THE DEVELOPMENT OF MALAYSIAN FOOD VARIETY INDICATOR (MFVI) AMONG LOW INCOME HOUSEHOLDS IN MALAYSIA: A PILOT STUDY

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INTRODUCTION AND BACKGROUND OF THE STUDY

Malaysia is a country of diverse races and religions, and one of the countries in Southeast Asia that has a vibrant economy, political stability and constant growth of industrial development. Strong economic growth has also changed the lifestyle of its people as well as in terms of food intake, especially in urban areas. Currently, the consumption of foods that are high in calories and protein are common among Malaysians (Zainal Badari *et al.,* 2012). This has increased the risk of chronic diseases, such as heart disease, diabetes mellitus, stroke and hypertension (Ministry of Health, 2010). Lifestyle changes in adults lead to unhealthy eating habits, socioeconomic pressure, and smoking and decreased physical activity, which lead to an increase in chronic disease risk factors (Lam & Khor, 1997).

Some studies show that the main causative factors of chronic diseases are overweight and obesity that are often related to unhealthy food intake, poor dietary habits and sedentary lifestyles (Williams, 2004; He & Evans, 2007; Norlaila, 2008; Kee *et al.,* 2008). The NHMS IV (Ministry of Health, 2011) reported that the prevalence of pre-obese and obesity among Malaysian adults 18 years and above were 33.3% and 27.2%, respectively, with the prevalence being higher among the Indians and Malays. The National Health and Morbidity Survey found that the rate of obesity has increased threefold, from 4.0% in 1995 to 14.0% in 2006 and 15.1% in 2011. This situation increases the risk of diet-related diseases such as hypertension and diabetes, which are among the main factors that contribute to death from cardiovascular disease in Malaysia (Ministry of Health, 2011). This can be linked to the growing intake of refined grains, added sugars, added fats, which are inexpensive, palatable and convenience (Darmon *et al.,* 2004: Drewnowski, 2004) but lack in vitamins, minerals and other micronutrients (Kant, 2000). The WHO (2003) reported that the link of the global obesity epidemic has a link with high consumption of energy-dense foods.

Weeks (2010) defined urban as place-based characteristics that incorporate elements of population density, social and economic organization, and the transformation of the natural environment into a built environment. Rapid economic and income growth, urbanisation, and globalisation are leading to a dramatic shift of Asian diets away from staples and increasingly towards livestock and dairy products, vegetables and fruit, and fats and oils (Pingali, 2006). Income and population growth, coupled with changes in lifestyle to one of urbanisation, have increased the demand for food and induced changes in food habits, food purchasing and consumption patterns. Furthermore, participation of women in the labor force is rising and has been linked to a greater demand for processed foods (Pingali, 2007). Moreover, urban households have more choice for

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different types of food, more open in accepting new foods on the market and able to accept the new instruments in the dietary study than in rural areas. The diet transition from low energy dense foods to high energy and protein dense foods were increased the prevalence of non-communicable disease (Zainal Badari *et al.,* 2012) especially among urban households. However, the increased food prices will reduce the adequacy of food intakes among low income households in urban areas (Kirkpatrick & Tarasuk, 2007).

The term of energy-dense foods are commonly used to characterize foods perceived as unhealthy while nutritious foods is defined as whole grains, lean meats, low-fat dairy products, and all legumes, vegetables and fruit (WHO, 2003). Increasing intake of the variety of foods across and within food groups is recommended in most dietary guidelines in order to ensure dietary adequacy of essential nutrients and to promote good health. Lack of variety diet is a particularly severe problem among poor and lower-income populations from developing countries including Malaysia and lead to the dietary inadequacy.

The concept of dietary adequacy embraces that of essential nutrient adequacy, but also takes into account other food components and food properties (Saviege *et al.,* 1997). Adequacy referred to a diet that meets requirements for energy and all essential nutrients (Ruel, 2003). Furthermore, Ruel (2003) defined the term of nutrient adequacy as the achievement of recommended intakes of energy and other essential nutrients. The majority of the studies related to the relationships between diet and health used nutrients such as energy, fat, protein, carbohydrate, vitamins and minerals to describe and quantify dietary intake, and turn to predict a particular health outcome. However, the health and dietary advice to individuals or group must be related to foods which are eaten (Hodgson et al., 1994). Moreover, the food intake itself may not be adequately described by nutrient intake because of biologically active components and properties in the food (Hodgson *et al.,* 1994).

