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VALIDITY AND REPRODUCIBILITY OF A FOOD FREQUENCY QUESTIONNAIRE AMONG LEBANESE ADULTS FOR THE ASSESSMENT OF FOOD GROUPS

by
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A thesis
submitted in partial fulfillment of the requirements
for the degree of Master of Science
to the Department of Nutrition and Food Sciences
of the Faculty of Agricultural and Food Sciences
at the American University of Beirut

Beirut, Lebanon
January 2019

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ACKNOWLEDGEMENTS

Foremost, my utmost appreciation and gratitude I offer to Almighty God.

I would like to take this opportunity to thank everyone who believed in me.

To my family who supported me all the way through: Thank you for your patience, support, trust and above all love.

I would like to thank University Research Broad (URB) funding: grant (#NUT.FN.22) and Purdue University for their support.

I owe my deepest appreciation to Dr. Farah Naja who guided me through my academic research. Thank you for your assistance, supervision, positivity and continuous encouragement.

I would like to thank Dr. Michele Forman for her guidance and support through conceptualization and implementation of this study. Also, special thanks to my committee members, Dr. Lara Nasreddine and Dr. Abla Sibai for their valuable experience in this study.

I would also like to thank the participants who took part in this study, your cooperation made all my work enjoyable. Thank you for your time, trust and friendliness.

Thank you to the research coordinator, Hiba Chatila, who worked with me and who was always positive, enthusiastic and helpful without your continuous encouragement I would not have been able to complete this thesis. Also, I would like to thank Ms. Nada Adra and Ms. Salpy Naalbandian for their help and effort in this study.

To my valuable friends, I would like to express my profound gratitude for your unfailing support and continuous encouragement through the process of my graduate years and thesis writing. This accomplishment would not have been possible without you. Thank you

Last but not least, I express my deep and profound appreciation to my good friend and thesis co-worker Raeda El Sayed Ahmad for her invaluable contribution to the making of this work.

AN ABSTRACT OF THE THESIS OF

Mariam Bilal Baroudi for Master of Science
Major: Nutrition

Title: Validity and Reproducibility of a Food Frequency Questionnaire among Lebanese adults for the Assessment of Food Groups

Background: Diet is a major modifiable risk factor in the etiology of chronic diseases. Dietary assessment is a critical step in evaluating diet-disease association and in formulating recommendation for dietary interventions. To date, there exists no valid dietary assessment tool for adults in Lebanon. The purpose of this study was to develop and examine the validity and reliability of a Food Frequency Questionnaire (FFQ) for the assessment of dietary intake in relation to food groups among Lebanese adults.

Methods: Healthy Lebanese adults of both genders, aged between 18 and 65 were recruited from various faculties and offices at the American University of Beirut (AUB), Lebanon (n=120) by convenient sampling. Participants completed the FFQ twice, during a one year interval. Within each of the four seasons of this one year, three 24-hour recalls (24-HRs) representing two weekdays and one weekend were collected. Sociodemographic, lifestyle questionnaire and anthropometric measurements were also collected. For the development of the FFQ, a list of 94 culturally appropriate food items were included and they were categorized into 23 food groups with 4 frequency options (daily, weekly, monthly, never). Food items were analyzed into food groups based on usage or similarities in composition. Similar grouping was conducted for the 24-HR. Calorie estimation of the various food groups was conducted using Nutritionist Pro software. For validity, dietary intake data collected via the FFQ was compared to the mean of repeated 24-HR recalls (MPRs). Percent difference in means, spearman rank correlations and Bland-Altman plots were used to assess the validity of the developed FFQ. Intra-class Correlation Coefficient (ICC), percent agreement, and weighted kappa (κ w) were used to evaluate the FFQ's reproducibility. Statistical Package for Social Sciences (SPSS) was used in the analysis and a $p<0.05$ indicated significance.

Results: Out of the 120 adults, 110 completed the study (dropout rate: 8.3%). The mean (±SD) age of subjects was 38.75 (±0.91) years. Mean difference derived from the mean of MPRs and FFQ-2 was positive for most food groups indicating an overestimation of intake. Spearman correlation coefficients (r) for the association of the FFQ and mean 24-HR for the validity ranged from 0.20 for 'fresh fruit juices' ($p<0.05$) and 0.74 for 'alcoholic beverages' ($p<0.01$). Bland-Altman's Limits of agreements (LoA) showed acceptable agreement between the FFQ and the mean of MPRs in estimating portions for most food groups with mean differences lying between -0.52 for 'Pizzas and pies' and 1.90 for 'meat' intake. The majority of data points in the Bland-Altman plots lied between the LoA, closer to the middle horizontal line. Larger differences between the FFQ mean 24-HR were observed for most groups at higher intake. As for the

reproducibility, ICC was calculated between FFQ-1 and FFQ-2. It ranged from 0.31 for ‘meat’ ($p<0.05$) to 0.97 for ‘miscellaneous’ food group ($p<0.01$). The latter included mustard, ketchup, pickles (cucumber, eggplant) and thyme. The κ w values and their agreement ranged from 0.22 “fair” for ‘pasta and other cereals’ food group to 0.96 “almost perfect” for ‘miscellaneous’ food group. The average percent agreement between FFQ-1 and FFQ-2 in ranking participants into the same or adjacent quartiles was 82.81%, highest for ‘miscellaneous’ (100%) and lowest for the pasta and other cereals’ food group (71.82 %).

Conclusion: Findings of this study suggested that the developed FFQ is a valid and reliable tool in assessing dietary intake among Lebanese adults. This FFQ could be used in future studies to examine nutritional status and evaluate diet-disease associations among adults in Lebanon.

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ABBREVIATIONS

24-HR	24-hour dietary recall
AUB	American University of Beirut
ADA	American Dietetic Association
BMI	Body mass index
CI	Confidence interval
Cm	Centimeter
DHQ	Diet History Questionnaire
DLW	Doubly labeled water
DR	Dietary Record
FAO	Food and Agriculture Organization
FFQ	Food frequency questionnaire
FFQ-1	The first administration of the Food Frequency Questionnaire
FFQ-2	The second administration of the Food Frequency Questionnaire
ICC	Intra-class correlation
IRB	Institutional Review Board
κ w	Weighted Kappa
Kg	Kilograms
m^2	Meter squared
LoA	Limits of Agreement
MENA	Middle East and North Africa
MPR	Multiple Pass 24-hour dietary Recall
n	Sample size
N/A	Not applicable
NCD	Non- Communicable Disease

NFSC	Nutrition and Food Sciences Department at AUB
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
Tbsp.	Tablespoon
USA	United States of America
UK	United Kingdom
USDA	United States Department of Agriculture
WD	Weekdays
WE	Weekend days
2 D	two dimensional
CVDs	cardiovascular diseases
LMIC	Low-middle income countries
EMR	Eastern-Mediterranean region
UAE	United Arab Emirates
SES	Socioeconomic status
IPAQ	International Physical Activity Questionnaire
METs	Metabolic Equivalents

CHAPTER I

INTRODUCTION

A. General Overview

Diet is a major modifiable risk factor in the etiology of chronic diseases including cardiovascular diseases (Stampfer, Hu, Manson, Rimm, & Willett, 2000), diabetes (Wennehorst et al., 2016), and all-cause mortality (Streppel et al., 2014).

Dietary assessment evaluates dietary intake in order to identify population at risk of diet- related problems, provide data for planning of nutrition support, modify nutritional recommendations and monitor the progress and efficacy of the adherence to dietary guidelines, therapy and interventions (Taren, Dwyer, Freedman, & Solomons, 2002).

The purpose for which the dietary assessment is needed, determines the tool to use (Wrieden, Peace, Armstrong, & Barton, 2003). Various methods have been developed for assessing dietary intake at the population level, each with strengths and limitations (Wrieden et al., 2003).They range from techniques such as 24 hour recalls, estimated or weighted food records, narrative diet histories and Food Frequency Questionnaires (FFQs), to a more complex biochemical approach such as measuring markers of nutrient intakes in blood, urine or other biological samples (Moghames et al., 2015).

Although weighed diet records and biomarkers are the ‘gold standards’ of dietary assessment, each of the various methods of dietary assessment presents a distinct set of advantages, associated errors and practical difficulties to be considered (Cade, Thompson, Burley, & Warm, 2002; Moghames et al., 2015). Food records and 24-hour

recalls (24-HRs) are commonly used and are time-consuming, require literacy, and costs of these methods make them unsuitable for large-scale studies (Willett, 1998). FFQs, on the other hand, are considered to be more practical and economical for the collection of dietary data in large-scale epidemiological studies for they are easier to administer, less intrusive, less time-consuming, relatively inexpensive and less burdensome for both interviewers and participants (McPherson, Hoelscher, Alexander, Scanlon, & Serdula, 2000; Willett, 1998). In addition, unlike 24-HRs and food records, which are both considered as short term dietary assessment tools, FFQs cover a longer period of dietary recall varying from months to years (Cade et al., 2002). Measuring average long-term diet may be more valuable than measuring the intake of few specific days, particularly when aiming to assess the relation between food and long-latent diseases with modifiable risk factors, such as obesity and diet related non-communicable diseases (Willett, 1998).

In order to understand the role of diet in prevention and control of disease, there is a need to have a valid, reliable assessment tool. FFQ has been validated in many countries such as Iran (Malekshah et al., 2006), United Arab Emirates (UAE) and Kuwait (Dehghan et al., 2012), and Jordan (Tayyem, Abu-Mweis, Bawadi, Agraib, & Bani-Hani, 2014b). However, since food consumption is culture specific, the accuracy of dietary intake information generated by FFQs is highly dependent on the validity and reproducibility of the FFQs in the populations in which they are intended to be used (Stevens et al., 1996).

Nevertheless, the validity of a tool for the assessment of diet is culture and ethnic specific (Stevens et al., 1996). Moreover, there is a nutrition transition, erosion of the traditional diets which are rich in fruits and vegetables (Naja et al., 2011), and a shift

toward a more westernized type of dietary intake (Carvalho, Dutra, Pizato, Gruezo, & Ito, 2014) which is a risk factor for non-communicable diseases and are associated with high intakes of processed, energy-dense, low nutrient foods (Drake et al., 2013; Willett & Stampfer, 2013; World Health Organization, 2003). To date, there exists no valid dietary assessment tool for adults in Lebanon. Hence, the purpose of this study is to validate the FFQ.

B. Objectives

The aim of this thesis was to validate a culturally sensitive FFQ for the assessment of dietary intake by food groups among Lebanese adults. More specifically, the objectives include:

- Develop a FFQ that capture food group intake with culturally appropriate food list that are commonly used among Lebanese adults as well as the portion size, frequency and an open-ended section.
- Determine the relative validity of the developed FFQ as compared to the means obtained by repeated Multiple Pass 24-HR recalls (MPR) over a period of 12 months.
- Evaluate the reproducibility of this FFQ after 12 months following initial administration.

CHAPTER II

LITERATURE REVIEW

A. Overview of Non-Communicable Diseases

Non-communicable diseases (NCDs) have been on rise worldwide (Food and Agriculture Organization of the United Nations, 2017). The three-main nutrition-related NCDs are: cardiovascular diseases (CVDs), diabetes and cancer, which have emerged as the leading causes of morbidity and mortality (Food and Agriculture Organization of the United Nations, 2017; Sibai, Fletcher, Hills, & Campbell, 2001).

Worldwide, 71% (around 2/3) of total deaths were attributed to NCDs (World Health Organization, 2018b) with over 75% (30.7 million) occurring in the low-middle income countries. (LMIC) (World Health Organization, 2015). These countries (LMIC) are undergoing nutrition and disease transition as a result of increased modernization and globalization (Global Health Institute & American University of Beirut, n.d.).

In 2008, almost 60% of total deaths (1.2 million) in Arab countries were due to NCDs (Naja et al., 2017).

In Lebanon, westernization and changes in lifestyle (World Health Organization, 2009) coupled with high literacy (85%) and high urbanization (81%) (World Health Organization, 2016) have contributed to a rapid increase in NCDs and obesity prevalence as well as the triple burden of malnutrition (World Health Organization, 2009).

The WHO-NCD country profile report (2014) showed that NCDs contributed to 85% of total deaths in Lebanon, with CVDs accounting for 47%, followed by cancer (22%), and diabetes (4%) (World Health Organization, 2014).

This change in lifestyle (physical inactivity, smoking, unhealthy eating patterns) has also led to nutrition transition from traditional Mediterranean diet (high in fruits and vegetables and complex carbohydrates) to a more westernized one (lower in carbohydrates, higher in animal-based food, high in sugar and processed food) in the Eastern-Mediterranean region (EMR) and more specifically in Lebanon (Naja et al., 2011; Naja et al., 2017; Sibai et al., 2010).

According to WHO, the major modifiable risk factors for most NCDs are the use of tobacco, alcohol consumption, physical inactivity, unhealthy diets, overweight and obesity and high blood pressure and cholesterol (Global Health Institute & American University of Beirut, n.d.; Kim & Oh, 2013; World Health Organization, 2017, 2018a).

Numerous studies have highlighted a strong association between dietary intake and chronic diseases (Food and Agriculture Organization of the United Nations, 2017), since diet is a major modifiable risk factor in the etiology of chronic diseases including CVDs (Stampfer et al., 2000), diabetes (Wennehorst et al., 2016), and all-cause mortality (Streppel et al., 2014).

Measuring average long-term diet may be more valuable than measuring the intake of a few specific days, particularly when aiming to assess the relation between food and related long-latent diseases with modifiable risk factors, such as obesity (Willett, 1998).

In order to understand the role of diet in prevention and control of disease, there is a need to have a valid, reliable assessment tool. The FFQ has been validated in many countries such as Iran (Malekshah et al., 2006), UAE and Kuwait (Dehghan et al., 2012), and Jordan (Tayyem, Abu-Mweis, Bawadi, Agraib, & Bani-Hani, 2014a). However, since food consumption is culture specific, the accuracy of dietary intake

information generated by FFQs is highly dependent on the validity and reproducibility of the FFQs in the populations in which they are intended to be used (Stevens et al., 1996). Thus, the validity of a tool for the assessment of diet is culture and ethnic specific (Stevens et al., 1996).

Moreover, the nutrition transition, erosion of the traditional diets which are rich in fruits and vegetables (Naja et al., 2011), and the shift toward a more westernized type of dietary intake (Carvalho et al., 2014) which are the risk factors for the NCDs-related dietary factors. These are associated with high intakes of processed, energy-dense, and low nutrient foods (Drake et al., 2013; Willett & Stampfer, 2013; World Health Organization, 2003). Also, obesity is increasing in Lebanon and in many countries of the MENA (World Health Organization, 2014). Hence, there is a need to validate the FFQ to accurately assess the dietary intake and relate it to diseases.

B. Dietary Assessment

1. Definition of Dietary Assessment

Dietary assessment estimates the quantity, quality and frequency of food and its dietary components consumed over a period of time. It is often conducted to calculate the intake of energy, food and food groups, as well as macro and micro nutrients in order to compare it against a reference method (Biro, Hulshof, Ovesen, & Cruz, 2002). Dietary assessment is needed in order to evaluate one's dietary intake, identify population at risk of diet- related problems, generate data to allow for the appropriate planning of nutrition support programs, modify nutritional recommendations and monitor the progress and efficacy of the adherence to dietary guidelines, therapy and interventions (Taren et al., 2002). The purpose for which the dietary assessment is

needed will determine the appropriate tool to use (Wrieden et al., 2003). Various methods have been developed for assessing dietary intake at the population level, each having certain strengths and limitations (Wrieden et al., 2003). The methods range from simple techniques such as dietary recalls, food records or diaries, dietary histories, observed intake and FFQs, to a more complex biochemical approach such as chemical analyses of duplicate collections of consumed food and biological assessments such as doubly-labelled water and plasma carotene, etc. (Moghames et al., 2015).

The complexity of diet is a true challenge for modern nutritional epidemiology since individuals are exposed to many causal factors. For instance, people are not aware of the content of the food they consume, and they rarely make changes to their diet at specific periods of time. People's nutrient intake also varies from one day to the another as they do not eat the same foods everyday (Willett, 1998). Evaluating the dietary intake of a population represents a true challenge for contemporary nutritional epidemiology (Serra-Majem et al., 2009). In order to measure food or nutrient intake, the dietary method should involve the following procedure: the individual should report all the food he/she consumes and identify the foods such that an appropriate item can be chosen from standard food tables. Quantifying the portion size of each food item, determining the frequency of the food consumed , as well as calculating the nutrient intake should also be considered (Wrieden et al., 2003).

The quality of a diet is assessed based on healthy eating patterns or food guides for the general population or whether it can prevent diet-related diseases (Carvalho et al., 2014). It can be assessed by measuring the macro and micronutrients or food and food groups that an individual consumes (Kolodziejczyk, Merchant, & Norman, 2012).

A central feature of the dietary intake of free living individuals is the variation from day to day superimposed on an underlying consistent pattern (Willett, 1998). This variation has been considered the main reason for the inability to find significant associations between an individual's dietary intake and disease (Van Staveren, Burema, Deurenberg, & Katan, 1988).

2. Dietary Assessment Methods

The complexity of dietary intake measurement and the challenges facing it make no single method able to assess dietary exposure perfectly under all conditions (Shim, Oh, & Kim, 2014). In other words, inaccurate dietary assessment may be a serious obstacle to understand the impact of dietary factors on disease (Shim et al., 2014).

Furthermore, the individual's ability to recall and conceptualize the exact potion sizes of food that has been already consumed determines how accurate the measurement of the long-term dietary exposure is. No method can assess dietary intake without error. For example, some individuals tend to report socially desirable dietary habits during the assessment of current dietary intake (Cade et al., 2002; Willett, 1998).

The most appropriate measurement method depends on the objectives of the research, its design, the accuracy of data required, funds, available resources and personnel, and the skills of population of interest (Huybrechts, De Backer, De Bacquer, Maes, & De Henauw, 2009; Shim et al., 2014). Dietary assessment methods can be collected at three different levels: the national, household, or the individual level. Although data collected at the individual level is the most useful for assessing the adequacy of a diet, household data and food supply provide information that can be used for other purposes (World Health Organization & Food and Agriculture Organization of the United Nations, 1996). There are two approaches to measure food

consumption by individuals: the prospective and retrospective methods, both of which are subjective estimates (Shim et al., 2014). The prospective methods require that subjects report their dietary intake either at the time of consumption or afterwards. These include the food records (weighted and estimated), observed intakes, and chemical analysis of duplicate diets. The prospective methods directly measure current diet and can be carried out for varying lengths of time, but they are labor intensive and require adequate literacy, they also might over or under estimate the accurate intake and might not reflect the actual diet. As for the retrospective methods, they involve recalling either recent or past data. These methods include 24-hour dietary recalls, FFQ and the diet histories. They are considered to be less labor intensive, as well as easier and less expensive to administer, but they could result in the collection of inaccurate data due to poor memory or the imprecise description of the portion size. In nutritional epidemiology, the most commonly used methods are the 24-hour recall, food record and the FFQ (Subar et al., 2001).

a. 24-Hour Recall

The 24-HR recall is an in-depth open-ended interview conducted by a trained dietary interviewer aiming to collect detailed information about everything the participant consumed (foods and beverages) from midnight to midnight of the previous day or over the last 24-HR period (Willett, 1998). The interview is usually conducted either face to face or by telephone (Thompson & Subar, 2001). It usually takes around 20 to 30 minutes to complete (Shim et al., 2014). Although it can be self-reported, it is recommended that the interview be carried out by a trained dietary interviewer who is better capable of being accurate and precise by taking into account the methods of food

preparations, ingredients used in mixed dishes, name of the brand of commercial products, and the use of dietary supplements (Willett, 1998). Sometimes the interviewee may be a parent or a caretaker if the subject is a child or mentally incapable adult (Willett, 1998). Intensive training for the interviewer is essential in order to obtain accurate and comprehensive recalls. The interviewer should maintain a neutral attitude toward all responses, ask non-judgmental questions, use open ended questions in probing for foods, and avoid asking leading questions (Willett, 1998).

The 24-HR method requires the accurate quantification of the amounts of foods that are estimated in reference to a common size container, standard measuring cups and spoons, a three-dimensional food model, or two-dimensional (2D) aids such as photographs (Shim et al., 2014) .

Typically, the data collected from several 24-HR is averaged together on both weekdays (WD) and weekends (WE) (Trabulsi & Schoeller, 2001) since a single day's intake is not representative of the individuals actual dietary intake (Block, 1982).

There are many advantages and disadvantages to the 24-HR method. Some of its advantages include the use of open-ended questions that allows participants to provide a detailed account of their dietary intake, thus resulting in an accurate estimation of their actual intake. It's relatively of low respondent burden since the literacy of the respondent is not required (Shim et al., 2014). Hence, the collected data is more likely to be representative of the general population (Thompson & Subar, 2001). Moreover, this method is quick and non-intrusive (Biro et al., 2002). The 24-HR method is suitable for large scale surveys and can be administered by telephone (Wrieden et al., 2003).

The main disadvantage of the 24-HR method, however, is its dependency on short-term memory (episodic) (Shim et al., 2014). It also only reflects the short-term

intake (Shim et al., 2014), not to mention biases that may be introduced by the recall process or the interviewer (Shim et al., 2014). Also, multiple days are required to assess the usual intake since a single observation provides poor measure of an individual's typical intake (Shim et al., 2014; Subar et al., 2006; Van Staveren et al., 1988; Wrieden et al., 2003). Fluctuations due to intra-individual day to day variation in nutrient intake might be present as well (Bingham, 1987; Block, 1982; Goldbohm et al., 1994; Margetts & Nelson, 1997). McPherson et al., (2000) states that highly trained interviewers are needed (McPherson et al., 2000).

A major source of error when collecting the 24-HR is related to the participant's memory which is associated with age, knowledge, mood, intelligence, gender, attention, and the consistency of eating patterns (Krall, Dwyer, & Coleman, 1988). Memory errors can be minimized by considerable training and practice of the interviewers. The interviewer's ability to help participants remember what they ate, by collecting a brief history of the previous day's activities and relating these activities to the food intake before the beginning of the recall questions, will help jog the participant's memory. Also, the participant will have the chance to carefully reflect on his/her eating behavior if provided in a relaxed and unhurried atmosphere (Willett, 1998).

In 1999, the United States Department of Agriculture (USDA) has developed the Multiple Pass Food Recall (MPR) which is a 5-step approach aiming to improve the 24-HR (Moshfegh et al., 2008). The steps to collect the 24-HRs using the MPR approach include:

1) Asking the participant to start by quickly listing the foods eaten in the preceding day without respect to time sequence,

2) Asking about any forgotten foods,

3) Asking the time and occasion at which foods were consumed,

4) Probing for specific details about each of the foods and beverages consumed, including their portion size, preparation method, brand names, and supplement intake,

5) And last, a final probe review of the consumed foods (Conway, Ingwersen, Vinyard, & Moshfegh, 2003).

b. Food Record

The food record method is an open-ended approach that requires the participant to record all the food and beverages consumed on one or more days. This usually includes detailed information about the participant's dietary intake such as brand names, ingredients and recipes of mixed dishes, methods of food preparation, the amounts consumed, and the portion sizes (Bingham et al., 1988; McPherson et al., 2000; Thompson & Subar, 2001). The amounts consumed are quantified either by using a scale or household measures such as cups or spoons or estimated using models, pictures or no aid (Thompson & Subar, 2001). Food intake is supposed to directly be recorded by the participant at the time of consumption to minimize the reliance on memory hence, reducing the potential recall biases (Willett, 1998). No more than seven days are included when multiple consecutive days are recorded and it is unsatisfactory to record more than four consecutive days since the participant's reported intake is likely to decrease and the foods and amounts consumed may be related such as eating left-overs from the previous days. Therefore, in order to increase the representativeness of the participant's diet, it is advantageous to collect non-consecutive single-day records (Thompson et al., 2002).

The food record (or dietary record methods) has some strengths and limitations. One of its strengths is the use of open-ended questions that provide a detailed intake data, thus reflecting the actual intake of participants. Since no interviewer is required, the interviewer bias is eliminated, and since it does not rely on memory, recall bias is also minimized (Thompson & Subar, 2001).

Some of its limitation, on the other hand, include the need for literacy and high motivation, and involves a high respondent burden since participants need to be trained before participating in order to obtain accurate data (Shim et al., 2014), also this might affect the representativeness of the study sample when comparing it to the general population (Thompson & Subar, 2001). Additionally, possible under-reporting might be present. The diet record is an expensive, time consuming method that focuses on the short-term intake (Shim et al., 2014; Thompson & Subar, 2001). Another disadvantage includes the need to have multiple days in order to be able to assess the usual intake. Possible changes to one's diet might also be present if repeated measures are taken (Thompson & Subar, 2001) or if difficulties to report complex dishes is present (Watson, Collins, Sibbritt, Dibley, & Garg, 2009). Also, participants might report "healthier foods" thus increasing the bias of reporting (Bliss, 2004; Thompson & Subar, 2001).

c. Food Frequency Questionnaire

Since short-term recall and food record methods are generally unrepresentative of one's usual intake (if only few days are assessed) and are inappropriate for assessing past diet, researchers have sought alternative methods for measuring long-term food intake (Willett, 1998). Since feasibility, cost, and time are limiting factors in large

epidemiological studies, the best method of choice was the FFQ (Dehghan et al., 2012) which was developed in the early 1950s (Willett, 1998). The FFQ is an essential tool in epidemiological research (Cade, Burley, Warm, Thompson, & Margetts, 2004; Willett, 1998) that requires the participants to report their usual intake by inquiring about the frequency (per day, per week, per month, or never) and amount of food they ate over a specific period of time. The FFQ has been developed for many countries worldwide (Willett, 1998). The purpose of the FFQ is its ability to capture the usual intake estimates over a long period of time (weeks, months, years) (Shim et al., 2014; Willett, 1998) this can yield more accurate results than measuring the intake of specific days. Hence, FFQ can be more applicable for studying the association of dietary intake with long-latent modern diseases such as NCD and cancer (Shim et al., 2014; Willett, 1998).

The FFQ usually requires around 45 to 60 minutes to be completed since many food items are presented (100-150 foods). The questionnaire can be either self-administered or collected by an interviewer (Shim et al., 2014).

The 3 main components of the FFQ are the: (1) food list, (2) portion size, and (3) the frequency response section (Willett, 1998). The inclusion of ethnic foods in the food list of the FFQs is more likely to improve the accuracy of assessing nutrient intake among that specific ethnic group (Khokhar et al., 2009).

The FFQ can be classified as quantitative, semi-quantitative, or qualitative (McPherson et al., 2000). The semi-qualitative or non-quantitative FFQ offers no additional information on portion size, whereas the quantitative FFQ includes an open-ended section and the size of portion is estimated by either weights, measures, or food models. The semi-quantitative FFQ is the one with specified portion sizes for foods that are consumed in typical portions and response answers are limited to the part on the

question of frequency of intake (McPherson et al., 2000; Serdula, Alexander, Scanlon, & Bowman, 2001; Willett, 1998).

Compared to other dietary assessment tools, FFQs, which capture the habitual intake, have considerable advantages in terms of practicality. They are easier to administer, inexpensive, less intrusive, and are generally suitable for long-term studies with large sample size (Shim et al., 2014; Willett, 1998; Willett & Hu, 2006).

Despite the major benefits of the FFQ, its use may be limited due to poor design and inappropriate application (Serra-Majem et al., 2009). Because the FFQ employs a closed-ended style, recall bias might arise, thus leading to a low level of accuracy. That's why the FFQ should be evaluated before being used as a dietary assessment tool, in which case a coefficient correlation of 0.5 to 0.7 is considered high (Shim et al., 2014; Willett, 1998). Other aspects of the FFQ is that it relies on generic memory which enables the participant to provide a global estimate of the types of foods, frequency of intake, and amounts eaten over a longer period of time (habit and repetitious actions). This is different from the episodic memory associated with the 24-HR method which provides the recall over a limited time span that covers immediate past events. However, it has been contended that errors associated with these forms of memory are not entirely independent of each other since both can still be influenced by social desirability and conceptualizing of portion sizes (Willett, 2001).

The FFQ method is based on estimates of portion sizes, thus over reporting of healthy food might be possible. Additionally, the FFQ needs to be validated in relation to a reference method (Wrieden et al., 2003) because non-validated FFQs can result in false or null or positive relationships between habitual dietary intake and chronic diseases (Tayyem et al., 2014a).

Many FFQs have been developed for different populations, purposes, and research needs. Some were developed in the United States and others throughout the world (Thompson & Subar, 2001) such as South Korea (Shim et al., 2014). A major limit of the FFQ arises from the fact that ethnicity, culture, individual preferences, economic status and others affect the dietary habits of each population (Teufel, 1997); also, incorrect estimations of exposure might lead to false associations between dietary exposure and health outcome (Cade, Thompson, Burley, & Warm, 2002); the FFQ should be developed and validated to each population according to different study purposes.

Hence, the development and validation of the FFQ should be culture-specific (Teufel, 1997).

The FFQ is able to predict health outcomes and compare the average dietary intakes at both the individual or group level (McPherson et al., 2000). The most common use of the FFQ is to rank individuals by their food and nutrient intake levels within a group when validated against more detailed and accurate methods of assessment (Block, 1982; Willett, 1998).

C. Validity and Reproducibility of the FFQ

The examination of the dietary association with disease at the level of individual foods, food groups, nutrients, and dietary patterns is frequently used. Thus, studies of questionnaire validity and reproducibility at these levels are important (Willett, 1998).

Various approaches have been used to evaluate and assess the performance of the FFQ which include: comparing the means, measuring validity and the

reproducibility of the FFQ, as well as comparisons with biochemical markers and others (Willett, 1998).

1. The Importance of Validated Dietary Assessment Methods

No dietary method can assess the intake without errors. Therefore, there is a need to test the validity of dietary assessment tools to make sure the relationship between the method and what it tends to measure and the interpretation of the assessment results is appropriate (Willett, 1998).

It is well known that there is no true gold standard in assessing the dietary methods (Block, 1982). Most validation studies are evaluated in comparison to a less-biased assessment method (Buzzard & Sievert, 1994; Kaaks, Riboli, & van Staveren, 1995; Kipnis, Carroll, Freedman, & Li, 1999; Kohlmeier & Bellach, 1995; Rockett et al., 1997). Validating against Doubly Labeled Water is expensive and restricted to small scale studies (Trabulsi & Schoeller, 2001).

Information from invalid FFQ, or any non-validated dietary assessment tool, will lead to false associations between dietary factors and diseases or disease-markers (Cade et al., 2002). This is why the validation of the FFQ is essential (Block, 1982; Cade et al., 2002; Cade et al., 2004). In addition, using dietary assessment tools that have been validated in other populations will contribute to less accuracy when collecting data, thus resulting in poor compliance. Hence, the dietary assessment method must be tailored and validated for the specific population of interest with regard to its food culture and characteristics (Willett, 1998).

Moreover, dietary interventions are known to treat and manage chronic diseases, hence, the efficacy of dietary intervention necessitates valid measures of diet (Segovia-Siapco, Singh, Haddad, & Sabaté, 2008).

Nutrition, in terms of dietary behaviors, food groups, macro and micro nutrients, and supplements have been shown to be associated with a variety of chronic diseases (Tarasuk & Brooker, 1997).

2. Validation Methods for FFQ

FFQ are tools that need to be validated in order to accurately measure the dietary intake and the performance of the questionnaire (Subar et al., 2001; Willett, 1998). Validation is needed to determine the habitual intake, since long-term exposure of a particular diet impacts the morbidity and mortality and investigate the diet-disease relationships. Willet defines validity as the degree to which the questionnaire (FFQ) is able to capture the aspects of diet that it was designed to measure (Willett, 1998). Since there is no perfect method to measure food intake, validation studies never compare a method with absolute truth; rather they compare one method with another that is maybe considered superior (Willett, 1998). In theory, the measurement errors of the FFQ and reference method should be independent (Cade et al., 2002) to avoid false high estimates of validity (Willett, 1998).

A recent review by Cade et al (2002) showed that a variety of different dietary assessment tools were used as a reference method. Fifty-six (25%) used the food record; 59 (26%) used a food record/diary (not including weighed diaries); 50 (22%) used the 24-hour recall; 14 (6%) used the DHQ; and 27 (12%) used another FFQ. One hundred and forty-four (64%) validation studies used only one reference method. Seven (3%)

validation studies used both the weighed record and 24-hour recall as reference methods (Cade et al., 2002).

a. Food Records or Dietary Recalls

For studies involving large numbers of individuals, it is challenging to collect data for multiple days of intake. The current use of recall and record methods in nutritional epidemiology has been to assess the validity of the FFQ, which is used as the main dietary data collection tool (Cade et al., 2002; Willett, 1998). This is done by collecting one or more recalls/records form a representative sample of the study population, then used to adjust associations between nutrient intake and risk of disease (Willett, 1998).

Dietary records (DR) are favored over the 24-HR method and are considered the ideal method when validating the FFQ because they produce the least correlated errors with the FFQ. Because dietary records are open-ended, they do not rely on memory. Additionally, portion sizes are weighted which allows a direct assessment (Feskanich et al., 1993; Garnett, Truswell, & Bonney, 1995; Willett, 1998, 2001). DR is used as the reference method in most of the validation studies (Serra-Majem et al., 2009). In a qualitative study, 75% of the validation studies used DR as the reference method (Cade et al., 2004).

