NUTRITIONAL STATUS OF UNIVERSITI MALAYSIA SABAH STAFF ASSESSED WITH FOOD AVAILABILITY, ANTHROPOMETRY AND DIETARY MEASUREMENTS

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THIS DISSERTATION WAS WRITTEN TO FULFILL A PART OF THE REQUIREMENT TO OBTAIN A DEGREE IN BACHELOR OF FOOD SCIENCE (FOOD SCIENCE AND NUTRITION) WITH HONORS

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ABSTRACT

Objective of this present study was to look at the nutritional status of UMS staff assessed with food availability, anthropometry and dietary measurements. The hypothesis was that nutritional status measured as dietary intake is related to food affordability measured as combined household income. Respondents were randomly selected employees of UMS, n = 169, aged 19 to 62 years. Nutrient intake was measured using interviewer administered 24-hour recalls and food servings by food frequency questionnaire (FFQ). Nutritional knowledge was measured using ten questions. Under-reporters of energy intake (EI) were determined as respondents with < 1.20 X BMR. BMR was estimated using equations by Ismail *et al.* (1998). Results showed that 27.81% of respondents were overweight; 8.88% were obese. 76.33% of respondents could answer six out of ten questions on nutritional knowledge. 57.40% had three meals a day (breakfast, lunch, dinner) but 57.40% respondents also did not have meals on-time. 89.35% did not achieve RNI based on their reported energy intake. Mean energy intake was 1551.14 ± 791.45 kcal/day. 51.48%, 59.17%, 92.31%, 73.96% and 62.13% did not achieve RNI for protein, fat, calcium, iron and vitamin C. However, FFQ showed that they consumed adequate servings of major food groups in the Food Guide Pyramid (FGP). 76.33% of respondents achieved FGP recommended servings for fish, poultry, meat and meat products; 78.11% for fruits and vegetables; and 50.89% for milk and milk products. 46.74% were determined as under-reporters of EI. There were no significant associations between consumption of recommended servings and combined household income for fish, poultry, meat and meat group (χ^2, p = 0.366), fruits and vegetables group (χ^2, p = 0.874) and milk and milk products group (χ^2, p = 0.707), level of nutritional knowledge (χ^2, p = 0.184, 0.638 and 0.874), and employment position levels for these three groups (χ^2, p = 0.314, 0.813 and 0.278). Further studies with adjustments of nutrient intakes for under-reporting of dietary intake identified in the present study are needed to test the hypothesis.

ABSTRAK

Penilaian Status Pemakanan di Kalangan Pekerja Universiti Malaysia Sabah (UMS) Melalui Amalan Pemakanan, Pengukuran Antropometri dan Pengukuran Diet.