Besides food, socioeconomic factor such as income also an important predictor of dietary adequacy (Nelson *et al.,* 2002). In Malaysia, the lower-income household was based on the monthly income of less than MYR2300. In 2009, 40.0% of Malaysian households had a monthly income of less than MYR2300, with the mean monthly income being MYR1440. Of this total, 90.6% were lower-income households (Tenth Malaysian Plan, 2010). Lower income level was associated with lower intake of energy (Nelson *et al.,* 2002). Furthermore, poverty is one of the main factors contributing to the poor nutritional status and dietary intakes (Vorster, 2002; Rousset *et al.,* 2006). This also contributed to the risk of chronic diseases because the poor often have no choice other than to rely on monotonous low nutrient dense diets (Cannon, 2001). Although lower-income populations spent more of their income on buying foods, the spending was more on energy-dense foods with higher palatability due to the lower prices (Zhang & Chen, 2007; Abbott, 2009), as often a healthy diet is perceived to be more expensive (Kearney & McElhone, 1999; Giskes *et al.,* 2002; Giskes *et al.,* 2007) coupled with limited access to healthy food, especially in rural areas (Buras, 2006).

Food variety and dietary diversity scores have been widely used in adult populations. The study by Karupaiah & Swee (2012) by using healthy eating index (HEI) scale to evaluate the women's diet quality in the urban community of Malaysia shows that low HEI scores among respondents and income was correlated with the HEI scores. However, the diet quality was measured by using HEI that was adapted from Kennedy *et al.,* (1995). Another study by Rashid, Smith & Rahman (2011) measured the dietary quality among Bangladeshi by using dietary diversity

scores which were focused on food group intake and shows that low diet quality among respondents. Furthermore, the socioeconomic background shows that low incomes and low education are the major factors for the households to be low in dietary quality. Study by Lo *et al.,* (2012) among older Taiwanese by using dietary diversity scores as an indicator of food security reported that peoples with low socioeconomic status had low dietary diversity and it cost more to achieve greater dietary diversity. In Qinghai, China, Yumi *et al.,* (2010) studies the relationship between food diversity and health among elderly by using 11-items Food Diversity Score Kyoto (FDSK-11) and reported that lower food diversity was associated with lower income status while higher food diversity was associated with lower blood glucose level. The lifestyle interventions were used to measure dietary diversity scores among general populations in Iran ad it was found that the lifestyle interventions was successful in improving dietary diversity scores and will increase the diet quality of the Iranian population (Sarrafzadegan *et al.,* 2009). Further studies Azadbakht & Esmaillzadeh (2010) to measure obesity and abdominal adiposity among Iranian Female youth by using dietary diversity scores shows that a direct association between energy intake and dietary diversity scores, negatively correlated with overweight, obesity and abdominal adiposity.

The most common method to measure the dietary intakes and adequacy that is applicable to the lower-income population and low-literacy levels is 24-hour recall, as it is less-time consuming, and does not burden the subjects, as they do not need to read or write to complete the recall (Basiotis *et al.,* 1987; Johnson *et al.,* 1998; Johnson, 2002; Gibson, 2005). Meanwhile, the latest methods to measure the quality of the diet are the food variety score (FVS) and dietary diversity score (DDS) where the FVS is used to measure a variety of foods by counting the number of different foods, and the DDS will measure dietary diversity of food groups (Zainal Badari *et al.,* 2012; Clausen *et al.,* 2005). Both of these methods still used the 24-hour recall techniques, and some studies used the food frequency questionnaires in order to measure the quality and variety of individual foods (Nicklas *et al.,* 2001; Foote *et al.,* 2004; Savy *et al.,* 2005), and the results are often used in developing food plans, policy and nutrition programs to increase the nutritional status of the community (Kant *et al.,* 1993), such as the Healthy Eating Index (Kennedy *et al.,* 1995), Diet Quality Index (Haines et al., 1999), and the Chinese Diet Quality Index (Stookey *et al.,* 2000). However, the data of these indexes were totally based on the calculation of scores that were defined by the researchers and there are no standard guidelines that can be used as a reference. There is great interest in developing countries to study the balanced and diversified diets, especially due to under-nutrition or over-nutrition and their consequences (WHO/FAO, 1996; Underwood, 1998; McCrory *et al.,* 1999). However, the estimation error has been the major problem in dietary intake surveys of the target population including Malaysia. Furthermore, there is no indicator can be used as a tool to measure dietary adequacy of the Malaysian population.

