DEVELOPMENT OF FOOD FREQUENCY QUESTIONNAIRE FOR UNIVERSITY STUDENTS

KOO PEI ING

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16 April 2010

KOO PEI ING (HN2006-6454)



CERTIFICATION

TITLE : DEVELOPMENNT OF FOOD FREQUENCY QUESTIONNAIRE FOR UNIVERSITY STUDENTS

DEGREE : FOOD SCIENCE AND NUTRITION

VIVA DATE : 13th May 2010

DECLARED BY

- 1. SUPERVISOR Dr. Yasmin Beng Houi Ooi
- 2. Examiner -1 Datin Rugayah Issa
- 3. Examiner -2 Adilah Md. Ramli
- 4. DEAN of SSMP Assoc. Prof. Dr. Mohd. Ismail Abdullah



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ABSTRACT

The main objective was to develop a suitable Food Frequency Questionnaire (FFQ) for university students. Items in FFQ were compared with 24-hour recall and a new developed FFQ consisting of 63 food items was developed. This new developed FFQ was compared with a three day weighed record (WR). A total of 20 Universiti Malaysia Sabah (UMS) undergraduates (9 male, 11 female; mean age 22.6 \pm 1.4 y) from out campus and in campus participated in the pilot test. Most respondents have normal body size (90%). FFQ significantly over-reported (p<0.05) in energy and certain nutrients compared with three day WR. Comparison of both FFQ and WR with Energy Intake to Basal Metabolic Rate (EI/BMR) showed that there were more high energy reporters when reporting nutrient intake using FFQ (50%) than WR (10%) in the pilot test. Main study was conducted on 396 subjects from UMS aged between 18 and 25 (164 male, 232 female; in campus 52%, out campus 41.4%). Most of the respondents in main study have normal body size (73.2%). FFQ showed significant higher estimation of energy and nutrients (p < 0.05) than WR. There was significant correlation (p < 0.05) between FFQ and WR for energy in the main study. Comparison between FFQ and WR with EI/BMR ratio showed that there were more high energy reporters when reporting intake using FFQ (44.7%) than WR (10%). In both stages, pilot test and main study showed that FFQ was over-reported in energy and nutrients. FFQ consisted of more high energy reporters. Based on these results, it was concluded that further development and improvement for FFQ was needed before the FFQ could be used to evaluate usual dietary intake of university students. Ten food items that commonly consumed by university populations are biscuit, rice, green leaf vegetables, chicken, anchovies, sweets, pork, bread, prawn and chip lekor.



ABSTRAK

PEMBANGUNAN BORANG KEKERAPAN PENGAMBILAN MAKANAN UNTUK PELAJAR-PELAJAR UNIVERSITI

Tujuan utama kajian ini adalah untuk membangunkan Borang Kekerapan Pengambilan Makanan (FFQ) yang sesuai untuk pelajar universiti. Item dalam FFQ telah dibandingkan dengan Ingatan Diet 24 jam dan FFQ baru yang mengandungi 63 item makanan telah dibangunkan. FFQ baru ini telah dibanding dengan Rekod Timbangan Makanan (WR). Sejumlah 20 pelajar (9 lelaki, 11 perempuan; umur min 22.6 ± 1.4 y) dari luar kampus dan dalam kampus Universiti Malaysia Sabah (UMS) terlibat dalam kajian rintis. Kebanyakan respondan mempunyai size badan yang normal (90%). FFQ menunjukkan terlebih lapor yang signifikan (p<0.05) dalam tenaga dan nutrien jika dibanding dengan tiga hari WR. Energy Intake to Basal Metabolic Rate (EI/BMR) telah menunjukkan lebih pelapor tenaga tinggi semasa melapor pengambilan nutrisi mereka dengan menggunakan FFQ (50%) daripada WR (10%). Kajian utama telah dijalankan pada 396 subjek dari UMS yang berumur antara 18 dan 25 (164 lelaki, 232 perempuan; dalam kampus 52%, luar kampus 41.4%). Kebanyakkan respondan dalam kajian utama ini mempunyai saiz badan yang biasa (73.2%). FFQ menunjukkan jangkaan signifikan yang tinggi bagi tenaga dan nutrien (p<0.05). Terdapat kolerasi yang signifikan (p<0.05) antara FFQ dan WR untuk tenaga dalam kajian utama. Nisbah EI/BMR telah menunjukkan lebih pelapor tenaga tinggi semasa melapor pengambilan nutrisi mereka dengan menggunakan FFQ (44.7%) daripada WR (10%) dalam kajian utama. Dalam kedua-dua peringkat ini, kajian rintis dan kajian utama telah menunjukkan FFQ terlebih melapor bagi tenaga dan nutrien. Lebih banyak pelapor tenaga yang tinggi terdapat dalam FFQ. Berdasarkan keputusan yang diperolehi, ia dapat disimpulkan bahawa FFQ ini memerlukan pembagunan dan pembaikkan yang berterusan sebelum dapat digunakan untuk menilai pengambilan diet pelajar universiti. Sepuluh makanan yang biasa dimakan oleh populasi universiti adalah biskut, nasi, sayur berdaun hijau, ayam, ikan bilis, gula-gula, babi, roti and keropok lekor.



