

**ASSESSMENT OF NUTRITIONAL STATUS, PHYSICAL
ACTIVITY AND BEHAVIOR TOWARDS WHOLE
GRAIN CONSUMPTION AMONG OVERWEIGHT AND
OBESE WORKING ADULTS IN KOTA BHARU
KELANTAN.**

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ABSTRAK

Penilaian status pemakanan, fizikal aktiviti dan tingkahlaku terhadap pengambilan bijirin penuh telah dijalankan ke atas 104 pekerja pejabat yang berlebihan berat badan dan obesiti di 10 pejabat kerajaan di Kota Bharu, Kelantan melalui kaedah kajian keratan rentas. Data dikumpulkan dengan menggunakan borang soal selidik sosio-demografi, borang tingkahlaku pengambilan bijirin penuh, borang aktiviti fizikal antarabangsa (IPAQ) dan borang ingatan diet 24 jam. Indeks jisim badan (BMI) dan ukurlilit pinggang telah diukur. Majoriti umur responden adalah 45 tahun dan dalam kalangan perempuan (64.4%). Min berat, dan BMI adalah masing-masing $76.98 \pm 9.92 \text{ kg}$, dan $30.77 \pm 3.80 \text{ kg/m}^2$. Prevalans mereka yang berlebihan berat badan adalah 56.2% dan 53.8% adalah obesiti. Risiko tinggi untuk obesity abdominal dan peratus lemak badan masing-masing 77.9% dan 81.7%. Sebanyak 29.8% responden mempunyai tahap fizikal aktiviti rendah, manakala 56.7%, 13.5% mempunyai tahap fizikal yang sederhana dan tinggi. Min kalori responden adalah $1814 \pm 674.6 \text{ kcal}$, 55% daripada karbohidrat, 14% daripada protein dan 31% daripada lemak. Manakala, min pengambilan harian bijirin penuh adalah 2.37 ± 1.71 manakala min saiz hidangan adalah 4.64 ± 2.73 . Majoriti responden mempunyai 68.3% positif tingkahlaku dan 78.8% mempunyai neutral tanggapan terhadap pengambilan bijirin penuh. Terdapat perkaitan linear yang significant diantara faktor umur ($b = -0.1$, 95% CI = -0.17, -0.02, $P < 0.05$) dan tenaga ($b = 0.002$, 95% CI = 0.00, 0.003, $p < 0.05$) dengan BMI, bilangan anak ($b = -0.015$, CI = -0.057, 0.028 $P < 0.05$) dengan ukurlilit pinggang dan pengambilan lemak ($b = 0.000$, 95% CI = 0.000, 0.000 $P < 0.05$) dengan peratus lemak dalam badan.

ABSTRACT

Assessment of nutritional status, physical activity and behavior towards whole grains consumption was carried out on 104 overweight and obese office workers by using a cross sectional study at ten government offices in Kota Bharu, Kelantan. Data was collected using questionnaire encompassing socio-demographic characteristics, behavior towards whole grains, International Physical Activity Questionnaire (IPAQ), and 24 hour dietary recall. Body Mass Index and waist circumference, were measured in order to assess their nutritional status. Majority of respondents was 45 years and 64.4% were females. The mean weight and BMI were 76.98 ± 9.92 kg, and 30.77 ± 3.80 kg/m², respectively. The prevalence of overweight and obesity were 56.2% and 53.8% respectively. High risk of abdominal obesity and body fat percentage were 77.9% and 81.7% respectively. A total of 29.8% of respondents had low physical activity level, while 56.7% and 13.5% were in moderate and high physical activity categories respectively. The mean calorie intake of respondent was 1814 ± 674.6 kcal, with 55% from carbohydrate, 14% from protein intake and 31% from fat. The mean of daily consumption of whole grain in a week and serving size of respondent were 2.37 ± 1.71 and 4.64 ± 2.73 respectively. Majority of respondents have (68.3%) of positive behavior towards whole grain and 78.8% have neutral perception towards whole grain. Significant linear relationship was found between age ($b = -0.1$, 95% CI = -0.17, -0.02, $P < 0.05$) and energy intake ($b = 0.002$, 95% CI = 0.00, 0.003, $p < 0.05$) with BMI, number of children ($b = -0.015$, CI = -0.057, 0.028 $P < 0.05$) with waist circumference and fat intake ($b = 0.000$, 95% CI = 0.000, 0.000 $P < 0.05$) with percentage of body fat.

CHAPTER 1: INTRODUCTION

1.0 Introduction

1.1 Background of the study

Overweight and obesity was defined as the abnormal or excessive fat accumulation that can causes impair in health (WHO, 2015). Overweight and obesity can be defined by Body Mass Index (BMI) which can be calculated using formula weight in kilograms/height in meters squared. Although BMI is not a measure of body fatness, but a person who classified as obese tend to have an excess of body fat (Control & Prevention, 2009). BMI greater than or equal to 25 kg/m² is classified as overweight for obesity if BMI is greater or equal to 30 kg/m² (WHO, 2015).