Although the 24-HR is less demanding for the participant than diet recording and less likely to influence the actual diet of the subjects, its sources of error tend to be more correlated with those in a dietary questionnaire. However, cooperation, high motivation, or the literacy of study subjects may be limited (Willett, 1998). Moreover, when subjects are of low-income status (Vucic et al., 2009), the 24-HRs, more

specifically the multiple pass food recall method may be the best alternative (Cade et al., 2002). Also, the use of the 24-HR as a reference method has been found to be easier to use and less expensive to administer when compared to the food record methods (Tayyem et al., 2014a), therefore, it has been used in many studies (Bohlscheid-Thomas, Hoting, Boeing, & Wahrendorf, 1997; Katsouyanni et al., 1997; Sharma et al., 2008). Since previous attempts in Lebanon failed to use dietary records as gold standard, because they require advanced literacy skills and high levels of motivation, we shifted toward the use of 24-HR as the reference method.

Evaluating intake through the 5-step multiple pass food recall technique has been shown to accurately assess energy and macronutrients (Conway, Ingwersen, & Moshfegh, 2004) and to have stronger correlation with doubly labelled water (DLW) and other dietary assessment method (Blanton, Moshfegh, Baer, & Kretsch, 2006).

Since the FFQ tends to capture the usual intake, dietary information collected should be representative of the corresponding dietary pattern.

b. Blood Biomarkers

Biochemical markers of nutrients in blood or other tissues have been used as determinants of the nutrition status, and as comparison method with other dietary reference method (Cade et al., 2002). Biochemical markers provide an estimate of dietary intake that is independent of the subject's reported dietary intake and therefore they are less prone to errors involved with underreporting or poor memory (Cade et al., 2002).

While biochemical markers are the gold standard for assessing the validity and reproducibility of a dietary questionnaire since their measurement errors are not

correlated with any errors of the dietary questionnaire (Willett, 1998), they are usually expensive, invasive or nutrient/ nutrient-group specific, so may only be used to validate one or a group of nutrients at a time e.g. carotenoids, Vitamin A, Vitamin E (Cade et al., 2002). Diet is not only the factor that affects the biochemical markers.

Other factors play a role as well, such as individual differences in digestion, absorption, utilization, uptake, metabolism, excretion and homeostatic mechanism which differs from one nutrient to the other (Margetts & Nelson, 1997; Willett, 1998).

Other errors associated with the biochemical markers are the differences between dietary assessment and the true intake, as well as the errors associated with the biochemical assay itself. (Cade et al., 2002; Margetts & Nelson, 1997; Willett, 1998).

Also, physiological variations, fluctuations of the biochemical indicator, differences in the bioavailability of some foods, and technical errors in the laboratory analysis might be present (Willett, 1998). Other limitation associated with this reference method is the limited number of known biomarkers to date and the lack of biomarkers for many nutrients such as total carbohydrates, sucrose, fiber, etc. (Willett, 1998).

c. Methods of Triads

The method of triad was developed to estimate the validity coefficient between the true intake and the intake estimated according to a more detailed measure, which in our case is the multiple pass 24-HRs, the FFQ, and the biomarkers (Kaaks, 1997).

Therefore, the ability to show that the FFQ is correlated with the recall method and the biochemical indicator strengthen the validity of the study. Also, the magnitude of the correlation between the FFQ, 24-HR and the biomarker provides evidence about the relative validity of the two-dietary methods (Willett, 1998). The three-way

comparison can be used to approximate the level of agreement between the test measure and the real intake by estimating the latter from the correlation between the three measures (Margetts & Nelson, 1997) and the underlying true intake (Willett, 1998).

3. Reliability of the FFQ

Another issue of the FFQ design is the reliability or reproducibility of the FFQ, which determines whether the FFQ is able to provide reproducible results and whether it is important for all types of study design. The reproducibility of the FFQ is the consistencies of the FFQ measurements on more than one administration to the same person. The most common interval between repeat measures is one year (Cade et al., 2002). When conducting the reproducibility study, it should be noted that the interval between the two administrations should not be as short as few days or weeks because participants will remember their previous answers nor too long because participants might change their dietary habits (Willett, 1998). On the other hand, high reproducibility does not always ensure valid measurements because high correlation might be a result of correlated errors (Willett, 1998).

The reproducibility of FFQ has been examined under a wide variety of conditions and it was assessed in 107 of the validation studies (45%) (Cade et al., 2004). A correlation coefficients ranging from 0.5 to 0.7 is usually used to compare the differences between the 2 responses of the FFQ (Cade et al., 2002; Willett, 1998).

When an interviewer administers the FFQ, two aspects of reliability should be distinguished: the inter-rater reliability and the intra-rater reliability. Inter-rater reliability assesses whether different interviewers are able to use the questionnaire similarly and achieve similar answers from the same subjects whereas intra-rater

reliability assesses whether repeated administration by the same interviewer gives similar answers (Cade et al., 2002).

D. Validation of the FFQ by Food and Food Group Consumption Estimates in Adults

Most of the FFQ validation studies were analyzed at the level of nutrient intake (both macro and micro nutrients) (Malekshah et al., 2006; Matos et al., 2012; Preston, Palacios, Rodríguez, & Vélez-Rodríguez, 2011; Sahashi et al., 2011; Tayyem et al., 2014b), 74% (166/223) (Cade et al., 2002). Only few of them exist on validating the FFQ at the food and food group levels (Kolodziejczyk et al., 2012; Willett, 1998) 52% (115/223) (Cade et al., 2002).

When validating the FFQ at the level of food and food groups, a major source of error regarding the food composition database can be eliminated. Furthermore, the variation from day-to-day of nutrient intake has been shown to be the highest (Willett, 1998).

In terms of relation between nutrition and disease, specific food groups or dietary patterns have been associated with a reduced or increased risk of specific long-latent diseases such as NCDs and cancer (Barlow, 2007; Willett, 1998). For example, a diet rich in fruits and vegetables have been associated with reduced incidence of cancer, blood pressure, coronary heart disease and strokes (Carvalho et al., 2014; Willett, 2010), while an increased consumption of dairy products was strongly associated with lowering insulin resistance (Pereira et al., 2002).

Food grouping has been used in many countries such as United States of America (USA), Japan, Denmark and others (World Health Organization & Food and Agriculture Organization of the United Nations, 1996). Classifying foods into

categories, rather than using the nutrient-based approach, makes it easier to develop dietary guidelines and recommendations based on the population's nutritional status. This is because the nutrient-based approach is commonly misapplied and is inadequately proven to develop effective nutrition education programs. Thus, might lead to confusion among policy makers and in the implementation of guidelines and interventions among educators and consumers. Also, scientific evidence has showed that nutrients interact differently when presented as foods and no single nutrient is able to summarize the benefits or protective effects alone unless clustered in a group (Willett, Reynolds, Cottrell-Hoehner, Sampson, & Browne, 1987; World Health Organization & Food and Agriculture Organization of the United Nations, 1996).

E. Available Validated FFQs for Adults

The validation of the FFQs at the level of nutrient and/or food groups has been assessed for studies involving all age groups for more than 20 years in countries such as USA, United Kingdom (UK), France, Sweden Australia, Japan, Brazil, Greece, Germany, etc. (Cade et al., 2004; Kolodziejczyk et al., 2012; McPherson et al., 2000) Table 12. Many countries have validated various FFQs depending on the target population since the FFQ should be tailored and validated specifically for the population under study. For example, in Japan, FFQs have been validated for studies involving children, adolescents, and adults (Kobayashi et al., 2011).

In MENA region, a validation of the FFQs has been done for adults in the Islamic Republic of Iran (Malekshah et al., 2006), UAE, and Kuwait (Dehghan et al., 2012), Israel (Shahar, Fraser, Shai, & Vardi, 2003; Shahar, Shai, Vardi, Brener-Azrad, & Fraser, 2003). However, to date, there is no validated FFQ for Lebanese adults.

Several published articles in Lebanon that were conducted to examine the dietary intake of the adult population and its association with diseases stated that their main limitation was the use of non- validated dietary assessment method (mainly the FFQ). (Al Thani et al., 2018; Naja et al., 2012; Naja et al., 2013; Naja et al., 2011; Nasreddine et al., 2018). This might have led to dilution of the association between diet and disease.

Therefore, there is an increased need to have a valid and reliable dietary assessment tool that is culture-specific, practical, cost effective, time efficient, and suitable for large population scale. To date, there exists no validated FFQ tailored for Lebanese adults to properly assess their food group intake.

Hence, the aim of this thesis is to validate a culturally sensitive FFQ for the assessment of dietary intake by food groups among Lebanese adults. More specifically, the objectives include:

- Develop a FFQ that capture food group intake with culturally appropriate food list that are commonly used among Lebanese adults as well as the portion size, frequency and an open-ended section.
- Compare food and nutrient intake from the developed FFQ to the means obtained by repeated Multiple Pass 24-HR recalls (MPR) over a period of 12 months.
- Evaluate the reproducibility of this FFQ after 12 months following initial administration.

CHAPTER III

METHODS

A. Study Design

This study is an observational, analytical, period cross-sectional study aimed at validating and testing the reproducibility of a FFQ against the mean of repeated 24-HR using the MPRs approach in a sample of Lebanese adults in order to assess dietary intake by food groups.

B. Ethics Approval

The study was reviewed by the Institutional Review Board (IRB) of the Social and Behavioral Sciences at the American University of Beirut (AUB). It was granted approval for a period of 2 years starting October 2016 (#NUT.FN.22). All documents used in data collection (both English and Arabic versions) were officially stamped by the IRB. After the research team explained the protocol of the study, individuals who accepted to participate signed a written consent form indicating their approval (Appendix I, II)**.** In addition, to ensure privacy and anonymity of all participants in the study, participants were assigned random identifiers to all the questionnaires, MPRs, consents they have completed. All files were kept in separate locked cabinets to which only investigators in this project had access to.

C. Study Participants

Validation should be done on a representative sample of the study population since demographic characteristics might affect the validation study's outcome (Margetts

& Nelson, 1997; Willett, 1998).

Healthy Lebanese adults of both genders, working in various faculties and offices at AUB were recruited with a sample size of 120 individuals. Eligible individuals who met the inclusion and exclusion criteria (Appendix III) and who agreed to take part in this study signed the written consent form.

Inclusion criteria included:

- Holding the Lebanese nationality or residing in Lebanon for more than 10 years
- Able to speak the Arabic language
- Between the ages of 18 and 65 years

Exclusion criteria:

- Non-Arabic speaking individuals
- Pregnant and breastfeeding women
- Individuals with chronic health conditions that require dietary modifications such as diagnosed with eating disorders, diabetes, renal diseases, liver diseases, etc.

Convenient sampling was used in order to recruit participants which included verbal announcements, flyers which were posted in the entrance of all academic faculties and departments at AUB, physical plant, student and staff cafeteria, and those who were interested contacted us and they were screened for eligibility. Only those who met the inclusion criteria were recruited.

D. Study Protocol

Participants were enrolled in this study for a period of 12 months during which up to 12 face-to-face interviews took place in a private setting at the American University of Beirut in Lebanon. Face to face interviews took place either at the

participant's offices – when applicable or subjects were invited to the Nutrition and Food Sciences Department (NFSC) department room 520 where interviews took place.

During the first interview, a socio-demographic questionnaire was administered in addition to the lifestyle questionnaire and the first FFQ (FFQ-1). Anthropometric measurements of each participant were measured and recorded during the first visit.

During each of the four seasons, we contacted the participants to schedule face-to-face interviews at AUB to collect three random 24-HR. The 24-HRs per season represented two weekdays and one weekend day, for a total of 12 days of 24-HRs. After 12 months, participants were invited for a second face-to-face interview at AUB whereby the second FFQ (FFQ-2) was administered (Figure 3.1). The seasons were defined as spring (March-May), summer (June-August), fall (September-November) and winter (December-February). Given that non-compliance might bias the validation analysis, participants who completed less than two 24-HRs per season or either of the two FFQs were considered as non-compliant and their data was not included in the analysis of this study.

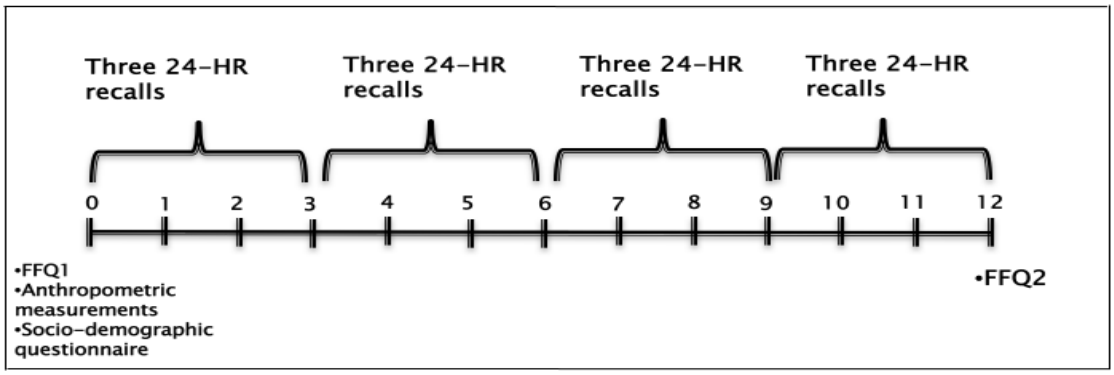


Figure 3.1. A schematic representation of the study protocol for data collection for the validation of a developed FFQ for the assessment of dietary intake among Lebanese adults.

E. Data Collection

1. Socio- demographic Questionnaire

During the first visit, after explaining the study, its protocol as well as signing the consent form, the trained research dietitian completed a standard socio-demographic questionnaire with the subject. The socio-demographic questionnaire included information about the participant's age, gender, education, marital status, occupation, and crowding index (Appendix IV). The dates of birth of the subjects as well as their medical history were also completed (Appendix IV). Variables of the socio-demographic questionnaire are portrayed in Table 4.1.

2. Lifestyle Questionnaire

The lifestyle questionnaire enquired about smoking and physical activity habits of the participants (Appendix IV). Current and past smoking habits (cigarettes, narghile, and cigars) were evaluated. The number of cigarettes or cigars smoked per day, week, or month was recorded. As for the use of narghile, the duration of smoking was evaluated by the number of minutes per day, week, or month.

Physical activity habits were assessed by the recommended guidelines for the Arabic version of the International Physical Activity Questionnaire (IPAQ) covering the last one month (Craig et al., 2003). The IPAQ short form is an instrument designed primarily for population surveillance of physical activity among adults (age range of 15-69 years). This questionnaire asks about three specific types of activities: walking (3.3 Metabolic Equivalents (METs)), moderate-intensity activities (4.0 METs) and vigorous-intensity activities (8.0 METs). In the current analysis, total physical activity MET-minutes/week for each individual was calculated based on the procedure described

below:

Expressed as MET-min per week: MET level x minutes of activity/day x days per week

For total physical activity MET-minutes/week = Walking (METs*min*days) + Moderate (METs*min*days) + Vigorous (METs*min*days).

According to the guidelines set by the IPAQ Research Committee (2005), the scores calculated are expressed based on METS-minutes per week (low < 600, moderate: at least 600 and high: at least 3,000) (Committee, 2005).

3. Anthropometric Measurements

Anthropometric measurements of the participants were taken using standardized techniques and calibrated equipment. The scale was calibrated using standard weights (10 kg, 20kg). The weight scale (SECA 877) and stadiometer (SECA 213) were used to measure weight in kilograms (kg) and height in centimeters (cm), respectively. For weight measurements, participants were asked to remove as much outerwear as possible, remove their shoes and socks, empty their pockets and remove added jewelry. Subjects were weighed to the nearest 0.1 kg. Height was measured to the nearest 0.1 cm with the subject barefoot. Body mass index (BMI) was calculated as weight (kg)/height (m^2). BMI was calculated as weight (kg)/height (m^2) and interpreted according to the WHO criteria as follows:

- Moderate and severe underweight: BMI < 17.0 kg/m2
- Underweight: BMI < 18.5 kg/m2
- Normal weight: BMI= 18.5–24.9 kg/m2
- Overweight: BMI= 25.0- 29.9 kg/m2

- Obesity*:* BMI $\geq$ 30.0 kg/m^2

All measurements were carried in duplicates and the average was used.

4. Dietary Intake Assessment

a. <u>The Multiple Pass Food Recall (MPR)</u>

The MPR was used to compare with the FFQ was validated. MRP is a 5-step approach, developed by the USDA (Moshfegh et al., 2008). The steps to collect the 24-HRs using the MPR approach included 1) quick food list recall, 2) forgotten food list probe 3) time and occasion at which foods were consumed, 4) detailed overall cycle and 5) final probe review of the consumed foods (Appendix V).

A minimum of three to twelve days of intake are generally required to characterize usual individual intake (Willett, 1998), therefore, up to 12 MPRs were collected from each participant who completed the consent, socio-demographic questionnaire and FFQ-1. The MPRs were divided into a set of three 24-HR per season (every 3 months) and each set represented 2 WDs and 1 WE day. In the settings of this study, paper based- MPRs were found more convenient and were used instead of computer-based MPRs. Each MPR sheet required the trained research assistant to request the time of each meal's intake, the food consumed, its portion size (whether standardized portions or by using a 2D food portion visual chart), preparation methods as well as the brand of the food, beverages and/or supplement consumed by the participant the previous day from time of waking up to the time going to bed at night and were recorded on an open questionnaire. The interview lasted for about 15- 20 minutes on average.

Participants were not aware of the exact day on which the 24-HR will be

collected to maintain the participants' regular dietary habits and avoid reporting socially-desirable answers.

b. The Food Frequency Questionnaire

A 4-page FFQ was designed to assess the dietary intake per energy and food categories among adults in Lebanon.

During the interview for the FFQ data collection, the trained research assistant enquired the participant's consumption of each food item over the past 12 months, the usual portion size intake and the frequency of the food consumed (per day, week, month or never). The FFQ also included an open-ended section in which participants provided information on additional foods, beverages or any supplement they usually consume on a regular basis and which are not already in the FFQ's food list, if any. The overall interview took 30 to 40 minutes on average.

In both the MPRs and FFQs data collection, a 2D food portion visual chart (Appendix VIII) was used in the purpose of aiding participants to estimate the exact portion size they consumed. This chart has been validated for use with adult men and women 20 to 70+ years of age as part of the Framingham Heart Study especially for the use of telephone dietary interviewing (Posner et al., 1992). Standardized portion sizes were also used for specific foods such as breads, potatoes, eggs, tuna cans, chocolate bars, croissants, chips bags and manakich, to name a few.

F. Development of the FFQ

This study's semi-quantitative FFQ contained three sections: the 94-item food list, identifiable portion sizes and a frequency response section (Appendix VI).

1. The Food List

The number of food items in the food list depends on the objective of the study, food availability, and the variability of food consumption in the population understudy (Cade et al., 2002).

The number of food items listed in FFQs tends tom vary in terms of importance. A review suggested that the number of items listed ranges from 5 to 350 (Cade et al., 2002). The FFQ of this study which is composed of 94 food items, is considered a reasonable number (Cade et al., 2002).

For the food item to be informative and therefore included in the food list of the FFQ, it should either contribute to absolute intake or differentiate between individuals. The 3 general characteristics include: the food item must be eaten reasonably by a considerable number of individuals. Second, the food must contain a substantial content of nutrient/food group of interest. Third, the use of different food should vary from person to person in order to be discriminating (Cade et al., 2002; Willett, 1998).

The compilation of a comprehensive food list was derived from:

- A review of 24-HR data (n = 200) previously collected in a sample of Lebanese adults as part of a national study conducted in Lebanon (Nasreddine et al., 2012). Food items that have been frequently cited (>5%) were added to the compiled list of the developed FFQ.
- The developed food list was checked by a panel of experts including licensed dietitians and a gastroenterologist, to ensure that it is inclusive of all foods regularly consumed by Lebanese adults.

- The food items list was checked by a convenient sample of 30 adults, similar in characteristics to the target population, to assess if the food list was clear, comprehensive, and culturally appropriate
- The food list was also compared to previously published FFQs, especially FFQs validated in the region.

Food items were listed using generic names and often, foods with similar nutritional qualities/culinary use were grouped together for clarity and ease of conduction.

The FFQ food list was composed of 94 food items categorized into 23 food groups:

Cereals and Cereals-Based Products – Pasta and Other Cereals – Potatoes and Potato Based Products – Vegetables – Fruits – Fresh Fruit Juices – Meat (Cured meat, meat, offals) – Poultry – Eggs– Fish and Seafood – Pulses –Nuts and Seeds – Milk and Dairy Products – Yogurt and Yogurt Based Products – Pizza and Pies – Mixed Dishes (vegetable based dishes) – Fats and Oils (Added on breads, Used in frying) – Sugar and Sugar Derivatives – Cakes and Pastries – Honey, Jam, Molasses, Pudding, Ice cream and Halawah – Alcoholic Beverages – Non- Alcoholic Beverages– Miscellaneous.

2. Portion Size

The purpose of a FFQ is to report usual intake and frequency of individual foods from a list of foods over a specified time period (Cade et al., 2002; Zulkifli et al., 1992); if absolute nutrient intake is needed, portion size must be included (Subar et al., 2003). In order to decrease inter-subject variability in serving size estimation, a 2D food portion visual chart was used for the sole purpose of assisting subjects.

For portion size, participants were given the option to express the portion size in terms of common household measurements (teaspoons, tablespoons, and cups) as well as standardized food portions for customary sized food items common in the Lebanese market. In order to assist in quantifying the reference portion size, a standard 2D food portion visual chart was used. This chart has been developed by Nutrition Consulting Enterprises and validated for use with adult men and women aged 20 to 70+ years as part of the Framingham Heart Study, especially for the use of telephone dietary interviewing (Posner et al., 1992). The FFQ under study did not include one specific portion size protocol in order not to lead subjects into a specific answer. In fact, correlation coefficients were higher when subjects were allowed to specify their own portion sizes when reporting intake (Wiecha, Hebert, & Lim, 1994)

3. Frequency Response

The frequency of the participant's food intake was indicated by how many times per day, week, or month the participant has consumed each food item. The frequency of foods rarely or never consumed was noted down. Moreover, seasonal adjustments were considered for fruits and foods that were eaten at specific times of the year such as hot beverages and ice cream, if applicable.

G. Data Analysis

1. Analysis of Food Items into Food Groups

Food items collected from the 24-HR were analysed using the The Nutritionist Pro software (version 1.2, 2002, First Data Bank, Nutritionist Pro, San Bruno, CA). Nutritionist Pro software uses a nutrient database from the Continuing Survey of Food Intake of Individuals released in 2002 (Spencer, Elon, Hertzberg, Stein, & Frank, 2005).

Lebanese composite dishes recipes using single food items from the USDA database were added to the Nutritionist Pro software, in order to cover Lebanese traditional foods commonly consumed among our target population. All food items from Nutritionist Pro software were extracted into an excel sheet and were given a code similar to the codes used in the FFQ. For each subject, the average weight (in grams) and calories of each food group consumed was calculated. After that, information obtained were extracted with others into SPSS for analysis.

Statistical data analysis was done to assess the validity and reproducibility of the FFQ by the 23 food groups : *Cereals and Cereals-Based Products – Pasta and Other Cereals – Potatoes and Potato Based Products – Vegetables – Fruits – Fresh Fruit Juices – Meat (Cured meat, meat, offals) – Poultry – Eggs– Fish and Seafood – Pulses –Nuts and Seeds – Milk and Dairy Products – Yogurt and Yogurt Based Products – Pizza and Pies – Mixed Dishes (vegetable based dishes) – Fats and Oils (Added on breads, Used in frying) – Sugar and Sugar Derivatives – Cakes and Pastries – Honey, Jam, Molasses, Pudding, Ice cream and Halawah – Alcoholic Beverages – Non- Alcoholic Beverages– Miscellaneous.* The portion intake of each food group was calculated as the average weight of each food item over the serving size. Food Servings have been adopted from 3 different databases: USDA exchanges, American Dietetic Association (ADA) exchanges or local weighting of typical portion sizes (Table 3.1). The whole FFQ was composed of a food list of 94 food items grouped into 23 food groups. Food items were divided into food groups based on usage, similarities in composition, the dietary guidelines, the impact of health and diseases with specific food groups, as well as the cultural and ethnic dietary trends of the target population. The analysis was performed based on the serving size intake (total number of portions of a

food group/day) and the total percent of calories intake (% of calories of a food group per total calories intake/day).

The same trained research dietitians who conducted the interviews with the study participants completed the data entry and data analysis.

Table 3.1. Food groupings for data analysis

Group number	Food groups	Number of items	Food items obtained from the FFQ and the 24 HR	Serving size
1	Cereals and Cereal-Based Products		Pita bread white, Whole wheat Pita Bread, Arabic saj, Tannour, Brioche, French toast, French toast whole wheat, Bagels, white French baguette, Whole French baguette, Oat Bran Bread, Toasted Rye Bread, Cereal Bar, Cereal Granola, kaak (finger or round), Bran or whole grain breakfast cereals, regular cereals, Puffed Corn Chocolate Flavored, Toast and crackers, MUESLI Dried Fruit and Nuts Cereal, Oats, Dry, Hard Salted Pretzel, Hamburger Bun, flour (white/ coconut), garlic bread	30g
2	Pasta and other cereals		Bulgur cooked, bulgur with vermicelli, Bourghoul bi banadoura, Bourghoul Bil Dfeen (Bulgur and chicken/meat) Chicken with rice, freekeh, moghrabieh, gratin, pumpkin kibbe, lasagne, macaroni gratin, pasta, pasta with yogurt and garlic, rice with vermicelli, spaghetti, maamoura, tortellini, mdardara, couscous, composite pasta cooked, plain noodles, white rice, cooked quinoa, brown rice, fried rice, rice with meats and nuts, Ground Psyllium Seeds	30g or 1/3 cup
3	Potatoes and potato-based products		French fries, potato chips regular, potato chips light, batata bl sayniyeh (with or without beef), batata hara bel kezbara, batata mehshi bi lahme, kshk with potato, kebbet el batata, yakhnet batata with meat, potato and squash soup, baked/ boiled potato, mashed potato, nachos, potato wedges, sweet potato, tortilla corn, Russian salad	1 medium potato=95g

4	Vegetables		canned asparagus, canned carrot juice, canned corn/mushroom/peas, vegetable mix frozen Carrot juice, Green salad, seasonal salad, dark green leafy vegetables, carrots, tomatoes, cucumber, spinach, thyme beetroot, pepper, green chicory, lettuce/cabbage/broccoli/kale, Mint leaves, parsley, radishes, fresh thyme, arugula, chopped onions, garlic clove, ginger, lemon juice, rocket and green thyme salad, tabbouleh tomato grilled with garlic, Caesar salad, boiled mushroom, tomato sauce canned, Beetroot salad, fattoush, coleslaw (with mayonnaise/ with lemon garlic)	1 cup =163g 1 cup =145g
5	fruits		Loquats, tangerines, Apple, Custard (Bullock's Heart or Cherimoya), apricots, fruits salad, blackberries, blueberries, cantaloupe, guava, cherries, strawberries, cranberries, apples, bananas, oranges, kiwi, mango, pears, plums, persimmon, pineapple, raspberries, peaches, pomegranate, figs, watermelon, grapes, fruit based desserts (cocktails) dried fruits (dates, apricots, raisins, figs) canned fruits (pineapple, plums)	1cup=170g ½ cup=70g 1cup=200g
6	Fruit juices	Fresh	orange juice, grapefruit juice	1cup=250g
7	Meat		Cured meat: Ham, mortadella (beef/pork), hotdog, turkey minced meat, sausages, kibbe, Hreese with meat, vegetable stew with meat (mixed dishes), kafta, shawarma meat, lamb, Steak beef/veal, kafta with potato bl saniyeh, kibbi b laban, meat fahita, sandwich beef shawarma, soup rice with meat balls, beef stroganoff, meat (lamb/beef): low medium high fat/ cooked, luncheon meats, hamburger Offals: Organ meat, Beef brain, liver (chicken, lamb), heart (raw, pan fried)	30g

9	Poultry		Poultry (breast, thigh, leg, wing, drumstick), nuggets, escalope, chicken curry, chicken fahita, Chinese chicken, hreese with chicken, sandwich chicken shawarma, shawarma chicken, tawook, chicken crispy/tenders/fingers, chicken patty, quesadilla chicken	30g
10	Eggs		3ejjeh eggs, eggs with potato, tomatoes and eggs, whole eggs, egg whites, fried/boiled eggs,	45g
11	Fish and seafood		Canned fish with oil, canned fish in water, fresh/frozen fish, whole/ fillet fish, salmon, sardine, shellfish (shrimp, calamari, crab), sushi,	30g
12	Pulses, nuts and seeds	Pulses	Beans, chickpeas/lentils/ fava beans, falafel, Fassoulia moutabal/ with meat, Fatteh hommos, fava beans with bulgur, foul b selek, mjadara, soup lentil/home's, adas moutabal, canned beans	30g
		Nuts and seeds	green almond, shredded coconut Raw nuts and seeds, roasted and unsalted nuts and seeds, roasted and salted nuts and seeds, peanuts, peanut butter, edamame, mixed nuts, seeds, soybeans	15g
13	Milk and dairy products		Cheese (low fat/ light/ white), double cream, feta, shaklish, halloumi, akkawi, cheese (high fat/yellow), kashkawan, brie, goat, gouda, mozzarella, swiss, cheddar, parmesan, cheese (processed/ creamy), picon, smeds, KELSEY'S Dip- Spinach Four Cheese, Mozzarella sticks, lactose free milk, dry milk (dry, non-fat), milkshake, full fat milk, low fat, fat free milk, hot chocolate mix prepared with 2 % milk, NESTLE CARNATION Rich Chocolate Hot Cocoa, Dry Mix, cream fraiche, kashta, whipped cream	45g 1 cup=250g
14	Yogurt and yogurt based products		Labne (regular, low fat, skim), yogurt (regular, light), cooked yogurt, laban ayran, greek yogurt (whole milk, low fat) laban immo	30 g 1cup=270g
15	Pizzas and pies		Manaeesh (cheese, zaatar, kshk), manouche saj (cheese, zaatar), pizza (vegetarian, pepperoni, margarita, pies, spinach fatayer, samsousak meat/ cheese, rkakat cheese, sfiha, shish barak	150g 25g

16	Vegetables based dishes (Mixed dishes)		boiled broccoli/cauliflower, vegetable soup chicory fried with onions, leb koussa with oil, sayniyet khodra, Warak Enab (Bi Zeit), eggplant, zucchini cabbage, chard beet leaves, grape leaves (stuffed with rice and meat), loubieh b lahme, Jew's mallow, okra/peas with meat, spinach, Artichoke, eggplant, cauliflower cooked	1 cup= 260g 1cup=220g
17	Fats and oil added on breads		butter/ghee, mayonnaise (regular, light), olive oil, tahini, Vegetable oil, vegetable ghee, guacamole sauce, hummus b tahini, tarator, sesame oil, coconut oil, flaxseed oil, avocado Olives (green, black)	1 tablespoon (tbsp.) =15g 5 olives=20g
18	Sugar and sugar derivatives		Sugar (white, brown), candy, jelly beans, marshmallow, chocolate (milk, dark), chocolate spread, chocolate syrup, cookie, wafer	20g
19	Cakes and pastries		Cakes and pastries, unfrosted muffins, frosted muffins, plain biscuits, stuffed biscuits, wafer biscuits croissant, doughnuts, kaak b haleeb, cookies, crepes, pancakes, delights Arabic sweets (baklawa, barazek, coconut sweets, ghraybe, halawet el jibn, jazareye, ater, katayef, mamoul, macaroon, sfof, shaabiyet), knefe	30-45g (38g) 90g
2	Honey, jam, molasses, pudding, ice cream and halaweh		Jam, molasses, halawa, honey, maple syrup, ice cream (regular, low fat), Jello, regular pudding (custard, mhalabiyeh, riz b halib, mghli, snayneye, low fat pudding,	1tbsp=20g 1cup=220g
21	Alcoholic beverages		Beer, whiskey, rum, vodka, wine, arak, gin,	120g
22	Non-alcoholic beverages		Instant Coffee powder/prepared, cappuccino, Turkish coffee, 2 in 1, 3 in 1 Nescafe, coffee creamer (original, fat free), tea, decaffeinated coffee, iced tea, herbal tea, energy and spots drinks, soda regular, soda diet, water, sparkling water canned fruit juices: kiwi strawberry drink, Drink Mix Orange Flavor, Prepared with Water (tang), tamarind, canned fruit juices, Jallab, aloe vera, lemonade, mulberry juice, apple/pineapple/grape/ cranberry juice	1 cup=220g 1cup=250g

23	Miscellaneous		mustard, zaatar, ketchup, pickles (cucumber, eggplant)	1 tbsp=20g
24	others		Béchamel sauce, garlic sauce, ranch (salad dip), kshk, rice with fava beans, soup chicken with vermicelli, barley water, popcorn, almond milk, protein shake, frosting, spices, cocoa powder, condensed milk, tomato paste, onion rings, pesto sauce, Caesar salad, barbecue sauce, chia seeds, soya sauce, artificial sugar, miso soup, vinegar	

(U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010); (American Diabetes Association and American Dietetic Association, n.d.); (Hwalla, N.., Nasreddine, L. & Farhat Jarrar, S., 2012)

2. *Statistical Analysis*

Statistical analysis was done using Statistical Package for Social Sciences 19.0 (SPSS for Windows, Version 19.0, Chicago: SPSS Inc.).