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LIST OF ABBREVIATIONS

FFQ	Food	Frequency	Questionnaire
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WR Weighed Record

MANS Malaysian Adults Nutrition Survey

UMS University Malaysia Sabah

SSMP School of Food Science and Nutrition

BMI Body Mass Index

MOH Ministry of Health

FAO Food and Agriculture Organization

WHO World Health Organization



LIST OF SYMBOLS

n	Number of subjects
s.d	Standard deviation
р	probability
%	Percentage
r	Spearman correlation coefficient
µд	Microgram
g	Gram
mg	Milligram
kcal	Kilocalorie



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CHAPTER 1

INTRODUCTION

1.1 Introduction

Dietary assessment methods had been developed to measure past and present intake of food, nutrients and identify the long-term effects of diet on development of chronic diseases. The ability to discern the relationship between diet and disease depends on the quality of the dietary instrument (Shahar *et al.*, 2003). This, in turn, depends on how accurately the instrument is able to reflect the dietary patterns of the population for university students.

There were numbers of methods that were available for dietary assessment, but there was no single method that consider accepted for all purposes, the selection of a method was dependent on the purposed used of data, abilities and commitment of subjects, and resources available for data collection and analyses (Simko *et al.*, 1995).

1.1.1 Food Frequency Questionnaire (FFQ)

FFQ was a common method that usually used in assessing an individual's longterm dietary intake of food and nutrients. The questionnaires were typically selfadministered, asking respondents to report their usual frequency of consumption of items from a list of food for a specific time period (Shahar *et al.*, 2003). Besides that, food frequency questionnaires were useful for ranking individuals according to food and nutrient intake rather than quantifying the actual amount of food they consumed (Jain and McLaughlin, 2000).

Qualitative FFQs consisted of food lists and response options asking about numbers of servings or units of foods consumed. Meanwhile, semiquantitative FFQs asking respondent about portion size. Some questionnaires required



respondents to describe a "typical" portion size. Meanwhile, some had stated an amount of serving and asking respondents to indicate whether their food intake is "small", "medium" or "large" (Simko *et al.*, 1995).

Accuracy of FFQ depended on whether most of the foods people consumed were included in the list of foods. If the population consumed foods which were not included in FFQ, nutrient intakes were underestimated. Thus, FFQ needed to be developed and validated for different populations. In addition, single question on FFQ often include several types of foods, this may work well for some nutrients but not others (Wolever, 2006).

FFQ was preferred in many studies because of two reasons: (1) it allowed for measurement of habitual intake over a long period of time (Jimenez & Moreno, 1995). Food frequency method relied on a food list and participants were asked to report frequency of consumption of each food item by week, months or years (Walker *et. al.*, 2003); and (2) it was relatively inexpensive and did not need trained enumerators (Jimenez & Moreno, 1995). For occupational groups that were trained to fill out forms suitable to use self-administered questionnaire which make it practicable to study large populations cheaply (Luepker *et al.*, 2004).

1.1.2 24-hour Recall (24-hr recall)

24-hour recalls provided good measurement in recent food intake and widely used in epidemiological surveys. The recall was obtained by interview or by selfadministered questionnaire. The choice depended on cost and the ultimate use of the recall information. If the purpose of the study was to obtain a more qualitative dietary assessment, self-administered recalls may be acceptable. On the other hand, interview questionnaire conducted by a trained dietary interviewer. 24-hr recall provided appropriate mean estimations for groups but not for individual because of large day-to-day variation in individual intakes (Walker *et al.*, 2003).

A typical 24-hour recall required subjects to recall all food they consumed and estimate the quantities in ordinary household measures or by shape and dimensions. The 24-hour recall had become a favored way of obtaining dietary



data. It required 15 to 20 minutes of interview time and it often taken at an unannounced time. Thus, this may minimized the probability that subjects modified their food habits in recall (Simko *et al.*, 1995).

1.1.3 Weighed dietary intake

Weighed dietary intake was a method that weighed all portions of individual food without weighing ingredients. This method determined usual dietary intake of an individual within very small limits of error with an acceptable degree of respondent burden. This method often used as a gold standard for comparison with various types of dietary assessment methods (Luepker *et al.*, 2004).