Worldwide prevalence of obesity has been doubled since 1980. In 2014, more than 1.9 billion adult population 18 years and older were overweight and over 600 million were obese. About 13% of the world's adult population with 11% of men and 15% of women were obese. Furthermore, 39% of adult aged 18 years and above, 38% of men and 40% of women were overweight (WHO, 2015). Based on National Health and Nutrition Examination Surveys (NHANES) years 2011-2014 the prevalence of obesity was 36.5% among U.S adults during 2011-2014 overall aged in middle aged 40-59 (40.2%) and older adults aged 60 and over (37.0%) was higher than among young adults aged 20-39 (32.3%). In term of gender, obesity was higher among women (38.3% than men (34.3%). Among both men and women, the prevalence of obesity according to age of men 40-59 (38.3%) higher than men aged

20-39 (30.3%). While women aged 40-59 (42.1%) higher prevalence of obesity than women aged 20-39 (34.4%) (Ogden, Carroll, Fryar, & Flegal, 2015).

The prevalence of overweight and obesity among shift workers are 49% and 11%, on call workers are 45% and 10% and day worker are 49% and 6% respectively (Nigatu *et al.*, 2016). Highest prevalence of overweight and obese among shift workers because of the disruption of biological rhythms, lifestyle changes and social isolations happened among workers. The effects of weight gains among shift workers also because of the poor sleep quality, shorts sleep and long duration of working hours which could increases fatigue (Scheer, Hilton, Mantzoros, & Shea, 2009).

Overweight and obese worker are associated with the low performance by decrease productivity, more frequency of absenteeism and long term sick leave and also effect the organisations by cost of absenteeism, loss productivity and disability. On the other hands, obese and overweight are associated with the health such as poor general health, poor mental health, poor sleep quality, high stress levels and poor vitality (van der Starre, Coffeng, Hendriksen, van Mechelen, & Boot, 2013).

Physical activity is defined as any bodily movement that produced by skeletal muscles required energy expenditure. Physical inactivity has been identified as causes of risk factor global mortality estimated 3.2 million of death globally (WHO, 2010). Based on National Health and Morbidity Survey, 2011 about 64.8% (11.4 million) of adults aged 18 years were physically active (IPH, 2008). The prevalence of physical activity based on 20 countries was low among women than male.

Physical activity was reported as low among 7-41% among females (Bauman, Allman-Farinelli, Huxley, & James, 2008).

Physical inactivity leads to 10 risk factors for death worldwide. Globally, 1 in 4 adults is not physically active. Moreover, around 23% of adults aged 18 and over were not active in 2010 (men 20% and women 27%). Across all regions, women were less active than men. The highest prevalence of insufficient physical activity is 31 % in Eastern Mediterranean Region, and 32% in Americas Regions while South-East Asia (15%) and African 21% were the lowest prevalence of insufficient physical activity (WHO, 2010).

Based on the study O'Neil *et al.*, (2010), the higher intake of dietary fibre are inversely associated with long term of weight gain. Furthermore, fibre intake also associated with improving the serum cholesterol, blood sugar control and blood pressure. Based on epidemiologic studies on dietary fibre, consumption of fibre such as unrefined, high fibre carbohydrates foods can helped in against chronic disease such as diabetes, cancer, heart disease and obesity (Slavin, 2005). Increasing dietary fibre intakes can assist in reducing body weight in adults, especially dietary fibre from the grains such as whole grains product (Du *et al.*, 2010). Dietary fibre is a total fibre that consists of non-digestible starch with lignin and functional fibre. Non digestible carbohydrates have beneficial for physiological effects in human body while, functional fibre consist of isolated (Slavin, 2005).

Whole grains are seeds that composed of three part including endosperm, bran and germs after removing inedible parts hulk and husk (Ferruzzi *et al.*, 2014).

In the USA, major consumption of whole grain products are wheat, oats, rice, maize and rye (Slavin, 2004). Based on USDA's Pyramid serving data base, foods that classified as whole grain include grains products namely, barley, buckwheat, bulgur, corn bran, popcorn, oats, whole wheat, brown rice, and rye (Linda, 2000).

The recommended serving size of whole grains consumption daily are half of the grains products which means three servings of whole grains, equally to 48g per days (Malaysia Dietary Guidelines 2010). According to Micha *et al.*, (2015), only 7.6% of adults population consumed more than 2.5 servings of wholegrain products perday.

1.2 Problem statements

The prevalence of overweight and obesity among Malaysian adults, female and male has reached an epidemic. According to Khambalia & Seen (2010), overweight and obesity in Malaysia are increasing in 1996 was 20.7% and rise up to almost 30.0% after 13 years of the survey, whereas obesity rise up from 5.5% in 1996 to 14.0% in 2009. Furthermore, overweight and obesity were highest among adults 40-59 years and among Indians followed by Malay, Chinese and Aborigines.

Based on the Malaysian National Health and Morbidity Survey (NHMS, 2006) male adults who are overweight is 20.1% while obese 4.0%. Then, the prevalence obesity of female adults increased from 7.6% in 1996 to 17.4% in 2006 (Kee *et al.*, 2008). Meanwhile prevalence of overweight and obesity among adults in Malaysia was reported from MANS and NHMS between 2000 and 2013, the results shown increasing trend. The prevalence of overweight increased from 26.7% in 2003

was reported by MANS to 29.1% 2006 by NHMS III and to 29.4% by NHMS IV. While the prevalence of obesity was reported 12.2% in 2003 by MANS 14% in 2006 by NHMS III and 15.1% in 2011 NHMS IV (Mohamed *et al.*, 2014). Therefore, obesity is one of the burden of health because can increase incidence of diabetes, CVD and also some types of cancer (Wan Nazaimoon *et al.*, 2011).