For all continuous variables in the socio-demographic and anthropometric questionnaire, means and standard deviations were calculated. On the other hand, categorical variables were taken as frequencies. Validity and reliability statistics were performed on total number of portions per food groups/day and percent energy intake per food group.

a. Validity Statistics

i. Mean Difference and Correlation Coefficients

Mean of the FFQ-2 and the MPRs were calculated. Mean difference of the two methods (FFQ-2 minus the mean of the MPRs) was also calculated as was the percent mean difference $\left(\frac{FFQ2-mean\ MPRs}{mean\ \ MPRs} \times 100\right)$ for all food groups for both the food portion intake and percent of energy intake.

Although it is useful to compare means for both methods, it is also important to provide data on the associations between the intakes measured by the 2 methods (Willett, 1998). Since correlation coefficients were by far the most commonly used statistical method in 168 (83%) of validation studies (Cade et al., 2002), spearman's correlation coefficient and agreement between FFQ-2 and MPRs were performed to validate this FFQ. Spearman's correlation coefficients rank individuals similarly, they measure the strength and direction of the association between two different measurements at individual level (Verger et al., 2017). They were computed for food group estimates between the two methods. In order to detect associations between dietary intake with health and disease, a correlation coefficient accepted for validity ranges should not be below 0.3 or 0.4 (Cade et al., 2002). Correlation coefficients (r) measure the strength of relation between the two methods but not the agreement (Bland & Altman, 1986). Hence, the Bland-Altman statistical method was also administered.

ii. Bland- Altman Method

In order to compare a new measurement technique with an established one, it is important to measure the agreement between both methods across the range of intakes (Bland & Altman, 1986). A review of 210 agreement studies found that 85 % of the studies used the Bland-Altman method as an agreement measure (Zaki, Bulgiba, Ismail, & Ismail, 2012). Bland-Altman method is also used to assess whether the difference between the methods is the same across the range of intakes, and whether the extent of agreement differs for low intakes compared with high intakes (Cade et al., 2004). The Bland-Altman method used the differences between observations on the same subject and graphically plotting them against the average of both methods per subject. It helped

determine if there is any bias (systematic difference) between the administrations of the questionnaire, and to what extent the two administrations agree (Limits of agreement LoA) (Cade et al., 2004).

The use of the Limits of Agreement (LoA) allowed to asses to what extent the 2 methods agree/disagree. If the limits are wide, then an overall bias may be present (Bountziouka & Panagiotakos, 2010).

The LoA are 2 values that 95% of the differences should lie between. LOAs are calculated as $mean\ difference - 1.96 \times\ 2\ standard\ deviation$ and$mean\ difference + 1.96 \times\ 2\ standard\ deviation$. P value less than 0.05 was considered statistically significant.

b. Reproducibility Statistics

i. Intraclass Correlation Coefficient

The Intraclass Correlation Coefficient (ICC) is used to describe how strongly units in the same group look like each other. It differs from other correlation coefficients in that it analyses data structured as groups, rather than data structured as paired ones. ICC estimates the differences within the subjects and not those among the observers (Bountziouka & Panagiotakos, 2010). However, the ICC ignores ordering variances and rather treats the two administered FFQs (1, 2) as two random instruments rather than specific methods (Zaki et al., 2012).Therefore, weighted kappa statistic was used.

ii. Kappa Test

The Kappa test is used to measure the agreement between 2 or more observers in

assigning the data into different categories. Weighted Kappa (κ w) was administered in this study instead of Kappa in order to see how close and how different the ratings of the 2 methods were. Also, to evaluate how well the FFQ can categorize individuals into quartiles of the food portions and percentage energy intake when compared with the FFQ-2. Frequencies of consumption (portion intake per food group as well as percentage energy intake per food group) measured by the 2 FFQ administrations were divided into quartiles and were compared to determine the degree of agreement in each category. According to Landis & Koch (1977), Kappa values were categorized for strength of agreement with the following ranges: 0.21 to 0.40 are considered fair, 0.41 to 0.60 moderate, 0.61 to 0.80 substantial and 0.81-1 almost perfect (Landis & Koch, 1977).

Percent agreement was calculated as quartiles:

number of subjects in quartiles 1-1,1-2 + number of subjects in quartile 2-1,2-2,2-3 + number of subjects in quartile 3-2,3-3,3-4 + number of subjects in quartiles 4-3,4-4 / n=110

H. Methodological Choices

1. Sample Size

For FFQ validation studies, a sample size between 100 and 200 participants is considered reasonable (Willett, 1998).

Validity correlations of 0.5 to 0.7 are generally expected and for 80% power and an alpha significate level of 0.05 the sample size will approximately be 110 (Willett, 1998).

As per a recent validation study conducted among a similar population, the dropout rate was at 4% (Moghames et al., 2016). Therefore, in order to account for potential dropout rates, a sample size of 120 individuals was recruited. This sample size will increase the statistical power of the study, especially in light of the intra- and inter-variability in dietary intake within and between participants respectively.

2. Dietary Assessment

a. Use of the Multiple Pass Food Recall as a Gold Standard

In this study, the MPR was used as a gold standard for dietary intake. In validation studies, individual estimates of intake collected from the FFQ must be compared with those measured by a more accurate method, a "gold standard". Given that there is no perfect measure of dietary intake, the FFQ can be validated against a more superior assessment method of intake. In this study, the 24-HRs was the method of choice for this purpose. It was collected using the MPR 5-step approach, developed the USDA (Moshfegh et al., 2008). This technique has been shown to accurately assess energy and macronutrient intake (Conway et al., 2004) and to have stronger correlation with DLW as compared with 2 FFQs, the Block FFQ and the National Cancer Institute's DHQ (Blanton et al., 2006). This approach has been shown to provide accurate dietary data especially when used with participants who are less cooperative, less motivated, illiterate, or of low-income when compared with other dietary assessment methods such as food records (Vucic et al., 2009; Willett, 1998).

b. Design of the Food Frequency Questionnaire

FFQs can reflect the past month, past few months or the past year depending on the researcher's line of interest (Willett, 1998). The reproducibility of the FFQ was

chosen to be 12 months apart since it is the period of time that is found to be not too soon for subjects to recall their FFQ-1 answers and at the same time, not too distant so that it reflects variation in response and true change in subject's dietary intake (Willett, 1998).

c. Administration by a Trained Research Dietician

In this study, 3 trained research dietitians administered the questionnaire. This is advantageous because nutritional assessment requires specialist training (McCarthy, Cole, Fry, Jebb, & Prentice, 2006) and correlation coefficients were higher for interviewer-based FFQs when compared with self-administered ones (Cade et al., 2004). In addition, self-administered FFQs require careful preparation and pre-testing as well as high literacy skills and motivation. They may also lead to an increased rate of exclusion due to high number of incomplete answers (Cade et al., 2002).

i. Choice of university for Recruitment

AUB has 3500 non-academic employees and 903 full time faculty member (American University of Beirut, 2018), making it the single largest employer in the Lebanese private sector (Waterbury, 2007). Given that AUB is a culturally diverse institution with employees from across the country and from various socioeconomic statuses; this renders it as a suitable site for participant recruitment.

ii. Length of study period

The production, availability, and accessibility of various foods in Lebanon is seasonal, especially for fruits and vegetables (FAO, 2007). Therefore, in order to accurately estimate all the intake of all food items and take into account any variation in

intake due to seasonal changes, the study was conducted over twelve months, with 24-HRs reflecting the intake of participants during each season.

CHAPTER IV

RESULTS

A. List of Variables Used in the Analysis

Variables of interest for the present analysis were derived from the first visit from the 24-HR and the FFQs. Description of variables used in this study is shown in Table 4.1.

Table 4.1. List of variables used in the analysis

Variable	Type	Description/Coding
Socio-demographic variables		
participant's age (years)	Continuous	
participant's age (years)	Categorical	1= 23-30 years 2=31-40 years 3= 41-50 years 4= ≥ 51 years
Sex of the participant	Categorical	1=Male 2=Female
BMI	Categorical	1= <18.5 Underweight 2= 18.5-24.9 Normal 3= 25-29.9 Overweight 4= 30-34.9 Obesity class1 5= ≥35 Obesity class 2
Governorate	Categorical	1=Beirut 2=Mount Lebanon 3=South 4=Nabatiyeh 5=North 6=Bekaa
Marital status of the participant	Categorical	1=single 2=married 3=widowed 4=divorced
Educational level of the participant	Categorical	1=no schooling 2=primary school 3=intermediate school

		4=high school 5=technical diploma 6=university degree
Specialized in health related major	Categorical	1=Yes 2=No 3=Not applicable
Occupation	Categorical	1=Academic, full time 2=Academic, part time 3=Non-academic, full time 4=Non-academic, part time 5=other
Crowding Index	Categorical	1=≥1 2=<1
Do you own the house you currently live in?	Categorical	1=Yes 2=No
How many cars does your household own?	Categorical	0=0 1=1 2=2 3= ≥3
Monthly Income	Categorical	1=<600,000L.L 2=600,000-999,999 L.L 3=1,000,000-1,499,000L.L 4=1,500,000-1,999,000L.L 5=2,000,000-2,499,000L.L 6=2,500,000-2,999,000L.L 7=>3,000,000L.L

B. Descriptive Data: Socio-demographics and Lifestyle Characteristics

A total of 120 participants were recruited for the study, 110 completed the study (91.67 % response rate). Main reasons for drop out were lack of interest and lack of time. In addition, when less than two 24-HR were collected in any season, or when 2 FFQs were not completely administered, participants were automatically dropped out.

Baseline sociodemographic and lifestyle characteristics of the study sample are presented in table 2 for the total sample (n=110) and separately for males and females. Overall, the study sample consisted of 60.9 % males and 39.1 % females with a mean age ± Standard Error of 41.28 ± 1.21 and 34.81±1.17 years, respectively. Most of the

participants (40 %) were classified as overweight with a BMI = 25-29.9kg/ m^2, with males having significantly higher BMI than females. Overall, the study sample presented a high prevalence of overweight and obesity (40% and 32.7% respectively) (p=0.00). Celibacy (never married, divorced, or widowed) was higher in women (62.8%) than men (29.9%). The majority of the participants (76.4%) reached a high school or above. Only 31.8 % of participants were specialized in a health-related major. Most of the participants had a non-academic job (85.5%). As for the monthly income of the household, half of the participants (50 %) reported earning above 3,000,000L.L. with females having a significantly higher income than males. Using the crowding index measure, 52.7 % of the households had a crowding index ≥1 persons/room, reflecting a low socioeconomic status (SES). Compared to males, a lower percentage of females smoked cigarettes (p <0.05). More than half of the study population (65.5 %) had a moderate intensity of physical activity.

Table 4.2. Socio-demographic characteristics and lifestyle characteristics of the study population by gender[a]

Variables	**n(%)**			
Socio-demographic variables	Total n=110	Males N=67 Mean (±SE)	Females N=43 Mean (±SE)	Significance [b]
Age (years)	38.75 (± 0.91)	41.28 (±1.21)	34.81 (± 1.17)	**P=0.000**
Age categorized				
23-35 years	43 (39.1)	19(28.4)	24(55.8)	X^2=11.120 **P=0.004**
35-45 years	34 (30.9)	21 (31.3)	13 (30.2)	
45-62 years	33 (30.0)	27 (40.3)	6 (14)	
BMI (kg/m^2)				
18.5-24.9 Normal	30 (27.3)	6 (9)	24 (55.8)	X^2=29.058, **P=0.000**
25.0-29.9 overweight	44 (40)	33 (49.3)	11 (25.6)	
≥30 obese	36 (32.7)	28 (41.8)	8 (18.6)	
Governorate				
Beirut	49 (44.5)	24 (35.8)	25 (58.1)	X^2=5.281,

Outside Beirut	61 (55.5)	43 (64.2)	18 (41.9)	**P=0.022**
Marital status				
Single, Widowed, Divorced	47 (42.7)	20 (29.9)	27 (62.8)	X^2=11.613, **P=0.001**
Married	63 (57.3)	47 (70.1)	16 (37.2)	
Education level				
Up to intermediate school	26 (23.6)	22 (32.8)	4 (9.3)	X^2= 16.437 **P=0.000**
High school	15(13.6)	13(19.4)	2(4.7)	
University/technical diploma	69(62.7)	32(47.8)	37(86.0)	
Specialized in health - related major (medicine, public health, nutrition, pharmacy, etc.)				
Yes	35 (31.8)	19 (28.4)	16 (37.2)	X^2=2.689, P=0.261
No	74 (67.3)	48 (71.6)	26 (60.5)	
Not applicable	1 (0.9)	0(0)	1 (2.3)	
Occupation				
Academic	16 (14.5)	5 (7.5)	11 (25.6)	X^2=6.917, **P=0.009**
Non- Academic	94 (85.5)	62 (92.5)	32 (74.4)	
Crowding Index				
<1	52 (47.3)	28 (41.8)	24 (55.8)	X^2=2.066, **P=0.151**
≥1	58 (52.7)	39 (58.2)	19 (44.2)	
Do you own the house you currently live in?				
Yes	75 (68.2)	44 (65.7)	31(72.1)	X^2=0.498, **P=0.480**
No	35 (31.8)	23 (34.3)	12 (27.9)	
How many cars does your household own?				
<1	58 (52.7)	43 (64.2)	15 (34.9)	X^2=9.027, **P=0.011**
2	35 (31.8)	16 (23.9)	19 (44.2)	
≥3	17 (15.5)	8 (11.9)	9 (20.9)	
Total monthly income?				
Below 3,000,000LL (2000$)	55 (50.0)	41 (61.2)	14 (32.6)	X^2= 8.591, **P=0.003**
Above 3,000,000LL (2,000$)	55 (50.0)	26 (38.8)	29 (67.4)	
Lifestyle practices – smoking				
Current smoker				
Yes	60 (54.5)	44 (65.7)	16 (37.2)	**P=0.003**

No	50 (45.5)	23 (34.3)	27 (62.8)	
How long have you been a smoker (Years)n=60	10.99 (1.01)	11.38 (7.99)	9.94 (7.27)	**P= 0.532**
Lifestyle practices – Physical Activity				
Low- intensity activity	26(23.6)	12(17. 9)	14(32.6)	X^2=3.413, **P=0.181**
moderate- intensity activity	72 (65.5)	48 (71.6)	24 (55.8)	
high- intensity activity	12 (10.9)	7 (10.4)	5 (11.6)	

[a] *Categorical variables are reported as N(%): frequency and percentage within column; continuous variables are reported as Mean ± SD. SD: Standard deviation.*
[b] *Significant differences between males and females; p value was derived from chi-square for categorical variables and from independent t test for continuous variables.*
BMI: body mass index (kg/m^2)
18.5-24.9 Normal, 25.0-29.9 Over-weight, ≥30 Obese
SE: standard error

C. Relative Validity of the Questionnaire (Comparison with the Mean of MPRs)

Mean, mean difference, and percent mean difference of dietary intake of FFQ- 2 and average of MPRs as expressed by portions of the various food groups (Table 4.3) and percent of energy intake of food groups (Table 4.4). Intake of food portions and percent of energy intake per food groups according to FFQ-2 and the mean of MPRs for comparative validity stratified by sex are displayed in Appendices XI, XII respectively.

The mean portion intake for ‘cereals and cereals based products’ food group for the Lebanese adults enrolled in the study sample measured by FFQ-2 was found to be 3.89±2.79 portions. The mean portion intake as measured by mean MPRS was 3.13± 1.80 portions. Therefore, the mean difference of these 2 methods was found to be 0.76± 1.98 with a percent mean difference of 25.13%. The same calculations were implemented for all food groups, as seen in Table 4.3 and for percent of energy intake per food group in Table 4.4.

Table 4.3. Intake of food portions per food groups according to FFQ-2 and the mean of MPRs for comparative validity

Food Groups	FFQ-2 ± S.D	24hr ± S.D	Difference ± S.D	Percent difference (%)
Cereals and cereals based products	3.89±2.79	3.13± 1.80	0.76± 1.98	25.13±64.38
Pasta and other cereals	3.58± 2.94	3.31± 2.12	0.27± 3.13	45.17± 147.00
Potatoes and potato based products	0.83± 0.88	0.52± 0.34	0.31± 0.80	69.31± 146.26
Vegetables	0.70± 0.59	0.99± 0.61	-0.29± 0.71	4.72± 128.01
Fruits	1.51± 1.24	0.88±0.63	0.63± 0.97	100.07± 192.90
Fresh fruit juices	0.13± 0.20	0.06± 0.12	0.07± 0.22	-18.40± 80.84
meat	4.09± 3.48	2.20± 1.58	1.90± 3.23	133.48± 193.15
Poultry	1.91± 2.26	1.59±1.26	0.32± 2.20	31.20± 116.67
Eggs	0.55± 0.69	0.39± 0.51	0.16± 0.52	40.98± 136.29
Fish and seafood	0.71± 0.87	0.67± 0.93	0.05±0.97	22.27± 155.86
pulses	1.60±1.71	1.51± 1.43	0.90± 1.87	8.39± 100.74
Nuts and seeds	1.51±2.27	0.56± 0.71	0.95± 2.16	224.72± 484.93
Milk and dairy products	0.91± 0.87	0.68± 0.51	0.24± 0.78	77.86± 210.32
Yogurt and yogurt based products	2.14± 3.57	1.84± 1.62	0.30± 3.52	95.09± 316.55
Pizzas and pies	0.39± 0.52	0.91±0.87	-0.52± 0.96	-31.12± 94.63
Vegetable based dishes	0.23± 0.18	0.34± 0.23	-0.11±0.25	-16.72± 82.41
Fats and oils	2.37± 1.40	1.57± 1.37	0.80± 1.57	160.06± 260.41
Sugar and sugar derivatives	1.91± 2.12	0.82± 0.72	1.09± 1.80	174.27± 284.91
Cakes and pastries	0.59±0.63	0.71± 0.51	-0.12± 0.67	1.66± 112.31
Honey, jam, molasses, pudding, ice-cream and halaweh	0.23± 0.32	0.20± 0.23	0.03± 0.33	-3.30± 122.39
Alcoholic beverages	0.30± 1.63	0.16± 0.77	0.14± 0.90	28.30± 84.88
Non-alcoholic beverages	9.14± 3.55	8.02± 2.57	1.15± 2.35	15.55± 32.32
Miscellaneous	0.43± 0.41	0.28± 0.32	0.15± 0.45	87.58± 222.89

Numbers in this table represent means± SD

A negative percent mean difference implied an underestimation of the FFQ when compared with the mean of the MPRs, while a positive percent difference showed

that the FFQ overestimated portions and percent energy intake per food groups.

The results found that the FFQ overestimated the intake of food portions ranging between 1.66 % for the ‘cakes and pastries’ food group and 224.72 % for the ‘nuts and seeds’ food group (Table 4.3).

In addition, the FFQ underestimated intake of percent energy intake of 9 food groups: ‘pasta and other cereals’, ‘vegetables’, ‘fresh fruit juices’, ‘meat’, ‘pulses’, ‘pizzas and pies’, ‘vegetables based dishes’, ‘cakes and pastries’ as well as ‘honey, jam, molasses, pudding, ice cream and halaweh’. Percent mean difference ranged between underestimating 75.28 % for ‘vegetables’ and overestimating 305.78 % for ‘fats and oils’ (Table 4.4).

Table 4.4. Percent of energy intake per food groups according to FFQ-2 and the mean of MPRs for comparative validity

Food Groups	FFQ-2 ± S.D	MPR ± S.D	Difference ± S.D	Percent difference (%)
Cereals and cereals based products	13.08± 7.76	12.76± 5.46	0.32± 5.85	2.73± 47.94
Pasta and other cereals	5.69± 4.10	7.93± 5.04	-2.24± 5.56	-2.61± 82.63
Potatoes and potato based products	7.81± 6.21	6.74±4.44	1.07± 5.62	32.09± 97.82
Vegetables	0.80± 0.83	4.16± 2.77	-3.36± 2.58	-75.28± 23.86
fruits	5.86± 4.24	4.63±3.18	1.23± 3.48	41.64± 105.83
Fresh fruit juices	0.65 ± 1.02	0.33± 0.72	0.32± 1.01	-25.30± 70.54
meat	4.15± 3.54	7.57±5.09	-3.41± 5.03	-33.11± 55.97
Poultry	4.22±4.13	5.04± 3.86	-0.81± 4.95	4.67± 93.36
Eggs	1.77± 2.35	1.57± 2.11	0.20± 1.79	42.24± 178.62
Fish and seafood	1.37±1.28	1.63± 2.18	-0.27± 2.16	2.44± 119.48
pulses	2.98± 2.93	3.75± 3.82	-0.78± 3.83	-10.65± 80.97
Nuts and seeds	5.18± 6.85	2.39± 2.93	2.79± 6.13	157.94± 370.98
Milk and dairy products	5.10± 4.73	4.86± 3.04	0.24± 4.53	22.26± 114.16
Yogurt and yogurt based products	1.97± 1.63	2.31± 2.02	-0.34± 1.92	19.34± 135.68
Pizzas and pies	4.85± 4.17	10.77± 7.41	-5.92± 7.24	-43.01± 48.90
Vegetable based dishes	1.82±1.92	4.29± 3.26	-2.47± 3.37	-38.41± 78.45
Fats and oils	10.94± 6.31	4.54± 3.34	6.40± 6.67	305.78± 435.53

Sugar and sugar derivatives	7.18± 7.18	3.72± 3.29	3.46± 5.59	119.52± 185.87
Cakes and pastries	4.18± 4.42	6.22± 4.25	-2.03± 5.19	-21.88± 77.60
Honey, jam, molasses, pudding, ice-cream and halaweh	1.01± 1.22	1.56± 1.70	-0.55± 1.90	-42.56± 55.01
Alcoholic beverages	1.05± 3.42	0.96± 5.28	0.08± 3.21	5.02± 66.01
Non-alcoholic beverages	3.48± 3.20	4.16± 2.93	-0.68± 3.11	0.16± 92.64
Miscellaneous	0.50± 0.76	0.91± 1.85	-0.41± 1.86	181.87± 594.20

Moreover, Spearman correlation coefficients for comparative validity between the FFQ and the mean of MPRs were computed for portion intake per food group (Table 4.5) as well as for percent energy intake per food group (Table 4.6). Spearman coefficients in both tables were all statistically significant except for percent energy intake for ‘fats and oils’, and ‘Honey, jam, molasses, pudding, ice-cream and halaweh’ food groups. The values for portion intake ranged between 0.20 for ‘fresh fruit juices’ and 0.74 for ‘alcoholic beverages’ (Table 4.5). As for the percent energy intake per food group, Spearman’s coefficients ranged between 0.23 for ‘fresh fruit juices’ and 0.74 for ‘alcoholic beverages’ (Table 4.6). Spearman correlations for portion intake and percent energy intake per food group obtained using FFQ-2 and the average of MPRs for comparative validity stratified by sex are displayed in Appendices XIII, XIV respectively.

Table 4.5. Spearman correlations for portion intake per food group obtained using FFQ-2 and the average of MPRs for comparative validity

Food Groups	Spearman’s r
Cereals and cereals based products	0.670**
Pasta and other cereals	0.314**
Potatoes and potato based products	0.503**
Vegetables	0.308**
Fruits	0.616**

Fresh fruit juices	0.199*
Meat	0.359**
Poultry	0.386**
Eggs	0.526**
Fish and seafood	0.217*
pulses	0.312**
Nuts and seeds	0.430**
Milk and dairy products	0.452**
Yogurt and yogurt based products	0.486**
Pizzas and pies	0.281**
Vegetable based dishes	0.402**
Fats and oils	0.346**
Sugar and sugar derivatives	0.626**
Cakes and pastries	0.351**
Honey, jam, molasses, pudding, ice-cream and halaweh	0.238*
Alcoholic beverages	0.741**
Non-alcoholic beverages	0.715**
Miscellaneous	0.385**

*** Correlation is significant at the 0.01 level*
**Correlation is significant at the 0.05 level*

Table 4.6. Spearman correlations for percent of energy intake per food group obtained using FFQ-2 and the average of MPRs for comparative validity

Food Groups	Spearman's r
Cereals and cereals based products	0.643**
Pasta and other cereals	0.298**
Potatoes and potato based products	0.495**
Vegetables	0.443**
Fruits	0.575**
Fresh fruit juices	0.226*
Meat	0.229*
Poultry	0.291**
Eggs	0.421**
Fish and seafood	0.258**
pulses	0.295**
Nuts and seeds	0.428**
Milk and dairy products	0.459**
Yogurt and yogurt based products	0.636**
Pizzas and pies	0.369**
Vegetable based dishes	0.318**
Fats and oils	0.183
Sugar and sugar derivatives	0.559**
Cakes and pastries	0.341**
Honey, jam, molasses, pudding, ice-cream and halaweh	0.079

Alcoholic beverages	0.742**
Non-alcoholic beverages	0.626**
Miscellaneous	0.355**

** P value < 0.05;*
*** P value < 0.01*

As part of validating the FFQ against the mean of MPRs, Bland-Altman plots were charted for portion intake for all food groups (Figure 4.1) and the mean difference, 95% LoA, slope, intercept, and confidence interval are presented for portion intake (Table 4.7). Mean difference, 95% Limits of Agreement (LoA) and regression slope of differences of FFQ-2 against the mean of MPRs for portion intake and percent energy intake per food group for assessment of relative validity stratified by sex are displayed in Appendix XV.

For most food groups, the mean difference was close to 0, lying between -0.52 for 'Pizzas and pies' and 1.90 for 'meat', thus indicating sufficient agreement between the 2 methods for most food groups. As for the Limits of Agreement, LoA between 4.72 and -3.20 for 'cereals and cereals based products' portion intake suggests that 95% of the difference between the FFQ and the MPRs mean lie between this range. For each food group, consistency of agreement was examined across the range of intakes. This was achieved by estimating the regression slope of differences (β) between the FFQ and mean of MPRs summarized in Table 4.7. A positive slope in differences indicates that the FFQ overestimated the intake when compared with the mean of the MPRs. A positive slope also indicates that at high levels of intake, there is a poor agreement between the FFQ and the MPRs (FFQ overestimates the intake). While a negative slope indicates that the FFQ underestimated the intake. For portion intake, the slopes ranged between -0.47 for 'pizzas and pies' and 0.96 for 'alcoholic beverages'.

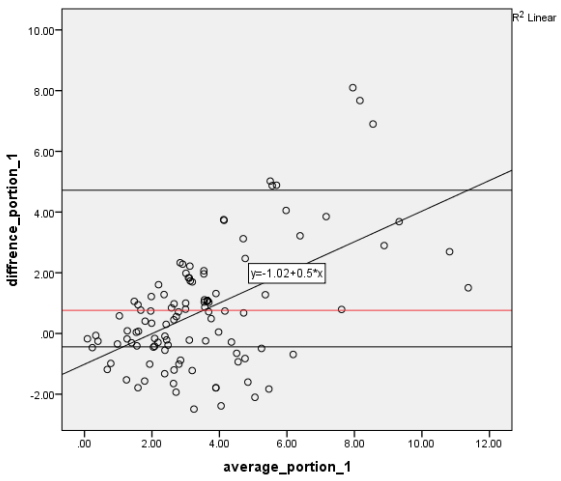
Table 4.7. Mean difference, 95% Limits of Agreement (LoA) and regression slope of differences of FFQ-2 against the mean of MPRs for portion intake per food group for assessment of relative validity

Food Groups	Mean Difference	95% LOA[a]		Beta / Slope[b]	Intercept	P value[c]	Confidence Interval[d]
Cereals and cereals based products	0.76	4.72	-3.20	0.543	-1.02	0.000	0.36, 0.65
Pasta and other cereals	0.27	6.53	-5.99	0.33	-1.47	0.000	0.23, 0.78
Potatoes and potato based products	0.31	1.91	-1.29	0.77	-0.47	0.000	0.96, 1.33
Vegetables	-0.29	1.13	-1.72	-0.04	-0.25	0.69	-0.34, 0.23
Fruits	0.63	2.57	-1.32	0.69	-0.31	0.000	0.63, 0.94
Fresh fruit juices	0.07	0.51	-0.36	0.49	-0.004	0.00	0.55, 1.11
meat	1.90	8.35	-4.56	0.690	-1.328	0.00	0.82, 1.23
Poultry	0.32	4.72	-4.08	0.54	-1.11	0.00	0.58, 1.06
Eggs	0.16	1.21	-0.89	0.39	-0.02	0.00	0.21, 0.54
Fish and seafood	0.05	1.98	-1.89	-0.08	0.11	0.44	-0.34, 1.15
pulses	0.09	3.83	-3.65	0.18	-0.33	0.06	-0.01, 0.55
Nuts and seeds	0.95	5.27	-3.38	0.84	-0.51	0.00	1.23, 1.58
Milk and dairy products	0.24	1.80	-1.33	0.53	-0.31	0.00	0.48, 0.91
Yogurt and yogurt based products	0.30	7.35	-6.74	0.67	-1.89	0.00	0.87, 1.34
Pizzas and pies	-0.52	1.40	-2.44	-0.47	0.03	0.00	-1.15, -0.55
Vegetable based dishes	-0.11	0.40	-0.61	-0.25	0.00	0.01	-0.66, -0.10
Fats and oils	0.80	3.94	-2.34	0.02	0.75	0.84	-0.24, 0.29
Sugar and sugar derivatives	1.09	4.68	-2.51	0.85	-0.51	0.00	1.03, 1.31
Cakes and pastries	-0.12	1.23	-1.47	0.22	-0.33	0.02	0.05, 0.59
Honey, jam, molasses, pudding, ice-cream and halaweh	0.03	0.69	-0.63	0.36	-0.08	0.00	0.26, 0.79
Alcoholic beverages	0.14	1.94	-1.65	0.96	-0.02	0.00	0.68, 0.76
Non-alcoholic beverages	1.11	5.89	-3.66	0.44	-2.04	0.00	0.22, 0.51
Miscellaneous	0.15	1.05	-0.75	0.25	0.01	0.00	0.11, 0.68

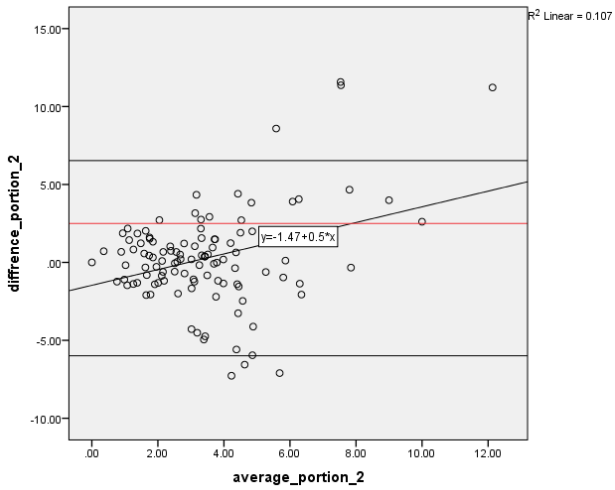
[a] LoA determined as mean difference ± 2×standard deviation of the differences
[b] Slope of the average of methods regressed on difference between methods
[c] Statistical significance of β
[d] Confidence interval of β

The Bland-Altman charts (Figure 4.1) graphically represent plots of the difference between the 2 methods against their mean and the LoA per food group thus showing any extreme or outlying observations. For most food groups, the regression line was positive, indicating that the FFQ tended to overestimate the intake when compared the average intake of the MPRs. However, for ‘Vegetables’, ‘Fish and seafood’, ‘Pizzas and pies’ and ‘Vegetable based dishes’, the FFQ tended to underestimate their intake; however, it was insignificant for ‘vegetables’ and ‘fish and seafood’ groups (Figure 4.1). In addition, for all food groups, the points on the graphs are closely assembled within the LoA, close to the middle horizontal line (zero difference), meaning that the FFQ’s estimation has low magnitude of error (no systematic biases). Bland-Altman charts for portion intake for all food groups as predicted by the FFQ and mean of MPRs stratified by sex are displayed in Appendices XVI, XVII respectively.