Objektif kajian ini membincangkan penilaian status pemakanan di kalangan pekerja UMS melalui amalan pemakanan, pengukuran antropometri dan pengukuran diet. Hipothesis kajian ini adalah penilaian status pemakanan melalui pengukuran diet berkaitrapat dengan keupayaan pembelian makanan yang diukur melalui jumalh pendapatan keluarga. Seramai 169 pekerja UMS yang berumur 19 – 62 tahun dipilih secara rawak sebagai responden dalam kajian ini. Pengambilan nutrien responden disukat dengan menggunakan ingatan semula 24jam dan kekerapan pengambilan makanan manakala pengetahuan pemakanan diuji dengan sepuluh soalan yang mudah dan senang difahami. Responden yang melapor kurang tenaga berbanding tenaga yang didapati dari makanan ditentukan dengan 1.20 X BMR. Persamaan Ismail *et al. digunakan menganggar BMR responden. Kajian mendapati 27.81% responden yang lebih berat dan 8.88% responden yang obesity didapati dalam kajian ini. Sebanyak 76.33% responden dapat menjawab enam daripada sepuluh soalan mengenai pemakanan. 57.40% responden memakan tiga kali sehari, iaitu sarapan pagi,makan tengah hari dan makan malam. Walaubagaimanapun, sebanyak 57.40% responden tidak makan ikut masa. Analisis ingatan semula 24jam menunjukkan bahawa sebanyak 89.35% responden yang tidak dapat memakan jumlah tenaga yang dicadangkan oleh RNI. Min tenaga yang didapati melalui makanan di kalangan responden adalah sebanyak 1551.14 ± 791.45kcal. Responden yang tidak dapat mencapai RNI bagi protein, lemak, kalsium, besi dan vitamin C adalah sebanyak 51.48%, 59.17%, 92.31%, 73.96% and 62.13%. Walaubagaimanapun, analisis FFQ menunjukkan bahawa responden dapat memakan jumlah sajian makanan yang mencukupi menurut piramid makanan. 76.33% responden mencapai rekemen piramid makanan bagi kumpulan ikan, daging dan hasil daging manakala sebanyak 78.11% dan 50.89% responden dapat memakan sajian makanan yang mencukupi dari kumpulan buah-buahan dan sayur-sayuran, dan susu, dadih dan keju. Peratus responden yang melapor kurang nutrien dan tenaga dari pengambilan makanan yang sepatutnya adalah sebanyak 46.74%. Hubungan yang tidak signifikan bersekutu ditunjukkan diantara jumlah pendapatan keluarga dengan pengambilan sajian makanan bagi kumpulan ikan, daging dan hasil daging (χ^2, $p = 0.366$), buah-buahan dan sayur-sayuran (χ^2, $p = 0.874$), dan susu, dadih dan keju (χ^2, $p = 0.707$), tahap pengetahuan pemakanan (χ^2, $p = 0.184$, 0.638 and 0.874), dan kumpulan perkhidmatan (χ^2, $p = 0.314$, 0.813 and 0.278). Kajian selanjutnya diperlukan untuk menyesuaikan jumlah nutrien yang didapat oleh responden yang melapor kurang nutrien dari pengambilan makanan yang sepatutnya untuk menguji hipotesis.*

ABBREVIATIONS

BMI	Body Mass Index
BMR	Basal Metabolic Rate
CANF	Calories – Animal products – No fiber
cm	centimetre
DHA	Decohexanoic acid
EE	Energy expenditure
EFA	Essential fatty acids
e.g.	Examples
EI	Energy intake
EPA	Eicopentanoic acid
FFQ	Food frequency questionnaire
kcal	kilocalories
kg	kilogram
KJ	KiloJoule
K.K	Kota Kinabalu
MJ/d	MegaJoule per day
NCCFN	National Coordinating Committee on Food and Nutrition
NutriCal	Nutrient calculator system
REI	Reported energy intake
RNI	Recommended Nutrient Intake
s.d.	Standard deviation
SSMP	School of Food Science and Nutrition
ST	Skinfold thicknesses
UMS	Universiti Malaysia Sabah
USA	United States of America
WHO	World Health Organization
WHR	Waist to hip ratio
WT	Weight
χ^2	Chi-square

SYMBOLS

>	More than
<	Less than
≤	Same or less than
≥	Same or more than
/	Or
=	Same
+	Plus
−	Minus
÷	Divide
%	Percent
±	Plus or minus
&	And
n	Number of respondents
p	Probability level
r	Pearson-product-moment correlation
Σ	Sum

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CHAPTER 1

INTRODUCTION

1.1 Background

Nutrition is a science that studies the interactions that occur between living organisms and food (Grosvenor & Smolin, 2002). Nutrition survey is used to determine which foods people are eating, to access people's nutritional health and to measure people's knowledge, attitude and behavior about nutrition and how these relate to health. Nutrition status survey examines the people themselves, using nutrition assessment methods (Cataldo *et al.,* 1999). It is a type of survey that evaluates people's nutritional status by using several methods such as food data intake, anthropometric measurements and physical examination.

Nutritional status is defined as a condition of a population's or individual's health as influenced by the intake and utilization of nutrients and non-nutrients (Boyle, 2003). Nutritional status of an individual or population can be determined through nutritional assessment. Nutritional assessment is an evaluation of the nutritional status of individuals or population through measurements of food and nutrients intake and evaluation of nutrient-related health indicators (Robert & Nieman, 2003). The World Health Organization (WHO) has defined that the ultimate purpose of nutritional assessment is to improve human health. The committee points out that nutritional status cannot be measured directly by a single test; rather assessment is dependent on the collective interpretation of relevant dietary and health data.