Obesity increase risks of chronic disease such as diabetes mellitus, hypertension, cardiovascular disease, metabolic syndrome and associated risk factors such as high cholesterol, high low density lipoprotein, low high density lipoprotein, high triglycerides and high waist hip ratio and waist circumference (Ng, Zaghloul, Ali, Harrison, & Popkin, 2011).

Abdominal obesity is a risk factors for chronic illness such as cardiovascular disease, diabetes mellitus and breast cancer (Balkau *et al.*, 2007). Abdominal obesity is determined by as waist circumference measurement (Han, Sattar, & Lean, 2006). And it is also a better indicator associated with risk of cardiovascular disease, and diabetes mellitus (Wittchen *et al.*, 2006).

As evidence in the World Health Survey, 18% of population in 51 countries were physically. Surprisingly, physical inactivity among Malaysian was higher than (16.5%) population in western pacific region countries (Guthold, Ono, Strong, Chatterji, & Morabia, 2008). The prevalence of sedentary lifestyle increased steadily with in younger age adults was 54.6%, 58.9% in aged 35-54 years old and 61.9% in older adults aged greater than or equal 55 years. Moreover, women (64.9%) were more sedentary than men (59.1%) (Control & Prevention, 1993). While in Malaysia prevalence of physical inactivity was 39.7% which was higher among women

(422.6%) than men (36.7%). This happened because majority of the population spent their time 74% in sedentary activities such as sleeping or lying down (Poh *et al.*, 2010).

In Malaysia about 40% obesity of population were employed because of the changes in worked related lifestyle contributed working adults become overweight and obesity such as computerization and mechanization (Cheong, Kandiah, Chinna, Chan, & Saad, 2010). Besides, working environment also important factors that associated with weight gain such as dietary patterns, physical activity, and weight control behaviours (Cheong *et al.*, 2010). Majority of office workers spent large amount of time through sitting such as working at desk and using computer (Jans, Proper, & Hildebrandt, 2007).

1.3 Research objective

1.3.1 General objective:

To assess the nutritional status, physical activities and behaviour towards whole grain consumption among an overweight and obese working adults in Kota Bharu, Kelantan.

1.3.2 Specific objectives:

1. To evaluate the association between dietary intake with Body Mass Index (BMI) among overweight and obese working adults in Kota Bharu, Kelantan.
2. To assess association between level of physical activity with Body Mass Index (BMI) among overweight and obese working adults in Kota Bharu, Kelantan.

3. To describe behaviour towards whole grain consumption among overweight and obese working adults in Kota Bharu, Kelantan.
4. To predict factors associated with nutritional status among overweight and obese working adults in Kota Bharu, Kelantan.

1.4 Research Questions

Is there any association of socio demographic with nutritional status (BMI, waist circumference and percentage body fat) among overweight and obese working adults in Kota Bharu, Kelantan.

1.5 Hypotheses

1.5.1 Null hypothesis (H_0)

There is no association between socio demographic with nutritional status (BMI, waist circumference and percentage body fat) among overweight and obese working adults in Kota Bharu, Kelantan

1.5.2 Alternative hypothesis (H_A)

There is an association between socio demographic with nutritional status (BMI, waist circumference and percentage body fat) among overweight and obese working adults in Kota Bharu, Kelantan?

1.6 Significant of study

Kelantan is the one of the state in east coast of Peninsular Malaysia and this location was chosen due to high prevalence of overweight adults. One of the fifth adult Malaysian population's health are poor and this prevalence are increasing by

age and its association with the chronic diseases among adults (Chan *et al.*, 2015). Individual's nutritional status is influenced by their regular food intake, amount of food they intake and the nutrition contents of the foods. So the nutritional status is very closely influenced by dietary foods intake which would reflected by body mass index and waist circumferences (Ahmed & Siwar, 2013).

Working adults are selected in this study as sample due to significant global epidemic of obesity among occupational related worker. In workplace, obese worker was related to the lower productivity and increase of the need in support service and management of disability. This is due to the work environment which stimulated overweight and obesity such as job stress, shift work and long work hours apart from dietary (Borak, 2011).

Other working environment factors that influenced obesity include fatigue, no movements, sleeping problems and stress. Apart from that, obesity and overweight were associated with absent, and sick leave (Starre *et al.*, 2013). Sedentary activities are very common among working adults because of the large amount of time are spent in sitting such as working at a desk and using computer. Moreover, workplace environment such as exercise equipment are important factors that can influence the physical activity behaviours in order to control weight gains (Cheong *et al.*, 2010). The energy content of food was derived from macronutrients such as carbohydrates, fat and protein, but reduce energy from fat was effective method in reducing the prevalence of obesity (Hession, Rolland, Kulkarni, Wise, & Broom, 2009; Willett, 2002). Dietary factors related to overeating and obesity such as dietary fat leading causes of weight gain (Roberts *et al.*, 1998; Willet, 2002). However, diet in low carbohydrates enhance weight loss (Eisenhauer, 2007). For

instance, in Malaysia white rice (cooked rice) was consumed by 97% of population which twice daily average 2 1/2 plates per day (Norimah *et al.*, 2008). The consumption of whole grain intake among adults in US population were very low which more than 70% of adult failed to consume whole grain which is less than 5 % consume three or more serving of whole grain (O'Neil *et al.*, 2010). Knowledge about the nutritional contents in the foods are low, thus health concern and nutritional content were important factors in choosing foods. (Muhihi *et al.*, 2012).