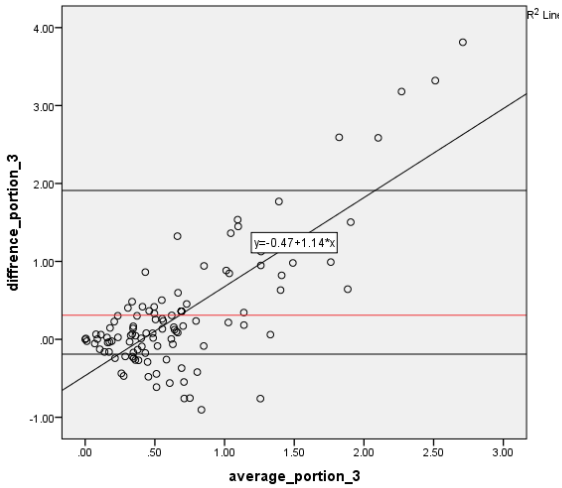
1. Cereals and cereal based products



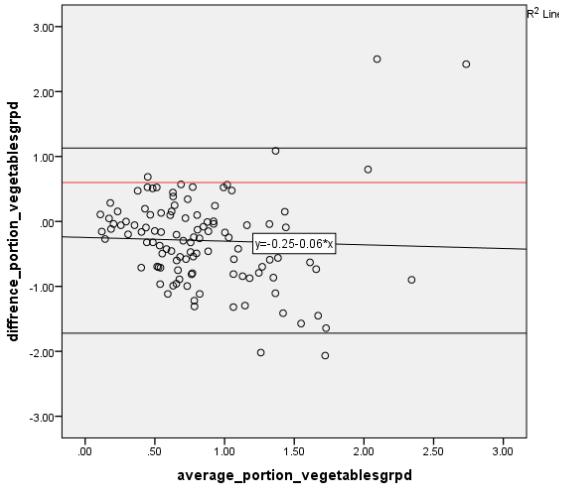
2. Pasta and other cereals



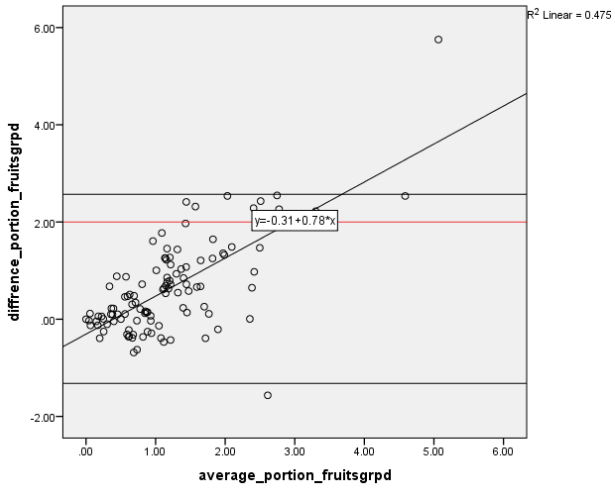
3. Potatoes and potato based products



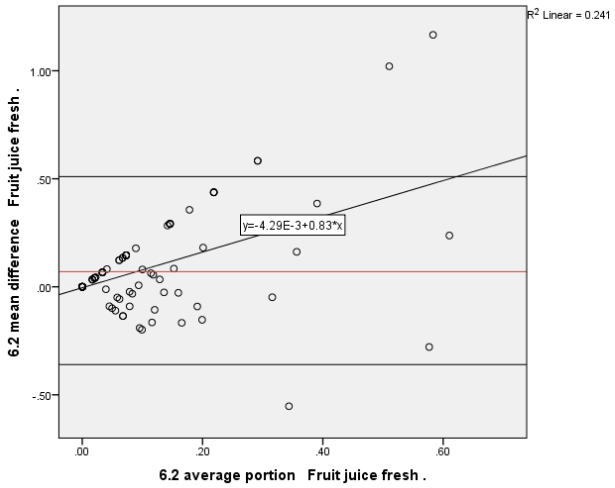
4. Vegetables



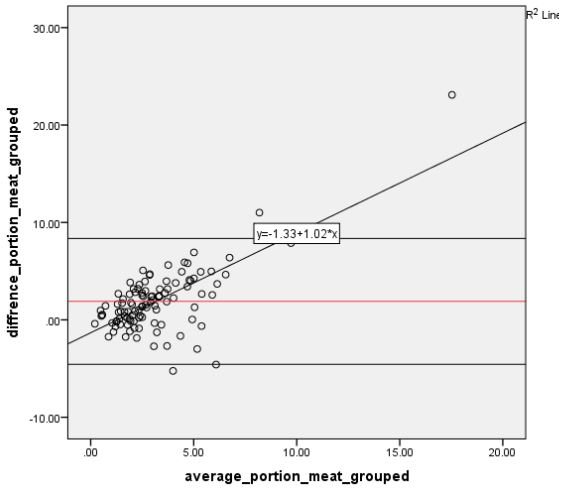
5. Fruits



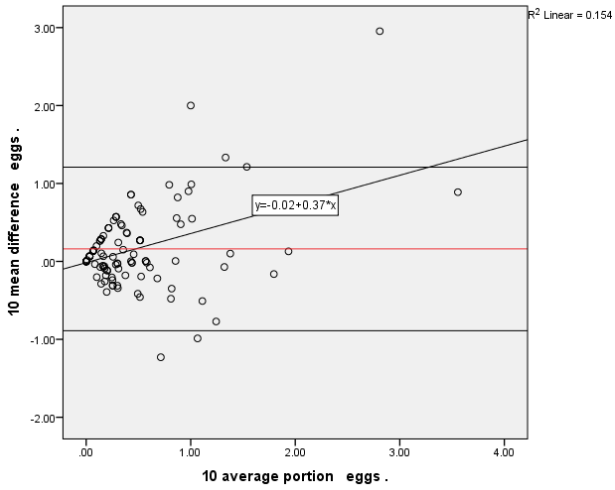
6. Fresh fruit juices



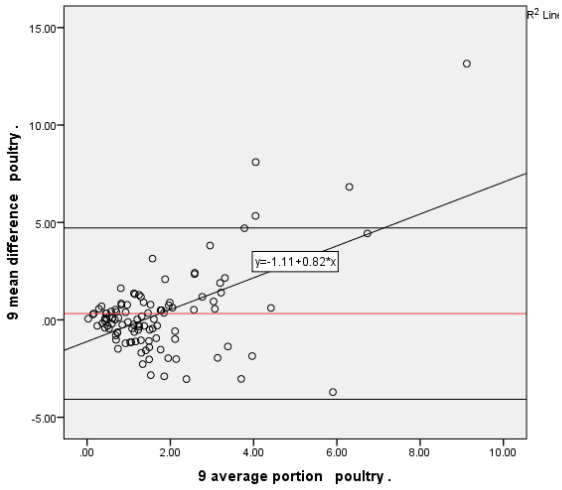
7. Meat



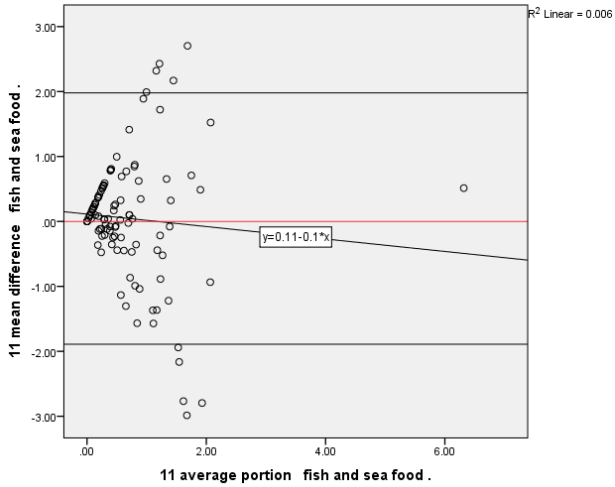
9. Eggs



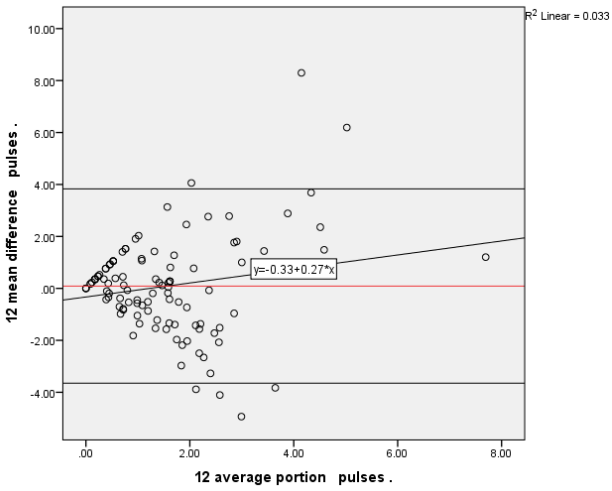
8. Poultry



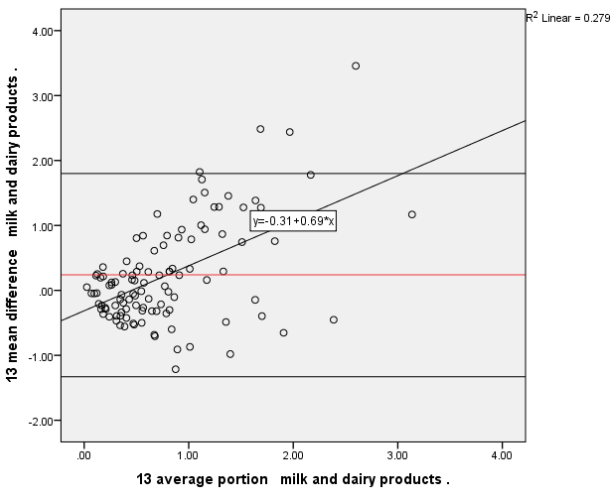
10. Fish and seafood



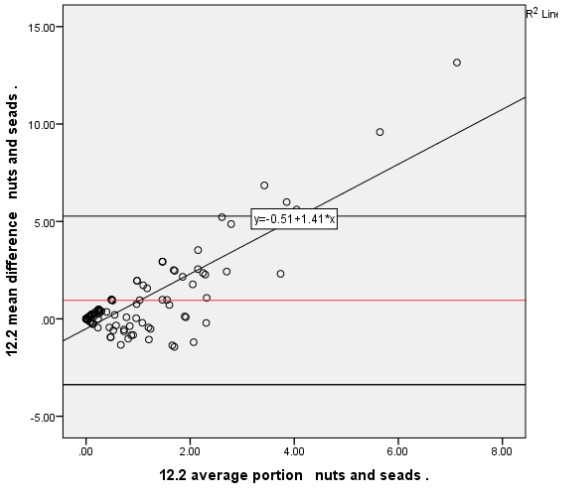
11. Pulses



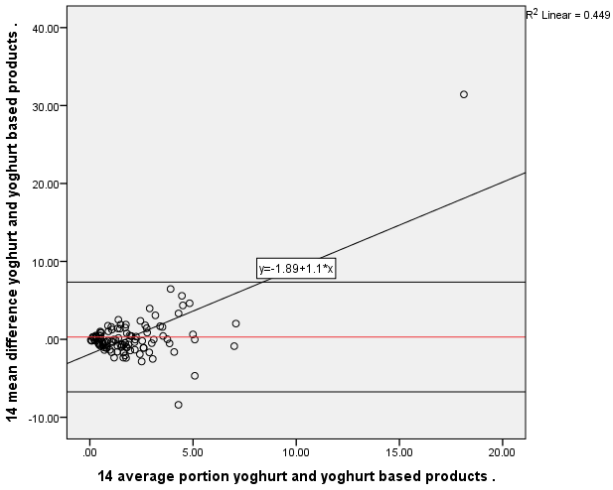
13. Milk and dairy products



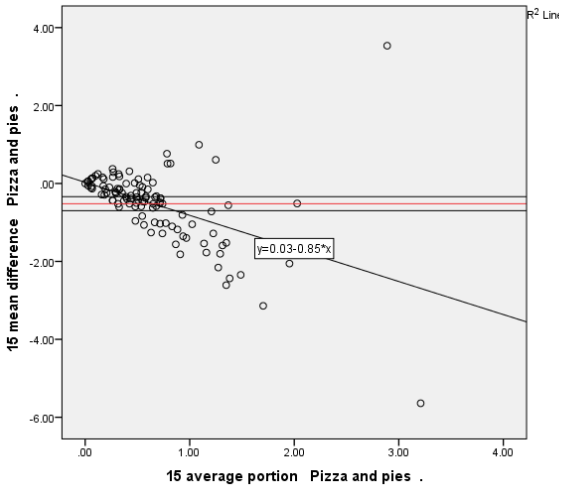
12. Nuts and seeds



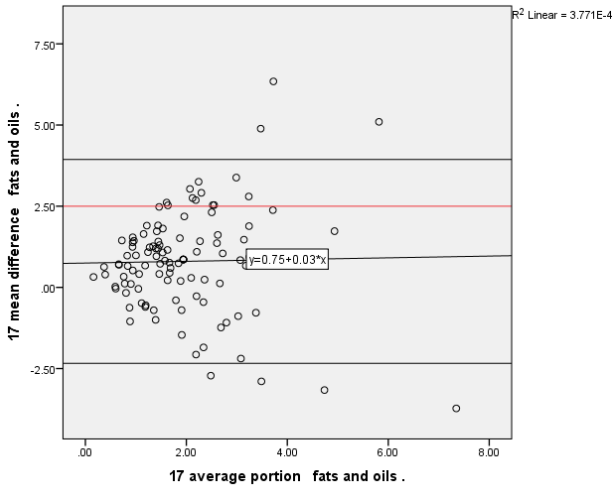
14. Yogurt and yogurt based products



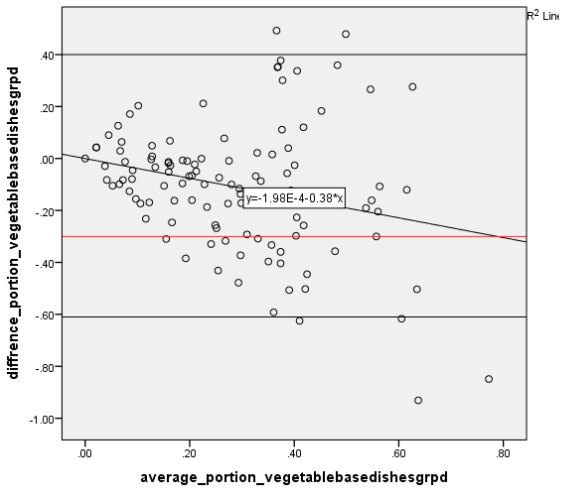
15. Pizzas and pies



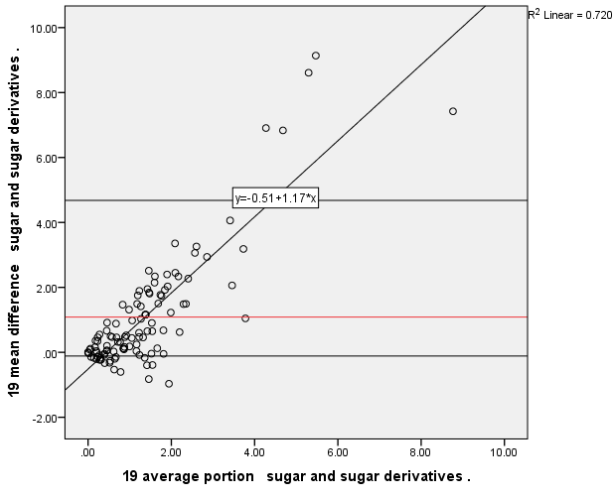
17. Fats and oils



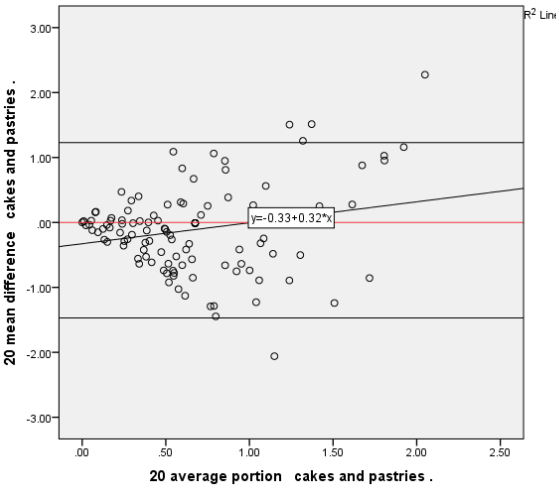
16. Vegetable based dishes



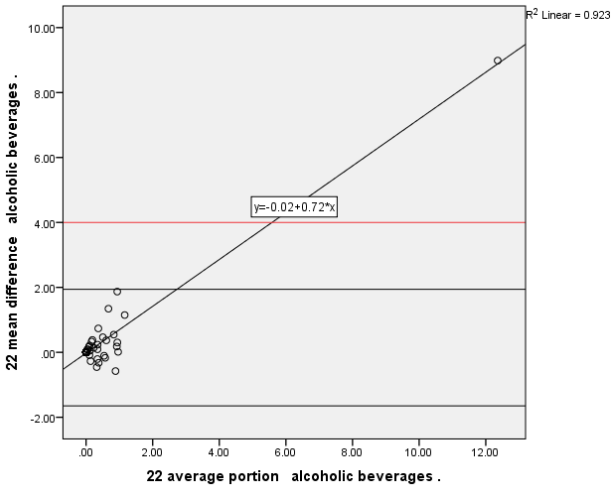
18. Sugar and sugar derivatives



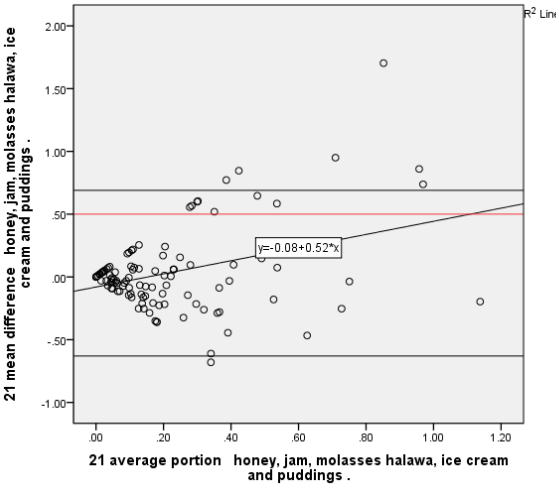
19. Cakes and pastries



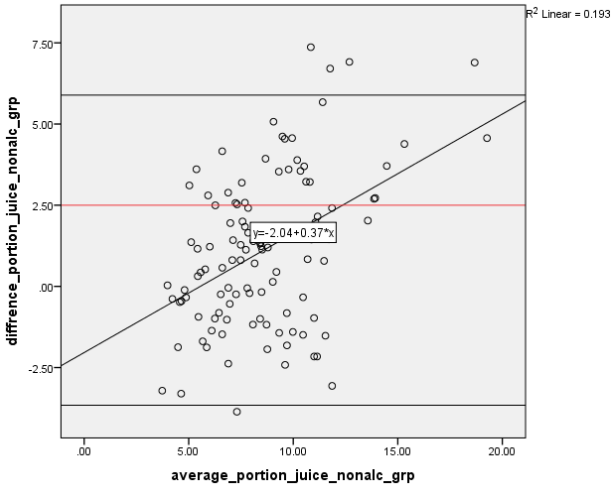
21. Alcoholic beverages



20. Honey, jam, molasses, pudding, ice-cream and halaweh



22. Non-alcoholic beverages



23. Miscellaneous

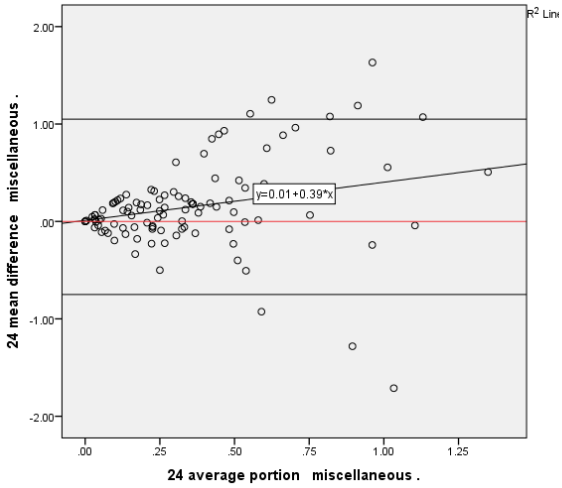


Figure 4.1. Bland-Altman charts for portion intake for all food groups as predicted by the FFQ and mean of MPRs

D. Relative Reproducibility of the Questionnaire (Comparison between FFQ-1 and FFQ-2)

In order to assess the reproducibility of the FFQ, ICC was calculated between FFQ-1 and FFQ-2, as displayed in Table 4.8 for food portions per food group and Table 4.9 for percent energy intake per food group. For food group portion intake, the ICC was significant for all food groups. An ICC greater than 0.50 was found for most food groups. The correlation range for reliability of the FFQ was found to range from 0.31 for ‘meat’ to 0.97, $p<0.01$, for ‘miscellaneous’ food group which includes mustard, ketchup, pickles (cucumber, eggplant) and zaatar, (Table 4.8). As for ICC for percent energy intake for food group shown in Table 4.9, it ranged between 0.29 for ‘vegetable based dishes’ food group, up to 0.76 for ‘fruits’.

Table 4.8. Intraclass Correlation Coefficients ICC for food portions intake per food group obtained using FFQ-1 and the FFQ-2 for comparative reliability

Food Groups	Mean FFQ-1 ± S.D	Mean FFQ-2 ± S.D	ICC
Cereals and cereals based products	5.49± 4.02	3.89± 2.79	0.612**
Pasta and other cereals	4.11± 4.90	3.58± 2.94	0.500**
Potatoes and potato based products	1.04± 1.54	0.83± 0.88	0.572**
Vegetables	0.81± 0.64	0.70± 0.59	0.459**
Fruits	1.68± 1.20	1.51± 1.24	0.711**
Fresh fruit juices	0.23± 0.31	0.13± 0.20	0.455**
Meat	4.82± 4.00	4.09± 3.49	0.313*
Poultry	2.31± 2.39	1.91± 2.26	0.696**
Eggs	0.63± 0.75	0.55±0.69	0.707**
Fish and seafood	1.18± 1.31	0.71± 0.87	0.446**
pulses	1.78± 2.18	1.60± 1.71	0.645**
Nuts and seeds	1.56± 1.98	1.51± 2.27	0.370**
Milk and dairy products	1.22± 1.17	0.91± 0.87	0.474**
Yogurt and yogurt based products	2.24± 2.79	2.14± 3.57	0.617**
Pizzas and pies	0.58± 0.61	0.39± 0.52	0.516**
Vegetable based dishes	0.30± 0.37	0.23± 0.18	0.347*
Fats and oils	2.59± 1.63	2.37± 1.40	0.609**
Sugar and sugar derivatives	2.15± 2.02	1.91± 2.12	0.824**
Cakes and pastries	0.83± 1.11	0.59± 0.63	0.455**
Honey, jam, molasses, pudding, ice-cream and halaweh	0.29± 0.44	0.59± 0.63	0.736**
Alcoholic beverages	0.23± 0.63	0.30± 1.63	0.549**
Non-alcoholic beverages	9.58± 4.21	9.14± 3.55	0.783**
Miscellaneous	0.45± 0.44	0.43± 0.41	0.969**

** P value < 0.05; ** P value < 0.01*

Table 4.9. Intraclass Correlation Coefficients (ICC) for percent energy intake per food group obtained using FFQ-1 and the FFQ-2 for comparative reliability

Food Groups	Mean FFQ-1 ± S.D	Mean FFQ-2 ± S.D	ICC
Cereals and cereals based products	14.53± 8.53	13.08± 7.76	0.592**
Pasta and other cereals	5.44± 4.02	5.69± 4.10	0.431**
Potatoes and potato based products	7.79± 7.78	7.81± 6.21	0.672**
Vegetables	0.94± 1.26	0.80± 0.83	0.338*
Fruits	5.96± 4.60	5.86± 4.24	0.764**
Fresh fruit juices	0.86± 1.20	0.65± 1.02	0.596**
Meat	4.82± 4.00	4.15± 3.54	0.325*
Poultry	4.49±3.51	4.22± 4.13	0.525**
Eggs	1.77± 2.29	1.77± 2.35	0.555**
Fish and seafood	1.99± 2.09	1.37± 1.28	0.319*
pulses	2.77±2.70	2.98± 2.93	0.523**
Nuts and seeds	5.10± 6.42	5.18± 6.85	0.428**
Milk and dairy products	5.85± 5.05	5.10± 4.73	0.453**
Yogurt and yogurt based products	1.89± 1.77	1.97± 1.63	0.581**
Pizzas and pies	5.64± 4.79	4.85± 4.17	0.308*
Vegetable based dishes	2.19± 3.72	1.82± 1.92	0.289*
Fats and oils	9.59± 6.13	10.94± 6.31	0.691**
Sugar and sugar derivatives	6.87± 5.82	7.18± 7.18	0.692**
Cakes and pastries	4.67± 5.39	4.18± 4.42	0.342*
Honey, jam, molasses, pudding, ice-cream and halaweh	1.01± 1.04	4.18± 4.42	0.642**
Alcoholic beverages	0.82± 2.12	1.05± 3.42	0.640**
Non-alcoholic beverages	4.38± 4.22	3.48± 3.20	0.597**
Miscellaneous	0.64± 0.85	0.50± 0.76	0.248

* P value < 0.05; ** P value < 0.01

Table 4.10. Values of agreement between the two methods (FFQ-1 and FFQ-2) as measured by the weighted kappa statistic and percent agreement results for food portions intake per food group for comparative reliability

Food Groups	Percent Agreement (%)			Weighted Kappa	95 % CI	Rank*
	Same quartile	Same and adjacent quartile	Extreme quartiles			
Cereals and cereals based products	44.55	86.36	13.64	0.429	0.308-0.549	Moderate
Pasta and other cereals	38.18	71.82	28.18	0.223	0.082-0.365	Fair
Potatoes and potato based products	48.18	85.45	14.55	0.458	0.336-0.580	Moderate
Vegetables	31.82	82.73	17.27	0.297	0.182-411	Fair
Fruits	45.45	83.64	16.36	0.405	0.280-0.531	Moderate
Fresh fruit juices	42.73	75.45	24.55	0.296	0.159-0.433	Fair
Meat	37.27	74.55	25.45	0.238	0.097-0.379	Fair
Poultry	36.36	81.82	18.18	0.331	0.207-0.454	Fair
Eggs	40	82.73	17.27	0.331	0.206-0.456	Fair
Fish and seafood	53.64	82.73	17.27	0.472	0.346-0.599	Moderate
pulses	35.45	75.55	24.45	0.246	0.111-0.382	Fair
Nuts and seeds	40.91	79.09	20.91	0.309	0.172-0.445	Fair
Milk and dairy products	35.45	78.18	21.82	0.260	0.122-0.398	Fair
Yogurt and yogurt based products	46.36	85.45	14.55	0.399	0.269-0.530	Fair
Pizzas and pies	46.36	85.45	14.55	0.423	0.299-0.548	Moderate
Vegetable based dishes	42.73	86.36	13.64	0.399	0.278-0.520	Fair
Fats and oils	45.45	80	20	0.363	0.232-0.493	Fair
Sugar and sugar derivatives	44.55	82.73	17.27	0.380	0.252-0.507	Fair
Cakes and pastries	38.18	81.82	18.18	0.336	0.208-0.464	Fair
Honey, jam, molasses, pudding, ice-cream and halaweh	49.09	81.82	18.18	0.414	0.282-0.546	Moderate
Alcoholic beverages	83.64	94.55	5.45	0.714	0.592-0.835	Substantial
Non-alcoholic beverages	40	85.45	14.55	0.385	0.265-0.505	Fair
Miscellaneous	94.55	100	0	0.956	0.922-0.990	Almost perfect

**(Landis & Koch, 1977)*

Reproducibility analysis results using Kappa agreement between the administrations of both the FFQ-1 and FFQ-2 for portions intake (Table 4.10) and percent energy intake per food group (Table 4.11) were computed to compare classification of food group's data into quartiles. Percent agreement in the same quartiles, adjacent quartiles and opposite quartiles of intake were also calculated.

For portion intake per food group, the weighted kappa values and their agreement rank ranged from 0.22 "fair" for 'pasta and other cereals' food group to 0.96 "almost perfect" for 'miscellaneous' food group. As for the reproducibility, the percent of individuals that were correctly classified into the same or adjacent quartile varied from 71.82 % for the 'pasta and other cereals' food group to 100% for 'miscellaneous'.

Table 4.11. Values of agreement between the two methods (FFQ-1 and FFQ-2) as measured by the weighted kappa statistic and percent agreement results for percent energy intake per food group for comparative reliability

Food Groups	Percent Agreement (%)			Weighted Kappa	95 % CI	Rank*
	Same quartile	Same and adjacent quartile	Extreme quartiles			
Cereals and cereals based products	47.27	85.45	14.55	0.414	0.287-0.541	Moderate
Pasta and other cereals	35.45	72.73	27.27	0.223	0.087-0.360	Fair
Potatoes and potato based products	51.82	88.18	11.82	0.502	0.383-0.621	Moderate
Vegetables	40	80.91	19.09	0.326	0.195-0.457	Fair
Fruits	41.82	80.91	19.09	0.363	0.236-0.489	Fair
Fresh fruit juices	43.64	72.73	27.27	0.309	0.171-0.446	Fair
Meat	37.27	75.55	24.45	0.238	0.097-0.379	Fair
Poultry	34.55	82.73	17.27	0.297	0.171-0.422	Fair
Eggs	36.36	80.91	19.09	0.311	0.183-0.439	Fair
Fish and seafood	36.36	80.91	19.09	0.282	0.148-0.416	Fair
pulses	39.09	72.27	27.73	0.297	0.164-0.429	Fair
Nuts and seeds	40	79.09	20.91	0.282	0.146-0.418	Fair

Milk and dairy products	36.36	77.27	22.73	0.282	0.151-0.413	Fair
Yogurt and yogurt based products	37.27	77.27	22.73	0.267	0.133-0.402	Fair
Pizzas and pies	36.36	73.64	26.36	0.238	0.100-0.377	Fair
Vegetable based dishes	45.45	90	10	0.458	0.340-0.576	Moderate
Fats and oils	37.27	75.45	24.55	0.282	0.150-0.414	Fair
Sugar and sugar derivatives	34.55	78.18	21.82	0.282	0.155-0.409	Fair
Cakes and pastries	45.45	77.27	22.73	0.341	0.201-0.480	Fair
Honey, jam, molasses, pudding, ice-cream and halaweh	39.09	81.82	18.18	0.341	0.214-0.467	Fair
Alcoholic beverages	82.73	90	10	0.779	0.655-0.904	Substantial
Non-alcoholic beverages	49.09	86.36	13.64	0.458	0.335-0.581	Moderate
Miscellaneous	33.64	79.09	20.91	0.253	0.123-0.383	Fair

*(Landis & Koch, 1977)

For percent energy intake of food groups, the weighted kappa values and their agreement rank ranged from 0.22 “fair” for the ‘pasta and other cereals’ to 0.78 “substantial” for ‘alcoholic beverages’. As for the reproducibility, the percent of individuals that were correctly classified into the same or adjacent quartile varied from 72.27 % for ‘pulses’ food group to 90% for both ‘vegetable based dishes’ and ‘alcoholic beverages’ food groups (Table 4.11).

CHAPTER V

DISCUSSION

A. Major Findings of the Study

Compared with other dietary assessment methods, FFQs are the most practical and cost-effective approach for assessing habitual intake and in assessing diet in large-scale nutritional epidemiological studies (Shim et al., 2014; Willett, 1998; Willett & Hu, 2006). However, since the food consumption is culture specific (Stevens et al., 1996) and food availability, accessibility and individual preferences can vary greatly between settings, it has been recommended that FFQ should be validated specifically for the populations they are intended to be used in order to provide the greatest chance for valid and reliable findings (Sharma, 2011; Teufel, 1997).

A large number of studies on validating FFQ exists in literature, however, only few are for food or food groups. (Segovia-Siapco et al., 2008).

To our knowledge, this is the first Arabic FFQ to be validated in Lebanon for adults. The validity of an Arabic semi-quantitative FFQ was evaluated against 8-12 MPRs in a sample of Lebanese adults. The 24-HR was chosen as the reference method for assessment of validity because they have high response rate and good quality of response, and do not to interfere with the actual dietary habits of the participants (Bohlscheid-Thomas et al., 1997; Malekshah et al., 2006). Also, they are easier to use, do not require literacy and less time consuming compared to food records (Tayyem et al., 2014b).

In addition, the reliability of the FFQ was assessed by administering the FFQ twice during a 1-year interval.

B. Main Findings on Relative Validity of the FFQ

The mean differences between portion intakes of each food group were compared between the FFQ and the mean of MPRs in order to assess the validity of this FFQ. In addition, spearman correlations coefficients as well as Bland-Altman statistics and plots were calculated to evaluate the validity.

In this study, the spearman correlations coefficients between the FFQ and the dietary recall ranged between 0.20 and 0. 74 and were significant with $p<0.01$ except for 'Fruit juices', 'Fish and seafood', and 'Honey, jam, molasses, pudding, ice cream and halaweh' food groups which were significant at $p< 0.05$ (Table 4.6).

1. Comparison with other validation studies:

Similar to our findings, validation studies of intake of food groups assessed by FFQ have correlations between 0.3 and 0.8 (Bohlscheid-Thomas et al., 1997; Cade et al., 2002; Feskanich et al., 1993; Goldbohm et al., 1994; Huybrechts et al., 2009; Jain, Howe, Johnson, & Miller, 1980; Pietinen et al., 1988; Salvini et al., 1989; Willett, 1998). (Table 5.1)

In this study, the 'Cereals and Cereal-Based Products' food group spearman correlation coefficient between the FFQ and the mean MPRs was 0.67 with $p<0.01$. When compared with similar validation studies (Appendix IX), this study's spearman correlation coefficient of 'Cereals and Cereal-Based Products' was higher than Siapco et al (2008)'s correlation coefficient of 0.47 and 0.42 of Steinmann *et al.* (2017). As for the 'potatoes and potato based products' food group, its correlation coefficient was valid with a coefficient of 0.50 higher than other validation studies (0.37, 0.11, 0.45, 0.155,

0.31, 0.184) (Bohlscheid-Thomas et al., 1997; Dehghan et al., 2013; Hu et al., 1999; Ogawa et al., 2017; Steinemann et al., 2017; Verger et al., 2017).

In this study, ‘fruits’ and ‘vegetables’ food groups had a correlation coefficient of 0.62 and 0.31 respectively. For both food groups, the correlation coefficients were higher than other validation studies (Barbieri, Crivellenti, Nishimura, & Sartorelli, 2015; Segovia-Siapco et al., 2008; Steinemann et al., 2017; Verger et al., 2017); but lower than the correlation coefficients (0.77 for vegetables and 0.63 for fruits) from Dehghan et al. (2012), a study conducted on 166 Chilean adults, validating the FFQ versus four 24-hour recalls (Dehghan et al., 2013). As for the ‘Fish and sea-food’ group, its correlation coefficient was 0.22, lower than all the comparable studies (Barbieri et al., 2015; Hu et al., 1999; Steinemann et al., 2017; Verger et al., 2017).