In a rapidly developing nation such as Malaysia, knowledge of the nutritional and health status of community groups is important to indicate how economic development has affected the health and nutritional well-being of its people. In

addition, such data can provide a basis for any remedial actions aimed at improving community health (Chee, Khor & Tee, 1997). For example, studies by Norimah A. & Haja Mohaideen Myden, 2003 shown that the middle-aged adults in selected areas of Selangor should adopt a more active lifestyle and be more cautious of their food habits to ensure healthy well being throughout their life span.

There are five major types of data needed to identify nutrition-related health problems or risks of related diseases. There include anthropometric measurements, biochemical data, clinical signs, dietary intake data and epidemiologic data (Owen *at al.* 1999). Anthropometric measurements are used to:

1. Evaluate the progress of growth in pregnant women, infants, children, and adolescent;
2. To detect undernutrition and overnutrition in all age groups;
3. To measure changes in body composition over time.

It is important to master the techniques of taking measurements (Cataldo *et al.*, 1999). Once the correct techniques are learnt, taking the measurements will become easy and accurate data could be obtained. However, these types of measurements generally require minimal equipment.

Numerous biochemical tests are available for accessing nutritional status. Biochemical data that are obtained include concentrations of substances in body fluids or tissues, such as red blood cell fatty acids, plasma cholesterol, urinary creatinine, serum iron, and glucose tolerance level (Owen *at al.* 1999). Moreover, data is also obtained from functional biochemical tests to measure the biological importance of a nutrient and the consequences of nutritional deficiency. However, functional tests are generally too invasive and expensive to employ in most field surveys of nutritional status (Boyle, 2003). Therefore, these tests are not conducted in the present study.

Medical history and physical examination are clinical methods to detect signs and symptoms of malnutrition. Medical history includes a description of the individual

and his or her living situation. Symptoms are disease manifestations that the patient is usually aware of and often complains about. Signs are observations made by a qualified examiner during physical examination (Robert & Nieman, 2003). Physical examinations include inspection of neck, eyes, nose, month and etc (Matarese & Gottschlich, 2003).

At the population level, indirect methods of measurements like the balance sheet or household budget surveys are used. The present study focused on individual's intake. Dietary intakes are assessed either by collecting an individual's retrospective intake data and current intake data or prospective intake data. Prospective intake data includes food inventory recorded by weight household measures; while retrospective intake data includes 24-hour recall, dietary history and food frequency questionnaire. Each of the method has its specific purposes, strengths, and weaknesses. The choice these methods depend on the purpose and setting in which the assessment is carried out. The purpose of obtaining dietary data is to determine the nutrient content of the food and the appropriateness of the intake for the particular individual. The prospective method involves recording data at the time it is consumed or shortly thereafter (Mahan & Escott-Stump, 2000). 24-hour recall method, food diary or daily food record, diet history interview and the food frequency questionnaire are examples method of measuring the food consumption of individual. Table 1-1 shows advantages and disadvantages of retrospective methods of dietary assessment.

Table 1-1: Advantages and disadvantages of retrospective methods of dietary assessment

Advantages	Disadvantages
Quick	Relies on memory
Cheap	No measurement of day-to-day variation in diet
Limited demands on subject	Conceptualization skills needed
Limited numerary skills	Observer bias possible

Source: Anderson, 1995

Epidemiology is from the Greek word, which means 'upon the people' and 'the study of epidemics'. Epidemiology is the study of the interrelationship between health and disease and other factors in the environment or lifestyle of different populations. Epidemiology does not determine the cause and effect relationship, but its pattern (Mahan & Escott-Stump, 2000). Epidemiologic methods include observations, counting cases or events, relating cases or events to the population at risk, making comparisons, developing the hypothesis, testing the hypothesis, drawing scientific inferences, conducting experimental studies and intervening and evaluating (Boyle, 2003).

University Malaysia Sabah (UMS) staff were chosen as respondents because they represent a small population that can be differentiated by age, gender, social status, dietary and eating habits. UMS employs 752 males and 461 females. UMS staff include lecturers, librarians and administrator and support staff which represent different socio-economic status. Furthermore, the dieting and eating habits may also differ from those who have different social-economic status (or different income levels).

