telephone Reminder Script

FOLLOW-UP/REMINDER CALL:
Hi <insert name>, this is <insert your name> about the Nutrition study. You completed a food recall for us last winter (a year ago) and again in late summer/early fall. Just touching base with you now to remind you that it's time to complete the Food Frequency Questionnaire survey. It will be sent to your mailing address within the next couple of weeks.

Has your mailing address changed in the last year?

Yes
↳Record below

No
↳ Thanks, you will receive the package in a few weeks.

And if you have any questions or problems completing the survey you can call **709-777-2043**. Leave your question when the answering machine indicates and someone will get back to you within the day.

(*The following is just a short reminder of what the study is about if you need it*):
The Food-Frequency Questionnaire is a primary tool for measuring dietary intake in various studies. However, because the way people eat differs from one population to the next there is no one food frequency questionnaire that is right for everyone. The Newfoundland and Labrador (NL) diet is known to be different from other North American populations. So, it's really important that we have an instrument that can be used on the Newfoundland and Labrador population. A food frequency questionnaire has been developed by people at MUN for the Newfoundland and Labrador population. But we don't know it really captures the Newfoundland and Labrador diet, so we'd like to test it.

Thanks so much for all your participation in this project!!

Participants' Information

Name:

Study ID

Mailing address: _____

_____

_____

Appendix D Demographic Survey Questionnaire

FFQ Validation Study

Demographic Survey

1. In what year were you born? 19 __ __

2. What is your sex?

   ❑ Female

   ❑ Male

3. What is your highest level of education? Please stop me when I get to the correct level.

   ❑ Some school but no high school certificate

   ❑ High school certificate

   ❑ Post-secondary education

4. How many people live in your community?

   ❑ Less than 10,00 people

   ❑ More than 10,000 people

5. What is your marital status?

   ❑ Single

   ❑ Separated/Divorced

   ❑ Married Living together

   ❑ Widowed

6. Are you currently employed?

   ❑ Yes

      ❑ Part-time

      ❑ Full-time

      ❑ Seasonal

   ❑ No

6a. Are you retired?

❑ Yes

❑ No

What is/was your occupation?_____

7. Do you currently smoke cigarettes daily?

❑ Yes

❑ No

7a. Did you ever smoke cigarettes daily?

❑ Yes

❑ No

This completes our survey. Thank you very much for your time and comments!

Appendix E Letter to the Participants

Dear Participant,

You are taking part in a study titled: 'Assessing the Validity of a Self-administered Food Frequency Questionnaire (FFQ) in the Adult Population of Newfoundland and Labrador'. We want to thank you for your participation in the 24-hour dietary recalls that you have completed. We are now reaching the final phase for this study – the FFQ survey.

The FFQ survey is a tool for measuring dietary intake. Dietary intake is an important factor in the development of chronic illnesses such as cardiovascular disease, diabetes, and certain cancers. The Newfoundland and Labrador (NL) diet is known to be different from the diets of other North American populations. Currently, there is no validated tool for measuring dietary intake in NL. This research project is designed to help us create an FFQ that is accurate for the NL population. Having an accurate tool for assessing dietary intake in NL will be beneficial for many areas of health research.

Please take a few moments to read through and complete the questionnaire based on what you were eating **OVER THE PAST 12 MONTHS**. Once the survey is completed, please return it using the enclosed pre-stamped envelope. No identifying information will be used in any report of the study data. All data will be reported in aggregate form only.

Please note that we have included a number of research abstracts with this package for your possible interest. Each of these pertains to work which has already been done with some of the information that you have provided to this project.

On behalf of the research team, I would like to take this opportunity to express a sincere thank-you for your valuable input to this important project. If you have any questions about the study or any concerns after taking part, please feel free to contact me directly.

Sincerely,

Dr. Peter Wang
Principal Investigator
NL Food Frequency Questionnaire Validation Study
Telephone: 709-777-8571
E-mails: peter.wang@med.mun.ca

Appendix F Food Frequency Questionnaire

Canadian Study of Diet and Health

Memorial University of Newfoundland

Who this questionnaire is for and what it asks about:

This questionnaire is to be completed by the person taking part in this study:

Part I asks about the foods you ate **OVER THE PAST 12 MONTHS**.

Part II asks about vitamins and other dietary supplements that you may have used.

If possible, please return this questionnaire within two weeks.

The completed questionnaire should be sealed in the pre-paid envelope and mailed back to:

Health Research Unit,
Room 2801A, Division of Community Health & Humanities,
Medicine, Health Science Centre,
300 Prince Phillip Drive,
St. John's, NL, Canada, A1B 3V6

If you have any questions about this form or the study, please do not hesitate to contact with us with **709-777-2043**; leave your question when the answering machine indicates and someone will get back to you within the day.

The information given to us in this questionnaire will be kept confidential.

Thank you for your time and assistance

HOW TO COMPLETE THIS QUESTIONNAIRE

We would like to know how often you ate certain foods **OVER THE PAST 12 MONTHS,** and their amounts.

Section A **(lists foods and portion sizes)**

Amounts are described in various ways, including the number of:

cups, teaspoons (tsp), ounces (oz), inches ("), pieces (e.g., 1 apple)
grams (gm), tablespoons (tbsp), millilitres (ml), centimetres (cm).

We want to know the ***Portion Size*** of your **USUAL SERVING.** We have given an example of an average portion size in the attached pamphlet. If your portion size was different than the average, you can indicate this by putting an **X** or 3in the circles for ***Smaller*** or ***Larger*** portion sizes. ***Smaller*** than average is about 25% or less than the average portion size, while ***Larger*** than average is about 25% or more than the average size. Leave the circle blank if your typical portion size was average.

One part of the attached pamphlet shows small, medium and large portion sizes for vegetables, meat and chicken. Some questions ask you to refer to the photos to help you figure out correct ***Food Portion Size.***

Section B **(asks about how often you ate certain foods OVER THE PAST 12 MONTHS)**

For each food item listed, choose **one** column (Per Day, Per Week, Per Month, or Never / Rarely) that best describes ***HOW OFTEN*** you ate or drank that item. For example, if you ate CREAM CHEESE 3 times a month during the year of interest, you would write (3) in the *PER MONTH* column. If you ate SWEET POTATOES only 2 times during the year of interest, you can place a checkmark (3) in *the NEVER OR RARELY* column.

Section C ***(To be completed only for seasonal foods)***

Some foods (for example fresh fruit and vegetables) are not available throughout the year. **For foods that you do not eat all year round** (i.e. in season only), indicate the number of months of the year that you ate them.

Please complete each question as best you can. We know that it is difficult to recall exactly how often you ate something. If you are not certain, try to give your best estimate. If you need help completing the FFQ please call (**709)-777-2043**. If the call is outside the St. John's area you can call collect.