To date, no attempt has been made to develop the food variety indicator in Malaysia. Thus, the aim of this study is to develop a Malaysian food variety indicator (MFVI) as a tool for the assessment of dietary diversity scores among urban Malaysian low income households. In this paper, a pilot study results was presented to show the useful of MFVI in measuring dietary diversity scores among selected low income households in Setapak, Kuala Lumpur.

METHODOLOGY

Scope of the Study

The present study was conducted in two phases. The first phase was focused on developing the MFVI for low income households. In the second phase, the dietary survey by using Food Frequency Questionnaire (FFQ) and the questionnaire of socio-demographic backgrounds.

Study Location and Sampling

For a pilot study, the present study has been done in Setapak, Kuala Lumpur. A hundred and fifty (150) respondents were purposively chosen from low income households that stay in the low cost houses in selected *Projek Perumahan Rakyat (PPR)*. The characteristics of the respondents were household income must be below than RM3500 per month, married couples, and have children and stay in low cost houses. The person in charge of food preparation in each household will be interviewed and asked to answer Food Frequency Questionnaire (FFQ) in order to measure their food consumption.

Phase 1: Development of Malaysian Food Variety Indicator

The MFVI was developed based on Malaysian Dietary Guidelines (NCCFN, 2010) and Healthy Eating Index (2010). Firstly, the food groups as stated in Malaysian Dietary Guidelines (NCCFN, 2010) were listed. The food groups were:

1. Cereals and grains
2. Fruits
3. Vegetables
4. Poultry/egg
5. Meat
6. Fish
7. Legumes
8. Milk and dairy products

The daily serving intake was adapted and modified from Malaysian Food Pyramid as stated in Malaysian Dietary Guidelines (NCCFN, 2010) which the calories value of 2000 kcal/day (NCFNN, 2010). For each food group, the score was given based on the Healthy Eating Index (2010) with the total score was 70 as shows in Table 1. Then, the score was divided based on the serving size taken daily with minimum score was 0 and highest score was 10, as shows in Table 2.

Table 1:
The score of food groups

Food group	Score
Cereals and grains	10
Fruits	10
Vegetables	10

Poultry/egg	5
Meat	5
Fish	10
Legumes	10
Milk and dairy products	10
Total score	**70**

Table 2:
The divided score for each food groups

Food group	Serving/ day	Max Score	Serving/ day	Median Score	Serving/day	Min Score
Cereals and grains	≥6	10	3-5	5	<3	0
Fruits	≥2	10	1	5	<1	0
Vegetables	≥3	10	1-2	5	<2	0
Poultry/egg	≥0.5	5	0.25	2.5	<0.25	0
Meat	≥0.5	5	0.25	2.5	<0.25	0
Fish	≥1	10	0.5	5	<0.5	0
Legumes	≥1	10	0.5	5	<0.5	0
Milk and dairy products	≥2	10	1	5	<1	0

Finally, the total score was categorised into low score, moderate score and higher score to show the level of MFVI as stated in Table 3.

Table 3:
The level of Malaysian Food Variety Indicator (MFVI)

Total score	Level
0-23	Low
24-48	Moderate
49-70	High

Phase 2: Dietary Survey

The selected respondents were interviewed by trained enumerator on their household food intake by using FFQ. The person in charge of the food in each household was asked to recall all food eaten by household members as listed in the FFQ. Then, the MFVI scores were done. The food intake pattern was measured based on the method of Zainal Badari *et al.,* (2012). The related criteria that can be used further for validation of the instruments were focusing more on the socioeconomic

background of respondents. The respondents were interviewed regarding their income level, education level, profession, and their expenditures (food and non-food).