Advantages of dietary intake methodology: (1) it involved a direct observation of dietary intake which did not rely on memory or recall; (2) it allowed daily variation in food intake described and gave an accurate measurement of portion or serving size of foods; (3) each food was required to be individually described; (4) flexible to be used for all eating occasions and; (5) retain detail about dietary structure which described when and how foods were eaten throughout the day as well as the order they were eaten within a meal.

1.2 Rationale

University was an important starting point for an individual because this was a period that re1q

present the increased of responsibility regarding food choices and healthy lifestyle practices. University or college students were mostly young adults that stay away from home. Dietary habits were different between those living at, and away from home. Research had been done on Greek students showed that students living at home had not changed their eating habits to any great degree. In contrast, students living away from home changed their eating habits significantly (Papadaki *et al.*, 2007).

University or college students usually had an imbalanced diet due to time constraints, convenience and cost of food. They usually busy for assignments or examinations. Papadaki (2007) identified changes in living environment, cost and



financial resources as well as increased availability of convenience and fast foods as the major causes affecting food choices in young adults.

Furthermore, students whether they were living on or off campus generally did not have enough cooking skills, inadequate cooking equipments and storage facilities. Besides, they lacked of experience in food shopping, preparation and planning meals. These populations had unique barriers in adapting healthful eating habits and often lacked of knowledge, skills, and self-efficacy needed for basic meal planning (Clifford *et al.*, 2006).

The purpose of conducting this study was to develop FFQ with suitable and appropriate serving sizes for university students. Most of the time, students preferred economic, convenient and fast service. Thus, they chose to have meals at restaurants around their residential area. The way of procurement for food was different for students living at, and away from home. This was because most of the restaurants or cafeterias had measured every dish at one point (for example: rice in one box, every dish in a ladle). Besides, current FFQs were less suitable for populations whom had less knowledge about household measurements. In addition, there were no appropriate FFQs specifically for university students until this moment.

1.3 Study Objective

- Develop a reliable and validated FFQ suitable for multi-ethnic university populations.
 - Determine commonly consumed food by university students.



CHAPTER 2

LITERATURE REVIEW

2.1 Food Frequency Questionnaire

FFQs were useful in describing intake of foods that may be consumed periodically (e.g alcohol). Nevertheless, FFQs were less able than recalls or records to obtain information about intake of specific food and amounts. FFQs demanded on long-term memory assuming the existence of a pattern that might or might not exist (Simko *et al.*, 1995). An article by Krummel and Etherton (1996) summarized that FFQ required subjects to integrate what usually they consumed and estimated their portion size, error might be occurred in the estimation of usual diet. There could be variation in the number of food included, whether information was collected on portion size and on cooking practices, and whether the food was raw fresh or frozen.

In Brazil, there was no published validated food frequency questionnaire developed to investigate usual food consumption of children for age 5 to 10 years old. An adult quantitative food frequency questionnaire had been repeated used in evaluated children's usual food intake without any appropriate investigation of its accuracy (Fumagalli *et al.*, 2008).

Some FFQs allowed study investigators to adapt the food list to their specific population. For example, based on pilot studies, an investigator decided to eliminate some foods from the food list than the population did not generally consumed and/or add foods commonly consumed. Foods on the food list might also be grouped or ungrouped, depending on the frequency of consumption of each item. When altering the food list on an FFQ, the food and nutrient database



must be updated according to the new food list. An FFQ should not be used in discriminately with all populations (Nelson and Williams, 2007).

2.2 Food record

Food record method consisted of a detailed diary of foods consumed over one or more days. It provided appropriate mean values for groups but not for individuals except the number of days was significant. Information collected at the time of consumption to avoid the limitation of memory. However, assessment was imprecise when dining out could interfered with dietary intake. McPherson *et al.* (2003) pointed out that there were no specific validation studies of portion size on validity in reporting food items.

An article by Thomson *et al.* (2002) showed that although food record usually used as reference method, few aspects that existed probably affected researchers to gather reliable and valid self-reported dietary intake data and these included: questionnaire format, participant motivation, perceived study burden, interests group of subjects or highly motivation subjects. Dietary measurement used this approach was not precise, the ability of dietary instrument to capture differences in intake over time was worthy of evaluation, given its importance to the interpretation of results from dietary intervention trials. Subjects ate was recorded after being weighed on a standard set of scales. Waste left over at the end of the meal was also weighed and recorded (Lawrence *et al.*, 1996).

Another similar study had been conducted by Beaton *et al.* (1997) showed that weighed intake had the greatest acceptance as provided the most accurate assessment of food and nutrient intakes. This was therefore most often used as the reference method. However, there were potential errors with all dietary assessment methods. These included: inaccurate reporting by subject, recorded which unrepresentative of usual food habits which recorded period was uncommon or too short, poor assessment of portion sizes, incorrect coding data and inappropriate analysis of data or interpretation.