Whole grain is one of the grain products that have high nutrients contents than refined and enriched grains which are about 10-14% are bran, 2.5-3.0% is germ and 80-85% is endosperms. Each of the parts of whole grains has nutrients content that can give health benefits for body. For examples, contents of whole grains bran have 45% of dietary fibre and 7% of bioactive components and 52% of fractions. While in germ there have 18% fibre, 6% bioactive components and 24% fractions (Fardet, 2010). In whole grains there have many protective components for digestive tract such as insoluble fibre, hormonal, antioxidants, anti-inflammation, anti-carcinogenic and cell signalling (Fardet, 2010). All of these components can help in reducing chronic disease such as CVD, types 2 diabetes mellitus, cancer and obesity (Slavin, 2004; Ferruzzi *et al.*, 2014; Ye, Chacko, Chou, Kugizaki, & Liu, 2012).

1.7 Conceptual Framework

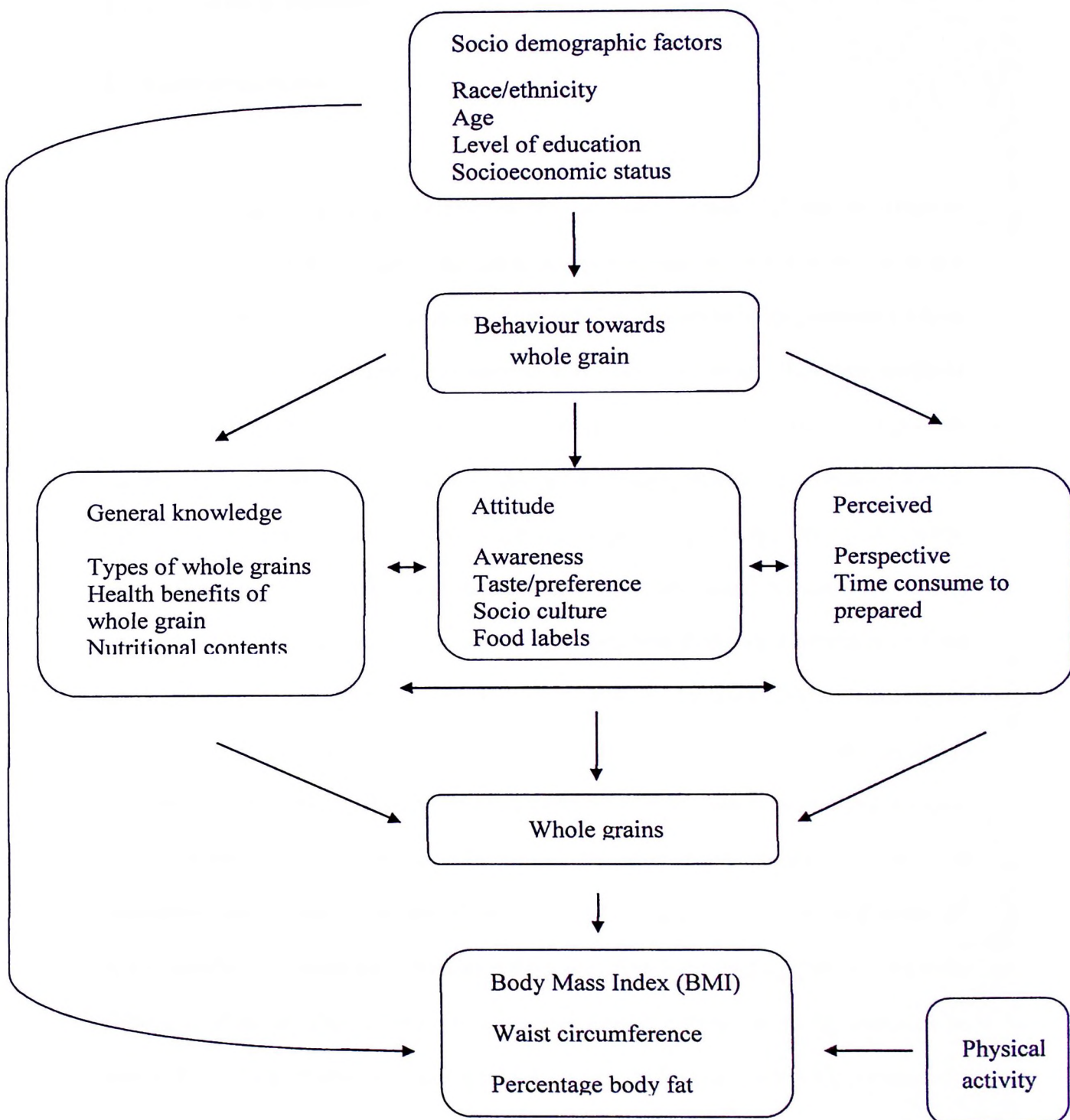


Figure 1.1: Conceptual Framework

CHAPTER 2: LITERATURE REVIEW

2.0 Literature Review

2.1 Nutritional status

Nutritional status is defining as the sufficient intake of diet to meet or exceeds of individual that can helped in keep the composition and function of health within the normal range. The process of equilibrium occurs in three processes which are decrease intake, increased requirements and alter utilization. However, lacks of nutrients will causes the changes in metabolic in relation to energy and protein metabolism. So, the malnutrition can cause consequences of altered intakes, functional changes and also anthropometric changes (Jeejeebhoy, Detsky, & Baker, 1990). Moreover, the nutritional statuses of people are based on the food intake regularly. In other words, the proper nutrition are based on exact amounts of food while excessive food intake can causes over nutrition but when too low amount of food results under nutrition (Ahmed & Siwar, 2014). Furthermore, nutritional status are very closely with the dietary fat intake (Bogers, Brug, van Assema, & Dagnelie, 2004). However, people are generally believe that high intake of fat constitutes with unhealthy diet and risk to health. Therefore, consuming the low intake of dietary fats make people feel goods and this can reflect intention for reducing dietary fat intake (Yong, Zalilah, & Yap, 2009). On the other hands, nutritional status also can be assess by anthropometric measurements by detect of loss or gain body components before and after of measurements (Jeejeebhoy *et al.*, 1990).

The dietary fat intake accuracy of female (52.7%) are higher than males (41%) while based on the under estimate dietary fat intake male (42.8%) are higher than female (32.9%) but there were not significant between male and female who over estimate dietary fat intake. Furthermore, dietary fat intakes effect the nutritional status based on BMI and WC. The mean of the BMI on accurate estimators (24.1 kg/m²), over estimator (25.8kg/m²) and under estimator (24.1kg/m²). The person who over estimate their dietary intake are significantly highest in mean BMI than accurate and under estimate and also significantly with the obese and overweight. Moreover, the adjustment of means of WC also higher among who are over estimator their dietary fat intake (Ahmed & Siwar, 2014).

Nutritional knowledge is an importance aspect to improve the nutritional status by healthy eating such as high in vegetables, fruits and lowest the fat intakes (Wardle, Parmenter, & Waller, 2000). Furthermore, nutritional knowledge is an importance aspects to reflect dietary behaviours for weight loss such as by avoiding high fat intake (Elder *et al.*, 2000), by changes into healthy eating cooking methods (Kennedy, Hunt, & Hodgson, 1998) improving knowledge by reading labels and reduced consumption of high energy and high fat foods (Kessler & Wunderlich, 1999). There are various of studies stated that improved the nutritional knowledge were importance factors in order to improves attitudes, beliefs for consumption of healthy diet for health status (Agurs-Collins, Kumanyika, Ten Have, & Adams-Campbell, 1997; Carson, Gillham, Kirk, Reddy, & Battles, 2002).