EXAMPLE

		Section A			Section B OVER THE PAST 12 MONTHS				Section C
	FOOD	Average Portion Size	Your Portion Size, if NOT Average		HOW OFTEN? (Complete one column only)				If Ate Food in Season Only enter Months per Year
			Smaller	Larger	per DAY (enter a number)	per WEEK (enter a number)	per MONTH (enter a number)	NEVER or RARELY (check)	
1	CREAM CHEESE	2 tbsp/ 30 ml/ 1 oz	O	O			3		
2	CANTELOUPE	1/8 or 1 slice	O	O		1			4
3	SWEET POTATOES	1 medium/ ½ cup	O	O				√	

	Section A				Section B OVER THE PAST 12 MONTHS				Section C
	FOOD	Average Portion Size	Your Portion Size, if NOT Average		HOW OFTEN? (Complete one column only)				If Ate Food In Season Only
			Smaller	Larger	per DAY (enter a number)	per WEEK (enter a number)	per MONTH (enter a number)	NEVER or RARELY (check)	enter Months per Year
	Beverages								
1	WHOLE MILK (any, include if in cereal & drinks)	1 cup/ 250 ml	0	0					
2	2% MILK, 2% Evaporated milk (any, if in cereal & drinks)	1 cup/ 250 ml	0	0					
3	SKIM MILK, 1% MILK (any, include if in cereal & drinks)	1 cup/ 250 ml	0	0					
4	MILK SHAKE	1 cup/ 250 ml	0	0					
5	YOGURT DRINK	1 cup/ 250 ml	0	0					
6	COFFEE (not decaffeinated)	1 cup/ 250 ml	0	0					
7	COFFEE (decaffeinated)	1 cup/ 250 ml	0	0					
8	TEA (not herbal)	1 cup/ 250 ml	0	0					
9	TEA (herbal)	1 cup/ 250 ml	0	0					
10	SUGAR (in tea and coffee)	1tsp or 1 cube	0	0					
11	COCA COLA, PEPSI, OTHER COLA	1 cup/ 250 ml	0	0					
12	DIET SOFT DRINKS	1 cup/ 250 ml	0	0					
13	OTHER SOFT DRINKS (not dietetic or cola)	1 cup/ 250 ml	0	0					
14	ORANGE or GRAPEFRUIT JUICE	¾ cup/ 175 ml	0	0					
15	APPLE or GRAPE JUICE	¾ cup/ 175 ml	0	0					
16	OTHER FRUIT JUCES (pineapple, cranberry, etc)	¾ cup/ 175 ml	0	0					
17	FRUIT DRINK/ LEMONADE	¾ cup/ 175 ml	0	0					
18	FRUIT DRINKS, ICED TEA	¾ cup/ 175 ml	0	0					
19	VEGTABLE JUICES	¾ cup/ 175 ml	0	0					
20	BEER or ALE	338 ml/ 1 bottle	0	0					
21	WHITE WINE	150 ml/ 5 oz	0	0					
22	RED WINE, SHERRY, PORT (or other fortified wine)	150 ml/ 5 oz	0	0					

	Section A				Section B OVER THE PAST 12 MONTHS				Section C
	FOOD	Average Portion Size	Your Portion Size, if NOT Average		HOW OFTEN? (Complete one column only)				If Ate Food In Season Only
			Smaller	Larger	per DAY (enter a number)	per WEEK (enter a number)	per MONTH (enter a number)	NEVER or RARELY (check)	enter Months per Year
23	LIQUOR (for example, whiskey, rum etc)	45 ml/ 1.5 oz	0	0					
	Dairy Products								
24	EGG (boiled, poached)	1 medium	0	0					
25	EGG (fried, scrambled, omelette)	1 medium	0	0					
26	CREAM CHEESE, Regular fat	2 tbsp/ 30 ml/ 1 oz	0	0					
27	CHEESE, Regular fat (such as cheddar, Swiss, processed)	1 slice/ 30 g/ 1oz	0	0					
28	CHEESE, Light (6-15% fat, such as cream cheese, cheddar)	1 slice/ 30 g/ 1oz	0	0					
29	CHEESE, Ultra Light (5% fat or less, such as cheddar)	1 slice/ 30 g/ 1oz	0	0					
30	COTTAGE or RICOTTA CHEESE	125 ml/ ½ cup	0	0					
31	CREAM (coffee, whipping, sour or regular)	1 tbsp/ 15 ml	0	0					
32	CREAM (half and half, light sour cream)	1 tbsp/ 15 ml	0	0					
33	COFFEE WHITENER (non-dairy)	1 tbsp/ 15 ml	0	0					
34	YOGURT, Regular (plain, 2.4% fat or more)	6 oz/ 170 g	0	0					
35	YOGURT, Light (plain, less than 2.4% fat)	6 oz/ 170 g	0	0					
36	YOGURT, Regular (fruit flavoured or frozen, 2.4% fat or more)	6 oz/ 170 g	0	0					
37	YOGURT, Light (fruit flavoured or frozen, less than 2.4% fat)	6 oz/ 170 g	0	0					
	Mixed Dishes								
38	SOUPS (creamed)	1 cup/ 250 ml	0	0					
39	SOUPS (non-creamed)	1 cup/ 250 ml	0	0					
40	PEA SOUP	1 cup/ 250 ml	0	0					
41	PASTA with meat sauce (spaghetti, lasagna)	1 cup/ 250 ml	0	0					
42	PASTA with tomato sauce (spaghetti)	1 cup/ 250 ml	0	0					
43	MIXED DISHES with cheese or cheese sauce (macaroni and cheese)	1 cup/ 250 ml	0	0					
44	PIZZA with meat	1 medium slice	0	0					