As for nuts and seeds (r=0.43), similar findings were reported by Hu et al., (1999) (0.45) and Dehghan et al., (2012) (0.35), even though they included only nuts in their food group, whereas a lower correlation was found by Bohlscheid et al., (1997) (0.18).

Similar findings were reported in literature for ‘milk and dairy products’ as well as ‘yoghurt and yoghurt based products’ (Bohlscheid-Thomas et al., 1997; Dehghan et al., 2012; Ogawa et al., 2017; Steinemann et al., 2017).

For the rest of food groups, the comparison with the literature is presented in the Appendix IX which summarizes the spearman correlations coefficients evaluating the validity between FFQs validated by food groups against 24-HR or food records (gold standard) for adults.

In this study, there has been an overestimation in certain food groups and underestimation in others. Compared to dietary records and recalls, FFQs tend to

overestimate intake (Block, 1982; Wrieden et al., 2003). This overestimation might be due to a problem that faces most dietary assessment methods which is underreporting of intake with 24-HR or dietary records (Knudsen et al., 2016; Paalanen et al., 2006).

a. Overestimation

The results of this study showed an overestimation of dietary intake by the FFQ as compared to the 24-HRs for all food groups (mean difference was positive) except for 'fresh fruit juices', 'pizzas and pies', 'vegetable based dishes', as well as 'honey, jam, molasses, pudding, ice cream and halaweh' food groups. This tendency of the FFQ to overestimate dietary intake was also reported by previous studies in both the adult and paediatric populations (Bel-Serrat et al., 2014; Bohlscheid-Thomas et al., 1997; Eck et al., 1991; Hollis et al., 2017; Livingstone, Robson, & Wallace, 2004; Medin et al., 2017; Nelson, Black, Morris, & Cole, 1989; Paalanen et al., 2006; Sahashi et al., 2011; Silva-Jaramillo, Neutzling, & Drehmer, 2015; Tabacchi et al., 2015; Watson et al., 2009). Such an overestimation was expected because FFQs are known to reflect higher estimates than the reference method, it might be because of potential underestimation of dietary recall and partly because averaging amount of intake over 1 year in a FFQ is prone to misjudgement in estimation (Fernández-Ballart et al., 2010; Verger et al., 2017). Also, such an overestimation could be due to the large number of foods listed under each food group in the FFQ (Bohlscheid-Thomas et al., 1997). Similarly, inaccurate reporting of consumption frequency and/or the amount of foods commonly consumed could be an additional source for this overestimation (Hunter et al., 1988).

Overall, the FFQ tends to overestimate intake when compared to the 24-HRs, especially for foods that are frequently consumed such as 'fruits', 'vegetables' and 'fats

and oils' since they are recalled with more consistency and therefore are less misclassified than those consumed occasionally (Block, 1982; Buch-Andersen, Pérez-Cueto, & Toft, 2016; Hebden, Kostan, O'Leary, Hodge, & Allman-Farinelli, 2013; Steinemann et al., 2017; Wrieden et al., 2003).

For fruits and vegetables food groups, the results of this study were comparable to the literature. FFQ tended to overestimate the intake of fruits and vegetables, a possible justification for this overestimation might be in response to social desirability where healthy foods tend to be over-reported (Macdiarmid & Blundell, 1998; Paalanen et al., 2006). Similar findings for overestimation were found by other validation studies (Buch-Andersen et al., 2016; Hebden et al., 2013; Steinemann et al., 2017; Verger et al., 2017). An overestimation of 'vegetables' food group only was reported by Fernandez-Ballart et al., (2010) and Kesse-Guyot et al., (2010). In contrast, Spencer et al., (2005), Lin et al., (2017) found that there was an underestimation of 'fruits' and 'vegetables' food groups (Lin et al., 2017; Spencer et al., 2005).

For 'fats and oils' food group there was an overestimation of intake. The findings of this study were consistent with those in the prior literature that overestimated fat intake (Spencer et al., 2005). 'Fats and oils' as well as 'sugar and sugar derivatives' tend to be overestimated by the FFQ with a mean difference of 160.06, and 174.27% respectively. These food groups are considered typical foods that are easily forgotten when reporting foods consumed when keeping the 24-HR. In the FFQ, the use of 'fats and oils' as well as 'sugar and sugar derivatives' were asked separately and that ensured they were reported. Whereas in the 24-HR, participants might forget to report if they added sugar to their coffee or to report the amount of fat

used in cooking or in salads. This might explain why they tend to be overestimated by the FFQ.

b. Underestimation

In contrast, certain food groups were underestimated in the FFQ when compared with the 24-HR such as vegetable-based dishes since it is difficult to estimate their portion size and rather tended to be ignored. Also, there was a tendency to underestimate unhealthy food groups such as sweets and cakes because they are known to be socially unaccepted foods and hence are usually underreported (Macdiarmid & Blundell, 1998; Paalanen et al., 2006). In this study, 'pizza and pies', 'cakes and pastries', and 'honey, jam, molasses, pudding, ice cream and halaweh' food groups were underestimated.

Comparing food groups across different studies can be challenging, because of differences in how foods are grouped, and due to cultural differences in what is eaten (Medin et al., 2017).

2. Findings on the Reproducibility of the FFQ

In order to evaluate reproducibility, the FFQ was administered twice, 1-year apart, minimizing potential temporal changes in subject's dietary intake

The intra-class correlation coefficients between the two FFQ administrations were between 0.31 for meat group to 0.97 for miscellaneous. The observed values of these measures suggested that the results were similar to the results of other reliability studies that reported correlation coefficient in the range of 0.5-0.7 between the two

administrations of an FFQ (Table 5.1). According to Cade et al. (2002) and Willet (1998), a reliability coefficient ranging between 0.5 and 0.7 is considered adequate.

Both spearman and ICC correlations were used to assess reliability between the 2 FFQs in similar validation studies. However, since spearman correlations consider only correlations or rankings, ICC is considered a more appropriate reproducibility test correlations since it takes into account the agreement and differences in ratings in addition to correlations between raters (Shrout & Fleiss, 1979).

This FFQ had similar correlation coefficients in most food groups as compared with similar validation studies from Iran (Esfahani, Asghari, Mirmiran, & Azizi, 2010), Jordan (Tayyem et al., 2014b), Germany (Bohlscheid-Thomas et al., 1997), France (Kesse-Guyot, Castetbon, Touvier, Hercberg, & Galan, 2010) (Appendix X).

In addition, the weighted kappa statistic was used to evaluate the reliability of this FFQ as it could represent the agreement and classification of quartiles of portion intakes between FFQ 1 and 2. The weighted kappa measured between the two FFQs in this study ranged from fair to almost perfect, from 0.22 to 0.96 for portions intake. When comparing this FFQ's weighted kappa with those from a similar validation studies, it showed that this study had higher weighted kappa values for all food groups than the weighted kappa values conducted on German adults (Haftenberger et al., 2010), 0.09 - 0.54, Barbieri et al., (2014) who conducted a FFQ validation study on Brazilian pregnant women in which kappa values ranged from 0.07 to 0.46, Moghames et al., (2016), 0.349 - 0.63, and Huybrechts et al., (2009), 0.15-0.43 (Table 5.1).

The percentage of individuals who were classified into the same and adjacent quartiles was, on average, 86.52% as the second FFQ, ranging from 71.82 % for 'pasta and other cereals' and 100% for 'miscellaneous' food group. Additionally, this study

had higher classification percentages for all food groups when compared to that of Barbieri *et al.* (2014) which was able to classify 59-84 % into the same or adjacent category as well as 68-94% of Haftenberger *et al*., (2010), 79.17-97.50% of Moghames et al., and 68-83% of Fernandez-Ballart et al., (2010).

Therefore, this FFQ had good reliability when measuring all food groups, having most ICC above 0.5, the minimum correlation for an assessment tool to be considered reliable (Cade et al., 2002).

In summary, the findings of this study suggested that this FFQ is valid and reliable in reflecting the actual food group consumption as well as in ranking the intake of Lebanese adults.

Table 5.1. Comparing methodology and correlation ranges of published FFQs validated by food groups

Author	Place/ country	Study population	Dietary assessment	Parameters used	Main findings
Moghames et al., 2016	Lebanon	111 Lebanese Children (5-10 years)	FFQ vs 4 MPR	• Mean difference • Spearman correlation • Percent agreement • 95% LOA • ICC • Kw	• Spearman correlation: 0.26-0.54 • ICC: 0.31– 0.73 • Percent agreement in same category: 79.17-97.50%
Tayyem et al.,	Jordan	101 men and women	FFQ vs 3 24-HR recalls	• Spearman rank correlation coefficient • Kendall's tau-b	• Spearman correlation:0.70-0.98 • Percent agreement: 25.5-43.6%

Bijani et al.,	Iran	200 subjects	FFQ vs 2 24hr recalls	• Median • Correlation coefficients • Bland Altman	• Correlation coefficients 0.25-0.62 for male and 0.25-0.60 for female
Esfahani et al., 2010	Iran	132 adult men and women	FFQ vs 12 24-HR recalls	• ICC spearman correlation • Median difference • Tertile classification	• ICC: 0.41-0.94 for men and 0.45-0.74 for women • Validity correlations: • 0.03-0.77 for men and 0.12-0.79 for women • Percent agreement: 12.8-60.6% for men and 15.7-62.9% for women
Bohlscheid et al., 1997	Germany	104 men and women 35-64 years	FFQ vs 12 24-HR recalls	• Median Difference • Spearman correlation • Correlation coefficients • Percent agreement • Quintiles	• Correlation coefficients: 0.14-0.90 • Spearman correlation: 0.49-0.89
Siapco et al., 2007	USA	87 adults 30-72 years	FFQ vs 6-8 24-HR recalls	• Mean difference • correlation coefficients • Kappa	• High Correlation coefficient 0.82

Hu et al., 1999	Boston	127 men 40-75 years	FFQ vs 1 wk diet record biomarkers	• Pearson Correlation • Factor loading matrix	• Correlation: 0.45-0.74 • Reliability correlation for factor scores: 0.70; 0.67
Ogawa et al., 2017	Japan	188 pregnant women	FFQ vs 3d-DR	• Mean intake • Spearman correlation coefficients • Percent agreement	• Spearman correlation: -0.02-0.57 • Percent agreement into same or adjacent quintiles: 60.4%
Barbieri et al., 2014	Brazil	75 adult pregnant women	FFQ vs 3 24-HR recalls	• Median • Pearson correlation coefficients • Percent agreement • Quadratic kappa	• Pearson correlation coefficient: 0.01-0.51 • Percent agreement into same or adjacent quartile:59-84% • Kappa: 0.07- 0.46
Haftenberger et al., 2010	Germany	161 participants (18-80 years)	FFQ vs 2 24-HR recalls	• Mean difference • Spearman correlation coefficients • Percent agreement • Weighted kappa	• Spearman correlation coefficient: 0.15-0.80 • Percent agreement: same or adjacent quartile: 68-94% • Weighted kappa: 0.09-0.54

Roy et al., 2016	Australia	100 young adults	FFQ vs weighted food record	• Spearman correlation coefficients • Median • Mean difference • Tertile scores • Weighted kappa • 95% LOA	• Weighted kappa: -0.11-1 • 95% LOA: -3.59-1.22
Steinmann et al., 2017	Switzerland	56 adults	FFQ vs 4-d weighted food record	• Mean difference • Spearman correlation coefficient	• correlation coefficient: 0.09-0.92
Jackson et al., 2012	Kanye Botswana	122 individual (18-75 years)	FFQ vs 4 24-HR recalls	• Spearman correlation coefficient • Weighted kappa • Percent agreement	• Spearman correlation: 0.18-0.58
Dehgan et al., 2012	Argentina	156 men and women	FFQ vs 4 24-HR recalls	• Mean difference • correlation coefficient • Percent agreement • Weighted Kappa	• correlation coefficient: 0.11-0.80 • Percent agreement in same category: 59-85%

Verger et al., 2017	France	324 adults	FFQ vs 3 web based 24-HR recalls	• Mean difference • Median • correlation coefficient • Percent agreement • Bland Altman	• Spearman correlation:0.16-0.65
Fernandez-Ballart et al., 2010	Spain	158 men and women (55-80 years)	FFQ vs 3d DR	• Percent agreement • Pearson correlation coefficient • ICC	• Reproducibility Pearson correlation coefficient: 0.50-0.82 • ICC: 0.63-0.90 • Validity Pearson correlation coefficient: 0.42-0.72 • ICC: 0.40-0.82 • Percent agreement in same or adjacent quartile: 68-83%
Kesse-Guyot et al., 2010	France	140 men and women	FFQ vs 24-HR dietary record	• Mean difference • Spearman correlation coefficient • Pearson correlation coefficient • ICC	• Reproducibility ICC: 0.25-0.83for men, 0.32-0.84 for women • Spearman correlation coefficient: 0.12-0.79 for men, 0.21-0.74 for women

Xia *et al.*, 2011	China	168 Chinese female adolescents (12-18 years)	FFQ vs nine 3 24-HR	• Spearman correlation • ICC • Kappa • Percent agreement	• Spearman correlation: 0.41-0.65 • ICC: 0.56 – 0.73 • Kappa: 0.35-0.52 • Percent agreement in same category: 64.9 – 83.9% • Misclassification: 1.2-5.4 %
Roumelioti & Leotsinidis, 2009	Greece	200 Greek children (10-12 years)	FFQ vs 7 24-HR	• Correlation coefficient • Kappa	• Spearman correlation: 0.58-0.90 • Kappa: 0.361-0.812
Matthys *et al.*, 2007	Belgium	104 Belgian adolescents (12-18 years)	FFQ vs 3 DR	• Spearman correlation	• Validity Spearman correlation: 0.20-0.64
Huybrechts et al., 2009	Belgium	650 Preschool children (2.5-6.5 years)	FFQ vs 3d EDR	• Median differences • ICC • Spearman • Weighted kappa • Bland Altman plots • Classification by quartiles	• ICC: 0.53-0.79 (moderate correlation) • Spearman: 0.23-0.62 • Weighted kappa: 0.15-0.43 • Percent agreement in the same or adjacent quartile: 67-88%

Baroudi et al., 2019	Lebanon	120 adults	FFQ vs 8-12 24-HR recalls	• Mean difference • Spearman correlation • ICC • Weighted Kappa • Percent agreement • Bland Altman	• Spearman correlation: 0.20-0.74 • ICC: 0.31-0.97 • Percent agreement in the same or adjacent quartile: 71.82-100% • Weighted kappa: 0.22-0.96

(Moghames et al., 2015), (Bijani et al., 2018), (Tayyem et al., 2014b), (Bohlscheid-Thomas et al., 1997),(Segovia-Siapco et al., 2008), (Hu et al., 1999),(Ogawa et al., 2017), (Barbieri et al., 2015), (Haftenberger et al., 2010), (Roy, Hebden, Rangan, & Allman-Farinelli, 2016), (Steinemann et al., 2017), (Jackson et al., 2013), (Saldiva et al., 2017), (Dehghan et al., 2013), (Verger et al., 2017), (Fernández-Ballart et al., 2010), (Kesse-Guyot et al., 2010), (Xia et al., 2011), (Roumelioti & Leotsinidis, 2009), (Esfahani et al., 2010; Huybrechts et al., 2009; Matthys, Pynaert, De Keyzer, & De Henauw, 2007)

CHAPTER VI

STRENGTHS, LIMITATIONS AND POTENTIAL BIASES

Some strengths of this study are that it included 8 to 12 24-HR administered over 12 months (3 recalls/season: 2 WDs, 1 WE), which reduced the daily and seasonal variations in our study population (representative of usual intake). The FFQs were conducted by trained interviewers that ensured adequate completion, helped participants understand the process and minimized the misinterpretation of portion size intake and frequencies. In addition, standardized portion sizes or 2 D food portion visual charts were used to help subjects accurately quantify what they consumed.

This study, however, have some limitations. When assessing the validity of a method (FFQ) using another method as reference (e.g. food record, dietary recall), it is important that the errors in the two methods are uncorrelated (Knudsen et al., 2016). The 24-HR, as compared with dietary records, cannot evaluate the exact validity and relative validity of an FFQ. But, because previous attempts have failed in Lebanon to use food records as gold standard, since it requires high literacy and high motivation, and since the gold standard should be culture-specific, 24-HR recall, more specifically the MPR approach which help in minimizing memory bias since it uses the 5 probing stages, was used as a gold standard.

A potential limitation of the present validation study is the lack of an objective reference measure, e.g. a biomarker of dietary intake independent of self-reported intake, with which to compare the FFQ, to further examine the validity of the FFQ (Steinemann et al., 2017). However, there is a lack of biomarkers to reflect wider aspects of dietary intake, and the use of biomarkers for validation of dietary assessment

methods is costly (Knudsen et al., 2016). On the other hand, the purpose of the FFQ is to rank the participants according to intake rather than to assess the absolute intake. Therefore, a relative validation method, such as the dietary recall, may be appropriate in assessing validity.

Another limitation is the use of USDA's food and nutrient database as the primary reference database for portion sizes since there is no food composition data specific to Lebanese food composition databases. However, for traditional Lebanese dishes, a specific food composition table developed for middle eastern foods was used (Pellet & Shadarevian, 1970).

Moreover, the high day-to-day variability of dietary intake, errors in estimation of portion size and limitations of recall ability might be the reason of the observed moderate agreement between the FFQ-2 and the mean of 24-HRs (Livingstone et al., 2004; Nelson et al., 1989).

Also, no data collected on access or availability of food groups. This is particularly important when comparing with other countries.

The way the questionnaire was built (e.g. 10 years ago, n=200) amidst the nutrition transition.

In light of the mentioned limitations, some potential biases that might affect the internal validity of the study such as memory, social desirability, recall and selection biases might be present. However, some were minimized. For example, in order to minimize the social desirability bias, interviewers were trained not to give any judgmental reactions during the interview. In addition, participants were not notified on the exact day of dietary assessment interview not to change their diets and to minimize the study effect bias. Also, in order to minimize recall bias (overweight subjects tend to

underestimate their intake whereas lower SES subjects tend to over-report their intake), interviewers were trained not to drill on answers, not to ask leading questions, and not to give any judgmental attitude. At the level of data entry, it was minimized by random checking. The considerable training and practice of the interviewers can minimize both memory errors and observer/interviewer bias.

CHAPTER VII

CONCLUSION AND RECOMMENDATIONS

To our knowledge, this is the first study to validate an Arabic semi-quantitative FFQ developed to measure the food groups' intake among Lebanese adults. The results of this study showed that the 94-item FFQ was valid in measuring all food groups in terms portion intake as well as percent energy intake. As for reliability, this study's results indicated a fair to almost perfect reproducibility for the assessment of portion intake and fair to substantial for percent energy intake for all food groups in the FFQ. Therefore, this FFQ can provide an accurate and precise assessment of dietary intake over a one-year period in this population; it also can be useful in ranking individuals accurately based on food group intake.

This FFQ can be considered as an appropriate tool to assess and characterize usual dietary intake of Lebanese adults in epidemiological studies. Since it can reflect long-term dietary intakes needed to assess diet-disease relationships of large number of subjects in epidemiological studies.

For future studies evaluating food groups' intake among adults, it is important to investigate the value of using this FFQ in diet-disease associations as well as monitoring the adherence of the Lebanese adult population to dietary guidelines, nutrition therapy and interventions. This FFQ can also help researchers track changes in diet over time. Dietitians and health care professionals who want to evaluate adult's dietary intake by food group and identify whether they are meeting or exceeding the food based dietary guidelines (FBDG) can also use it. It is also useful for policy makers and governmental

to use it in order to address practical nutritional messages and monitor population health intervention programs.

APPENDICES

APPENDIX I

PARTICIPANT CONSENT FORM (ENGLISH VERSION)

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RESEARCH CONSENT FORM, PROTOCOL #: NUT.FN.22

1. Title of Research
Validity and Reliability of a Food Frequency Questionnaire to Assess Dietary Intake among Lebanese adults.
2. Principal Investigator
Dr. Farah Naja, American University of Beirut
3. What is the purpose of this study?
The purpose of this study is to examine the validity and reliability of a Food Frequency Questionnaire (FFQ) for the assessment of dietary intake among Lebanese adults. Our goal is to compare the dietary intake data we collect via the FFQ to 24-hour dietary recalls (24-HRs) and blood biomarkers (carotenoid, tocopherols, and retinols). We aim to enroll 120 adults aged between 18 and 65 years old from various faculties and offices at the American University of Beirut (AUB) to participate in this study. This project is being sponsored by the URB at AUB and the University of Texas at Austin.
4. How will we recruit subjects like you?
Flyers will be posted on AUB campus. Subjects will be asked to indicate their interest in participating in the study by email or by phone. They will be invited to come to the research unit at the Nutrition and Food Sciences Department in AUB. A brief screening form will be filled to verify eligibility for the study. Subjects will be part of the study if they meet the inclusion and exclusion criteria. A total of 120 subjects will be recruited.
5. What will I do if I choose to be in this study?
In order to study dietary intake it is important that we be able to identify the kinds and amounts of foods and beverages that people are consuming and how they reflect in their blood biomarkers. Therefore, if you choose to participate in the study, we will conduct with you a total of 14 face-to-face interviews to collect the data. During the first interview, we will administer the sociodemographic and lifestyle questionnaires and the first FFQ, and a second FFQ will be administered one year later. After the first visit, blood collection for the analysis of the blood biomarker carotenoid, tocopherols, and retinols (in addition to the lipid profile) will be conducted at the American University of Beirut Medical Center (AUBMC), during the first season (15 ml) and the last season (15 ml) of the study period. Hence, only two blood samples will be collected (a total of 30 ml from both blood drawings). Within each of the four seasons of this one year, we will call you three times to set three meeting times with you in order to conduct three face-to-face interviews to complete the three 24-hour recalls (24-HRs) representing two weekdays and one weekend per season. We will then compare the dietary intake data we collected via the FFQ to the 24-HRs and the blood biomarkers (carotenoid, tocopherols, and retinols).

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6. How long will I be in the study?

We will administer our data collection questionnaires through 14 face-to-face interviews with a trained Research Assistant over a period of 12 months. The face to face interviews will take place at the participants' office (if applicable), or the subject will be invited to the NFSC department, room 520 (clinical research room).

7. What are the possible risks or discomforts?

There will be a tiny bit of discomfort during blood collection via venipuncture. There is always a slight chance for bruising, infection, pain or fainting when blood is collected. However, a certified phlebotomist at AUBMC will collect blood following the standard venipuncture techniques in the sitting position. Unforeseeable risks may arise during the study procedure. There is also a risk of breach of confidentiality. However, safeguards are in place as listed in the confidentiality section of this document.
Note that at the end of the study when all samples are analyzed, the researchers will share the test results with all participating subjects and will advise them to discuss the results with the subjects' family physician.

8. Are there any potential benefits?

There are no personal direct benefits for you if you participate in this project. However, your participation may help the research team at AUB develop and validate an FFQ which will be a useful tool in estimating dietary intake in a large sample size of this population and will fill a critical knowledge gap in the assessment of nutritional status of Lebanese adults, especially in the light of consistent documented associations between food intake and obesity as well as the influence of dietary intake on chronic disease risk.

9. Are there costs to me for participation?

You will receive a monetary compensation (15 USD) in cash on each day of blood withdrawal as a compensation for your waiting time and transportation.

10. Who can I contact if I have questions about the study?

If you have questions or concerns, or if you think the research has hurt you in any way, you can contact:
Dr. Farah Naja
Tel: 009611350000, ext: 4504
Email: fn14@aub.edu.lb

If you have questions about your rights as a volunteer, or you want to talk to someone outside the research team, please contact:
Biomedical Sciences Institutional Review Board
American University of Beirut, Lebanon
Tel: 00961 1 374374, ext: 5445
Email: irb@aub.edu.lb

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11. Will information about me and my participation be kept confidential?

Data collection will be conducted in a manner that preserves the confidentiality of all subjects and ensures that no breach of participants' privacy occurs. All the data will be collected, managed and stored by team members only. A random coded study ID will be assigned to each participant at the time of enrollment. This study ID will be used to identify all data collected. The study ID key will be contained in a password protected file on password protected computers accessible only to the investigators of the study, as well as the selected research team members involved in data entering, cleaning and coding. All hard copies will be stored in locked cabinets with access only to the investigators. The project's research records may be reviewed by the research team at Nutrition and Food Science department at AUB and University of Texas, Austin. Any published reference to the data obtained in this study will not make reference to any of your personal data in identifiable form.

_____**I ALLOW** the use of my collected information to be shared with collaborators.

_____**I DO NOT ALLOW** the use of my collected information to be shared with collaborators.

12. What are my rights if I take part in this study?

Your participation in this study is voluntary. You may choose not to participate or, if you agree to participate, you can withdraw your participation at any time without penalty or loss of benefits to which you are otherwise entitled.

13. Additional Choices

The analysis of collected blood samples will take place at the AUBMC laboratory (Beirut) and Craft Technologies Inc. (US). Leftover samples will be discarded according to institution policy. In case you consented for your leftover blood samples to be used for future research, they will be stored at the NFSC department.

- You may join this study even if you do not permit blood withdrawal. Please indicate your choice on the appropriate line below:

_____**I PERMIT** blood withdrawal.

_____**I DO NOT ALLOW** blood withdrawal.

- You may join this study even if you do not permit the storage and use of your left-over samples for future research. Please indicate your choice on the appropriate line below:

_____I **PERMIT** the storage and use of my left-over samples for future research.

_____I **PERMIT** the storage of my leftover samples but request to be contacted to seek permission of use for future research.

_____I **DO NOT ALLOW** storage or the use of my left-over samples for future research.

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- We would also like your permission to contact you about participating in future studies. You may still join this study even if you do not permit future contact beyond the study period. You may also change your mind about this choice. Please indicate your choice on the appropriate line below:

_____**YES**, you may contact me. Please provide us with your mobile number:

_____**NO**, you may **NOT** contact me.

Documentation of Informed Consent

I have had the opportunity to read this consent form and have the research study explained. I have had the opportunity to ask questions about the research study, and my questions have been answered. I am prepared to participate in the research study described above. I will be offered a copy of this consent form after I sign it.

Participant's Signature — Date / Time

Participant's Name

Researcher's Signature — Date / Time

Researcher's Name

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APPENDIX II

PARTICIPANT CONSENT FORM (ARABIC VERSION)

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AUB American University of Beirut
Faculty of Agricultural and Food Sciences

نموذج الموافقة على الاشتراك ببحث علمي، رقم البروتوكول: NUT.FN.22

1. عنوان البحث
تقييم دقّة إستمارة العادات الغذائية بين الراشدين اللبنانيين
2. الباحث الرئيسي
د. فرح نجا، الجامعة الأميريكيّة في بيروت
3. ما هدف هذا البحث؟
تهدف هذه الدراسة إلى النظر في صلاحية ودقة إستمارة العادات الغذائية لتقييمها بين الراشدين اللبنانيين. نرمي إلى مقارنة بيانات العادات الغذائية التي نجمعها من خلال الاستمارة بالمأكولات التي يتناولها الشخص في 24 ساعة الماضية وبالواصمات الحيوية في الدم (carotenoid, tocopherols, and retinols). نهدف إلى إشراك 120 راشداً بين عمر 18 و65 من عدة كليات ومكاتب في الجامعة الأميريكية في بيروت في هذه الدراسة. وهذا المشروع هو ممول من قبل مجلس الأبحاث الجامعي في الجامعة الأميريكية في بيروت وجامعة تكساس في أوستن.
4. كيف سيتمّ اختيار المشاركين في الدراسة؟
سيتم نشر الاعلان عن الدراسة في الجامعة الأميريكية في بيروت. يعبّر الأشخاص عن رغبتهم بالمشاركة من خلال البريد الاكتروني أوالاتصال الهاتفي. يطلب من هؤلاء الأشخاص زيارة قسم التغذية في الجامعة الأميريكية في بيروت، و تُملأ عندها استمارة لمعرفة اذا كان الشخص مخوّلاً للانضمام حسب شروط الدراسة. سيتم اختيار 120 أشخاص للمشاركة في هذه الدراسة.
5. ما الذي سيحدث اذا قررت المشاركة في هذا البحث؟
لدراسة العادات الغذائية، من المهمّ أن نستطيع تحديد أنواع وكميات المأكولات والمشروبات التي يتناولها الأشخاص وكيفية انعكاس ذلك في الواصمات الحيوية في الدم. لذا إذا قرّرت أن تشارك في الدراسة، سنجري معك 14 مقابلة وجهاً لوجه لجمع البيانات. خلال المقابلة الأولى، سنضع استمارات متعلّقة بأسلوب الحياة والعوامل الاجتماعية والديمغرافية واستمارة العادات الغذائية الأولى وبعد سنة نجري استمارة العادات الغذائية الثانية. بعد الزيارة الأولى، يتمّ سحب الدم لتحليل الواصمات الحيوية(carotenoid, tocopherols, and retinols) بالإضافة إلى نسبة الدهون في الدم في المركز الطبي في الجامعة الأميركية في بيروت خلال الفصل الأول (15 مل) والأخير (15 مل) من فترة الدراسة. لذا سيتمّ سحب عينات الدم مرتين فقط (مجموع 30 مل). في غضون كلّ من الفصول الأربعة لهذا العام، سنتّصل بك ثلاث مرات لتحديد ثلاثة لقاءات بغية إجراء ثلاث مقابلات وجهاً لوجه لإتمام رصد المأكولات التي يتناولها الشخص في الـ24 ساعة الماضية على ثلاث دفعات ويمثل هذا يومين في الأسبوع وعطلة نهاية أسبوع واحدة في الفصل. كما سنقارن بيانات العادات الغذائية التي جمعناها عبر الاستمارة بالمأكولات التي تمّ تناولها خلال 24 ساعة وبالواصمات الحيوية (carotenoid, tocopherols, and retinols).

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11. ماذا سيحل بالمعلومات المجموعة عن المشتركين؟

سنحرص على حماية المعلومات المتعلقة بك واعتماد السرّيّة المطلقة. سوف نستخدم رمز للتعرف عليك في سجلاتنا بدلاً من استخدام اسمك. وسيتم مراقبة سجلاتك وقد يتم التدقيق بها من دون إنتهاك السرية.
سيتمّ حفظ نموذج الموافقة في خزانة مقفلة في مكتب الباحث الرئيسي، بينما سيتم حفظ الإستبيانات التي تمّ ملؤها في خزانة مقفلة في مكتب مخصص لهذا البحث. كما سيتمّ حفظ نسخ إلكترونية من البيانات والتأمين عليها بكلمة سريّة. سيتمكن فريق البحث في قسم التغذية في الجامعة الأميريكية في بيروت ، وفي جامعة تكساس في أوستن فقط الاطلاع على المعلومات الخاصة بك. لن نحدد هويتك في أي تقارير أو مطبوعات ناتجة عن هذا البحث.

_____ **أسمح** باستخدام المعلومات التي تم جمعها عني لمشاركتها مع باحثين آخرين.

_____ **لا أسمح** باستخدام المعلومات التي تم جمعها عني لمشاركتها مع باحثين آخرين.

12. ما هي حقوقك عند المشاركة في هذا البحث؟

يجب أن تدرك بأن مشاركتك في هذه الدراسة هي طوعية. لديك حرية قبول أو رفض المشاركة في هذه الدراسة من دون أي تأثير سلبي عليك ومن دون خسارة أي من المنافع التي تحقّ لك.

13. خيارات إضافية

يتم تحليل عينات الدم في مختبر الجامعة الأمريكية في بيروت وفي مختبر Craft Technologies Inc. في الولايات المتحدة الأمريكية. أما بقايا الدم، يتم التخلص منها وفقاً لسياسة المؤسستين. في حال سمحت للباحثين بحفظ بقايا من عينات الدم لتستخدم في أبحاث لاحقة، يتم تخزين هذه البقايا في قسم التغذية في الجامعة الأمريكية في بيروت.

- يمكنك الانضمام إلى هذه الدراسة حتى إذا كنت لا تسمحين لنا بسحب عينات الدم. يرجى الإشارة إلى اختيارك بعلامة على الخط المناسب أدناه :

_____ **أسمح** بسحب عينات الدم.

_____ **لا أسمح** بسحب عينات الدم.

- يمكنك الانضمام إلى هذه الدراسة حتى إذا كنت لا تسمح لنا بحفظ أو إستخدام بقايا من عينات الدم في أبحاث مقبلة. يرجى الإشارة إلى اختيارك بعلامة على الخط المناسب أدناه:

_____ **أسمح** بحفظ وإستخدام بقايا من عينات الدم في أبحاث مقبلة.

_____ **أسمح** بتخزين بقايا من عينات الدم لكن اطلب أن يتم الاتصال بي للتصريح بإذن لاستخدام هذه العينات في أبحاث مقبلة.

_____ **لا أسمح** بحفظ وإستخدام بقايا من عينات الدم في أبحاث مقبلة.

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6. كم من الوقت سيستغرق هذا البحث؟

ستتم استمارات جمع البيانات من خلال 14 مقابلة شخصية مع مساعد أبحاث مدرّب على فترة 12 شهراً. ستتم مقابلات البحث في مكتب المشارك (إن أمكن) أو يدعى المشارك إلى قسم التغذية في الجامعة الأمريكية في بيروت، غرفة 520 (غرفة البحوث).