2.2 Physical activity of adults

“Physical activity is defined as any bodily movement that produced by skeletal muscles that required energy expenditure” (WHO, 2010). Exercises are healthy lifestyles that can influence the habits of food intake and there has many advantages such as helping in reducing risks of various diseases. Furthermore, physical activities are beneficial by increasing the fitness of the body and the well-being of the brain (WHO, 2005). Furthermore, regular and adequate level of physical activity in adults can help in reducing the risk of non-communicable disease such as hypertension, coronary heart disease, stroke, diabetes, breast, colon cancer, improve bone and functional health also key for energy expenditure and base for energy balance and weight control (WHO, 2010). On the other hand, physical activity are associated with the longevity (I.-M. Lee & Paffenbarger, 2000) and lower rate of disability (Schroder *et al.*, 2004)

Reducing intensity of physical activity because of the increased mechanisation at work, during travel at leisure and in the home (Livingstone, Robson, Wallace, & McKinley, 2003). Globalization in developing and developed countries led to physical inactivity (WHO, 2003). Physical inactivity was risk factor of variety chronic disease such as diabetes mellitus, colon, and breast cancer, cardiovascular disease, obesity, hypertension, bone and joint diseases and also depression (WHO, 2003). Factors associated with decreased of physical activity in Malaysia, such as industrialisation and urbanisation causes increase more sedentary lifestyle among Malaysian and also increase of dietary intakes (Azmi *et al.*, 2009). According to NHMS II, only 11.6% of adults were doing regular physical activities and according to gender, men was twice (16.2%) doing physical activity than women

(7.7%) only (IPH, 1999). Moreover, NHMS 111 stated that 43.7% of adults were physically inactive with 35.5% men and 50.5% women (IPH, 2008). According to WHO, 2008 Malaysia has lower prevalence physical inactivity 19.6% among women (23.2%) and men (16.0%). In Malaysia, A third of reported having ever exercise, 14% had exercise, majority of population spending 74% of the day in sedentary activities, 15% of the day light intensity activities and 10% of the day doing moderate to vigorous intensity activities (Poh *et al.*, 2010).

In adults physical activity are very important aspect that they needed to be consider as habits in order to improve the cardiorespiratory and muscular fitness, bone health, and reduce risk of NCDs. Examples of physical activity are walking, dancing, gardening, hiking, swimming, cycling and doing household chores (WHO., 2010). Light or moderate activity defined as activity about 10 minutes can cause light sweating or slightly increased heart rate while vigorous activity can cause heavy sweating and heart rate (Barnes, Schoenborn, & Statistics, 2003). Moreover, the recommendation of physical activity for adults at least 150 minutes of moderate intensity activity in a week and at least 75 minutes of vigorous intensity activity a week and for muscle strengthening activities at least 2 or more days a week. Furthermore, for the health benefits adults needed to increase their moderate intensity activity to 300 minutes per week and 150 minutes for vigorous intensity activity (WHO, 2010).