INSTRUMENTS

Food Frequency Questionnaire

The food frequency questionnaire (FFQ) was designed and used to determine the food consumption patterns of the respondents. The FFQ was developed and adapted from the food frequency questionnaires of Zainal badari et al., (2012). The FFQ consisted of two components: a) a list of foods and portion size of foods and b) a set of frequency-of-use response categories. A total of 126 items of food was listed in this FFQ and was divided into 15 groups.

The respondents were asked to choose only one response regarding the frequency of intake for each food item the following responses: more than six times per day, 4-5 times per day, 2-3 times per day, once a day, 5-6 times per week, 2-4 times per week, once a week, 1-3 times per month, or no intake. The MFVI score was then estimated using the score developed previously (Table 2) and was calculated for each food group to get the total score as in Table 1.

Questionnaire

The self-administered questionnaire was used to get the information of socioeconomic background of respondents, the factors that influence the food intakes of respondents, and the food habit of respondents.

Data Collection

The data was collected in non-festive season, and were conducted by the trained enumerators. The main reason for the non - festive season is because the actual intake of foods among respondents is more accurate during this time.

Data Analysis

The descriptive analyses were used to describe the socio demographic characteristics of the respondents and to measure the scores and level of MFVI among respondents.

Study Limitations

The present study is a pilot study, so that the results cannot be used to represent the population of study location. Furthermore, the present study was initial study on development of food variety indicator and the validation process need to be done once the complete data was collected and analysed. The improvement of food variety indicator should be done in order to measure the bigger sample size, thus the validation process can detecting the weaknesses and strengths of the present study.

RESULTS

Socio Demographic Backgrounds

A total of 150 respondents were selected in the present study. Table 4 shows the demographic characteristics of the respondents. The mean age of respondents was 45.15 years old which 47.8%

of respondents in a ranged age of 26-51 years old. Majority of respondents (62%) was female and 91.3% was Malay. Most of the respondents (36.7%) work in private sector followed by self-employed (28.0%). Majority of respondents (66.0%) have household members of 5-9 people with the mean household members was 5.53.

The education level of respondents shows that 36.0% of them had *Sijil Pelajaran Malaysia (SPM),* followed by *Sijil Tinggi Persekolahan Malaysia (STPM)* or certificate (28.7%) and diploma or degree (22.0%). The mean monthly household income of respondents was RM2734 with majority of them had monthly household income in a range of more than RM 2500-3500 (63.5%). Most of the respondents stay at flat houses (96.0%) and 73.3% of the respondents own their houses.

Malaysian Food Variety Indicator (MFVI) Scores

The FFQ was used to indicate the food intake among respondents. From the fifteen groups of food in the FFQ, the food groups were re-categorized again to eight groups as stated in Table 1. Thus, the MFVI was measured based on the score of new food groups. The results show that the mean serving intakes per day for cereals and grains group was 4.13 serving, while the mean score of MFVI for this group was 4.10. The mean serving intakes of fruits per day among respondents was 2.40 with the mean score of MFVI was 4.23. For vegetables, the mean serving intakes per day was 2.65 serving among respondents and the mean MFVI score was 5.00.

Furthermore, for poultry/egg group, the mean serving intakes among respondents was 1.68 serving daily with the total mean MFVI score was 4.77. For meat group, the mean serving intakes per day of respondents was 0.78 and the mean score of MFVI was 3.48. For fish and legumes groups, the mean serving intakes were 1.26 and 0.40 respectively, while the mean scores of MFVI for both groups were 5.48 and 2.10 respectively.

Moreover, the mean serving intakes among respondents for milk and dairy products group was 1.09 serving per day with the mean MFVI score was 2.87. Table 5 shows the daily mean serving intakes of food groups among respondents and the total mean scores of MFVI.

The Malaysian Food Variety Indicator (MFVI) level

Based on the total mean MFVI scores of respondents for each food groups, the MFVI level was calculated and measured as shows in Table 6. The results stated that most of the respondents had moderate level of MFVI score (45.3%) with the score of 24-47. The highest level of MFVI score was 48-70 with 39.3% of respondents reached this level. For the lowest level with the score 1-23, the results show that 28.6% of respondents were in this level.