	Section A			Section B OVER THE PAST 12 MONTHS				Section C
	FOOD	Average Portion Size	Your Portion Size, if NOT Average Smaller Larger	HOW OFTEN? (Complete one column only) per DAY (enter a number)	per WEEK (enter a number)	per MONTH (enter a number)	NEVER or RARELY (check)	If Ate Food In Season Only enter Months per Year
45	PIZZA with vegetable only	1 medium slice	0 0					
46	MEAT STEW with carrots, other vegetables	1 cup/ 250 ml/ photo A, medium	0 0					
47	CHILI with meat or Con Carne	1 cup/ 250 ml	0 0					
	Vegetables							
48	POTATOES (mashed, boiled, baked etc)	1 medium/ ½ cup/ 125 ml	0 0					
49	FRENCH FRIES or FRIED POTATOES	1 cup/ 250 ml	0 0					
50	CARROTS (raw or cooked)	1 medium/ ½ cup /125 ml	0 0					
51	BROCCOLI	1 cup/ 250 ml	0 0					
52	CABBAGE, COLESLAW	½ cup/ 125 ml	0 0					
53	CAULIFLOWER	½ cup/ 125 ml	0 0					
54	CORN	1 ear / ½ cup	0 0					
55	PEAS or LIMA BEANS	½ cup/ 125 ml	0 0					
56	GREEN or YELLOW BEANS	½ cup/125 ml	0 0					
57	BEANS or LENTILS (baked or boiled beans, kidney beans, chickpeas)	½ cup/ 125 ml cooked	0 0					
58	SPINACH and other green leafy vegetables (greens, collards, kale, mustard greens etc)	½ cup cooked or 1 cup raw	0 0					
59	GREEN SALAD (with lettuce)	1 cup/ 250 ml	0 0					
60	CUCUMBER	½ cup/ 125 ml sliced	0 0					
61	TOMATOES (fresh)	1 medium/ ½ cup/ 125 ml	0 0					
62	TOMATOES (canned, pureed or sauce)	½ cup/125 ml	0 0					
63	ONIONS (raw or cooked)	½ cup/ 125 ml	0 0					
64	BEETS (boiled or pickled)	½ cup/125 ml	0 0					
65	TURNIPS or RUTABAGAS	1 medium/ ½ cup/ 125 ml	0 0					
66	OTHER ROOT VEGETABLES (sweet potatoes, yams, radish, etc)	½ cup/125 ml	0 0					

Section A					Section B OVER THE PAST 12 MONTHS				Section C
	FOOD	Average Portion Size	Your Portion Size, if NOT Average		HOW OFTEN? (Complete one column only)				If Ate Food In Season Only
			Smaller	Larger	per DAY (enter a number)	per WEEK (enter a number)	per MONTH (enter a number)	NEVER or RARELY (check)	enter Months per Year
67	YELLOW SQUASH (winter type)	½ cup/125 ml	0	0					
68	ZUCCHINI or EGGPLANT	½ cup/125 ml	0	0					
69	SWEET PEPPER (green, red or yellow)	½ cup/125 ml	0	0					
70	ASPARAGUS or BRUSSEL SPROUTS	½ cup/125 ml	0	0					
71	BEAN SPROUTS, ALFALFA SPROUTS	½ cup/125 ml	0	0					
72	PICKLES, RELISH	1 div/ 2 tbsp	0	0					
73	AVOCADO	½ medium	0	0					
74	OTHER VEGETABLES (celery, mushrooms, etc., raw or cooked)	½ cup/125 ml	0	0					
	Meats and Fish								
75	GROUND BEEF, Regular (hamburger, meat loaf, in casseroles etc)	85 g/ 3 oz/ 3" patty	0 2 oz	0 4 oz					
76	GROUND BEEF, Medium (hamburger, meat loaf, in casseroles etc)	85 g/ 3 oz/ 3" patty	0 2 oz	0 4 oz					
77	GROUND BEEF, Lean (hamburger, meat loaf, in casseroles etc)	85 g/ 3 oz/ 3" patty	0 2 oz	0 4 oz					
78	ROAST BEEF	photo B, medium	0	0					
79	STEAK	photo B, medium	0	0					
80	PORK CHOP	photo B, medium	0	0					
81	ROAST PORK	photo B, medium	0	0					
82	BAKED HAM	photo B, medium	0	0					
83	BACON	2 slices	0	0					
84	VEAL	photo B, medium	0	0					
85	LAMB	photo B, medium	0	0					
86	HOT DOG or WIENER (Enter buns/rolls under item 116)	1 hot dog/ 2 oz	0	0					
87	SAUSAGE	85 g/ 3 oz	0	0					
88	CORNED BEEF	1 slice	0	0					

Section A					Section B OVER THE PAST 12 MONTHS				Section C
	FOOD	Average Portion Size	Your Portion Size, if NOT Average		HOW OFTEN? (Complete one column only)				If Ate Food In Season Only
			Smaller	Larger	per DAY (enter a number)	per WEEK (enter a number)	per MONTH (enter a number)	NEVER or RARELY (check)	enter Months per Year
89	COLDCUTS (ham, salami, bologna, etc)	1 medium slice/ 30g/ 1 oz	0	0					
90	LIVER	85 g/ 3 oz	0	0					
91	FRIED CHICKEN	photo C, medium	0	0					
92	CHICKEN / TURKEY (roasted or stewed)	photo C, medium	0	0					
93	CHICKEN / TURKEY, SKIN REMOVED	photo C, medium	0	0					
94	SALTED/ DRIED MEAT	photo C, small	0	0					
95	PICKLED MEAT (canned)	photo C, small	0	0					
96	SHELLFISH (shrimp, lobster, crab)	85 g/ 3 oz/ photo C, small	0	0					
97	FRIED FISH	170 g/ 6 oz/ photo B, medium	0	0					
98	FISH (baked or broiled)	170 g/ 6 oz/ photo B, medium	0	0					
99	CANNED FISH (tuna, salmon)	½ can/ 48 ml/ 1.7 oz	0	0					
100	SMOKED FISH or LOX	85 g/ 3 oz/ photo C, small	0	0					
101	SALTED/ DRIED FISH	85 g/ 3 oz/ photo C, small	0	0					
102	PICKLED FISH	85 g/ 3 oz/ photo C, small	0	0					
103	SEA-BIRDS, SEAL	85 g/ 3 oz/ photo C, small	0	0					
104	CARIBOU, MOOSE	85 g/ 3 oz/ photo C, small	0	0					
105	PARTRIDGE, OTHER WILD BIRDS	85 g/ 3 oz/ photo C, small	0	0					
	Cereals and Grains								
106	BRAN or GRANOLA CEREALS (including All Bran)	½ cup/ 125 ml	0	0					
107	WHOLE WHEAT CEREALS (such as shredded wheat)	½ cup/ 125 ml/ 1 biscuit	0	0					
108	CEREALS, NOT SUGAR COATED (such as Special K)	½ cup/ 125 ml	0	0					
109	HOT CEREALS (for example, oatmeal)	½ cup/ 125 ml	0	0					
110	SUGAR COATED CEREALS	½ cup/ 125 ml	0	0					
111	OTHER BREAKFAST CEREALS	½ cup/ 125 ml	0	0					