7. هل يمكن لهذا البحث أن يضرّك؟

ليس هناك مخاطر متوقعة ناتجة عن مشاركتك في هذه الدّراسة. انما قد تشعر بالانزعاج لدى سحب عيّنة دم صغيرة عبر وخز الوريد وهناك احتمال الإصابة بالتهاب أو رضة أو وجع أو فقدان الوعي عندها. سيتولى اختصاصي في الفصد في المركز الطبي في الجامعة الأميركية في بيروت سحب الدم باتباع التقنية الصحيحة لأخذ عينة الدم ويكون المشارك في وضعية الجلوس. قد تنشأ مخاطر غير متوقعة أثناء إجراء الدراسة. كما هناك احتمال خسارة سرية المعلومات، لكن فريق البحث يتبع الإجراءات اللازمة من أجل حماية هذه السرية.
من المهم الملاحظة أنه في ختام الدراسة حيث يكون قد تم تحليل كل عينات الدم، سيقوم الباحثون بمشاركة نتائج التحاليل مع جميع المشاركين في البحث وينصحونهم بمناقشة النتائج مع طبيب العائلة.

8. هل يمكن لهذا البحث أن يفيدك؟

لا يقدم هذا البحث فوائد مباشرة لك. انما مشاركتك العامة في هذه الدراسة تساعدنا في جمع معلومات هامة وتصديق إستمارة العادات الغذائية التي قد تساعد في تقدير هذه العادات لدى عينة كبيرة من السكّان وستكون كفيلة بسدّ فجوة علمية أساسية في تقييم الوضع الغذائي للراشدين اللبنانيين، خصوصاً وسط روابط موثّقة ومتناسقة بين تناول الطعام والسمنة وتأثير العادات الغذائية على خطر الإصابة بأمراض مزمنة.

9. هل هناك تكلفة عند المشاركة في هذه الدراسة؟

يحصل المشارك على قيمة نقدية (15 دولار) في كل يوم سحب الدم لقاء وقت الانتظار وتكلفة النقل.

10. مع من يمكنك التحدث للاستفسار عن الدراسة؟

لطرح أية أسئلة أو مخاوف، أو إذا كنت تعتقد أن البحث أضرّ بك أو قد يضرّ بك، يمكنك التحدث مع:

د. فرح نجا، الجامعة الأميركيّة في بيروت
رقم الهاتف: 009611350000، الرقم الداخلي: 4504
البريد الإلكتروني: fn14@aub.edu.lb

إذا كان لديك أسئلة حول حقوقك كمشارك بالبحث، أو كنت ترغب في التحدث مع شخص من خارج فريق البحث، يرجى الإتصال ب:

مجلس لجنة الأخلاقيات للعلوم الطبية
الجامعة الأميركية في بيروت، لبنان
رقم الهاتف: 009611374374، الرقم الداخلي: 5445
البريد الإلكتروني: irb@aub.edu.lb

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- نود الحصول أيضاً على إذنك للاتصال بك من أجل المشاركة في دراسات مستقبلية. بامكانك الانضمام لهذه الدراسة حتى ولو لم تسمح بأن نتصل بك في المستقبل. كما ويمكنك أيضا أن تبدّل رأيك في هذا الموضوع. يرجى الإشارة إلى اختيارك بعلامة على الخط المناسب أدناه:

_____ **نعم، أوافق** على معاودة الإتصال بي. يرجى تزويدنا برقم هاتفك:_____

_____ **كلا، أرفض** معاودة الإتصال بي.

صفحة التوقيع للمشاركة

المشاركة

لقد قرأت وفهمت المعلومات أعلاه. أوافق طوعاً على الانضمام الى البحث المشروح في هذا النموذج. سوف أحصل على نسخة من هذا النموذج بعد توقيعي عليه .

الاسم الكامل للمشارك

توقيع المشارك **التاريخ**
الوقت

الاسم الكامل للشخص الحاصل على الموافقة

التوقيع **التاريخ**
الوقت

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APPENDIX III

SCREENING FORM PROTOCOL (ENGLISH VERSION)

Institutional Review Board
American University of Beirut

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Faculty of Agricultural and Food Sciences

Screening Form. Protocol # NUT.FN.22

Date I__I__I - I__I__I - I__I__I DD - MM - YY	Interviewer's Name _____	Location (Campus/Hospital) _____

For a participant to be eligible for the study "Validity and Reliability of FFQ to Assess Dietary Intake among Lebanese Adults", all inclusion criteria must be "YES", and all exclusion criteria must be "NO".

Inclusion criteria	**Yes**	**No**
1. Aged between 18 and 65 years at the time of enrollment		
2. Lebanese nationality or living in Lebanon for more than 10 years		
3. Able to speak and understand the Arabic language		
Exclusion criteria	**Yes**	**No**
1. Pregnant or breastfeeding woman		
2. Student		
3. Suffers from a chronic health condition that requires dietary modification (e.g. eating disorder, diabetes, renal or liver disease etc.)		

If applicable, what are the reasons for refusal to participate in the research project?

- _____
- _____

Version 1: Date: 1-06-16

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APPENDIX IV

SOCIO-DEMOGRAPHIC AND ANTHROPOMETRIC MEASUREMENTS' QUESTIONNAIRE (ENGLISH VERSION)

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DATA COLLECTION FORM – VISIT 1

1	**Personal Information Questionnaire**		
1.1	**Interviewer's name**		
1.2	**Subject ID**	|_|_|_|_|	
1.3	**Date**	____/____/_____ dd/ mm/ yyyy	
1.4	**Name**		
1.5	**Department**		
1.6	**Telephone number**	**Mobile:** **Landline:**	**Best time to contact you?** ____:____ am/pm
1.7	**Email**		
1.8	**Address**		

*Please circle only **1 answer** in the below questions, unless otherwise indicated.*

2	**Sociodemographic Questionnaire**	
2.1	**Date of birth**	____/____/_____ dd/ mm/ yyyy
2.2	**Gender**	1. Male 2. Female
2.3	In which **area** of Lebanon do you live?	1. Beirut 2. Mount Lebanon 3. South 4. Nabatiyeh 5. North 6. Bekaa
2.4	**Marital status**	1. Single 2. Married 3. Widowed 4. Divorced
2.5	What is the highest **educational level** that you have achieved?	1. No schooling 2. Primary school 3. Intermediate school 4. High school 5. Technical diploma 6. University degree
2.6	Did you specialize in a **health-related major** (medicine, biology, public health, nutrition, pharmacy, etc.)	1. Yes 2. No 3. Not applicable

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	Skip if you did not receive a technical diploma or university degree.	
2.7	What is your **occupation**?	1. Academic, full-time 2. Academic, part-time 3. Non-academic, full-time 4. Non-academic, part-time 5. Other, please specify: _____
2.8	What is the total **number of individuals** living in your house? *Including relatives or family members that frequently live with you on a semi-permanent basis.*	|_|_|_|
2.9	How many **rooms** are there in your house? *Excluding the kitchen, bathrooms, hallways, garage, and open balconies.*	|_|_|_|
2.10	Do you and/or your husband **own the house** you currently live in?	1. Yes 2. No
2.11	How many **cars** does your household own? *This includes cars owned by yourself, your spouse and any of your children.*	|_|_|_|
2.12	What is the **total monthly income** of the family (L.L.)? *Including the sum of salaries of the couple, income coming from relatives, and income coming from renting a house, land, or other assets.*	1. Less than 600,000 (less than $ 400) 2. 600,001 – 999,999 ($401 – $666.9) 3. 1,000,000 – 1,499,000 ($ 667 – $999.9) 4. 1,500,000 – 1,999,000 ($ 1,000 - $1,332.9) 5. 2,000,000 – 2,499,000 ($ 1333 - $ 1,666.9) 6. 2,500,000 – 2,999,000 ($1,667 – $1,999.9) 7. Above 3,000,000 ($2,000)
3	**Lifestyle Practices – Smoking**	
3.1	Are you a **current smoker**?	1. Yes 2. No
3.2	How long have you been a smoker?	1. _____ months 2. _____ years 3. Not applicable
3.3	If yes, how many of the following **do** you usually smoke?	1. Cigarettes *(number of cigarettes)* a. _____ per day b. _____ per week c. _____ per month 2. Cigars *(number of cigars)* a. _____ per day b. _____ per week c. _____ per month 3. Narghili *(total number of minutes)* a. _____ per day b. _____ per week

		c. _____ per month
3.4	Are you a **past smoker**?	1. Yes 2. No
3.5	For **how long** did you smoke?	1. _____ months 2. _____ years 3. Not applicable
3.6	If yes, how many of the following **did** you usually smoke?	1. Cigarettes *(number of cigarettes)* a. _____ per day b. _____ per week c. _____ per month 2. Cigars *(number of cigars)* a. _____ per day b. _____ per week c. _____ per month 3. Narghili *(total number of minutes)* a. _____ per day b. _____ per week c. _____ per month
4	**Lifestyle Practices - Physical Activity *(during the past 7 days)*** Please think about the activities you do at work for more than 10 minutes, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. (IPAQ – short format (Craig *et al.*, 2003; [30])	
4.1	During the last 7 days, on how many days did you do **vigorous physical activities** like heavy lifting, digging, aerobics, or fast bicycling? *(Activities that make you breathe much harder than normal and that you did for at least 10 minutes at a time)*	1. I__I__I days per week 2. No vigorous physical activities *(Skip to question 4.3)*
4.2	If yes, **how much time** did you usually spend doing **vigorous** physical activities on one of those days?	1. _____ hours per day 2. _____ minutes per day 3. I don't know/ I'm not sure
4.3	During the last 7 days, on how many days did you do **moderate physical activities** like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.	1. I__I__I days per week 2. No moderate physical activities *(Skip to question 4.5)*
4.4	**How much time** did you usually spend doing **moderate** physical activities on one of those days?	1. _____ hours per day 2. _____ minutes per day 3. I don't know/ I'm not sure
4.5	Think about the time you spent **walking in the last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.	1. I__I__I days per week 2. No walking *(Skip to question 4.7)*
4.6	**How much time** did you usually spend **walking** on one of those days?	1. _____ hours per day 2. _____ minutes per day

		3. I don't know/ I'm not sure
4.7	The last question is about the time you spent **sitting** on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.	1. _____ hours per day 2. _____ minutes per day 3. I don't know/ I'm not sure
5	**Anthropometric Measurements**	
5.1	Weight	l__l__l__l.l__l kg
5.2	Height	l__l__l__l.l__l cm
6	**Supplement intake**	
6.1	Do take any vitamin / mineral / herbal supplements?	1. Yes, *please specify:*

Brand (eg; EuroFer)	**Type** (eg; Iron)	**Dose/pill** (eg:300 mg)	**Frequency** (eg: day)

2. No

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APPENDIX V

24-HR RECALL (ENGLISH VERSION)

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TWENTY-FOUR HOUR RECALL FORM

1	**Personal Information Questionnaire**	
1.1	**Interviewer's name**	
1.2	**Subject ID**	I__I__I__I
1.3	**Date**	____/____/_____ dd/ mm/ yyyy
1.4	**Day of the week**	

2. 24-hour recall

2.1 Please recall what you ate and drank the previous day from the time you woke up until the next morning. Please include recipes and brand names when necessary.

Time	Food eaten	Amount	Method of preparation

1

Time	Food eaten	Amount	Method of preparation

2.2 Was yesterday a usual day?

1. Yes
2. No, *please specify*: _____

APPENDIX VI

FOOD FREQUENCY QUESTIONNAIRE (ENGLISH VERSION)

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Food Frequency Questionnaire

1. **Food Frequency Questionnaire** - *Please think about your eating patterns* ***during the past year****. Please indicate your usual intake of each of the following food items per day, week, or month. Please be as precise as you can in your recall.*

CODE	FOOD ITEM	REFERENCE PORTION	USUAL PORTION	FREQUENCY
1	**CEREALS AND CEREAL-BASED PRODUCTS**			
1.1	White bread	1 large Arabic loaf/ 1 medium Arabic loaf/ 1 baguette		□ D □ W □ M □ Never
1.2	Brown/whole wheat bread	1 large Arabic loaf/ 1 medium Arabic loaf/ 1 baguette		□ D □ W □ M □ Never
1.3	Ka'ak products	1 finger sized		□ D □ W □ M □ Never
1.4	Toast and crackers	1 regular toast		□ D □ W □ M □ Never
1.5	Breakfast cereals, regular	Side A/ 1 small box		□ D □ W □ M □ Never
1.6	Breakfast cereals, bran or whole grain	Side A/ 1 small box		□ D □ W □ M □ Never
2	**PASTA AND OTHER CEREALS**			
2.1	Bulgur, cooked	Side A		□ D □ W □ M □ Never
2.2	Pasta/noodles, cooked	Side A		□ D □ W □ M □ Never
2.3	Rice and rice-products	Side A		□ D □ W □ M □ Never
3	**POTATOES AND POTATO- BASED PRODUCTS**			
3.1	French Fries	Side A		□ D □ W □ M □ Never
3.2	Potato	1 medium portion		□ D □ W □ M □ Never
3.3	Potato chips, regular	S / M / L bag		□ D □ W □ M □ Never
3.4	Potato chips, light	S / M / L bag		□ D □ W □ M □ Never
4	**VEGETABLES**			
4.1	Vegetables, canned	Side A		□ D □ W □ M □ Never
4.2	Vegetables, raw	Side A		□ D □ W □ M □ Never
4.3	Salad, green	Side A		□ D □ W □ M □ Never
5	**FRUITS**			
5.1	Fresh fruits	Side A/ 1 medium portion		□ D □ W □ M □ Never
5.2	Canned fruits	Side A/ 1 medium portion		□ D □ W □ M □ Never
5.3	Dried fruits	Side A		□ D □ W □ M □ Never
5.4	Fruit-based desserts (cocktails)	Side A		□ D □ W □ M □ Never
6	**FRUIT JUICES**			
6.1	Fruit Juices, Canned	Side A/ 1 regular (240 mL)		□ D □ W □ M □ Never
6.2	Fruit Juices, Fresh	Side A		□ D □ W □ M □ Never
7	**MEAT- Cured Meat**			
7.1	Cured meat, except ham (luncheon meat,	Side B/ Hotdog size/ Regular cured meat slice/		□ D □ W □ M □ Never

1

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Food Frequency Questionnaire

	hotdog)			
7.2	Ham	Regular cured ham slice		□ D □ W □ M □ Never
7.3	Meat (beef), cooked, low fat	Side B		□ D □ W □ M □ Never
7.4	Meat (beef),cooked, medium - high fat	Side B		□ D □ W □ M □ Never
7.5	Meat (lamb), cooked, high fat	Side B		□ D □ W □ M □ Never
8	**MEAT- Offals**			
8.1	Organ meat (liver, heart, brain, etc.)	Side B		□ D □ W □ M □ Never
9	**MEAT- Poultry**			
9.1	Poultry	Leg/ thigh/ breast/ Side B		□ D □ W □ M □ Never
9.2	Poultry, breaded (nuggets, escalope)	Nuggets/ Side B		□ D □ W □ M □ Never
10	**MEAT- Eggs**			
10.1	Eggs, whole	1 egg		□ D □ W □ M □ Never
11	**MEAT- Fish and Seafood**			
11.1	Fish	Side B		□ D □ W □ M □ Never
11.2	Fish, canned with oil (tuna, sardines)	1 large can/ 1 small can		□ D □ W □ M □ Never
11.3	Fish, canned without oil (in water)	1 large can/ 1 small can		□ D □ W □ M □ Never
11.4	Shellfish	Shrimp: 1 medium Calamari: 1 medium Crab stick: 1 stick		□ D □ W □ M □ Never
12	**PULSES, NUTS AND SEEDS**			
12.1	Beans, Chickpeas, Fava Beans, Lentils	Side A		□ D □ W □ M □ Never
12.2	Nuts and seeds	Side A		□ D □ W □ M □ Never
12.3	Falafel	1 falafel piece		□ D □ W □ M □ Never
13	**MILK AND DAIRY PRODUCTS**			
13.1	Cheese (low fat / light/white)	1 square/triangular portion/ Side A or B		□ D □ W □ M □ Never
13.2	Cheese (high fat/yellow)	1 square/triangular portion/ Side A or B		□ D □ W □ M □ Never
13.3	Cheese (processed, creamy)	1 square/triangular portion/Side A or B		□ D □ W □ M □ Never
13.4	Full fat milk, milk-based beverages	Side A/ 1 carton of flavored milk		□ D □ W □ M □ Never
13.5	Low fat milk, milk-based beverages	Side A/ 1 carton of flavored milk		□ D □ W □ M □ Never
14	**YOGURT AND YOGURT- BASED PRODUCTS**			
14.1	Labneh, regular	Side A		□ D □ W □ M □ Never
14.2	Labneh, low fat and	Side A		□ D □ W □ M □ Never

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	skim (0-2%)			
14.3	Yogurt, regular	Side A/1 ayran bottle		□ D □ W □ M □ Never
14.4	Yogurt, light	Side A/1 ayran bottle		□ D □ W □ M □ Never
15	**PIZZAS AND PIES**			
15.1	Pies, 'Manaeesh'	1 large/ 1 bouchee		□ D □ W □ M □ Never
15.2	Pies, small (e.g.: fatayer, sambousek)	1 small		□ D □ W □ M □ Never
15.3	Pizza	Side A or B/ 1 small bouchee		□ D □ W □ M □ Never
16	**MIXED DISHES**			
16.1	Artichoke, eggplant, cauliflower cooked	Side A		□ D □ W □ M □ Never
16.2	Chicory, fried with onions	Side A		□ D □ W □ M □ Never
16.3	Eggplant, zucchini, cabbage, grape leaves (stuffed with rice & meat)	Side A/ 1 medium portion		□ D □ W □ M □ Never
16.4	Stew (Jews mallow, okra, peas, spinach) *without rice	Side A		□ D □ W □ M □ Never
17	**FATS AND OILS (ADDED ON BREADS)**			
17.1	Butter/ghee	Side A		□ D □ W □ M □ Never
17.2	Mayonnaise, regular	Side A		□ D □ W □ M □ Never
17.3	Olive oil	Side A		□ D □ W □ M □ Never
17.4	Tahini	Side A		□ D □ W □ M □ Never
17.5	Vegetable oil	Side A		□ D □ W □ M □ Never
17.6	Olives	1 medium olive		□ D □ W □ M □ Never
18	**FATS AND OILS (USED IN FRYING)**			
18.1	Butter/ghee	Side A		□ D □ W □ M □ Never
18.2	Olive oil	Side A		□ D □ W □ M □ Never
18.3	Vegetable ghee	Side A		□ D □ W □ M □ Never
18.4	Vegetable oil	Side A		□ D □ W □ M □ Never
19	**SUGAR AND SUGAR DERIVATIVES**			
19.1	Sugar	Side A		□ D □ W □ M □ Never
19.2	Candy	1 small		□ D □ W □ M □ Never
19.3	Chocolate	1 medium bar/ Side B		□ D □ W □ M □ Never
19.4	Chocolate spread	Side A		□ D □ W □ M □ Never
20	**CAKES AND PASTRIES**			
20.1	Cakes and pastries	Side B		□ D □ W □ M □ Never
20.2	Arabic sweets	Side B		□ D □ W □ M □ Never
20.3	Biscuits	Side B/ 1 medium		□ D □ W □ M □ Never
20.4	Croissant	Side B/ 1 large		□ D □ W □ M □ Never
20.5	Doughnuts	Side B/ 1 medium		□ D □ W □ M □ Never
21	**HONEY, JAM, MOLASSES AND HALAWAH**			

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Food Frequency Questionnaire

21.1	Jam	Side A		□ D □ W □ M □ Never
21.2	Sugar derivatives (molasses, halawa, honey)	Side A		□ D □ W □ M □ Never
21.3	Ice cream, regular	1 scoop/ 1 stick		□ D □ W □ M □ Never
21.4	Ice cream, low fat	1 scoop/ 1 stick		□ D □ W □ M □ Never
21.5	Pudding, regular (custard, mhalabiye)	Side A/ 1 medium container		□ D □ W □ M □ Never
21.6	Pudding, low fat	Side A/ 1 medium container		□ D □ W □ M □ Never
22	**ALCOHOLIC BEVERAGES**			
22.1	Beer	Side A/ 1 bottle		□ D □ W □ M □ Never
22.2	Spirit drinks (whiskey, rum, vodka)	Side A/ 1 drink		□ D □ W □ M □ Never
22.3	Wine	Side A/ 1 glass		□ D □ W □ M □ Never
23	**NON-ALCOHOLIC BEVERAGES**			
23.1	Coffee instant, Nescafe, Turkish	Side A		□ D □ W □ M □ Never
23.2	Coffee creamer	Side A		□ D □ W □ M □ Never
23.3	Tea	Side A		□ D □ W □ M □ Never
23.4	De-caffeinated coffee or herbal tea	Side A		□ D □ W □ M □ Never
23.5	Energy & sports drink	Side A/ 1 can (330 mL)		□ D □ W □ M □ Never
23.6	Soda, regular	Side A/ 1 can (330 mL)		□ D □ W □ M □ Never
23.7	Soda, diet	Side A/ 1 can (330 mL)		□ D □ W □ M □ Never
23.8	Water	Side A/ 1 Liter		□ D □ W □ M □ Never
24	**MISCELLANEOUS**			
24.1	Ketchup	Side A		□ D □ W □ M □ Never
24.2	Mustard	Side A		□ D □ W □ M □ Never
24.3	Zaatar (thyme+sesame)	Side A		□ D □ W □ M □ Never
24.4	Pickles	1 M. cucumber/Side A		□ D □ W □ M □ Never

25 **Are there any other foods and/or beverages that were not mentioned above that you usually eat at least once per week?**

1. Yes, *please specify*:

Food/beverage	Serving size	Serving/ week

2. No

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APPENDIX VII

FOOD FREQUENCY QUESTIONNAIRE (ARABIC VERSION)

American University of Beirut
Faculty of Agricultural and Food Sciences

إستبيان وتيرة إستهلاك الطعام

1. **إستبيان وتيرة إستهلاك الطعام.** يرجى منك التفكير بالنمط الغذائي الخاص بك الذي اتّبعته خلال **العام** الماضي. الرجاء تحديد الكمية المتناولة عادةً **في اليوم** أو **الأسبوع** أو **الشهر** لكل من المواد الغذائية التالية. الرجاء أن تكون أجوبتك دقيقة قدر المستطاع.

CODE	الطعام	مثال عن حجم الحصة	الحصة الإعتيادية	وتيرة الإستهلاك
1	**الحبوب والمنتجات المرتكزة على الحبوب**			
1.1	خبز أبيض	رغيف خبز عربي كبير/ رغيف خبز عربي وسط/ خبز فرنجي (baguette)		يوم □ أسبوع □ شهر □ أبداً □
1.2	خبز أسمر/ قمحة كاملة	رغيف خبز عربي كبير/ رغيف خبز عربي وسط/ خبز فرنجي (baguette)		يوم □ أسبوع □ شهر □ أبداً □
1.3	منتوجات الكعك	كعك بحجم الاصبع		يوم □ أسبوع □ شهر □ أبداً □
1.4	توست وكراكرز	توست وسط		يوم □ أسبوع □ شهر □ أبداً □
1.5	حبوب الفطور العادية	Side A/ علبة صغيرة		يوم □ أسبوع □ شهر □ أبداً □
1.6	حبوب الفطور المصنوعة من النخالة أو الحبوب الكاملة	Side A/ علبة صغيرة		يوم □ أسبوع □ شهر □ أبداً □
2	**المعكرونة والحبوب الأخرى**			
2.1	برغل، مطبوخ	Side A		يوم □ أسبوع □ شهر □ أبداً □
2.2	معكرونة/نودلز، مسلوقة	Side A		يوم □ أسبوع □ شهر □ أبداً □
2.3	الأرز والمنتجات المرتكزة على الأرز	Side A		يوم □ أسبوع □ شهر □ أبداً □

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3	البطاطا ومنتجاتها			
3.1	بطاطا مقلية	Side A		يوم □ أسبوع □ شهر □ أبداً □
3.2	بطاطا	حصّة واحدة وسط		يوم □ أسبوع □ شهر □ أبداً □
3.3	رقائق البطاطا، عادي	كيس S / M / L		يوم □ أسبوع □ شهر □ أبداً □
3.4	رقائق البطاطا، لايت	كيس S / M / L		يوم □ أسبوع □ شهر □ أبداً □
4	الخضار			
4.1	خضار معلّبة	Side A		يوم □ أسبوع □ شهر □ أبداً □
4.2	خضار، نيئة	Side A		يوم □ أسبوع □ شهر □ أبداً □
4.3	سلطة، خضراء	Side A		يوم □ أسبوع □ شهر □ أبداً □
5	الفاكهة			
5.1	الفاكهة الطازجة	حصة وسط/ Side A		يوم □ أسبوع □ شهر □ أبداً □
5.2	الفاكهة المعلّبة	حصة وسط/ Side A		يوم □ أسبوع □ شهر □ أبداً □
5.3	الفاكهة المجفّفة	Side A		يوم □ أسبوع □ شهر □ أبداً □
5.4	الحلويات المُعدّة من الفاكهة	Side A		يوم □ أسبوع □ شهر □ أبداً □
6	عصائر الفاكهة			
6.1	عصائر الفاكهة المعلّبة	Side A/ مل 240علبة عصير		يوم □ أسبوع □ شهر □ أبداً □
6.2	عصائر الفاكهة الطازجة	Side A		يوم □ أسبوع □ شهر □ أبداً □
7	اللحوم – اللحوم الباردة والمعلّبة			
7.1	لحوم باردة باستثناء لحم الخنزير (مرتديلا - hotdog)	Side B/ /حجم اللحوم الباردة الوسط حجم hotdog		يوم □ أسبوع □ شهر □ أبداً □
7.2	لحم خنزير - Ham	حجم اللحوم الباردة الوسط		يوم □ أسبوع □ شهر □ أبداً □
7.3	لحم (بقر)، مطبوخ، قليل الدهون	Side B		يوم □ أسبوع □ شهر □ أبداً □

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7.4	لحم (بقر)، مطبوخ، معتدل/غني الدهون	Side B		يوم □ أسبوع □ شهر □ أبداً □
7.5	لحم (غنم)، مطبوخ، غني بالدهون	Side B		يوم □ أسبوع □ شهر □ أبداً □
8	**اللحوم – لحوم الأعضاء**			
8.1	لحوم الأعضاء	Side B		يوم □ أسبوع □ شهر □ أبداً □
9	**اللحوم – الدواجن**			
9.1	دواجن، ذات لحم	ساق/فخذ/صدر Side B		يوم □ أسبوع □ شهر □ أبداً □
9.2	دواجن، مغلّفة بالطحين أو الكعك (nuggets - escalope)	حجم Nuggets/ Side B		يوم □ أسبوع □ شهر □ أبداً □
10	**اللحوم – البيض**			
10.1	بيضة كاملة	بيضة واحدة		يوم □ أسبوع □ شهر □ أبداً □
11	**اللحوم – الأسماك وثمار البحر**			
11.1	الأسماك	Side B		يوم □ أسبوع □ شهر □ أبداً □
11.2	الأسماك المعلّبة بالزيت (تونة - سردين)	تنكة كبيرة/ تنكة صغيرة		يوم □ أسبوع □ شهر □ أبداً □
11.3	الأسماك المعلّبة من غير زيت (معلب بالماء)	تنكة كبيرة/ تنكة صغيرة		يوم □ أسبوع □ شهر □ أبداً □
11.4	ثمار البحر	قريدس: 1 وسط كالماري: 1 وسط كراب: 1 أصبع		يوم □ أسبوع □ شهر □ أبداً □
12	**بقول، مكسّرات، وبذور**			
12.1	فاصوليا، حمّص، فول، عدس، بذور	Side A		يوم □ أسبوع □ شهر □ أبداً □
12.2	مكسّرات	Side A		يوم □ أسبوع □ شهر □ أبداً □
12.3	فلافل	1 وسط فلافل		يوم □ أسبوع □ شهر □ أبداً □

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13	**الحليب ومنتجاته**			
13.1	جبن (قليل الدسم/لايت/بيضاء)	حصة واحدة = مثلث/مربع Side A or B		يوم □ أسبوع □ شهر □ أبداً □
13.2	جبن (غني بالدسم/صفراء)	حصة واحدة = مثلث/مربع Side A or B		يوم □ أسبوع □ شهر □ أبداً □
13.3	جبن (مصنّع-كريمه)	حصة واحدة = مثلث/مربع Side A or B		يوم □ أسبوع □ شهر □ أبداً □
13.4	الحليب ومشروبات الحليب الكاملة الدسم	Side A/ كرتونة حليب وسط		يوم □ أسبوع □ شهر □ أبداً □
13.5	الحليب ومشروبات الحليب القليلة/الخالية الدسم	Side A/ كرتونة حليب وسط		يوم □ أسبوع □ شهر □ أبداً □
14	**اللبن ومنتجاته**			
14.1	لبنه، عادي	Side A		يوم □ أسبوع □ شهر □ أبداً □
14.2	لبنه، لايت/ خالية الدسم	Side A		يوم □ أسبوع □ شهر □ أبداً □
14.3	لبن، عادي - كامل الدسم	Side A/ عبوة عيران		يوم □ أسبوع □ شهر □ أبداً □
14.4	لبن، خفيف أو خالي من الدسم	Side A/ عبوة عيران		يوم □ أسبوع □ شهر □ أبداً □
15	**البيتزا والفطائر**			
15.1	مناقيش	منقوشة كبيرة / bouchee صغيرة		يوم □ أسبوع □ شهر □ أبداً □
15.2	معجّنات، حجم صغير	حصة صغيرة		يوم □ أسبوع □ شهر □ أبداً □
15.3	بيتزا	Side A or Side B / bouchee صغيرة		يوم □ أسبوع □ شهر □ أبداً □
16	**الأطباق**			

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16.1	أرضي شوكي، باذنجان، قرنبيط مطبوخ	Side A		يوم □ أسبوع □ شهر □ أبداً □
16.2	هندبة، مقلية مع البصل	Side A		يوم □ أسبوع □ شهر □ أبداً □
16.3	باذنجان، كوسى، ملفوف، ورق عنب *محشي بالأرز واللحم	Side A/ كوسى وسط 1		يوم □ أسبوع □ شهر □ أبداً □
16.4	يخنة (ملوخية، بامية، بازلاء، سبانخ) * دون رز	Side A		يوم □ أسبوع □ شهر □ أبداً □
17	**الدهون والزيوت (المُضافة إلى الخبز، السلطات، الخ)**			
17.1	زبدة/سمنه	Side A		يوم □ أسبوع □ شهر □ أبداً □
17.2	مايونيز، عادي	Side A		يوم □ أسبوع □ شهر □ أبداً □
17.3	زيت زيتون	Side A		يوم □ أسبوع □ شهر □ أبداً □
17.4	طحينة	Side A		يوم □ أسبوع □ شهر □ أبداً □
17.5	زيت نباتي	Side A		يوم □ أسبوع □ شهر □ أبداً □
17.6	زيتون	وسط زيتون 1		يوم □ أسبوع □ شهر □ أبداً □
18	**الدهون والزيوت (المُستخدمة للقلي)**			
18.1	زبدة/سمنه	Side A		يوم □ أسبوع □ شهر □ أبداً □
18.2	زيت زيتون	Side A		يوم □ أسبوع □ شهر □ أبداً □
18.3	سمن نباتي	Side A		يوم □ أسبوع □ شهر □ أبداً □
18.4	زيت نباتي	Side A		يوم □ أسبوع □ شهر □ أبداً □
19	**السكّر ومشتقّاته**			
19.1	سكّر	Side A		يوم □ أسبوع □ شهر □ أبداً □
19.2	سكاكر	حصة سكاكر صغيرة		يوم □ أسبوع □ شهر □ أبداً □
19.2	شوكولا	حصة شوكولا وسط/ Side B		يوم □ أسبوع □ شهر □ أبداً □

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19.3	كريمة شوكولا (chocolate spread)	Side A		يوم □ أسبوع □ شهر □ أبداً □
20	**الكيكات والحلويات**			
20.1	كيك	Side B		يوم □ أسبوع □ شهر □ أبداً □
20.2	حلويات عربيّة	Side B		يوم □ أسبوع □ شهر □ أبداً □
20.3	بسكويت	Side B/ وسط 1		يوم □ أسبوع □ شهر □ أبداً □
20.4	كرواسان	Side B/ كبيرة 1		يوم □ أسبوع □ شهر □ أبداً □
20.5	كعك الدونتس	Side B/ وسط 1		يوم □ أسبوع □ شهر □ أبداً □
21	**عسل، مربّى، دبس وحلاوة**			
21.1	مربّى	Side A		يوم □ أسبوع □ شهر □ أبداً □
21.2	مشتقّات السكّر (دبس، حلاوة، عسل)	Side A		يوم □ أسبوع □ شهر □ أبداً □
21.3	بوظة، عادي	1 scoop/ 1 stick		يوم □ أسبوع □ شهر □ أبداً □
21.4	بوظة، قليلة الدسم	1 scoop/ 1 stick		يوم □ أسبوع □ شهر □ أبداً □
21.5	بودنغ، عادي (كسترد- مهلبية)	Side A		يوم □ أسبوع □ شهر □ أبداً □
21.6	بودنغ، قليل الدسم	Side A		يوم □ أسبوع □ شهر □ أبداً □
22	**المشروبات الكحولية**			
22.1	بيرة	Side A		يوم □ أسبوع □ شهر □ أبداً □
22.2	المشروبات الكحولية من غير النبيذ، باستثناء البيرة (ويسكي، رم، فودكا)	Side A		يوم □ أسبوع □ شهر □ أبداً □