Table 4:
Socio demographic backgrounds of respondents (N=150)

Variables	Frequency (n)	Percent (%)
Age (years)		
23-35		
36-51	28	18.6
52-71	82	47.8
* 45.15±11.05	40	33.6

Sex		
Male	57	38.0
Female	93	62.0
Race		
Malay	137	91.3
Indian	10	6.7
Chinese	2	1.3
Others	1	0.7
Religion		
Islam	136	90.7
Hindu	10	6.7
Christian	4	2.7
Occupation		
Self-employed	42	28.0
Government sector	19	12.7
Private sector	55	36.7
Not working/housewife	34	22.7
Education Level		
Primary school	16	10.7
Secondary School/SPM	54	36.0
STPM/Certificate	43	28.7
Diploma/Degree	33	22.0
Master/Ph.D	4	2.7
Household income (Monthly)		
<RM2500	55	36.5
RM2500-3500	95	63.5
*RM2734±486.99		
Household Size		
1-4 person	46	30.7
5-9 person	99	66.0
10-12 person	5	3.33
*5.53±2.07		
Residence Type		
Flat	144	96.0
Terrace	6	4.0
Residence Ownership		

Owner	110	73.3
Rental	40	26.7

*Mean ± Standard Deviation (SD)

Table 5:
Mean daily serving intakes and MFVI scores among respondents (N=150)

Food groups	Maximum MFVI score	Mean daily serving intake	Mean MFVI Scores
Cereals and grains	10	4.13	4.10
Fruits	10	2.40	4.23
Vegetables	10	2.65	5.00
Poultry/egg	5	1.68	4.77
Meat	5	0.78	3.48
Fish	10	1.26	5.48
Legumes	10	0.40	2.10
Milk and dairy products	10	1.09	2.87

Table 6:
Malaysian Food Variety Indicator (MFVI) Level among respondents (N=150)

MFVI level	Score	Frequency (n)	Percent (%)
Low	1-23	43	28.6
Moderate	24-47	68	45.3
High	48-70	59	39.3

CONCLUSION

This is the first attempt in Malaysia to develop food variety indicator that can be used to measure food variety among Malaysian population. Information concerning the population's food intakes and the calorie values suggested based on the physical activity level of populations were crucial in determining this indicator. The food intakes of population was based on the daily serving intakes of food and the data then be calculated for food variety indicator, and for the present study, it can be concluded that the increment of daily serving intakes will increase the food variety indicator scores of respondents. Furthermore, the Malaysian Food Variety Indicator level of respondents was moderate, and it can be increased if the respondents have enough knowledge of healthy eating. Moreover, even though the results were based on the pilot study, the Malaysian Food Variety Indicator (MFVI) can be used to measure food variety intake of respondents.

Implication of the Study

The Malaysian Food Variety Indicator (MFVI) can be used as a tool to measure food variety and dietary diversity scores of the population and at the same time can be used to measure nutrients adequacy. Thus, the agencies such as Ministry of Health, Malaysian Health Promotion Board, non-government agencies related to food and nutrition can use this method for their programs related to food and dietary intakes. Besides that, the individuals who are interested to measure their food intakes such as nutritionists, health practitioners, and researchers can use this method in their program and activities, in order to encourage general population on how to be more healthy by eating variety of foods.

Study Suggestion

There are some suggestions to improve the present study. Firstly, the numbers of respondents should be increased to represent the population. By increased the respondents, the results are more accurate and the bias of respondents can be reduced. Secondly, the validation of the indicator should be done by comparing the scores with other methods that were published such as dietary diversity scores, so that this indicator can be used to measure the dietary diversity score as well. Thirdly, the indicator should be used among middle and high income of respondents, in order to examine their food variety intakes and at the same time to measure their nutrient adequacy. This also can be used to compare the food variety level of different level of incomes in population. Lastly, this indicator can be used to develop the web or mobile applications, so that any people in population can use it easily without having certain instruments.