Section A				Section B OVER THE PAST 12 MONTHS				Section C
	FOOD	Average Portion Size	Your Portion Size, if NOT Average Smaller Larger	HOW OFTEN? (Complete one column only) per DAY (enter a number)	per WEEK (enter a number)	per MONTH (enter a number)	NEVER or RARELY (check)	If Ate Food In Season Only enter Months per Year
112	SUGAR ON CEREAL	1 tsp	0 0					
113	100% WHOLE GRAIN or DARK BREAD	1 slice	0 0					
114	60% WHOLE GRAIN, LIGHT RYE	1 slice	0 0					
115	WHITE BREAD	1 slice	0 0					
116	WHITE BREAD ROLLS (including hot dog buns etc)	1 roll	0 0					
117	WHOLE WHEAT ROLLS	1 roll	0 0					
118	CRACKERS (snack or soda type)	5	0 0					
119	BRAN/OAT MUFFIN	1 medium, ½ extra large	0 0					
120	OTHER MUFFIN (plain cake, with berries)	1 medium, ½ extra large	0 0					
121	PANCAKES, WAFFLES	1 medium	0 0					
122	MACARONI, SPAGHETTI, NOODLES (plain)	1 cup cooked/ 250 ml	0 0					
123	RICE	½ cup cooked/ 125 ml	0 0					
124	CRISP SNACKS (potato chips, popcorn, pretzels etc)	1 cup	0 0					
	Fruits							
125	APPLE, PEAR	1 medium	0 0					
126	CITRUS FRUITS (orange, grapefruit)	1 orange, ½ grapefrut	0 0					
127	BERRIES (strawberries, blueberries, bakeapples)	½ cup/ 125 ml	0 0					
128	GRAPES	½ cup/ 125 ml	0 0					
129	BANANA	1 medium	0 0					
130	PEACH, PLUM, NECTARINE, APRICOT	1 medium	0 0					
131	CANTALOUPE	1/8 or 1 slice	0 0					
132	WATERMELON	1 wedge, 3" base	0 0					
133	HONEYDEW MELON	1/8 or 1 slice	0 0					
134	MANGO	1 medium	0 0					
135	PAPAYA	1 medium	0 0					

Section A					Section B OVER THE PAST 12 MONTHS				Section C
	FOOD	Average Portion Size	Your Portion Size, if NOT Average		HOW OFTEN? (Complete one column only)				If Ate Food In Season Only
			Smaller	Larger	per DAY (enter a number)	per WEEK (enter a number)	per MONTH (enter a number)	NEVER or RARELY (check)	enter Months per Year
136	APPLESAUCE	½ cup/ 125 ml	0	0					
137	DRIED FRUITS (raisins, dates, prunes)	2 tbsp/ 2 dates	0	0					
138	CANNED FRUIT (all kinds)	½ cup/ 125 ml	0	0					
139	ALL OTHER FRUIT (fresh kiwi, pomegranate, etc.)	1 medium	0	0					
	Desserts and Sweets								
140	CAKES	1 slice, 2" x 4" x 1"	0	0					
141	PIES and TARTS	1 slice	0	0					
142	DONUTS and SWEET ROLLS	1	0	0					
143	COOKIES	1	0	0					
144	ICE CREAM	½ cup/ 125 ml	0	0					
145	LIGHT or DIET ICE CREAM	½ cup/ 125 ml	0	0					
146	PUDDING	½ cup/ 125 ml	0	0					
147	DIET or LIGHT PUDDING	½ cup/ 125 ml	0	0					
148	JELLO	½ cup/ 125 ml	0	0					
149	POPSICLES, FREEZIES	1	0	0					
150	CHOCOLATE BAR and CHOCOLATE CANDY	1 bar / 50g or 5 candy size	0	0					
151	CANDY (without chocolate)	1 caramel	0	0					
	Miscellaneous								
152	TOFU, TEMPEH	¼ cup, 2" x 2" x 1" piece	0	0					
153	KETCHUP	1 tbsp	0	0					
154	MAYONNAISE/ MIRACLE WHIP, Regular fat (on bread, salad, meat, etc)	1 tbsp	0	0					
155	MAYONNAISE/ MIRACLE WHIP, Light (on bread, salad, meat, etc)	1 tbsp	0	0					
156	SALAD DRESSING, Regular fat (French, Italian etc)	1 tbsp	0	0					
157	OIL (in cooking)	1 tbsp	0	0					

Section A				Section B OVER THE PAST 12 MONTHS				Section C
	FOOD	Average Portion Size	Your Portion Size, if NOT Average Smaller Larger	HOW OFTEN? (Complete one column only) per DAY (enter a number)	per WEEK (enter a number)	per MONTH (enter a number)	NEVER or RARELY (check)	If Ate Food In Season Only enter Months per Year
158	BUTTER (on vegetables or bread; exclude use in baked and mixed dishes)	1 pat/ 1 tbsp	O O					
159	MARGARINE (on vegetables or bread; exclude use in baked or mixed dishes)	1 pat/ 1 tbsp	O O					
160	PEANUT BUTTER	1 tbsp	O O					
161	PEANUTS	30g/ 1 oz	O O					
162	OTHER NUTS	30g /1 oz	O O					
163	JAM, JELLY, HONEY, SYRUP	1 tbsp	O O					
164	GRAVY	4 tbsp	O O					
165	CHOCOLATE or STRAWBERRY SYRUP	1 tbsp	O O					
166	CHOCOLATE SPREADS	1 tbsp	O O					
167	SAUCES (white, cream, Mornay)	30 ml/ 1oz/ 2 tbsp	O O					
168	WHEAT BRAN	1 tbsp	O O					
169	WHEAT GERM	1 tbsp	O O					

Continue on next page ⟶

PART 2 - USE OF VITAMINS AND DIETARY SUPPLEMENTS

Now we would like to know about your use of vitamins and dietary supplements.
OVER THE PAST 12 MONTHS, did you take any of the following? If Yes, then specify usual brand and amount and how long you took them.

Vitamin and Amount – if used, ⟹	How many pills did you take per week?	How long had you taken them?
Vitamin C (EXAMPLE) ○ None ○ Below 500 ■ 500-1000 ○ above 1000 mg	0 5 per week	2 4 months
Multivitamins that include minerals ○ No ○ Yes If yes, usual brand _____ ⟹	per week	months
Multivitamins, no minerals ○ No ○ Yes If yes, usual brand _____	per week	months
B Complex vitamins ○ No ○ Yes If yes, usual brand _____	per week	months
In the following items, DO NOT INCLUDE use of the above MULTIVITAMINS		
Vitamin A ○ None ○ Below 10000 ○ 10000-15000 ○ above 15000 IU	per week	months
Vitamin C ○ None ○ Below 500 ○ 500-1000 ○ above 1000 mg	per week	months
Vitamin E ○ None ○ Below 400 ○ 400-800 ○ above 800 IU	per week	months
Beta-carotene ○ None ○ Below 10000 ○ 10000-15000 ○ above 15000 IU	per week	months
Folic acid ○ None ○ Below 1.0 ○ 1.0 mg ○ above 1.0 mg'	per week	months
Calcium ○ None ○ Below 250 ○ 250-500 ○ above 500 mg	per week	months
Iron ○ None ○ Below 100 ○ 100-200 ○ above 200 mg	per week	months
Other dietary supplements (e.g., yeast, cod liver oil, etc) ○ No ○ Yes, specify type: _____ _____	per week per week	months months

' 1 mg = 1000 micrograms

Thank you very much for completing this questionnaire! Because we want to be able to use all the information you have provided, we would greatly appreciate it if you would please take a moment to review each page making sure that you:

- Did not skip any page
- Completely erased any changes you may have made

We welcome any other information or comments that you would like to give us:

_____

_____

_____

THANK YOU VERY MUCH for your assistance in this research!