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22.3	نبيذ	Side A		يوم □ أسبوع □ شهر □ أبداً □
23	**المشروبات الغير كحولية**			
23.1	قهوة سريعة التحضير، نسكافيه، قهوة تركية	Side A		يوم □ أسبوع □ شهر □ أبداً □
23.2	شاي	Side A		يوم □ أسبوع □ شهر □ أبداً □
23.3	قهوة خالية من الكافيين أو شاي بالأعشاب/زهورات	Side A		يوم □ أسبوع □ شهر □ أبداً □
23.4	مشروب الطاقة أو الرياضة	Side A		يوم □ أسبوع □ شهر □ أبداً □
23.5	مشروبات غازيّة	Side A		يوم □ أسبوع □ شهر □ أبداً □
23.6	مشروبات غازيّة دايت خالية من السكر	Side A		يوم □ أسبوع □ شهر □ أبداً □
23.7	مياه	Side A		يوم □ أسبوع □ شهر □ أبداً □
24	**المشروبات الغير كحولية**			
24.1	كاشب	Side A		يوم □ أسبوع □ شهر □ أبداً □
24.2	خردل	Side A		يوم □ أسبوع □ شهر □ أبداً □
24.3	زعتر وسمسم	Side A		يوم □ أسبوع □ شهر □ أبداً □
24.4	كبيس	1 حصة كبيس خيار / Side A		يوم □ أسبوع □ شهر □ أبداً □

25 **هل هناك أطعمة و / أو مشروبات أخرى تتناولها عادة مرة واحدة على الأقل في الأسبوع ولم يرد ذكرها اعلاه ؟**

1. نعم , يرجى التحديد:

الطعام/المشروب	حجم الحصة	كمية الإستهلاك في الاسبوع

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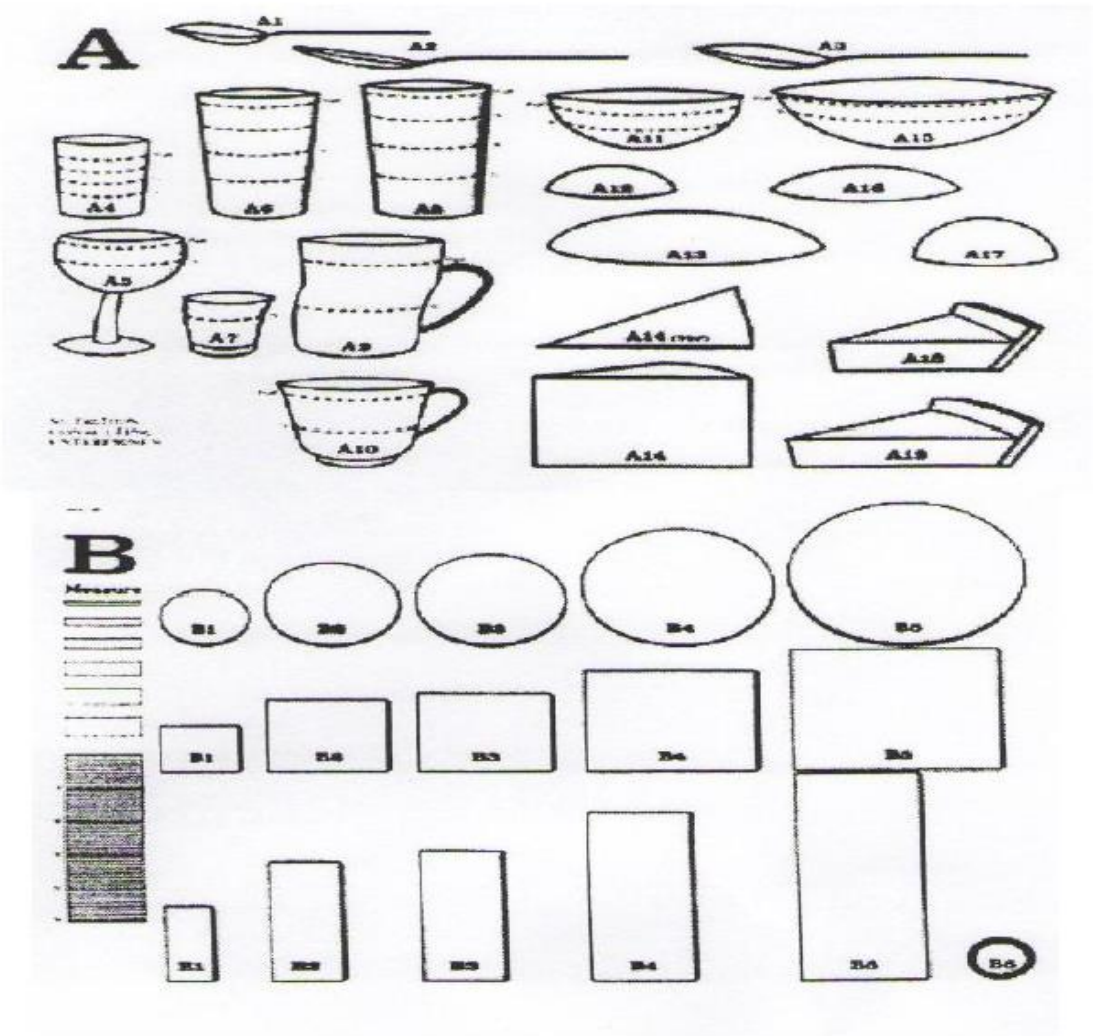
APPENDIX VIII

THE 2-D PORTION SIZE FOOD VISUAL POSTER
(NOT TO SCALE)

FOOD PORTION SIZE ILLUSTRATION



The above figure is a miniature of a poster that shows the real size of food portions (length: 60 cm, width: 48 cm)

Reference: Millen B and Morgan JL. The 2D Food Portion Visual. Farmingham, MA: Nutrition Consulting Entreprises, 1996

APPENDIX IX

SUMMARY OF SIMILAR FFQ VALIDATION STUDIES' VALIDATING FOOD GROUPS IN ADULTS AND THEIR VALIDITY CORRELATION FINDINGS

Food Groups	Spearman correlations for validity between FFQ-2 and DR or 24-hour recalls									This study's Spearman correlation coefficients (**p<0.01; * p<0.05)
	Bohlscheid et al., 1997	Siapco et al., 2008	Barbieri et al., 2014	Dehgan et al., 2012	Verger et al., 2017	Esfahani et al., 2010 Men/women	Ogawa et al., 2017 (DR)	Steinmann et al., 2017 (DR)	Hu et al., 1999 (DR)	
Cereals and Cereal-Based Products		0.47						0.42 (Cereals and grains)		0.670**
Potatoes and potato-based products	0.37			0.11	0.184	0.24/0.43	0.155	0.31	0.45	0.503**
Vegetables	0.34	0.25	0.005	0.77	0.224	0.66/0.50	0.331	0.29		0.308**
fruits	0.50	0.32	0.28	0.63	0.439	0.71/0.31	0.313	0.59	0.67 0.76	0.616**
Fruit juices			0.26							0.199*
Meat	0.53				0.373		0.221	0.68		0.359**
Poultry									0.48	0.386**
Eggs	0.41		0.05	0.30	0.155		0.405	0.41	0.56	0.526**
Fish and seafood	0.21		0.30		0.327			0.31	0.74	0.217*
Pulses	0.14					0.25/0.28		0.13 (legumes)	0.46	0.312**
Nuts and seeds	0.18			0.35 (nuts)		0.51/0.38			0.45 (nuts)	0.430**
Milk and dairy products	0.56		0.38	0.53		0.73/0.56	0.54	0.40 without cheese		0.452**
Yogurt and yogurt based products					0.557					0.486**
Pizzas and pies									0.29 (pizza)	0.281**

Fats and oils	**0.43**	**0.40**		**0.80**	**0.395**					**0.346****
Sugar and sugar derivatives		**0.13**	**0.20**			**0.77/0.65**		**0.25 (desserts)**	**0.51**	**0.626****
Cakes and pastries										**0.351****
Honey, jam, molasses, pudding, ice cream and halaweh		**0.18**				**0.53/0.60 (Honey, jam)**				**0.238***
Alcoholic beverages	**0.90**	**0.85**		**0.47**	**0.650**		**-0.015**	**0.71**		**0.741****
Non-alcoholic beverages		**0.68**		**0.43**						**0.715****

(Bohlscheid-Thomas et al., 1997), (Segovia-Siapco et al., 2008), (Barbieri et al., 2015), (Dehghan et al., 2013), (Verger et al., 2017), (Ogawa et al., 2017), (Steinemann et al., 2017), (Esfahani et al., 2010; Hu et al., 1999)

APPENDIX X

SUMMARY OF SIMILAR FFQ VALIDATION STUDIES' VALIDATING FOOD GROUPS IN ADULTS AND THEIR RELIABILITY CORRELATION FINDINGS

Food Groups		**Correlation coefficients measuring reproducibility between FFQ-1 and FFQ-2**							**This study's correlation coefficient ****
	Moghames et al., 2015 Lebanon	**Tayyem et al., 2014 Jordan**	**Esfahani et al., 2010 Iran (men/women)**	**Haftenberger et al., 2010 Germany**	**Bohlscheid et al., 1997 Germany**	**Huybrechts et al., 2009 Belgium**	**Hu et al., 1999 Boston**	**Kesse-Guyot et al., 2010 France (men/women)**	
Cereals and Cereal-Based Products	0.825					0.54			0.612**
Potatoes and potato-based products			0.64/0.45	0.27	0.71		0.67	0.53/0.53	0.572**
Vegetables	0.720	0.757	0.76/0.74	0.29	0.54	0.58		0.69/0.68	0.459**
fruits	0.851	0.786	0.83/0.64	0.51	0.61	0.68	0.71	0.75/0.32	0.711**
Fruit juices						0.62			0.455**
Meat	0.690	0.848		0.29	0.77				0.313*
Poultry							0.74		0.696**
Eggs		0.983		0.20	0.73		0.68	0.83/0.74	0.707**
Fish and seafood				0.36	0.77		0.61	0.65/0.66	0.446**
Nuts and seeds			0.58/0.46		0.66		0.53 (nuts)	0.68/0.68 (nuts)	0.370**
Pulses	0.822	0.822 (legumes)	0.66/0.52 (legumes)				0.36	0.25/0.48 (legumes)	0.645**
Milk and dairy products	0.809		0.73/0.68	0.63 (milk)	0.55	0.70			0.474**

Yogurt and yogurt based products	0.809								0.617**
Pizzas and pies							0.60 (pizza)		0.516**
Fats and oils	0.337	0.695		0.70	0.57			0.37/0.58	0.609**
Sugar and sugar derivatives		0.815	0.86/0.83	0.45 (sweets)			0.54	0.62/0.69	0.824**
Cakes and pastries	0.752	0.815							0.455**
Honey, jam, molasses, pudding, ice cream and halaweh			0.54/0.83 (honey, jam)						0.736**
Alcoholic beverages				0.60	0.89			0.72/0.84	0.549**
Non-alcoholic beverages	0.776			0.61				0.58	0.783**

*Spearman correlation; **Intraclass correlation (ICC)

(Moghames et al., 2015), (Tayyem et al., 2014b), (Haftenberger et al., 2010), (Bohlscheid-Thomas et al., 1997), (Huybrechts et al., 2009), (Hu et al., 1999), (Esfahani et al., 2010; Kesse-Guyot et al., 2010)

APPENDIX XI

INTAKE OF FOOD PORTIONS PER FOOD GROUPS ACCORDING TO FFQ-2 AND THE MEAN OF MPRS FOR COMPARATIVE VALIDITY STRATIFIED BY SEX

Food Groups	**FFQ-2 ± S.D**		**24hr ± S.D**		**Difference ± S.D**		**Percent difference (%)**	
	M	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Cereals and cereals based products	4.93±2.97	2.27±1.39	3.73±1.87	2.21±1.20	1.21±2.32	0.06±0.96	38.63±68.66	4.10±51.05
Pasta and other cereals	3.82±3.41	3.20±1.98	3.37±2.29	3.22±1.86	0.45±3.66	-0.02±2.08	59.26±170.57	23.70±99.28
Potatoes and potato based products	0.97±0.98	0.61±0.64	0.57±0.37	0.45±0.29	0.40±0.90	0.17±0.59	72.57±156.75	64.33±130.33
Vegetables	0.72±0.52	0.66±0.69	0.96±0.60	1.05±0.63	-0.24±0.66	-0.39±0.79	15.72±130.52	-12.41±123.54
Fruits	1.70±1.43	1.20±0.79	0.96±0.72	0.76±0.44	0.75±1.13	0.44±0.64	114.20±214.64	79.36±155.83
Fresh fruit juices	0.15±0.23	0.10±0.15	0.04±0.10	0.08±0.15	0.10±0.26	0.25±0.11	-21.58±90.68	-15.01±71.74
meat	4.73±4.10	3.11±1.86	2.58±1.81	1.60±0.81	2.14±3.87	1.51±1.81	120.27±164.81	153.31±229.97
Poultry	2.38±2.65	1.17±1.14	1.86±1.43	1.18±0.79	0.53±2.62	-0.01±1.24	35.98±123.39	24.10±106.98
Eggs	0.69±0.80	0.34±0.40	0.46±0.58	0.28±0.35	0.23±0.59	0.05±0.37	58.21±152.07	9.16±95.62
Fish and seafood	0.87±1.02	0.47±0.46	0.62±1.01	0.74±0.79	0.25±0.95	-0.28±0.92	72.55±196.15	-33.94±54.39
Pulses	1.82±1.89	1.26±1.33	1.62±1.59	1.33±1.13	0.19±2.09	-0.07±1.50	13.74±108.40	0.83±89.85
Nuts and seeds	1.67±2.58	1.25±1.66	0.56±0.69	0.55±0.73	1.10±2.53	0.70±1.41	283.40±580.99	119.58±201.01
Milk and dairy products	1.02±0.96	0.73±0.68	0.71±0.53	0.63±0.49	0.33±0.82	0.10±0.70	86.90±202.81	64.09±223.05
Yogurt and yogurt based products	2.76±4.34	1.17±1.35	2.12±1.70	1.39±1.39	0.64±4.32	-0.22±1.55	86.34±265.47	108.42±384.74
Pizzas and pies	0.47±0.63	0.26±0.23	1.13±1.01	0.57±0.43	-0.65±1.18	-0.31±0.39	-23.80±109.36	-43.43±61.88
Vegetable based dishes	0.21±0.18	0.26±0.18	0.30±0.21	0.40±0.26	-0.09±0.24	-0.14±0.27	-16.70±90.13	-16.75±70.76
Fats and oils	2.65±1.48	1.94±1.15	1.91±1.59	1.04±0.66	0.74±1.74	0.90±1.27	144.96±237.50	183.80±294.29
Sugar and sugar derivatives	2.14±2.27	1.56±1.82	0.91±0.80	0.69±0.55	1.23±1.89	0.87±1.65	170.32±235.81	180.65±353.49
Cakes and pastries	0.71±0.69	0.40±0.46	0.72±0.52	0.69±0.49	-0.01±0.75	-0.29±0.50	23.50±131.88	-32.75±57.92
Honey, jam, molasses, pudding, ice-cream and halaweh	0.31±0.38	0.10±0.14	0.24±0.26	0.14±0.15	0.07±0.39	-0.03±0.18	9.05±122.50	-21.27±121.90
Alcoholic beverages	0.42±2.07	0.12±0.30	0.20±0.98	0.09±0.22	0.21±1.13	0.03±0.24	48.09±93.87	4.12±70.00
Non-alcoholic beverages	9.61±3.90	8.40±2.80	8.81±2.55	6.81±2.09	0.81±2.58	1.59±1.99	8.87±31.03	25.96±31.87
Miscellaneous	0.46±0.41	0.38±0.41	0.30±0.33	0.24±0.31	0.16±0.43	0.14±0.49	83.65±231.65	93.46±212.16

APPENDIX XII

PERCENT OF ENERGY INTAKE PER FOOD GROUPS ACCORDING TO FFQ-2 AND THE MEAN OF MPRS FOR COMPARATIVE VALIDITY STRATIFIED BY SEX

Food Groups	FFQ-2 ± S.D		24hr ± S.D		Difference ± S.D		Percent difference (%)	
	M	F	M	F	M	F	M	F
Cereals and cereals based products	14.73±8.18	10.51±6.34	14.10±5.76	10.67±4.22	0.62±6.22	-0.16±5.27	4.96±47.46	-0.75±49.04
Pasta and other cereals	4.71±3.49	7.22±4.55	7.29±5.30	8.92±4.48	-2.58±5.78	-1.70±5.21	-4.27±83.99	-0.09±81.44
Potatoes and potato based products	7.78±6.32	7.86±6.12	6.82±4.52	6.61±4.35	0.95±6.10	1.26±4.84	23.61±99.07	45.01±95.62
Vegetables	0.66±0.52	1.02±1.13	3.19±1.82	5.68±3.29	-2.53±1.78	-4.65±3.09	-71.86±26.91	-80.62±17.07
Fruits	5.51±4.11	6.41±4.43	4.55±3.19	4.75±3.20	0.96±3.40	1.66±3.60	31.39±97.59	56.65±116.43
Fresh fruit juices	0.65±1.05	0.65±0.97	0.22±0.46	0.51±0.98	0.43±1.17	0.15±0.69	-32.94±72.21	-17.19±70.13
meat	4.83±4.17	3.10±1.86	8.20±5.89	6.58±3.31	-3.37±5.94	-3.47±3.19	-26.36±58.59	-43.24±50.80
Poultry	4.52±4.70	3.76±3.04	5.28±4.01	4.66±3.63	-0.76±5.44	-0.89±4.13	-4.13±86.91	17.76±101.90
Eggs	1.99±2.80	1.41±1.37	1.67±2.24	1.42±1.89	0.33±1.85	-0.01±1.71	55.09±201.32	18.50±126.73
Fish and seafood	1.46±1.38	1.22±1.11	1.33±2.09	2.10±2.25	0.13±1.81	-0.88±2.51	30.10±141.90	-28.47±79.18
Pulses	2.76±2.41	3.31±3.61	3.75±4.05	3.75±3.50	-0.99±4.00	-0.44±3.57	-12.57±79.94	-7.94±83.54
Nuts and seeds	4.68±6.73	5.96±7.05	2.16±2.56	2.74±3.42	2.53±6.46	3.21±5.63	179.71±439.09	118.94±200.93
Milk and dairy products	5.19±5.21	4.98±3.93	4.62±3.06	5.24±2.99	0.56±4.83	-0.26±4.01	28.91±118.49	12.12±107.82
Yogurt and yogurt based products	2.09±1.81	1.79±1.31	2.33±1.85	2.29±2.29	-0.24±2.03	-0.49±1.74	4.54±102.50	41.89±173.59
Pizzas and pies	5.40±4.84	4.00±2.68	12.06±7.79	8.77±6.35	-6.66±7.79	-4.77±6.18	-44.22±50.03	-40.96±47.51
Vegetable based dishes	1.29±1.37	2.65±2.34	3.44±2.79	5.62±3.51	-2.16±2.96	-2.97±3.92	-38.90±90.16	-37.70±58.44
Fats and oils	9.34±4.27	13.42±8.03	5.17±3.61	3.56±2.61	4.18±4.88	9.86±7.61	182.35±248.88	499.74±577.72
Sugar and sugar derivatives	6.79±6.65	7.78±7.98	3.72±3.56	3.71±2.86	3.07±4.09	4.07±6.53	117.15±180.32	123.34±196.84
Cakes and pastries	4.76±5.18	3.29±2.67	5.52±3.72	7.31±4.82	-0.76±5.27	-4.02±4.43	-7.01±89.88	-45.32±44.57
Honey, jam, molasses, pudding, ice-cream and halaweh	1.14±1.18	0.82±1.26	1.42±1.46	1.79±2.02	-0.28±1.70	-0.97±2.13	-33.89±58.99	-55.16±46.66
Alcoholic beverages	1.08±3.73	1.00±2.89	1.23±6.69	0.55±1.30	-0.15±3.57	0.45±2.57	4.55±66.49	5.59±69.43
Non-alcoholic beverages	3.05±2.66	4.16±3.84	4.25±2.86	4.02±3.05	-1.20±2.42	0.14±3.84	-19.55±71.21	30.85±112.78
Miscellaneous	0.45±0.60	0.56±0.96	0.91±2.03	0.90±1.54	-0.46±2.01	-0.34±1.61	91.98±504.77	316.70±693.43

APPENDIX XIII

SPEARMAN CORRELATIONS FOR PORTION INTAKE PER FOOD GROUP OBTAINED USING FFQ-2 AND THE AVERAGE OF MPRS FOR COMPARATIVE VALIDITY STRATIFIED BY SEX

Food Groups	**Spearman's r**	
	M	**F**
Cereals and cereals based products	0.471**	0.614**
Pasta and other cereals	0.254*	0.482**
Potatoes and potato based products	0.472**	0.534**
Vegetables	0.368**	0.304*
Fruits	0.624**	0.588**
Fresh fruit juices	0.038	0.445**
Meat	0.319**	0.337*
Poultry	0.373**	0.310*
Eggs	0.521**	0.485**
Fish and seafood	0.352**	0.210
Pulses	0.271*	0.413**
Nuts and seeds	0.407**	0.471**
Milk and dairy products	0.482**	0.425**
Yogurt and yogurt based products	0.438**	0.494**
Pizzas and pies	0.072	0.520**
Vegetable based dishes	0.329**	0.430**
Fats and oils	0.338**	0.187
Sugar and sugar derivatives	0.611**	0.607**
Cakes and pastries	0.318**	0.426**
Honey, jam, molasses, pudding, ice-cream and halaweh	0.185	0.322*
Alcoholic beverages	0.728**	0.783**
Non-alcoholic beverages	0.694**	0.767**
Miscellaneous	0.322**	0.556**

APPENDIX XIV

SPEARMAN CORRELATIONS FOR PERCENT OF ENERGY INTAKE PER FOOD GROUP OBTAINED USING FFQ-2 AND THE AVERAGE OF MPRS FOR COMPARATIVE VALIDITY STRATIFIED BY SEX

Food Groups	**Spearman's r**	
	M	**F**
Cereals and cereals based products	0.680**	0.533**
Pasta and other cereals	0.185	0.450**
Potatoes and potato based products	0.459**	0.535**
Vegetables	0.338**	0.549**
Fruits	0.571**	0.582**
Fresh fruit juices	0.060	0.435**
Meat	0.205	0.292
Poultry	0.333**	0.250
Eggs	0.430**	0.385*
Fish and seafood	0.339**	0.202
Pulses	0.271*	0.338*
Nuts and seeds	0.410**	0.467**
Milk and dairy products	0.442**	0.460**
Yogurt and yogurt based products	0.612**	0.696**
Pizzas and pies	0.353**	0.335*
Vegetable based dishes	0.167	0.240
Fats and oils	0.347**	0.122
Sugar and sugar derivatives	0.530**	0.616**
Cakes and pastries	0.371**	0.374*
Honey, jam, molasses, pudding, ice-cream and halaweh	0.144	0.061
Alcoholic beverages	0.708**	0.796**
Non-alcoholic beverages	0.656**	0.620**
Miscellaneous	0.247*	0.539**

APPENDIX XV

MEAN DIFFERENCE, 95% LIMITS OF AGREEMENT (LOA) AND REGRESSION SLOPE OF DIFFERENCES OF FFQ-2 AGAINST THE MEAN OF MPRS FOR PORTION INTAKE PER FOOD GROUP FOR ASSESSMENT OF RELATIVE VALIDITY

Male:

Food Groups	Mean Difference	95% LOA[a]		Beta / Slope[b]	Intercept	P value[c]	Confidence Interval[d]
Cereals and cereals based products	1.21	5.84	-3.43	0.523	-1.18	0.000	0.33, 0.77
Pasta and other cereals	0.45	7.76	-6.86	0.388	-1.81	0.001	0.26. 0.99
Potatoes and potato based products	0.40	2.20	-1.41	0.779	-0.520	0.000	0.95, 1.43
Vegetables	-0.24	1.08	-1.16	0.152	-0.050	0.220	-0.58, 0.14
Fruits	0.75	2.99	-1.50	0.695	-0.308	0.000	0.59, 0.99
Fresh fruit juices	0.10	0.62	-0.42	0.685	-0.036	0.000	1.07, 1.83
meat	2.14	9.88	-5.59	0.696	-1.771	0.000	0.80, 1.35
Poultry	0.53	5.78	-4.72	0.563	-1.339	0.000	0.56, 1.20
Eggs	0.23	1.42	-0.96	0.413	0.008	0.001	0.18, 0.59
Fish and seafood	0.25	2.15	-1.64	0.012	0.245	0.925	-0.25, 0.27
pulses	0.19	4.36	-3.97	0.177	-0.256	0.152	-0.99, 0.62
Nuts and seeds	1.10	6.16	-3.95	0.871	-0.648	0.000	1.35, 1.79
Milk and dairy products	0.33	1.97	-1.32	0.591	-0.319	0.000	0.49, 0.99
Yogurt and yogurt based products	0.64	9.28	-8.00	0.741	-2.494	0.000	0.99, 1.57
Pizzas and pies	-0.65	1.70	-3.01	0.436	0.024	0.000	-1.28, 0.41
Vegetable based dishes	-0.08	0.39	-0.57	0.141	-0.034	0.256	-0.59, 0.16
Fats and oils	0.74	4.23	-2.74	0.080	0.991	0.522	-0.45, 0.23
Sugar and sugar derivatives	1.23	5.00	-2.55	0.844	-0.478	0.000	0.95, 1.29
Cakes and pastries	-0.01	1.49	-1.50	0.285	-0.320	0.019	0.07, 0.80
Honey, jam, molasses, pudding, ice-cream and halaweh	0.07	0.86	-0.72	0.372	-0.083	0.002	0.22, 0.92
Alcoholic beverages	0.21	2.48	-2.05	0.974	-0.010	0.000	0.68, 0.77
Non-alcoholic beverages	0.81	5.96	-4.35	0.556	-3.551	0.000	0.29, 0.65
Miscellaneous	0.16	1.01	-0.70	0.231	0.032	0.060	-0.01, 0.66

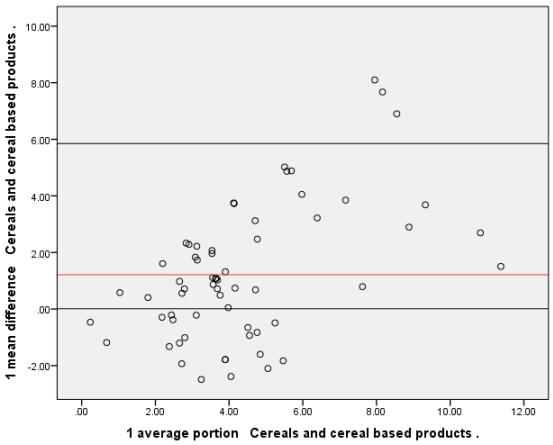
Female:

Food Groups	Mean Difference	95% LOA[a]		Beta / Slope[b]	Intercept	P value[c]	Confidence Interval[d]
Cereals and cereals based products	0.06	1.98	-1.86	0.223	-0.338	0.151	-0.07, 0.42
Pasta and other cereals	-0.02	4.14	-4.18	0.073	-0.321	0.641	-0.31, 0.49
Potatoes and potato based products	0.17	1.35	-1.01	0.698	-0.377	0.000	0.69, 1.36
Vegetables	-0.39	1.19	-1.96	0.093	-0.505	0.552	0.33, 0.61
Fruits	0.44	1.71	-0.83	0.608	-0.242	0.000	0.41, 0.98
Fresh fruit juices	0.03	0.24	-0.19	0.042	0.022	0.788	-0.21, 0.28
meat	1.51	5.12	-2.10	0.692	-1.111	0.000	0.75, 1.48
Poultry	-0.01	2.47	-2.48	0.357	-0.691	0.019	0.10, 1.07
Eggs	0.05	0.79	-0.68	0.149	-0.001	0.341	-0.18, 0.52
Fish and seafood	-0.28	1.55	-2.11	0.485	0.309	0.001	-1.52, -0.42
pulses	-0.07	2.9	-3.07	0.165	-0.400	0.289	-0.22, 0.72
Nuts and seeds	0.69	3.52	-2.12	0.733	-0.168	0.000	0.68, 1.24
Milk and dairy products	0.09	1.50	-1.30	0.338	-0.239	0.027	0.06, 0.94
Yogurt and yogurt based products	-0.22	2.87	-3.31	0.032	-0.167	0.840	-0.47, 0.39
Pizzas and pies	0.31	0.46	-1.08	0.583	0.016	0.000	-1.13, -0.44
Vegetable based dishes	-0.14	0.40	-0.68	0.360	0.043	0.018	-0.99, -1.00
Fats and oils	0.90	3.64	-1.84	0.507	-0.498	0.001	0.44, 1.44
Sugar and sugar derivatives	0.87	4.16	-2.43	0.861	-0.631	0.000	1.08, 1.58
Cakes and pastries	-0.29	0.71	1.29	0.070	-0.245	0.654	-0.47, 0.30
Honey, jam, molasses, pudding, ice-cream and halaweh	-0.03	0.33	-0.39	0.053	-0.022	0.734	-0.61, 0.43
Alcoholic beverages	0.03	0.50	-0.44	0.366	-0.009	0.016	0.07, 0.66
Non-alcoholic beverages	1.59	5.57	-2.39	0.384	-0.974	0.011	0.08, 0.59
Miscellaneous	0.14	1.12	-0.84	0.288	-0.025	0.061	-0.03, 1.08