Wolever (2006) showed the accuracy of portion size estimation could be improved by providing subjects with a scales on which to weight everything they consumed, but this was not only increased the expenses to collect the dietary information, but increased the difficulty involved, in turn, may reduced the ability or willingness to comply. Another similar study had been conducted by Bellack and Edlund (1992) showed that weighed intake method was a very precise method, in which all food intake was weighed by the client or a trained person. Nevertheless, this method was very time-consuming and rarely used except in research.

A study had been conducted by Lawrence *et al.* (1996) showed that weighed record had lost its pre-eminence as a gold standard as nutritionists had came to understand more about the problems of underreporting and non compliance. However, several studies showed food record as the most accurate method and suitable to be used as reference method. Joshi *et al.* (2005) showed that food record was one of the most accurate methods available and also referred to as precise and weighed individual inventory method. On the other hand, study carried out by Arnold *et al.* (2005) showed that food records were considered as "gold standard" of measurement. Therefore, other methods such as the FFQ, if validated properly, might be more useful with least burden on subjects. In present study, weighed dietary record was used as reference method.

2.3 24-hour recall

24-hour recall method widely used to collect dietary information because it was simple, imposed least burden to subjects and did not require literacy in respondent. However, study conducted by Karvetti and Knuts (1985) showed that individuals did not report their food consumption accurately during the 24-hour recall for various reason related to memory, interview situation or embarrassment. This resulted in the underestimation and overestimation of nutrient intake.

Study conducted by Leslie *et al.* (1998) among children of fourth grade. In their study, they found out that although 24-hour recall showed a certain degree of accuracy in the dietary assessment of young adults, it might be less accurate for younger age group. Young children were not familiar with portion sizes and the



elderly who experienced memory declined need other tools such as photographs and other visual aids to help them quantified their recall food intake, thus improved accuracy of recall.

Another study conducted by Marjan *et al.* (1999) on 40 male and 25 female students to assess dietary intake of University Putra Malaysia. Their study showed that 24-hour recall dietary recall was a reliable method of assessing nutrient intake particularly among young adults of this age group. They also found out that although the results showed a high degree of validity, it was just a presumptuous that 24-hour recall was the best method for young adults. This was because the validity based on one-day weighed record. The small and biases of the sample size as well as sampling technique, which was based on volunteers, might influence the results.

2.4 Comparison between two different methods

Many methods had been developed for the dietary assessment of individuals, such as dietary records, 24-hour recall, food frequency questionnaire, diet history and weighed food record. All of these methods had their strengths and weakness (Thomson and Byers, 1994).

Several studies related in evaluating validity for two different methods had been carried out world wide. However, most of the studies conducted had missed out the importance of suitability for portion sizes and food items in their questionnaire, whether they were suitable for their study groups. Present study was conducted based on portion sizes and food items that applicable for university students.

Study conducted by Bingham (1987) to estimate the group means nutrient intake by comparing 24-hour recalls with diet records for the same individuals. They found out that similar instrument performed differently in different populations. The choice of instrument had to be appropriate to the particular population and research purposed.



2.4.1 Comparison between FFQ and other method

In recent years, there had been an increased amount of studies on the development of validated food frequency questionnaire. Validation of FFQ was done by comparing between FFQ with another method. For example comparing FFQ with 24-hour recall or weighed dietary record. However, comparing these methods did not allow for direct validation where each of the method may affected by physiologic and environmental factors (Gascon *et al.*, 2003). Although FFQs were effective in ranking individuals with respect to their intake, they were not as useful for quantifying intake, it was therefore difficult to compare the amount of intake in one study to the next (Krummel and Etherton, 1996).

2.4.2 Comparison between food record and other methods

The level of detailed available from weighed dietary records was very high in contrast to information from short dietary questionnaire. The conceptual and cognitive difficulties required to keep a weighed dietary record were different to those required to answer a short question. In theory, this would result in the errors by each method was largely independently of each other. This was a desirable feature in selection of a method against which to assess the performance of a short dietary question (Riley *et al.*, 2001).

2.4.3 Comparison between FFQ and weighed dietary record

A study conducted by Paalanen *et al.* (2006) showed that Food frequency questionnaire had its limitation where it was based on the subject's memory and because of the predefined food list, some of the food information may be missed. In order to obtain a standard validated FFQ, weighed food intake records was used to compare with food frequency questionnaire. Weighted dietary record was a method that used to determine the usual dietary intake of individual within very small limits of error. It was also often used as a comparison method to assess various types of dietary questionnaire because it was a distinctly different method requiring different skills (Riley *et al.*, 2001).

Validation of FFQ was done through comparison to a seven-day food record (Jain and McLaughlin, 2000). In their study, the seven-day food record included a



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