For Office Use Only

Study #: _____

Interviewer: _____

Date completed (D/M/Y): _____

Appendix G Information Pamphlet

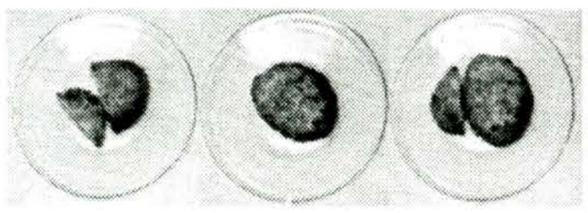
Portion Size Guide

When you are measuring how much you are eating, please use these photos for foods in the questionnaire that refer you to pictures A, B, C to help estimate your usual portion size. All the food is shown in 9" dish.

Picture A: can be used for Vegetables, Rice, Spaghetti, Salads, Potatoes etc.

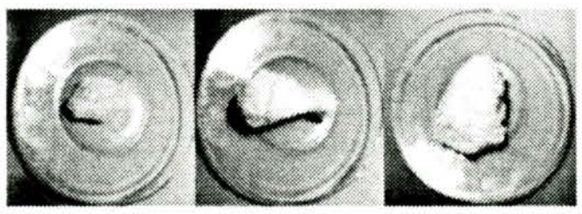
Small (S) Medium (M) Large (L)

Picture B: can be used for Meats, Steaks, Chops, Fish etc.



Small (S) Medium (M) Large (L)

Picture C: can be used for Chicken, Turkey etc.



Small (S) Medium (M) Large (L)

**Size of dinner plates shown above is 9 inches.*

Assessing the Validity of a Self-administered Food-frequency Questionnaire (FFQ) in the Adult Population of Newfoundland and Labrador

MEMORIAL UNIVERSITY

Health Research Unit,

Division of Community Health & Humanities,

Medicine, Health Science Centre,

Memorial University of Newfoundland

St. John's, NL, Canada, A1B 3V6

Telephone: +1 (709) 777-2043

A Guide to Measuring Your Food Consumption

Background

The Food-Frequency Questionnaire (FFQ) is a primary tool for measuring dietary intake in research. Much of the current evidence suggests that diet is of primary importance in the development of chronic illnesses such as cardiovascular disease, diabetes, and certain cancers. The Newfoundland and Labrador (NL) diet is known to be different from the diets of other North American populations, and there is no validated tool for measuring dietary intake in this province yet. A valid tool to collect dietary intake data from residents of NL has significant public health implications.

The Aim

The goal of this study is to develop a Newfoundland and Labrador based FFQ which is valid and can be self-administrated.

Procedure

The designed study has three major phases that are required for people's full participation. Specifically, there are two rounds of 24-hour recalls (winter/spring 2011 and fall 2011) and one FFQ survey in winter/spring 2012. The completion and return of the enclosed FFQ is the third and final phase of this study.

Questionnaire Guide

This guide will help you with some of questions that may be unclear. Please pay particular attention to:

- *Light and Regular*

  You will see that questions about **fat** or **dairy products** often separate out regular and light brands.

- *Question 86* HOT DOG or WIENER

  This question refers to the **meat portion** only. If you eat wieners with a bun, check the bun portion in the bread section

- *Question 89* BOLOGNA

  People who cut their own sometimes cut a **thicker slice**. If you do, please tick "**Larger**" for the portion size.

- *Question 95* PICKLED MEAT

  This is the category salt beef would fit under. The salted/dried meat in **Question 94** beef jerky and those kind of meat. Pickled fish in **Question 102** is asking about things like bottled pickled herring.

- *Question 158-159* BUTTER and MARGARINE

  Be sure to **keep separate** the amount of margarine and butter you eat.

- *Question 164* GRAVY

  This asks about an average serving of **1/4 cup [4 tablespoon]**. Many of us use much more than this. If you do, you would tick the **"Larger"** portion.

Appendix H Revised Food Frequency Questionnaire

Canadian Study of Diet and Health

Memorial University of Newfoundland

Who this questionnaire is for and what it asks about:

This questionnaire is to be completed by the person taking part in this study:

Part I asks about the foods you ate **OVER THE PAST 12 MONTHS**.

Part II asks about vitamins and other dietary supplements that you may have used.

If possible, please return this questionnaire within two weeks.

The completed questionnaire should be sealed in the pre-paid envelope and mailed back to:

Health Research Unit,
Room 2801A, Division of Community Health & Humanities,
Medicine, Health Science Centre,
300 Prince Phillip Drive,
St. John's, NL, Canada, A1B 3V6

If you have any questions about this form or the study, please do not hesitate to contact with us with **709-777-2043**; leave your question when the answering machine indicates and someone will get back to you within the day.

The information given to us in this questionnaire will be kept confidential.

Thank you for your time and assistance

HOW TO COMPLETE THIS QUESTIONNAIRE

We would like to know how often you ate certain foods **OVER THE PAST 12 MONTHS,** and their amounts.

Section A **(lists foods and portion sizes)**

Amounts are described in various ways, including the number of:

cups, teaspoons (tsp), ounces (oz), inches ("), pieces (e.g., 1 apple)
grams (gm), tablespoons (tbsp), millilitres (ml), centimetres (cm).

We want to know the ***Portion Size*** of your **USUAL SERVING.** We have given an example of an average portion size in the attached pamphlet. If your portion size was different than the average, you can indicate this by putting an **X** or 3in the circles for ***Smaller*** or ***Larger*** portion sizes. ***Smaller*** than average is about 25% or less than the average portion size, while ***Larger*** than average is about 25% or more than the average size. Leave the circle blank if your typical portion size was average.