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REFERENCES

Abbott, P. (2009). Development dimensions of high food prices. *OECD Food, Agriculture and Fisheries Working Papers*. 18, Retrieved from http://www.oecd.org/agriculture/agricultural policiesandsupport/monitoringfarmsupportandevaluatingpolicy/42972908.pdf

Azadbakht, L & Esmaillzadeh, A. (2010). Dietary diversity score is related to obesity and abdominal adiposity among Iranian female youth. *Public Health Nutrition*, 14, 62-69.

Basiotis, P. P., Walsh, S. O., Cronin, R. J., Kelsay, J. L., & Mertz, W. (1987). Number of days of food intake records required to estimate individual and group nutrient intakes with defined confidence. *Journal of Nutrition*, 117, 1638-1641.

Buras, S. (2006). *The cost and availability of the thrifty food plan in Southeast Louisiana.* Louisiana State University: Master Science Thesis. United States of America.

Cannon, G. (2001). Diet related chronic disease. *Focus*, February, 1-2.

Clausen, T., Charlton, K. E., Gobotswang, K. S. M., & Holmboe-Ottesen, G. (2005). Predictors of food variety and dietary diversity among older persons in Botswana. *Nutrition*, 21, 86-95.

Darmon, N., Briend, A., & Drewnowski A. (2004). Energy-dense diets are associated with lower diet costs: a community study of French adults. *Public Health Nutrition*, 7, 21-27.

Darmon, N., Briend, A., & Drewnowski, A. (2004). Energy dense diet are associated with lower diet costs: a community study of French adults. *Public Health Nutrition*, 7, 21-27.

Drewnowski, A. (2004). Obesity and the food environment: dietary energy density and diet costs. *American Journal of Preventive Medicine*, 94, 1555-1559.

Drewnowski, A. (2005). Concept of a nutritious food: toward a nutrient density score. *American Journal Of Clinical Nutrition*, 82, 721-732.

Foote, J. A., Murphy, S. P., Wilkens, L. R., Basiotis, P. P., & Carlson, A. (2004). Dietary variety increases the probability of nutrient adequacy among adults. *Journal of Nutrition*, 134, 1779-1785.

Gibson, R. S. (2005). *Principles of nutritional assessment*. (2nd Ed). New York, NY: Oxford University Press, Inc.

Giskes, K., Turrell, G., Patterson, C., & Newman, B. (2002). Socio-economic differences in fruit and vegetables consumption among Australian adolescents and adults. *Public Health Nutrition*, 5, 663-9.

Giskes, K., Van Lenthe, F. J., Brug, J., Mackenbach, J. P., & Turrell, G. (2007). Socioeconomic inequalities in food purchasing: the contribution of respondent-perceived and actual (objectively measured) price and availability of foods. *Preventive Medicine*, 45, 41-48.

Haines, P. S., Siega, R. A. M., & Popkin, B. M. (1999). The Diet Quality Index revised: a measurement instrument for populations. *Journal of the American Dietetic Association*, 99, 697-704.

He, M., & Evans, A. (2007). Are parents aware that their children are overweight or obese? *Canadian Family Physician*, 53, 1493-1499.

Hodgson, J. M., Hsu-Hage, B., H. & Wahlqvist, M. L. (1994). Food variety as a quantitative descriptor of food intake. *Ecology of Food and Nutrition,* 32,137-148.

Johnson, R. K. (2002). Dietary intake-how do we measure what people really eating? *Obesity Research*, 10, 63-67S.

Johnson, R. K., Soultanakis, R. P., & Matthews, D. E. (1998). Literacy body fatness are associated with underreporting of energy intake in U.S. low-income women using multiple-pass 24-hour recall: a doubly labeled water study. *Journal of the American Dietetic Association*, 98, 1136-1140.

Kant, A. K., Schatzkin, A., Harris, T. B., Ziegler, R. G., & Block, G. (1993). Dietary diversity and subsequent mortality in the First National Health and Nutrition Examination Survey Epidemiologic Follow-up Study. *American Journal of Clinical Nutrition*, 57, 434-440.

Kant, A., K. (2000). Consumption of energy-dense, nutrient poor foods by adult Americans: nutritional and health implications. The third National Health and Nutrition Examination Survey, 1988-1994. *American Journal of Clinical Nutrition*, 72, 929-936.