2.3 Obesity and workers

Risk of BMI are more likely to have health risk, short term disability and illness absence and also higher healthcare cost (Burton, Chen, Schultz, & Edington, 1998). Furthermore, obesity also associated with the decreased productivity of work by limitations of work especially based on time to completed the tasks, ability to perform physical job demand and increasing the annual cost for loss productivity per worker (Gates, Succop, Brehm, Gillespie, & Sommers, 2008). Moreover, obese worker are significantly associated with the loss productivity time than normal weight or overweight, where caused the high cost of loss productivity time of workers (Ricci & Chee, 2005). Furthermore, obesity is an important driver of cost in workplace such as obese employers had higher sick leave or disability use, workplace injuries, health care cost based on claims (Schmier, Jones, & Halpern, 2006). On the other hand, increasing of obesity can effect the medical spending of the growth over time between 1978 to 2001, 12% for obesity alone, 38 % spending for diabetes, 22 % for hyperlipidemia, 41 % for heart disease (Thorpe, Florence, Howard, & Joski, 2004).

Abdominal obesity is a key of central adiposity and risk factors of cardiovascular disease, hypertension and diabetes mellitus in adults and based on NHMS III abdominal obesity was determined based on the waist circumference (Kee *at al.*, 2008). Abdominal (central) obesity is the main of deposits of body fat at abdomen (intra-abdominal or visceral) and upper body region. Furthermore, this body fat mass is influenced by gender, age, ethnicity, level of energy balance, composition of diet, level physical activity and socio factors (Bouchard, Bray, & Hubbard, 1990). There were several way to measure abdominal obesity but the most

convenient method in waist circumference in order to identify overweight and abdominal obese (Lean, Han, & Deurenberg, 1996). The cut of point waist circumference based on Asian population was men >90 cm and women >80 cm (WHO/IASO/IOTF, 2000). However, waist circumference measurement of adult is part of nutritional status of Malaysian population (IPH, 2008). The prevalence of abdominal obesity among Malaysia adults was 17.4% and highest among women (26.0%) compared with men (7.2%). The prevalence was steadily rise with age and with those already married (Kee *et al.*, 2008).

2.4 Sitting time and obesity

Sedentary behaviours is others definition of sitting time involves activities with a very low energy expenditure (1.0-1.8 metabolic equivalents MET), sitting or supine position (Bertais *et al.*, 2005; Hu *et al.*, 2001; Jakes *et al.*, 2003; Kronenberg *et al.*, 2000; Salmon, Bauman, Crawford, Timperio & Owen, 2000). Furthermore, nowadays, almost all of jobs involve sitting at work. Sitting time at work is determine largely by nature of the work such as workers in occupations and sectors have long period of sitting and causes lack of activity by sitting less during their leisure time. However, workers who are less sitting during works causes spend more time sitting during leisure time (Jan *et al.*, 2007).

Works are major source of sedentary behaviours by one third to one half of their workday sitting down (Jans *et al.*, 2007; Miller & Brown, 2004; Mummery, Schofield, Steele, Eakin, & Brown, 2005; Nang *et al.*, 2015). Workers tends to spend sitting time during works 7 hours per day by 2 hours of this time involved at

work and travelling to, from work (Jans *et al.*, 2007). However, occupational sitting time was differs for every worker in different occupations (Dunan, Badland, & Mummery, 2010; Jakes *et al.*, 2003; Jans *et al.*, 2007).

Global prevalence of overweight and obesity was rise 23.2% and 9.8% respectively (Kelly, Yang, Chen, Reynolds, & He, 2008). The prevalence of obesity was rise but not associated with decline leisure time physical activity alone but is possibly influenced by increase in sedentary behavior (Allman-Ferinelli, Chey, Merom & Bauman, 2010; Bauman *et al.*, 2008). Sedentary behavior may associate with overweight and obesity by occupational sitting, leisure time sitting and TV viewing (Proper, Singh, Van Mechelen & Chinapaw, 2011; Thorp, Owen, Neuhaus & Dunstan, 2011; Van Uffelen *et al.*, 2010).

2.5 Dietary intake and obesity

The energy content of food was derived from macronutrients such as carbohydrates, fat and protein, but reduce energy from fat was effective method in reducing the prevalence of obesity (Hession *et al.*, 2009; Willett, 2002). On the other hand, dietary energy from protein associated with weight loss and prevents weight gain (Claessens, Van Baak, Monsheimer & Saris, 2009; Lejeune, Kovacs & Westerterp-Plantenge, 2005; Skov, Tuoubro, Ronn, Holm & Astrup, 1999; Weigle *et al.*, 2005; Westerterp-Plentenga, Lejeune, Nijs, Van Ooijen, & Kovacs, 2004). This happened because diet high induced thermogenesis (Mikkelsen, Toubro, & Astrup, 2000), increase satiety (Astrup, 2005; Weigle *et al.*, 2005) and decreased hunger (Skov *et al.*, 1999). However, dietary carbohydrates intake was not associated with BMI (Ma *et al.*, 2005). But diet in low carbohydrates enhance weight loss (Agatston, 2003; Eisenhauer, 2007).