One part of the attached pamphlet shows small, medium and large portion sizes for vegetables, meat and chicken. Some questions ask you to refer to the photos to help you figure out correct ***Food Portion Size.***

Section B **(asks about how often you ate certain foods OVER THE PAST 12 MONTHS)**

For each food item listed, choose **one** column (Per Day, Per Week, Per Month, or Never / Rarely) that best describes ***HOW OFTEN*** you ate or drank that item. For example, if you ate CREAM CHEESE 3 times a month during the year of interest, you would write (3) in the *PER MONTH* column. If you ate SWEET POTATOES only 2 times during the year of interest, you can place a checkmark (3) in *the NEVER OR RARELY* column.

Section C ***(To be completed only for seasonal foods)***

Some foods (for example fresh fruit and vegetables) are not available throughout the year. **For foods that you do not eat all year round** (i.e. in season only), indicate the number of months of the year that you ate them.

Please complete each question as best you can. We know that it is difficult to recall exactly how often you ate something. If you are not certain, try to give your best estimate. If you need help completing the FFQ please call (**709)-777-2043**. If the call is outside the St. John's area you can call collect.

EXAMPLE

	Section A				Section B OVER THE PAST 12 MONTHS				Section C
	Food Item	Average portion size	Your Portion Size, if NOT Average		HOW OFTEN? (Complete one column only)				If Ate Food In **Season** Only
			Smaller	**Larger**	per **DAY** (enter a number)	per **WEEK** (enter a number)	per **MONTH** (enter a number)	**NEVER** or **RARELY** (check)	enter **Months Number** per Year
1	CREAM CHEESE	2 tbsp/ 1 oz	O	O			***3***		
2	MELONS	1/8 or 1 slice	O	O		***1***			***4***
3	SWEET POTATOES	1 medium/ ½ cup	O	O				√	

	Section A				Section B OVER THE PAST 12 MONTHS				Section C
	Food Item	Average portion size	Your Portion Size, if NOT Average		**HOW OFTEN?** (Complete one column only)				If Ate Food In Season Only
			Smaller	**Larger**	per **DAY** (enter a number)	per **WEEK** (enter a number)	per **MONTH** (enter a number)	**NEVER** or **RAREL Y** (check)	enter **Months Number** per Year
	Beverages								
1	WHOLE MILK (any, include if in cereal & drinks)	1 cup/ 250 ml	O	O					
2	2% MILK, 2% Evaporated milk (any, if in cereal & drinks)	1 cup/ 250 ml	O	O					
3	SKIM MILK, 1% MILK (any, include if in cereal & drinks)	1 cup/ 250 ml	O	O					
4	MILK SHAKE	1 cup/ 250 ml	O	O					
5	YOGURT DRINK	1 cup/ 250 ml	O	O					
6	COFFEE (instant or ground, not decaffeinated)	1 cup/ 250 ml	O	O					
7	COFFEE (decaffeinated)	1 cup/ 250 ml	O	O					
8	TEA (black)	1 cup/ 250 ml	O	O					
9	TEA (herbal)	1 cup/ 250 ml	O	O					
10	COCA COLA, PEPSI, OTHER COLA	1 cup/ 250 ml	O	O					
11	DIET SOFT DRINKS	1 cup/ 250 ml	O	O					
12	OTHER SOFT DRINKS (not diet or cola)	1 cup/ 250 ml	O	O					
13	ORANGE or GRAPEFRUIT JUICE	¾ cup/ 175 ml	O	O					
14	APPLE or GRAPE JUICE	¾ cup/ 175 ml	O	O					
15	OTHER FRUIT JUICES (pineapple, cranberry, etc.)	¾ cup/ 175 ml	O	O					
16	FRUIT DRINK (such as lemonade, iced tea, fruit punch)	¾ cup/ 175 ml	O	O					
17	VEGTABLE JUICES	¾ cup/ 175 ml	O	O					
18	BEER or ALE, REGULAR	335 ml/ 1 bottle	O	O					
19	BEER or ALE, LIGHT	335 ml/ 1 bottle	O	O					
20	WHITE/RED WINE, SHERRY, PORT (or other fortified wine)	150 ml / 5 oz	O	O					
21	LIQUOR (vodka, whiskey, rum, mixed alcohol etc.)	45 ml/ 1.5 oz	O	O					

Section A				Section B OVER THE PAST 12 MONTHS				Section C
Food Item	Average portion size	Your Portion Size, if NOT Average		**HOW OFTEN?** (Complete one column only)				If Ate Food In Season Only
		Smaller	**Larger**	per **DAY** (enter a number)	per **WEEK** (enter a number)	per **MONTH** (enter a number)	**NEVER** or **RAREL Y** (check)	enter **Months Number** per Year
	Dairy Products							
22	EGG (boiled, poached)	1 large	O	O				
23	EGG (fried, scrambled, omelette)	1 large	O	O				
24	CREAM CHEESE, REGULAR	2 tbsp/ 30 ml/ 1 oz	O	O				
25	CREAM CHEESE, LIGHT	2 tbsp/ 30 ml/ 1 oz	O	O				
26	CHEESE, REGULAR (such as cheddar, Swiss, processed)	1 slice/ 30 g/ 1oz	O	O				
27	CHEESE, LIGHT (6-15% fat, such as cheddar)	1 slice/ 30 g/ 1oz	O	O				
28	CHEESE, ULTRA-LIGHT (5% fat or less, such as cheddar)	1 slice/ 30 g/ 1oz	O	O				
29	COTTAGE/RICOTTA CHEESE	125 ml/ ½ cup	O	O				
30	CREAM, REGULAR (coffee, whipping or sour)	1 tbsp/ 15 ml	O	O				
31	CREAM, LIGHT (half and half, light sour cream)	1 tbsp/ 15 ml	O	O				
32	COFFEE WHITENER (non-dairy)	1 tbsp/ 15 ml	O	O				
33	YOGURT, REGULAR (plain, 2.4% fat or more)	6 oz/ 170 g	O	O				
34	YOGURT, LIGHT (plain, less than 2.4% fat)	6 oz/ 170 g	O	O				
35	YOGURT, REGULAR (fruit flavoured or frozen, 2.4% fat or more)	6 oz/ 170 g	O	O				
36	YOGURT, LIGHT (fruit flavoured or frozen, less than 2.4% fat)	6 oz/ 170 g	O	O				
	Mixed Dishes							
37	SOUPS (creamed, canned)	1 cup/ 250 ml	O	O				
38	SOUPS (non-creamed, canned)	1 cup/ 250 ml	O	O				
39	PEA SOUP (homemade)	1 cup/ 250 ml	O	O				
40	HOMEMADE SOUPS (non-cream)	1 cup/ 250 ml	O	O				
41	PIZZA, HOMEMADE, FROZEN	1 medium slice	O	O				
42	PIZZA, FAST FOOD	1 medium slice	O	O				
43	CHILI with meat or Con Carne	1 cup/ 250 ml	O	O				