Karupiah, T., & Swee, W. C. S. (2013). Dietary health behaviors of women living in high rise dwellings: a case study of an urban community in Malaysia. *Journal of Community Health*, 38, 163-171.

Kearney, J., & McElhone, S. (1999). Perceive barriers in trying to eat healthier-results of a Pan-EU Consumer Attitudinal Survey. *British Journal of Nutrition*, 81, 133-137S.

Kee, C. C., Jamaiyah, H., Noor Safiza, M. N., Geeta, A., Khor, G. L, Suzana, S., Jamalludin, A. R., Rahman, R., Ahmad, A. Z., Ruzita, A. T., Wong, N. F., & Ahmad, F.Y. (2008). Abdominal obesity in Malaysia adults: National Health and Morbidity Survey III (NHMS III, 2006). *Malaysian Journal of Nutrition*, 14, 125-135.

Kennedy, E. T., Ohls, F., Carlson, S., & Fleming, K. (1995). The Healthy Eating Index: design and application. *Journal of the American Dietetic Association*, 95, 1103-1108.

Kimura, Y., Okumiya, K., Sakamoto, R., Ishine, M., Wada, T., Kosaka, Y., Wada, C., Ishimoto, Y., Hirosaki, M., Kasahara Y., Konno, A., Chen, W., et al., (2009). Comprehensive geriatric assessment of elderly highlanders in Qinghai, China IV: Comparison of food diversity and its relation to health of Han and Tibetan elderly. *Geriatric Gerontology International*, 9, 359-365.

Kirkpatrick, S. I., & Tarasuk, V. (2007). Adequacy of food spending is related to housing expenditures among lower-income Canadian households. *Public Health Nutrition*, 10, 1464-1473.

Lam, Y. L., & Khor, G. L. Risk factors among coronary heart disease patients in National Heart Institute, Kuala Lumpur. *Malaysian Journal of Nutrition*, 3, 103-106.

Lazarou, C., & Newby, P. K. (2011). Use of dietary indexes among children in developed countries. *Advances in Nutrition*, 2, 295-303.

Lee, M. S., Huang, Y. C., Su, H. H., Lee, M. Z., & Wahlqvist, M. L. (2011). A simple food quality index predicts mortality in elderly Taiwanese. *The Journal of Nutiriton, Health & Aging,* 15, 815-821.

Lo, Y. T., Chang, Y. H., Lee, M. S., & Wahlqvist, M. L. (2012). Dietary diversity and food expenditure as indicators of food security in older Taiwanese. *Appetite*, 58, 180-187.

McCrory, M. A., Fuss, P. J., McCallum, J. E., Yao, M., Vinken, A. G., Hays, N. P., & Roberts, S. B. (1999). Dietary variety within food groups: association with energy intake and body fatness in men and women. *American Journal of Clinical Nutrition*, 69, 440-447.

Ministry of Health (2011). *National Health and Morbidity Survey 2011 Fact Sheet*. Putrajaya, Malaysia.

Ministry of Health. (2010). *Health facts 2008* (brochure). Putrajaya, Malaysia.

National Coordinating Committee on Food and Nutrition [NCCFN]. (2010). *Malaysian dietary guidelines*. (2nd Ed). Kuala Lumpur, Malaysia: Ministry of Health.

National Coordinating Committee on Food and Nutrition [NCCFN]. (2005). *Recommended nutrient intakes for Malaysian.* Kuala Lumpur, Malaysia: Ministry of Health.

Nelson, M., Dick, K., & Holmes, B. (2002). Food budget standards and dietary adequacy in low-income families. *Proceedings of the Nutrition Society*, 61, 569-77.

Nicklas, T. A., Baranowski, T., Cullen, K. W., & Berenson, G. (2001). Eating patterns, dietary quality and obesity. *Journal of American College of Nutrition*, 20, 599-608.

Norlaila, M. T. (2008). Preliminary study on factors contributing to obesity among married women-a qualitative approach. *Malaysian Journal of Nutrition*, 14, S14.

Pingali, P. (2006). Westernization of Asian diets and the transformation of food systems: Implications are researched and policy. *Food Policy*, 32, 281-298.