Dietary factors related to overeating and obesity such as dietary fat leading causes of weight gain (Roberts et al., 1998; Willet, 2002). Moreover, energy intake was affected by eating patterns such as associated by lower meal and snack frequencies, energy densities and portion consumed (Bellisle, McDevitt, & Prentice, 1997; Huang, Roberts, Howarth, & McCrory, 2005; Kirk, 2000). In Malaysia white rice (cooked rice) was consumed by 97% of population which are twice daily average 2 1/2 plates per day (Norimah, *et al.*, 2008). The consumption of whole grain intake among adults in US population are very low which are more than 70% of adult failed consume whole grain which is less than 5 % consume three or more serving of whole grain (O'Neil *et al.*, 2010).

2.6 Whole grain

Grain is the one of wide variety of based product that consume by whole population in worldwide, come from the Poaceae family or grass family fruits and also known as kernel, seed and caryopsis and this food products are divided by three types because of the different processing methods. These grains products are including refined grains, whole grains and enriched grains (Dietary Guideline for American, 2010). However, based on Van der Kamp et al., (2014) whole grains are products that come from Poaceae family and divided by three types of grains, included cereals, Pseudocereals and wild rice. Hence, examples of cereals products are wheat, rice, barley, maize, rye, oats, millets, sorghum, teff, triticale, canary seed, fonio, and for the pseudocereals are amaranth, buckwheat and quinoa. But amaranth, quinoa and buckwheat are not from Poaceae family but there have similar characteristics of the cereal grains. Furthermore, Slavin, (2004) stated the examples

of whole grains are wheat, oats, rice, maize, rye, barley, triticale, sorghum, and millet. While based on Hernot *et al.*, (2008) whole grains are including barley, corn, oat, rice and wheat that have three main fractions which are endosperm, germ and bran.

Definitions of the whole grains are different based on the country whereby based on AACCI, (1999) definitions are all cereals and pseudocereals grains are whole grains. While based on the Institute of Grocery Distribution, (2007) whole grains are all cereals and generally accepted pseudocereals. Additionally, Healthgrain,2010 stated all cereals and pseudocereals grains are whole grains (Asp, Poutanen, Richardson, & Van der Kamp, 2010).

Refined grains are food based products that already undergo milled process method by removed the bran, germ and only starchy part are left and low in nutrients content in order to help in long shelf life and finer texture. The nutrients that lose during milled process are dietary fibres, iron, and B vitamins (Dietary Guideline for American, 2010). Furthermore, based on (Radhika, Van Dam, Sudha, Ganesan, & Mohan, 2009) refined grains are including foods that removed the bran and germ and loss of the dietary fibre, vitamins and minerals. Therefore, examples of refined foods are polished white rice, vermicelli, biscuits, white bread, white flour, and semolina. While enriched grains are products from refined grains but added some of nutrients contents such as B vitamin and iron that loss during milled process (Dietary Guideline for American, 2010).

Whole grains are seeds that composed of three parts including endosperm, bran and germ after removing inedible parts hulk and husk. In 2006, AACCI

definition states that whole grains are “ intact, ground, cracked or flakes fruit of the grain whose principle components, the starchy endosperm, germ and bran, are present in same relatives proportions as they exist in the intact grain” was adopted by the United State Food and Drug Administration (FDA), (Ferruzzi *et al.*, 2014; Moura, Lewis, & Falk, 2009). Furthermore, whole grains defines as “the grains that consist of the intact, ground, cracked or flaked kernel after removal of inedible parts such as hull and husk” but still consist of component such as endosperm, germ and bran. This definition was same because of the some of the components are losses during processing method such as <2% of the germ, <10% of bran, but it still need to allows but during further process such as baking, malting and fermentation might be determined type of the grains either it is whole grain, refined grain and fortified grains (Ferruzzi *et. al*, 2014).

Whole grains are more better than refined grains because it was rated as more healthier, more natural, more balance in nutritional value, more filling, energy was release by slowly and more digestible. Furthermore, during refined process the bran and germ was removed thus, causes lowering the nutrient such as vitamin, mineral, antioxidant, fibre, phytophenolic acid and phytoestrogen but rich only in starch (Simha, 2005). Furthemore, based on Hernot *et al.*, (2008) whole grains have more nutrients and phytochemicals than refined grains to helps in against chronics diseases because prebiotics effects of whole grains make it more digestible than refined grains.

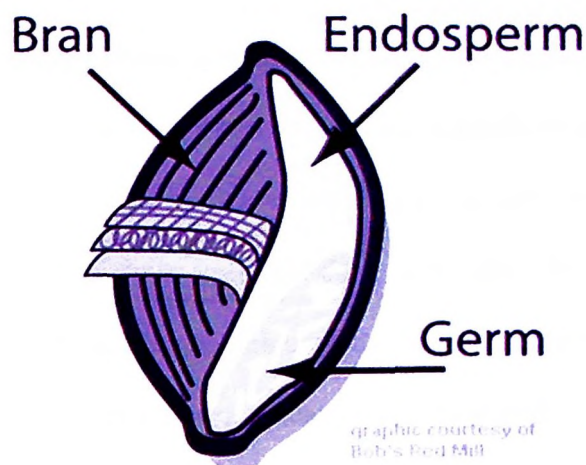


Figure 2.1: whole grains

(Smith, n.d)

Whole grain consists of three parts including bran, endosperm and bran which are not removing during the milling process. This whole grain consist a lot of the nutrient value compared in refined grains. The bran is one part of whole grain that is fibre rich outer layer and tough enough to protect endosperm and embryo and consisted antioxidants, B vitamin and fibre. While germ is the embryo that responsible for germinate. And consisted of B vitamin, protein, mineral and healthy fat (smith, n.d). These two parts are removed when milling process to longer shelf life. These parts also have basic amino acid, phytochemicals that responsible act as antioxidants (Simha, 2005).