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44	MACARONI& CHEESE with cheese or cheese sauce/powder	1 cup/ 250 ml	O	O					
45	PASTA WITH TOMATO SAUCE (such as spaghetti)	1 cup/ 250 ml	O	O					
46	PASTA WITH MEAT SAUCE (such as spaghetti, lasagna)	1 cup/ 250 ml	O	O					
47	MEAT STEW with carrots, other vegetables	photo A, medium	O	O					
	Vegetables								
48	POTATOES (mashed, boiled, baked etc.)	1 medium/ ½ cup/ 125 ml	O	O					
49	FRENCH FRIES or FRIED POTATOES	1 cup/ 250 ml	O	O					
50	CARROTS (raw or cooked)	1 medium/ ½ cup /125 ml	O	O					
51	BROCCOLI (raw or cooked)	1 cup/ 250 ml	O	O					
52	CABBAGE, COLESLAW	½ cup/ 125 ml	O	O					
53	CAULIFLOWER (raw or cooked)	½ cup/125 ml	O	O					
54	CORN	1 ear / ½ cup	O	O					
55	PEAS or LIMA BEANS	½ cup/125 ml	O	O					
56	GREEN or YELLOW BEANS	½ cup/125 ml	O	O					
57	BEANS or LENTILS (baked or boiled beans, kidney beans, chickpeas)	½ cup/125 ml cooked	O	O					
58	SPINACH and other green leafy vegetables (greens, collards, kale, mustard greens etc.)	½ cup cooked or 1 cup raw	O	O					
59	GREEN SALAD (with lettuce)	1 cup/ 250 ml	O	O					
60	CUCUMBER	½ cup/ 125 ml sliced	O	O					
61	TOMATOES (fresh)	1 medium/ ½ cup/ 125 ml	O	O					
62	TOMATOES (canned, pureed or sauce)	½ cup/125 ml	O	O					
63	ONIONS (raw or cooked)	½ cup/125 ml	O	O					
64	BEETS (boiled or pickled)	½ cup/125 ml	O	O					

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65 TURNIPS or RUTABAGAS	1 medium/ ½ cup/125 ml	O	O					
66 OTHER ROOT VEGETABLES (sweet potatoes, yams, radish, etc.)	½ cup/125 ml	O	O					
67 CELERY	½ cup/125 ml	O	O					
68 MUSHROOMS (fresh or canned)	½ cup/125 ml	O	O					
69 SWEET/HOT PEPPER (green, red or yellow)	½ cup/125 ml	O	O					
70 ASPARAGUS or BRUSSEL SPROUTS	½ cup/125 ml	O	O					
71 BEAN or ALFALFA SPROUTS	½ cup/125 ml	O	O					
72 PICKLES, RELISH	1 dill/ 2 tbsp	O	O					
73 AVOCADO	½ medium	O	O					
74 OTHER VEGETABLES (summer squash, zucchini, eggplant etc.)	½ cup/125 ml	O	O					
Meats and Fish								
75 GROUND BEEF, REGULAR (hamburger, meat loaf etc)	85 g/ 3 oz/ 3" patty	O 2 oz	O 4 oz					
76 GROUND BEEF, MEDIUM (hamburger, meat loaf etc)	85 g/ 3 oz/ 3" patty	O 2 oz	O 4 oz					
77 GROUND BEEF, LEAN (hamburger, meat loaf etc)	85 g/ 3 oz/ 3" patty	O 2 oz	O 4 oz					
78 GROUND BEEF, EXTRA LEAN (hamburger, meat loaf etc)	85 g/ 3 oz/ 3" patty	O 2 oz	O 4 oz					
79 ROAST BEEF	photo B, medium	O	O					
80 STEAK/ SHORT-RIBS	photo B, medium	O	O					
81 PORK CHOP	photo B, medium	O	O					
82 ROAST PORK	photo B, medium	O	O					
83 BAKED HAM	photo B, medium	O	O					
85 BACON	2 slices	O	O					
86 LAMB	photo B, medium	O	O					
87 HOT DOG or WIENER (Enter buns/rolls under item 116)	1 hot dog/ 2 oz.	O	O					
88 SAUSAGE	85 g/ 3 oz.	O	O					

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89	CORNED BEEF	1 slice	O	O					
90	COLDCUTS (ham, salami, lunchmeat, bologna, etc.)	1 medium slice/ 30g/ 1 oz.	O	O					
91	LIVER	85 g/ 3 oz.	O	O					
92	FRIED CHICKEN or CHICKEN NUGGETS	photo C, medium	O	O					
93	CHICKEN / TURKEY (roasted or stewed)	photo C, medium	O	O					
94	CHICKEN / TURKEY, SKIN REMOVED	photo C, medium	O	O					
95	SALTED MEAT	photo C, small	O	O					
96	PICKLED MEAT (brined)	photo C, small	O	O					
97	SHELLFISH (shrimp, lobster, crab)	photo C, small	O	O					
98	FRIED FISH	170g/6oz/ photo B, medium	O	O					
99	FISH (baked or broiled)	photo B, medium	O	O					
101	CANNED FISH (tuna, salmon)	½ can/ 48 ml/ 1.7 oz.	O	O					
102	SALTED/ DRIED FISH	photo C, small	O	O					
103	PICKLED FISH	photo C, small	O	O					
104	SEA-BIRDS, SEAL	photo C, small	O	O					
105	CARIBOU, MOOSE	photo C, small	O	O					
106	PARTRIDGE, OTHER WILD BIRDS	photo C, small	O	O					
	Cereals and Grains								
107	READY-TO-EAT CEREALS, WHOLE GRAIN (such as shredded wheat, multigrain)	½ cup/ 125 ml	O	O					
108	READY-TO-EAT CEREALS, SUGAR COATED (such as honey nut, lucky charms)	½ cup/ 125 ml	O	O					
109	READY-TO-EAT CEREALS, NOT SUGAR COATED (such as Special K)	½ cup/ 125 ml	O	O					