The present survey is done to identify the nutritional status of UMS staffs in the main campus in Kota Kinabalu. The nutritional status can be accessed by measuring the anthropometric, health history, diet history, 24-hour recall and food frequency questionnaire (FFQ). Height, weight, body mass index (BMI), BMI

classification, wrist circumference, frame size, waist circumference, hip circumference, waist to hip ratio (WHR) and percentage body fat were measured. Anthropometry is especially important to decide whether the person is suffering from obesity. Being overweight is associated with a wide range of health problems, including heart disease, back pain and joint problems, cancer, hypertension and diabetes as well as psychosocial problems (Chambers & Swanson, 2005); while diet history and FFQ are used to determine the eating behavior and whether respondents were eating balanced diet for optimum health (Robert & Nieman, 2003).

Nutritional knowledge is one of the factors that will affect nutritional status and eating patterns. Therefore, a questionnaire was designed to test the nutritional knowledge of UMS staff. The questionnaire on nutritional knowledge contains only closed-ended questions because it was quicker and easier for both respondents and researchers. Only basic knowledge of nutrition was tested in this survey. This basic nutritional knowledge can be obtained in various ways, such as through education, books or mass media (Parmenter, 2002).

1.2 Objectives

1. Evaluating the nutritional status of University Malaysia Sabah (UMS) staff.
2. Accessing the nutritional knowledge and eating habits of UMS staff.
3. To know whether socio-economic status affects the nutritional status of UMS staff.
4. To estimate under-reporting of energy intake from 24-hour recall.

CHAPTER 2

LITERATURE REVIEW

2.1 Nutritional Status

Nutritional status is defined as a state of health as it is influenced by the intake and utilization of nutrients. An evaluation of the nutritional status of populations and individuals can identify nutritional needs and can be used to make public health recommendations and to plan diets for both individuals and populations group to meet these needs (Grosvenor & Smolin, 2002).

Health condition of an individual or population can be accessed through nutritional assessment. Nutritional assessment is an evaluation of the nutritional status of individuals or population through measurements of food and nutrients intake and evaluation of nutrient-related health indicators. In addition, nutritional assessment determines respondent's age, health, lifestyle and socio-economic status which affect nutrient needs and the ability to understand and follow nutrition advice (Cataldo *et al.*, 1999). Measurement of nutrient intake is probably the most widely used indirect indicator of nutritional status. It is used routinely in national nutrition monitoring surveys, epidemiologic studies, nutrition studies of free-living participants (those living outside a controlled setting), and various federal and state health and nutrition programme evaluations (Robert & Nieman, 2003).

The nutritional status of the population is monitored by examining and comparing trends in food intake and health. This is done by interviewing individuals within the population to determine what food is actually consumed and collecting information on health and nutritional status. An individual nutritional assessment requires a review of past and present dietary intake, assessment of body size, a

medical history and physical examination, and laboratory measurements (Grosvenor & Smolin, 2002).

2.2 Ways to Determine the Nutritional Status

Assessors rely on many sources of data such as historical information, physical examinations, anthropometric measurements and laboratory tests to assess nutritional status of an individual or population (Cataldo *et al.*, 1999). Nutritional status cannot be measured directly by a single test; rather assessment is dependent on the collective interpretation of relevant dietary and health data. There are five major types of data needed to identify nutrition-related health problems or risks of related diseases; which include anthropometric measurements, biochemical data, clinical signs, dietary intake data and epidemiologic data (Owen *at al.* 1999)

2.2.1 Dietary Assessment

Nutrition research requires a valid measurement of habitual food intake. Standard methods used to determine habitual food intake include interviewing subjects about their usual or past intake and food records kept by the subjects at the time of consumption (Goris & Westerterp, 1999). These methods include food records, food frequency questionnaires and 24-hour recalls. Each of these methods has strengths and weaknesses related to their intended use and validity (Johnson, 2002).

There are several methods to obtain dietary data. Different dietary assessment methods may be in used for a number of purposes and in choosing a particular method it is important to bear in mind exactly what the purposes of a particular study are. Generally, there are two main categories of methods employed in diet assessment methodology, retrospective and prospective methods. Retrospective methods include 24-hour recall, diet history and food frequency

questionnaire; while prospective methods include weighed food inventory and estimated food inventory (Anderson, 1995). Table **2-1** shows reasons for dietary assessment.