While endosperm is the most carbohydrates supply, protein, mineral and vitamin in whole grains and consist energy benefits for the whole grains for germination by give water and nutrient for the whole grains and give energy to development of sprouts up for the sunlight and photosynthesizing process (Smith, n.d.). About 50-70 % of whole grain is starch, 8-18% is protein and few vitamin and mineral but low in fibre (Simha, 2005).

There are some studies about how to recognize whole grain products based on the food labelling are the foods that list as the first ingredient on the food label (Gaskins *et al.*, 2010). Then other ways are by looking at amount of the fibre content in per serving either it is in total fibre, insoluble fibre or soluble fibre, example of the fibre content in each 100g of the whole grains products are for the brown rice about 3.5g, wild rice 6.2g, corn 7.3g, oats 10.6g, wheat 12.2g, amaranth 15g, rye 15.1g and barley 17.3g (He *et al.*, 1995; USDA, 2016). Furthermore, according to Ferruzzi *et al.*, (2014) whole grain items that already added bran, germ and fibre and products with 25% and >51% or more whole grain weight, also from the 'dark' breads. While in British the words whole grain and whole meal are used to describe flours and foods from the whole grain, specifically the wholemeal are used to for the flour and bread regulations (Instruments, 2016).

Dietary Guideline for American, (2010) recommended at least half of grain products should be whole grain instead of refine grain food. Therefore, among American less than 5% who consumed whole grain but in average they eat less than 1 ounce per day. In Malaysia the recommended amount of whole grain at least half of grain product from whole grain which means that at least three to four serving of whole grains products needed to be consume per day (Malaysia Dietary Guidelines, 2010). While in Canada the recommendation amount of whole grain is at least half of grain product each day or three serving whole grain product such as barley, brown rice, oat, quinoa and wild rice. On the other hand, in Denmark and Sweden minimum recommendation intake are 75 g for 2400 calories intake while 63g for 2000 calories intake. In Singapore "eat at least one serving of whole grain per day such as brown rice or wholemeal bread" (Whole Grain Council, 2014).

Based on the Higgins, (2007) stated that in Food guide pyramids was advised to eat 6- 11 serving of grains and most of that need to be whole grains. In American less than 8% of the adults consume whole grains 6.7 serving which means least three serving per day. While based on National Health and Nutrition Examination Survey (NHANES), from 1999-2000 only 6% of women consume whole grain three and more per day while 30% are not consume whole grain at all, whereas in 2001-2002 less than 10% was whole grain that consumed (O'Neila *et al.*, 2010).

The serving size of the whole grains are different based on the types of the whole grains which are $\frac{1}{2}$ cup (97g) of cooked brown rice and $\frac{1}{2}$ cup (117g) cooked oat these foods can be a single serving that need to be consumed per day. While actually brown rice will give 26g of whole grain per serving and oatmeal 17g per serving of whole grain this types of foods are different because oatmeal are in dry matter. Furthermore, the weight recommendation of the whole grain consumption about 48g per day means three serving of whole grain and each of serving 16g foods (Ferruzzi *et al.*, 2014).

Based on the global population of the whole grains consumption among adults only 7.6%, means more than 2.5 serving per day (Micha *et al.*, 2015). Furthermore, based on O'Neila *et al.*, (2010) studied adults in US who are age 19 until 50 years old consume 0.63 serving while age 51 and above consume 0.77 serving per day of whole grain and percentage adults who consume whole grain more than 3 serving was 4.9% for age 19 until 50 years old and 6.6% for age 19 until 50 years old. Then about 72% adults consumed whole grain foods less than 0.6 serving per day.

Based on Norimah *et al.*, (2008) in Malaysia the consumption of whole grain among adolescent age 13 and 14 years old was low than Malaysian dietary guideline 2010 which are only 0.14 g serving for male while for female 0.24g serving per day, while for the children age 2 until 19 years old who consume whole grain as regular basic are only 9% (Koo, K, & Ruzita, 2015). To my knowledge, there are no published studies on consumption of whole grain among adults in Malaysian.

The common barriers of the consumption of whole grains are appearances of foods, cost, taste, texture, lack of knowledge of benefits of whole grains, and also cannot identify the whole grains foods (Koo *et al.*, 2015). While according to Simha, (2005) the most common factors that affected whole grain consumption are inability identify whole grain, taste, cost, family eating habits or culture practice, lack of knowledge of benefits of whole grains.

Then same factors are proved by McMackina, Deana, Woodsidea, & McKinley, (2012) said the barriers of increasing consumption of whole grains because of a few factors such as sensory practices, knowledge to identify, health belief, cost, and social factors such as family culture practices. Other studies from Ferruzi *et al.*, (2014) also explained the same barriers consumption of whole grains which are taste, culture practice, knowledge to identify, health belief, and cost. Previous studies there also same barriers for consumption of whole grain such as lack of knowledge, inability identify, cost, taste, and time prepared of whole grain (Ruxton & Derbyshire, 2014).

While based on the Larson *et al.*, (2010) the factors that always low consumption of whole grain are based on the social cognitive theory (SCT) including