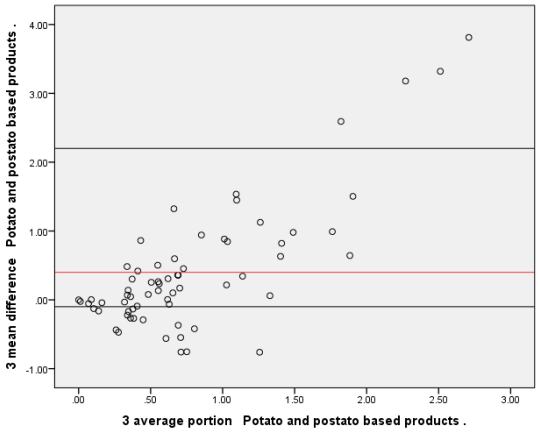
APPENDIX XVI

BLAND-ALTMAN CHARTS FOR PORTION INTAKE FOR ALL FOOD GROUPS AS PREDICTED BY THE FFQ AND MEAN OF MPRS FOR MALES

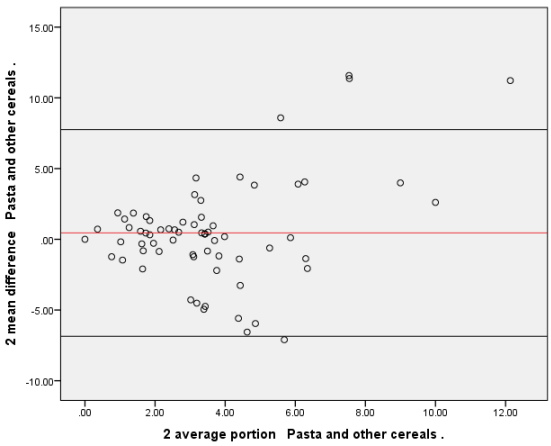
1. Cereals and cereal based products



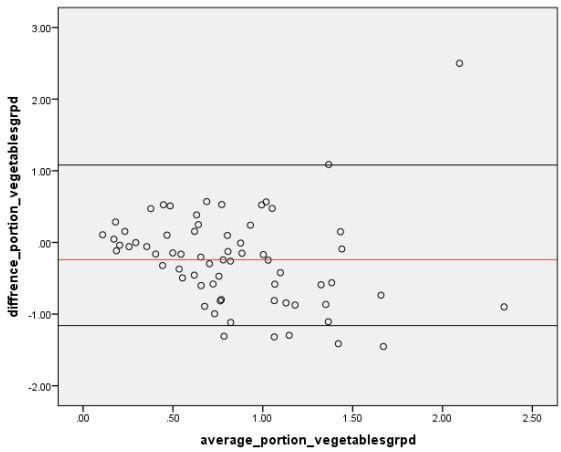
3. Potatoes and potato based products



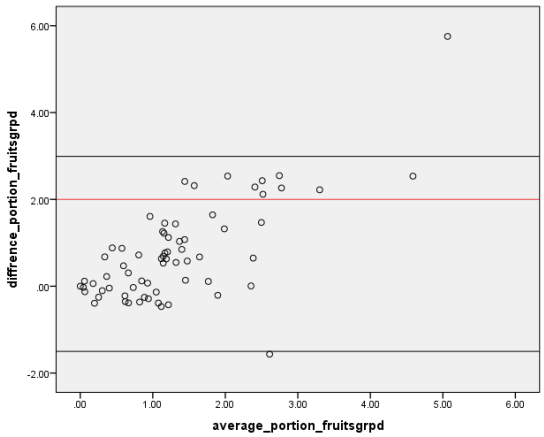
2. Pasta and other cereals



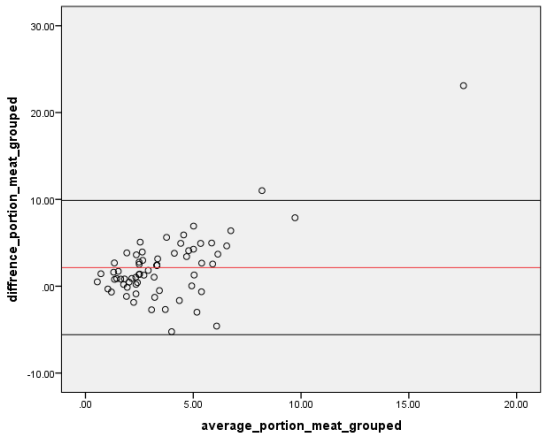
4. Vegetables



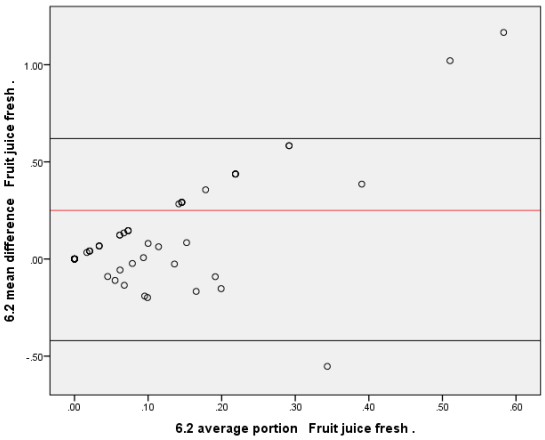
5. Fruits



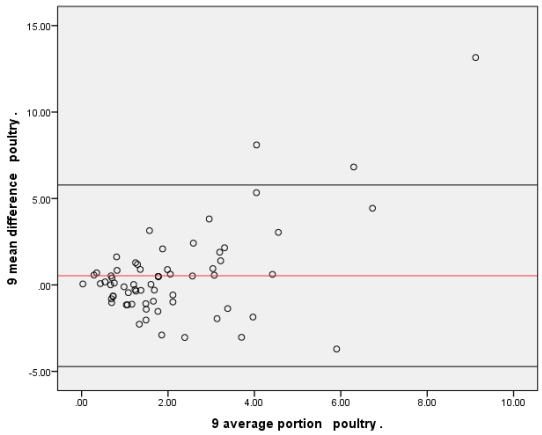
7. Meat



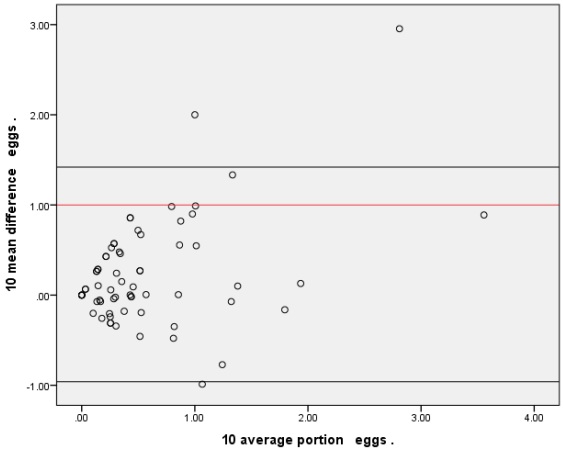
6. Fresh fruit juices



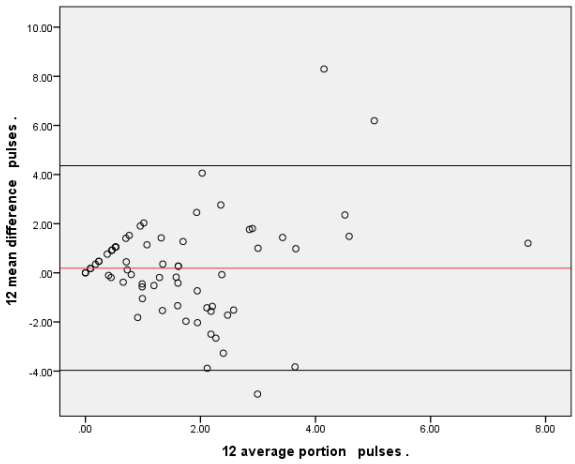
8. Poultry



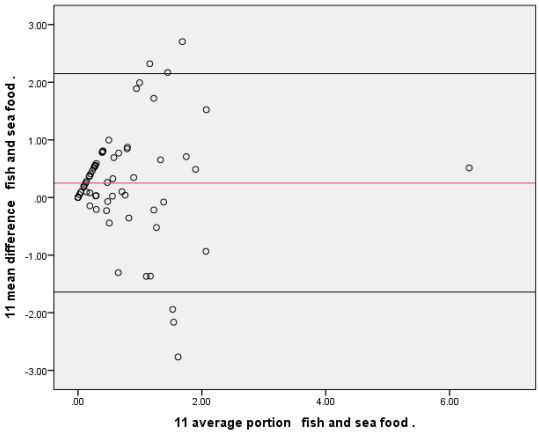
9. Eggs



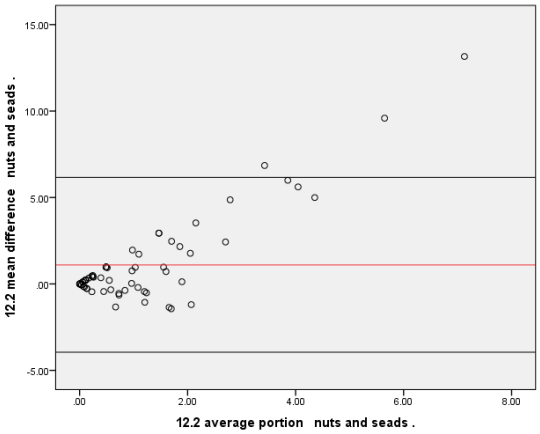
11. Pulses



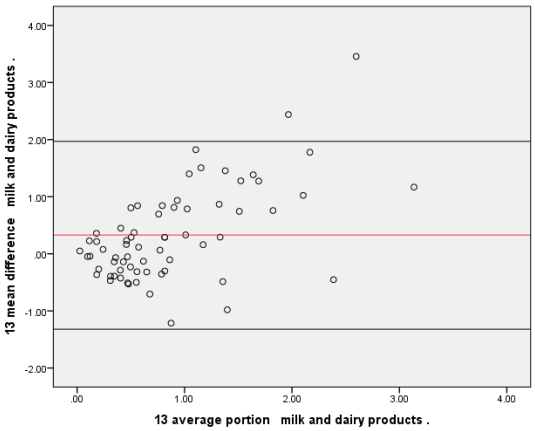
10. Fish and seafood



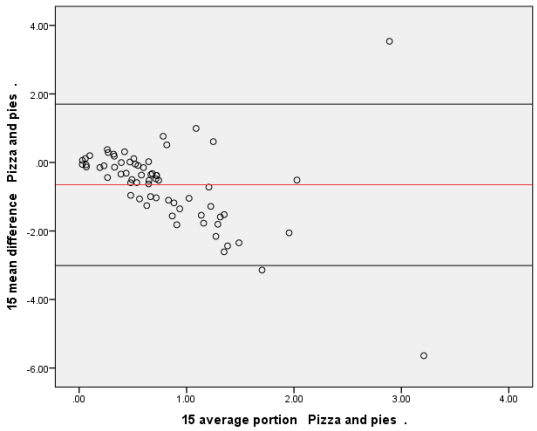
12. Nuts and seeds



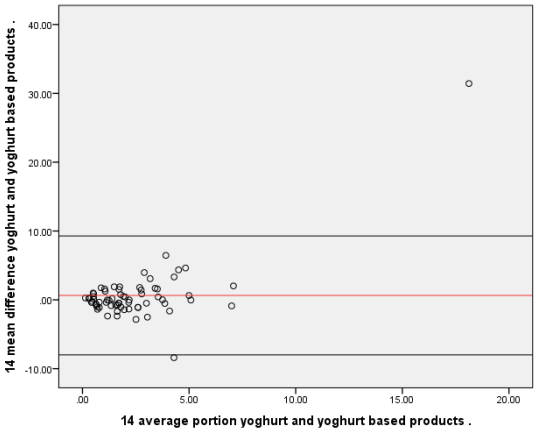
13. Milk and dairy products



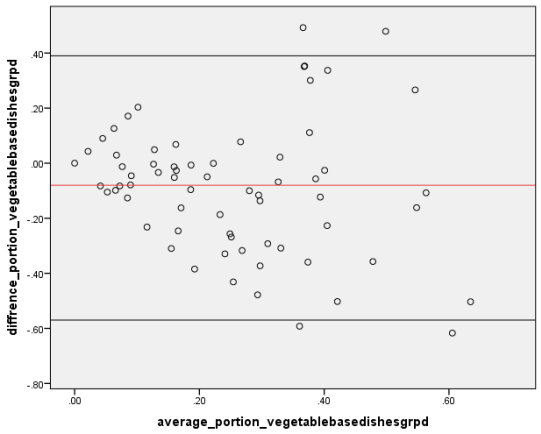
15. Pizzas and pies



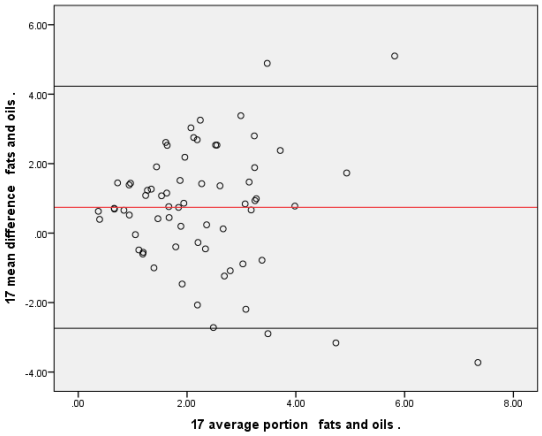
14. Yogurt and yogurt based products



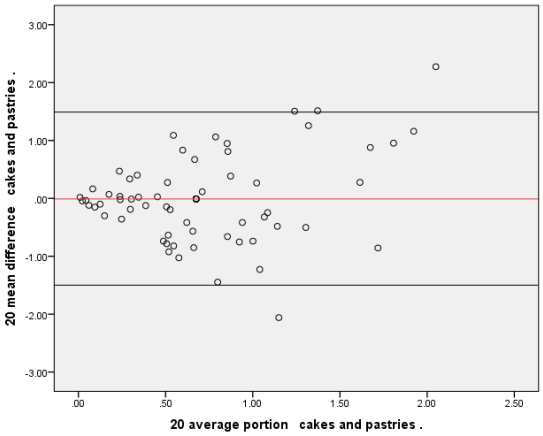
16. Vegetable based dishes



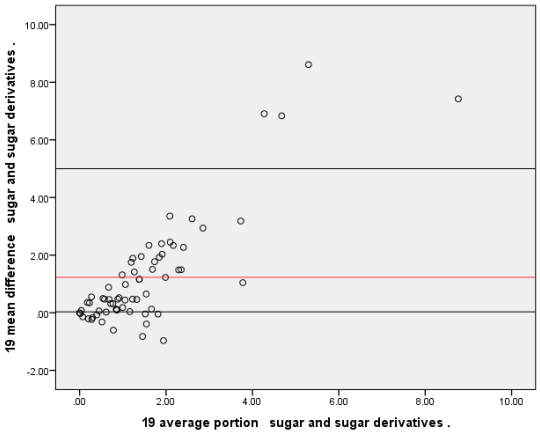
17. Fats and oils



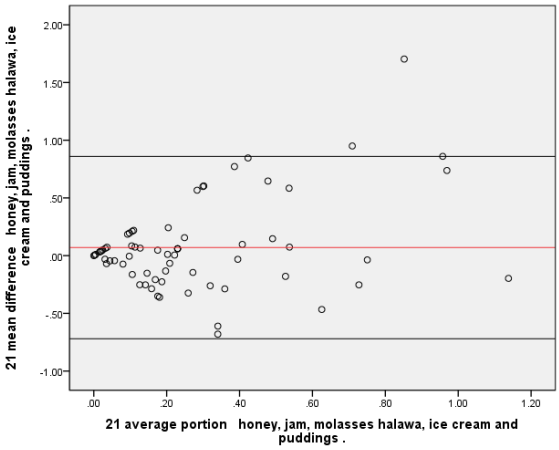
19. Cakes and pastries



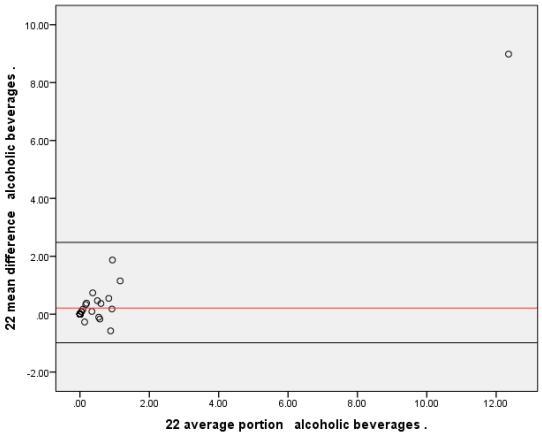
18. Sugar and sugar derivatives



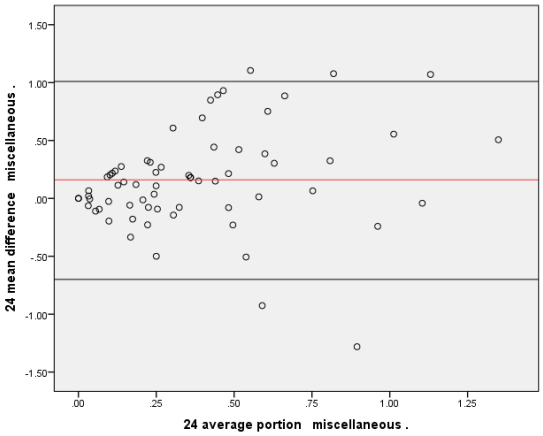
20. Honey, jam, molasses, pudding, ice-cream and halaweh



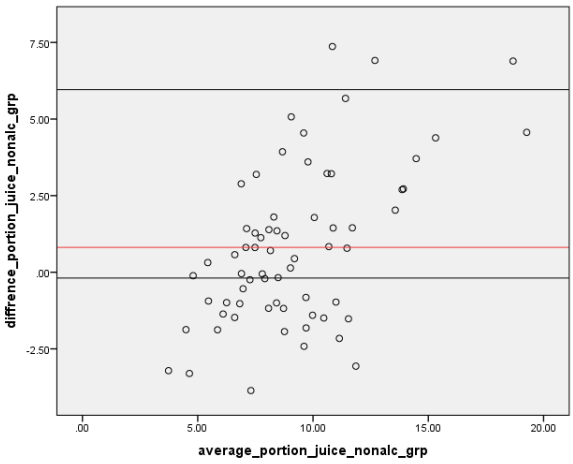
21. Alcoholic beverages



23. Miscellaneous



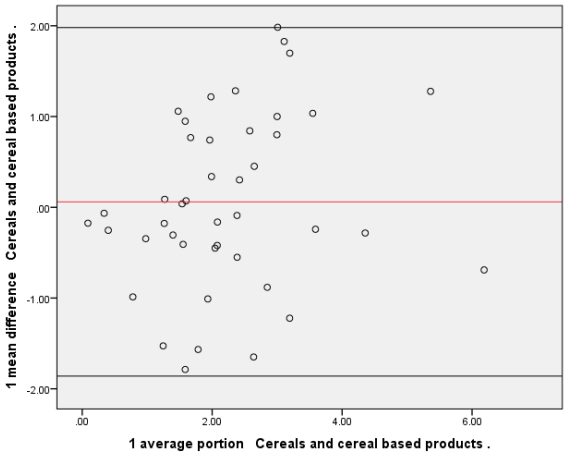
22. Non-alcoholic beverages



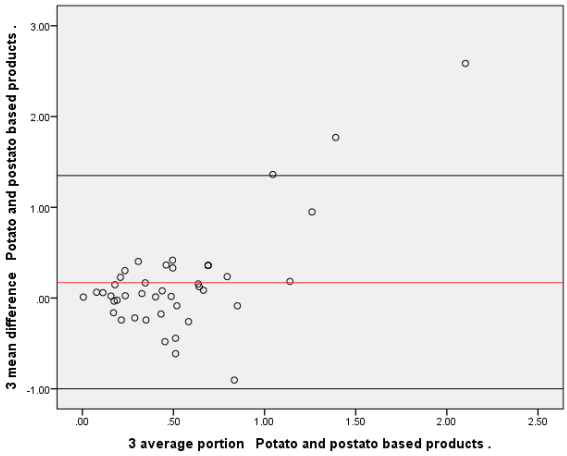
APPENDIX XVII

BLAND-ALTMAN CHARTS FOR PORTION INTAKE FOR ALL FOOD GROUPS AS PREDICTED BY THE FFQ AND MEAN OF MPRS FOR FEMALES

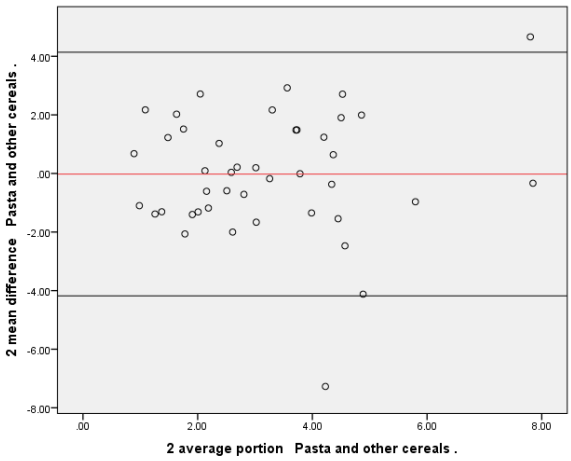
1- Cereals and cereal based products



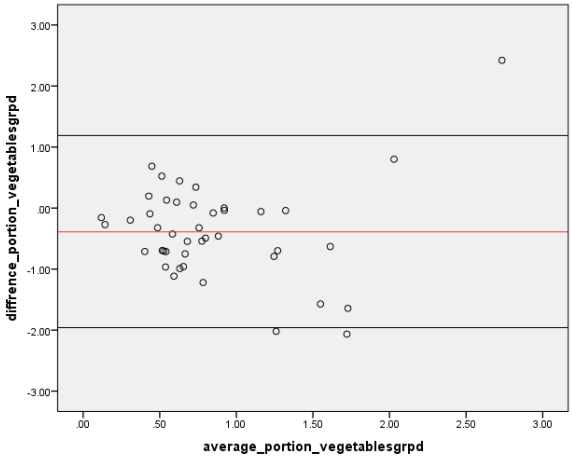
3- Potatoes and potato based products



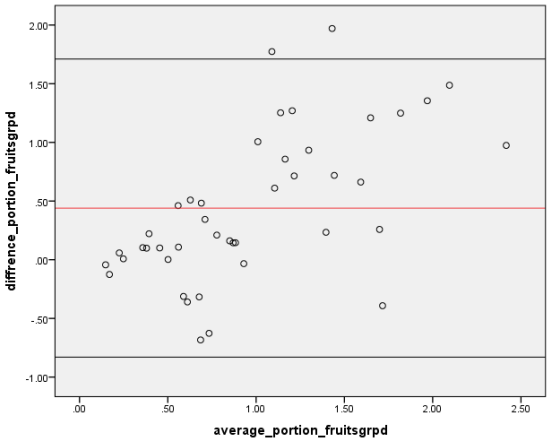
2- Pasta and other cereals



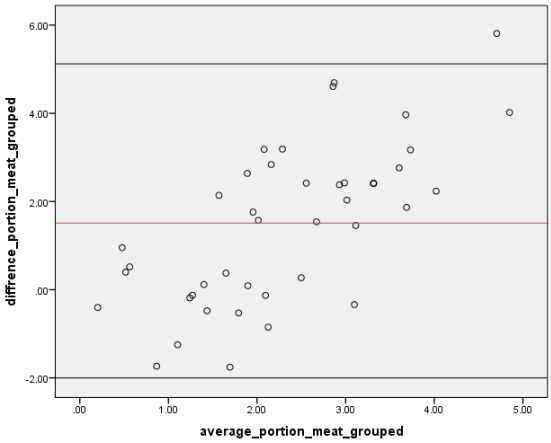
4- Vegetables



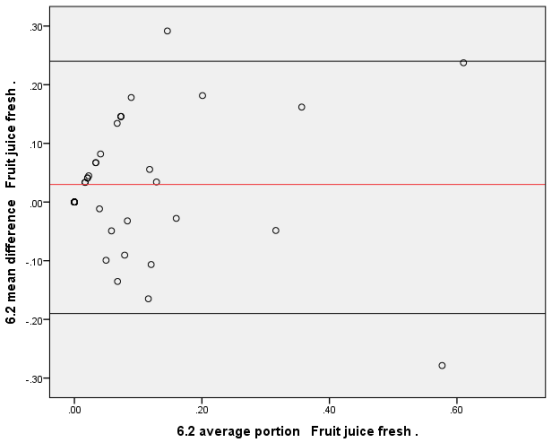
5- Fruits



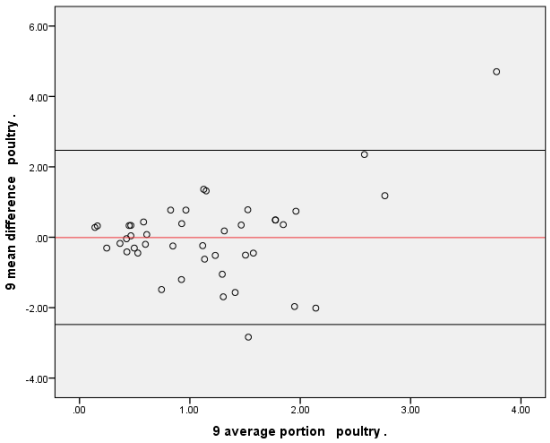
7- Meat



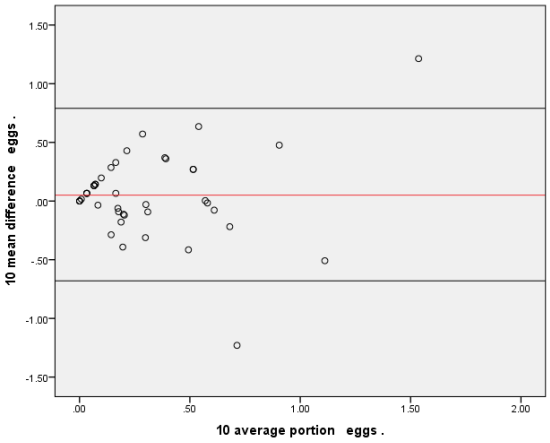
6- Fresh fruit juices



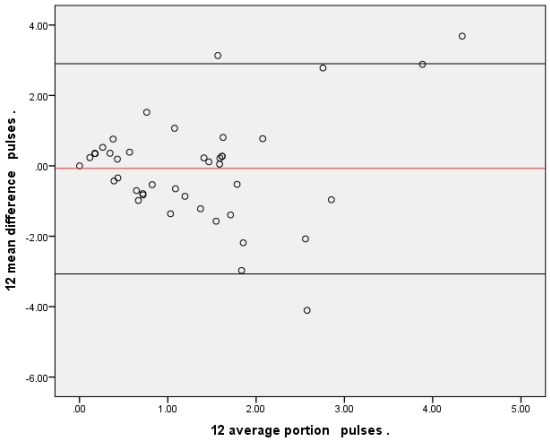
8- Poultry



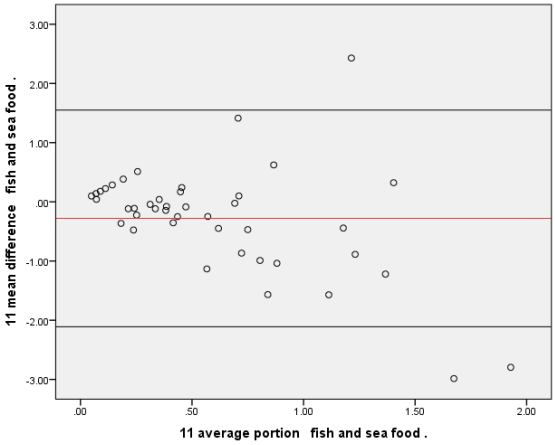
9- Eggs



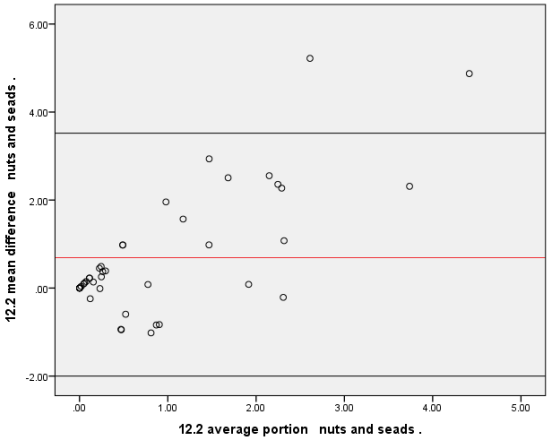
11- Pulses



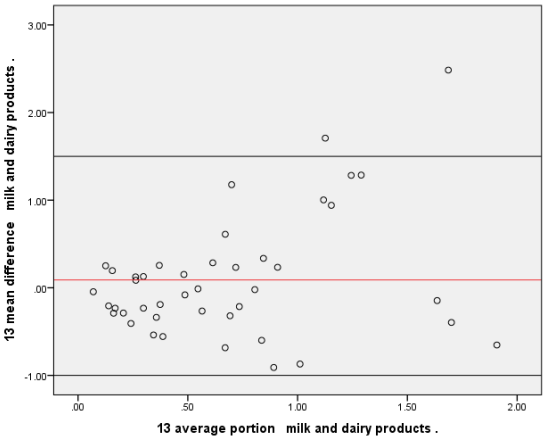
10- Fish and seafood



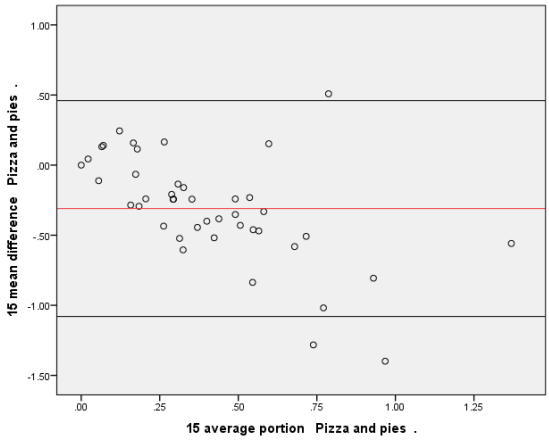
12- Nuts and seeds



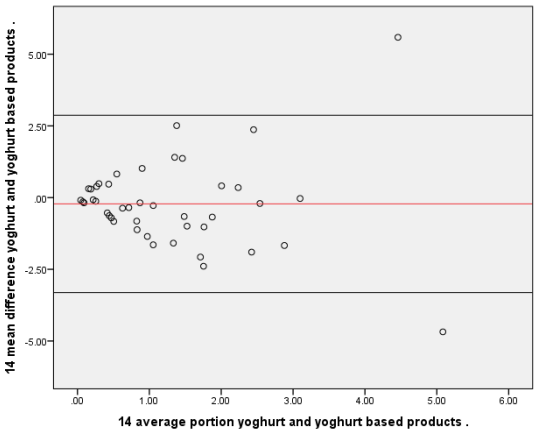
13- Milk and dairy products



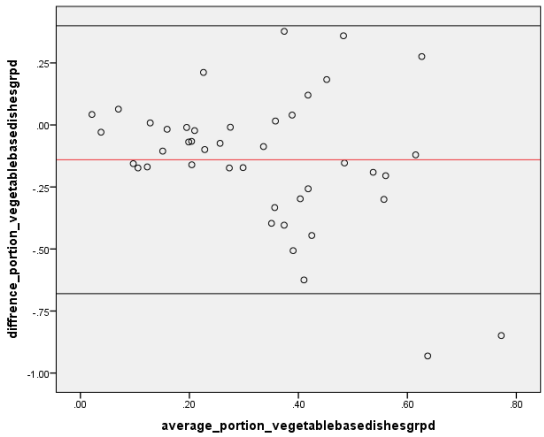
15- Pizzas and pies



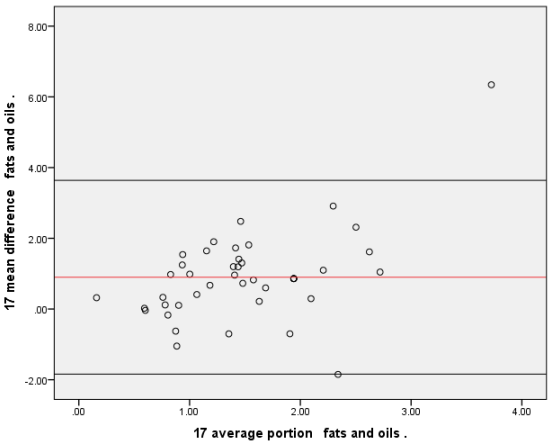
14- Yogurt and yogurt based products



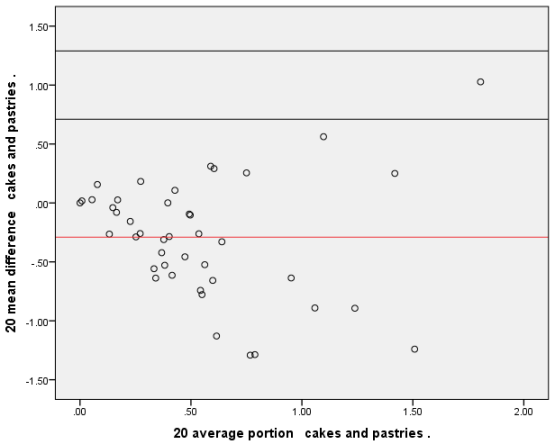
16- Vegetable based dishes



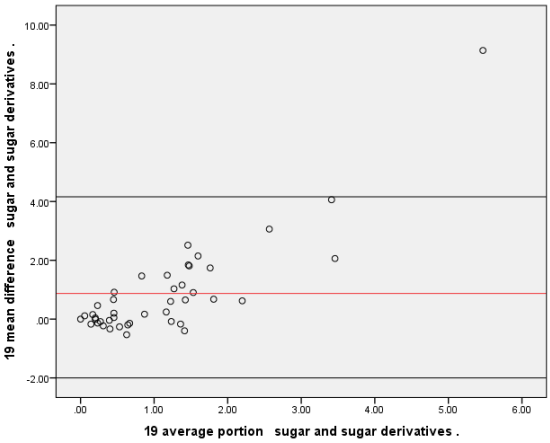
17- Fats and oils



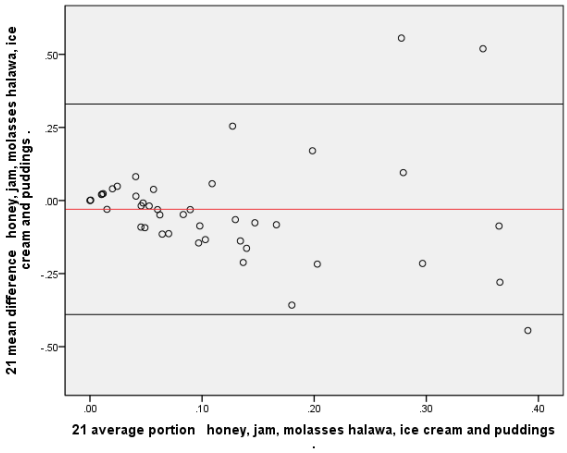
19- Cakes and pastries



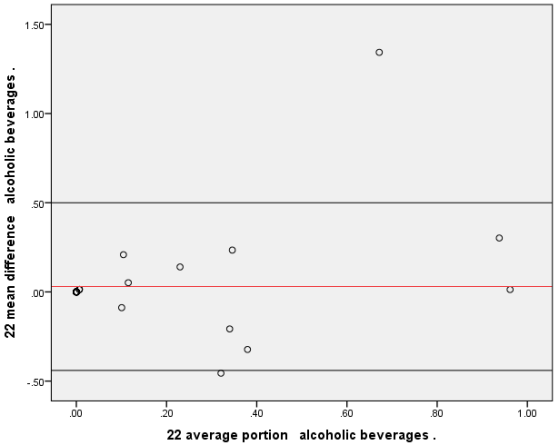
18- Sugar and sugar derivatives



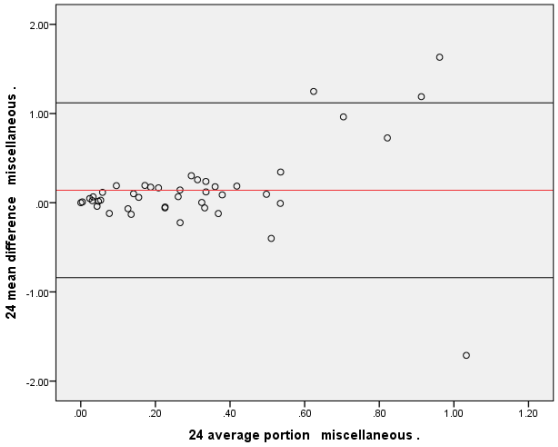
20- Honey, jam, molasses, pudding, ice-cream and halaweh



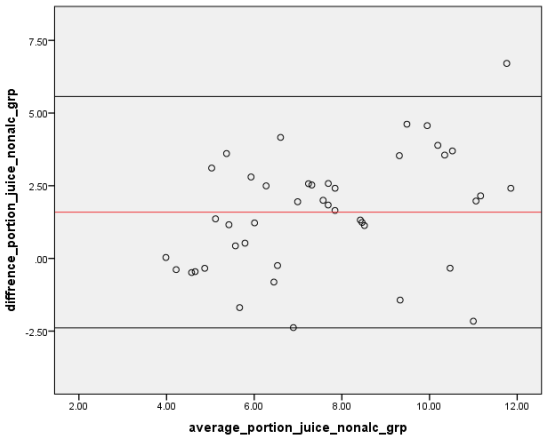
21- Alcoholic beverages



23- Miscellaneous



22- Non-alcoholic beverages



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