Table 2-1: Reasons for dietary assessment

Reasons for dietary assessment	Purposes	Variables of interest
General description	General assessment of food	Eating pattern Food intake
Cultural understanding	Food and behavioural associations	Eating pattern Food intake Socio-cultural variables
Assessment of health welfare	Nutrition intake	Food intake Nutrient intake
Behavioural change	Prescription of dietary advice	Eating pattern Food intake Socio-cultural variables Nutrient intake
Behavioural change	Encourage dietary compliance	Food intake
Assessment of success of professional practice	To evaluate the effectiveness of dietary	Food intake Nutrient intake

Source: Anderson, 1995

2.2.1.1 Retrospective Methods

Retrospective methods require subjects to recall aspects of their diet. This may involve remembering the type and amount of all individual items consumed over specified periods of time (Garrow *et al.,* 2000). The most usual of theses methods are 24-hour recall, diet history and food frequency questionnaire (Anderson, 1995).

The main advantages of the retrospective methods are that they are quick to administer compared to prospective methods. They are also less expensive in terms of equipment and the time taken for interviewers to see subjects. A further advantage for prospective methods is that there is a lower respondent burden than required; as a result, percentage to obtain a more representative data from subjects is also

increased. Besides that, they can also be used to access diet in the past, which may be relevant to studies where the underlying causes of chronic diseases such as heart disease or cancer may be of interest.

Many sources of bias may affect retrospective dietary assessment. Errors in memory result in the omission of foods from the assessment. This may be a problem for some elderly subjects and for children under the age of about 12. Moreover, subjects must have good skills relating to the perception and conceptualization of food portion size while using these methods (Garrow *et al.*,2000).

2.2.1.1.1 24-hour Recall

Dietary intake can be obtained using 24-hour recall (Moy & Suriah, 2002). This method is designed to quantitatively assess current intake (Johnson, 2002). 24-hour recall can be conducted in person or by telephone with similar results (Tran *et al.*, 2000).

The interviewer asks the respondents what they ate in the previous 24-hour in direct chronological order from the first food in the morning to the last foods before breakfast on the day of the interview. The information is obtained through systematic repetition of open-ended questions. To standardise the data collection, Dehgham *et al.*, 2005 prepared a manual of procedures for the respondents. The interviewers used a food atlas modified from food portion sizes: A photographic atlas containing colour pictures of eight different portion sizes of foods commonly eaten is shown to the respondents. The interviewer then uses information obtained for analysis (Cataldo *et al.*, 1999).

24-hour recall is probably the most widely used assessment in clinical dietetic practice because it is simple, and inexpensive (Anderson, 1995). 24-hour recall requires only short-term memory, and if the recall is unannounced, the diet is not changed. The main advantage of 24-hour recall is that it is very quick to administer

(10-15 minutes) (Garrow *et al.*, 2000). This method is relatively brief, and subject burden is less in comparison with food records. It is appropriate for use in comparison with food records (Johnson, 2002). Furthermore, it is appropriate because the subjects do not need to read or write to complete the recall.

Disadvantages of the 24-hour recall include the inability of a single day's intake to describe the usual diet (Johnson, Soultanakis & Mathhews, 1998). A subject may have a high intake on one day, and a low intake the next. The success of the recall depends on the memory, cooperation, and communication ability of the subject. Trained interviewer is needed in this method (Johnson, 2002). Besides that, researchers found that in some cases as little as one-third of what had actually been consumed were reported, although in some cases this was as much as three times the amount eaten (Anderson, 1995).

In addition, 24-hour recall can be used to compare with the food frequency data as a crude way to access its content relative validity. A multiple 24-hour recall from the same individuals on randomly selected days is used to validate or calibrate the FFQ (Owen *at al.* 1999). This method is also used to further understand usual food intake and meal patterns of subjects to provide a summary of foods typically consumed at each mealtime the day before the examination. Biochemical test is conducted to access their haemoglobin concentrations (Clausen *et al.*, 2004).

Self-reporting energy intake for the previous day was obtained using multiple pass 24-hour recall. Briefly, this method consists of three passes: the quick list, detailed description, and the review. It is designed to minimise under-reporting. Subjects were provided two-dimensional food models to aid in portion size estimation during an orientation session before the study (McKenzie *et al.*, 2002).

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