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110 HOT CEREALS (such as oatmeal)	½ cup/ 125 ml	O	O					
111 WHOLE GRAIN or MIXED-GRAIN BREAD	1 slice	O	O					
112 WHOLE WHEAT BREAD	1 slice	O	O					
113 HOMEMADE BREAD	1 slice	O	O					
114 WHITE BREAD	1 slice	O	O					
115 OTHER BREAD (French, raisin, banana, etc.)	1 slice	O	O					
116 WHITE BREAD ROLLS (including hot dog buns etc.)	1 roll	O	O					
117 WHOLE WHEAT ROLLS	1 roll	O	O					
118 CRACKERS	5	O	O					
119 BISCUITS	5	O	O					
120 BRAN/OAT MUFFIN	1 medium, ½ extra large	O	O					
121 OTHER MUFFIN (plain cake, chocolate, berry/fruit)	1 medium, ½ extra large	O	O					
122 BAGELS	1	O	O					
123 PANCAKES, WAFFLES	1 medium	O	O					
124 MACARONI, SPAGHETTI, NOODLES (plain)	1 cup cooked/ 250 ml	O	O					
125 WHOLE WHEAT NOODLES	1 cup cooked/ 250 ml	O	O					
126 RICE	½ cup cooked	O	O					
127 DUMPLINGS	1	O	O					
128 CRISP SNACKS (potato chips, popcorn, pretzels etc.)	1 cup	O	O					
Fruits								
129 APPLE, PEAR	1 medium	O	O					
130 CITRUS FRUITS (orange, clementine, grapefruit)	1 orange, ½ grapefruit	O	O					
131 BERRIES (strawberries, blueberries, bakeapples, blackberries)	½ cup/ 125 ml	O	O					
132 GRAPES	½ cup/ 125 ml	O	O					

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133 BANANA	1 medium	O	O					
134 PEACH, PLUM, NECTARINE, APRICOT	1 medium	O	O					
135 MELONS (cantaloupe, watermelon, honeydew)	1/8 or 1 slice	O	O					
136 PINEAPPLE	1 slice	O	O					
137 MANGO	1 medium	O	O					
138 APPLE/CRANBERRY SAUCE	½ cup/ 125 ml	O	O					
139 DRIED FRUITS (raisins, dates, prunes)	2 tbsp/ 2 dates	O	O					
140 CANNED FRUIT (all kinds)	½ cup/ 125 ml	O	O					
141 ALL OTHER FRUIT (fresh kiwi, pomegranate, etc.)	1 medium	O	O					
Desserts and Sweets								
142 SUGAR added to tea, coffee, cereal	1 tsp/ 1 cube	O	O					
143 SWEETENERS (saccharin, splenda)	1 tsp/1 package	O	O					
144 CAKES	1 slice, 2" x 4" x 1"	O	O					
145 PIES and TARTS	1 slice	O	O					
146 DONUTS and SWEET ROLLS	1	O	O					
147 COOKIES	1	O	O					
148 ICE CREAM	½ cup/ 125 ml	O	O					
149 ICE CREAM, LIGHT or DIET	½ cup/ 125 ml	O	O					
150 PUDDING	½ cup/ 125 ml	O	O					
151 PUDDING, LIGHT or DIET	½ cup/ 125 ml	O	O					
152 JELLO	½ cup/ 125 ml	O	O					
153 POPSICLES, FREEZIES	1	O	O					
154 CHOCOLATE BAR and CHOCOLATE CANDY	1 bar / 50g or 5 candy size	O	O					
155 CANDY (without chocolate)	1 caramel	O	O					
156 SWEETS (toffees, mints)	1	O	O					

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	Miscellaneous							
157 KETCHUP	1 tbsp	O	O					
158 MAYONNAISE/ MIRACLE WHIP, REGULAR (on bread, salad, meat, etc.)	1 tbsp	O	O					
159 MAYONNAISE/ MIRACLE WHIP, LIGHT (on bread, salad, meat, etc.)	1 tbsp	O	O					
160 SALAD DRESSING, REGULAR (French, Italian etc)	1 tbsp	O	O					
161 SALAD DRESSING, LIGHT		O	O					
162 OIL (in cooking)	1 tbsp	O	O					
163 BUTTER (on vegetables or bread; exclude use in baked and mixed dishes)	1 pat/ 1 tbsp	O	O					
164 MARGARINE (on vegetables or bread; exclude use in baked or mixed dishes)	1 pat/ 1 tbsp	O	O					
165 PEANUT BUTTER	1 tbsp	O	O					
166 PEANUTS	30g/ 1 oz	O	O					
167 OTHER NUTS	30g /1 oz	O	O					
168 JAM, JELLY, HONEY, SYRUP	1 tbsp	O	O					
169 GRAVY	4 tbsp	O	O					
170 CHOCOLATE or STRAWBERRY SYRUP	1 tbsp	O	O					
171 CHOCOLATE SPREADS	1 tbsp	O	O					
172 SAUCES (mustard, barbecue, soy sauce)	30 ml/ 1oz/ 2 tbsp	O	O					
173 WHEAT BRAN	1 tbsp	O	O					
174 WHEAT GERM	1 tbsp	O	O					
175 BREAD STUFFING	1 tbsp	O	O					

Continue on next page ....

PART 2 - USE OF VITAMINS AND DIETARY SUPPLEMENTS

Now we would like to know about your use of vitamins and dietary supplements OVER THE PAST 12 MONTHS, did you take any of the following? If Yes, then specify usual brand and amount and how long you took them.

EXAMPLE Vitamin and Amount if used ⇨	How many pills did you take per week?		How long had you taken them?	
➢ **Vitamin C** O None O Below 500 ✓ 500-1000 O above 1000 mg	0 5	Per week	2 4	months
➢ Multivitamins that include minerals O No O Yes If yes, usual brand _____		Per week		months
➢ Multivitamins, no minerals O No O Yes If yes, usual brand _____		Per week		months
➢ B Complex vitamins O No O Yes If yes, usual brand _____		Per week		months
In the following items, DO NOT INCLUDE use of the above MULTIVITAMINS				
➢ Vitamin A O None O Below 10000 O 10000-15000 O above 15000 IU		Per week		months
➢ Vitamin C O None O Below 500 O 500-1000 O above 1000 mg		Per week		months
➢ Vitamin E O None O Below 400 O 400-800 O above 800 IU		Per week		months
➢ Beta-carotene O None O Below 10000 O 10000-15000 O above 15000 IU		Per week		months
➢ Folic acid O None O Below 1.0 O 1.0 mg O above 1.0 mg*		Per week		months
➢ Calcium O None O Below 250 O 250-500 O above 500 mg		Per week		months
➢ Iron O None O Below 100 O 100-200 O above 200 mg		Per week		months
➢ Other dietary supplements (yeast, cod liver oil, etc) O No O Yes, specify type: _____		Per week		months

* 1 mg = 1000 micrograms

Thank you very much for completing this questionnaire! Because we want to be able to use all the information you have provided, we would greatly appreciate it if you would please take a moment to review each page making sure that you:

- Did not skip any page
- Completely erased any changes you may have made

We welcome any other information or comments that you would like to give us:

_____

_____

_____

THANK YOU VERY MUCH for your assistance in this research!

For Office Use Only

Study #: _____

Interviewer: _____

Date completed (D/M/Y): _____