Pingali, P. (2010). Changing food systems in the developing world. In Dube, L., Bechara, A., Dagher, A., Drewnowski, A., LeBel, J., James, P., & Yada, R. Y. (Eds.). *Obesity prevention: the role of brain and society on Individual Behavior* (511-520). Burlington: Elsevier, Inc.

Rashid, D. A., Smith, L. C., & Rahman, T. (2011). Determinants of dietary quality: evidence from Bangladesh. *World Development*, 39, 2221-2231.

Rose, D.,Meershoek, S., Ismael, C., & McEwan, M. (2002). Evaluation of a rapid tool for assessing household diet quality in Mozambique. *Food and Nutrition Bulletin*, 23, 181-189.

Rousset, S., Droit-Vole,t S., & Broirie, Y. (2006). Change in protein intake in elderly French people living at home after a nutritional information program targeting protein consumption. *Journal of the American Dietetic Association*, 106, 253-261.

Ruel, M. T. (2003). Operationalizing dietary diversity: a review of measurement issues and research priorities. Journal of Nutrition, 133, 3911S-3926S.

Sarrafzadegan, N., Azadbakht, L., Mohammadifard, N., Esmaillzadeh, A., Safawi, M., Sajadi, F., Alikhasi, H., Maghroun, M., & Kelishadi, R. (2009). Do lifestyle interventions affect dietary diversity score in the general populations?. *Public Health Nutrition*, 12, 1924-1930.

Savige, G. S., Hsu-Hage, B. H., & Wahlqvist, M. L. (1997). Food variety as nutritional therapy. *Current Therapeutic*, March, 57-67.

Savy, M., Martin-Preve,l Y., Sawadogo, P., Kameli, Y., & Delpeuch, F. (2005). Use of variety/diversity scores for diet quality measurement: relation with nutritional status of women in rural area in Burkina Faso. *European Journal of Clinical Nutrition*, 59, 703-716.

Stookey, J. D., Wang, Y., Ge, K., Lin, H., & Popkin, B. M. (2000). Measuring diet quality in China: The INFH-UNC-CH Diet Quality Index. *European Journal of Clinical Nutrition*, 54, 811-821.

Tenth Malaysia Plan 2010 (2011). Malaysia Prime Minister's Department. Putrajaya, Malaysia: Economic Planning Unit.

Underwood, B. A. (1998). From research to global reality: the micronutrient story. *Journal of Nutrition,* 128, 145-151.

Vorster, H. H. (2002). The emergence of cardiovascular disease during urbanization of Africans. *Public Health Nutrition*, 5, 239-243.

Wang, W. C., Worsley, A., & Cunningham, E. . (2008). Social ideological influences on reported food consumption and BMI. *International Journal of Behavioral Nutrition & Physical Activity*, retrieved from http://www.ijbnpa.org/5/1/20

Weeks, R. (2010). Defining urban areas. In Rashed,T., & Jurgens, C. (Eds.). *Remote sensing of urban and suburban areas: remote sensing and digital image processing 10* (33-45). San Diego: Springer Science+Business Media B. V.

WHO. (2003). *Diet, nutrition and the prevention of chronic diseases*. Report of a joint WHO/FAO/Expert consultation. WHO Technical Report Series 916. Geneva, Switzerland: World Health Organization.

WHO/FAO. (1996). *Preparation and use of food-based dietary guidelines.* Geneva, Switzerland: Nutrition Programme.

Williams, T. (2004). *This=that: a life-size photo guide to food serves.* Toowong, Australia: Trudy Williams Nutrition & Dietetics Pty Ltd.

Zainal Badari, S. A., Arcot, J., Haron, S., Paim, L., Sulaiman, N., & Masud, J. (2012). Food variety and dietary diversity scores to understand the food intake pattern among selected Malaysian households. *Ecology of Food & Nutrition*, 51, 265-299.

Zhang, Q., & Chen, Z. (2008). Impact of Local Food Prices on the Relationship between Food Stamp Program Participation and Bodyweight Status of Adults in the South. In Majchrowicz, A. T. (Eds.), *RIDGE Project Summaries, 2007: Food Assistance and Nutrition Research Innovation and Development Grants in Economics Program* (pp 9-10). Washington, DC: U. S. Department of Agriculture/Economic Research Service.