VALIDATION OF THE MALAY VERSION OF PREGNANCY PHYSICAL ACTIVITY QUESTIONNAIRE (PPAQ) AND THE ASSESSMENT OF PHYSICAL ACTIVITY, DIETARY INTAKE AND GESTATIONAL WEIGHT GAIN RATE AMONG PREGNANT WOMEN IN KOTA BHARU, KELANTAN

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by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

ACOG	American College of Obstetrics and Gynaecology
AI	Adequate intake
BMI	Body mass index
CI	Confidence interval
CVD	Cardiovascular disease
DRI	Dietary Reference Intakes
EAR	Estimated Average Requirements
EPU	Economic Plan Unit
FAO	Food and Agricultural Organization
FPL	Federal poverty line
GDM	Gestational diabetes mellitus
GWG	Gestational weight gain
ICC	Intraclass correlation coefficient
IOM	Institute of Medicine
IQR	Interquartile range
KPAS	Kaiser Physical Activity Survey
LAC	Latin America and the Caribbean
LGA	Large-for-gestational-age
LPA	Light physical activity
LR	Likewise ratio
LTPA	Leisure time physical activity
MANS	Malaysian Adults Nutrition Survey
METs	Metabolic equivalents
MPA	Moderate physical activity
MREC	Medical Research Ethics Committee
MVPA	Moderate to vigorous physical activity
NCCFN	National Coordinating Committee on Food and Nutrition
NCD	Non-communicable disease
NHMS	National Health and Morbidity Survey
NRC	National Research Council
OR	Odd ratio
PLI	Poverty line income

PNSS	Pregnancy Nutrition Surveillance System
PPAQ	Pregnancy Physical Activity Questionnaire
PRAMS	Pregnancy Risk Assessment Monitoring System
p-value	Probability value
RDA	Recommended Dietary Allowance
RDI	Reference Dietary Intakes
RE	Retinol equivalents
RNI	Recommended nutrient intakes for Malaysia
ROC	Receiver operation characteristics
SD	Standard deviation
SGA	Small-for-gestational-age
SPSS	Statistical Package for the Social Sciences
US	The United States
USM	Universiti Sains Malaysia
VPA	Vigorous physical activity
WHO	World Health Organization
WIC	Women, Infants and Children
WISH	Women and Infants Starting Healthy

LIST OF SYMBOLS

n	Sample size
r	Pearson correlation coefficient
<	Less than
>	More than
≥	More than and equal to
α	Alpha
β	Beta
p	Probability value, *p*-value
df	Degree of freedom
%	Percentage
=	Equal to
Δ	Precision

PENSAHIHAN BORANG SOAL SELIDIK AKTIVITI FIZIKAL SEMASA MENGANDUNG VERSI MELAYU (PPAQ) DAN PENILAIAN AKTIVITI FIZIKAL, PENGAMBILAN MAKANAN DAN KADAR PENINGKATAN BERAT SEMASA MENGANDUNG DI KALANGAN WANITA MENGANDUNG DI KOTA BHARU, KELANTAN

ABSTRAK

Peningkatan berat semasa mengandung memainkan peranan penting dalam menentukan hasil kandungan. Peningkatan berat sewaktu mengandung merupakan perhatian penting dalam permasalahan kesihatan awam memandangkan ianya mempunyai perkaitan dengan pertambahan berat selepas melahirkan anak dan juga indeks jisim badan yang tinggi di kemudian hari. Oleh itu, kajian ini bertujuan menilai kesahihan Borang Soal Selidik Aktiviti Fizikal Semasa Mengandung versi Melayu (PPAQ-M), pengambilan makanan dan aktiviti fizikal serta menentukan faktor peramal terhadap peningkatan berat sewaktu mengandung dalam kalangan wanita mengandung. Peringatan pengambilan makanan 24-jam tunggal digunakan untuk menilai pengambilan makanan manakala pedometer dan PPAQ-M yang telah disahkan digunakan untuk menilai aktiviti fizikal dalam kalangan subjek. Kajian ini terdiri daripada dua fasa, fasa pertama berkenaan kebolehpercayaan dan kesahihan PPAQ-M yang melibatkan 60 wanita mengandung manakala fasa kedua adalah penentuan pengambilan makanan, aktiviti fizikal dan faktor peramal terhadap peningkatan berat sewaktu mengandung yang melibatkan 210 wanita mengandung yang mendapatkan pemeriksaan antenatal di kilinik-klinik kesihatan terpilih di Kota Bharu. Analisis pekali korelasi dalam kelas (ICC) digunakan untuk menilai kebolehpercayaan PPAQ-M. Pekali korelasi Pearson antara nilai jumlah aktiviti yang didapati daripada PPAQ-M dengan jumlah langkah daripada pedometer digunakan

untuk menentukan kesahihan PPAQ-M. Regresi Logistik Berganda digunakan untuk menentukan faktor GWG. Nilai ICC adalah 0.679 (95% CI 0.515, 0.795) bagi jumlah aktiviti dan berjulat antara 0.542 hingga 0.679 bagi intensiti aktiviti termasuk sedentari, ringan, sederhana dan kuat. Bagi jenis aktiviti, nilai ICC berjulat dari 0.236 hingga 0.776 yang mana melibatkan aktiviti isi rumah dan penjagaan, pekerjaan, sukan atau senaman dan kenderaan serta tidak aktif. Pekali korelasi Pearson menunjukkan terdapat hubungan positif dan sederhana yang signifikan antara jumlah aktiviti dengan bilangan langkah ($r = 0.394$, $p = 0.002$). Didapati peratusan penambahan berat semasa mengandung (GWG) yang tidak mencukupi (34.8%) dan berlebihan (44.8%) adalah tinggi dalam kalangan kalangan subjek. Regresi Logistik Berganda yang telah diselaraskan menunjukkan hanya tahap pendapatan isi rumah merupakan faktor risiko bagi peningkatan berat semasa mengandung untuk kategori berlebihan. Kajian ini menunjukkan PPAQ-M mempunyai kebolehpercayaan dan kesahihan yang boleh diterima yang mana PPAQ-M boleh digunakan untuk menilai aktiviti fizikal dalam kalangan wanita mengandung. Hasil faktor peramal peningkatan berat semasa mengandung telah menyimpulkan bahawa wanita mengandung yang berisiko untuk mempunyai GWG berlebihan boleh dikenal pasti di awal kandungan lagi dan perlu disasarkan untuk intervensi pengurusan berat semasa mengandung atau selepas bersalin.

VALIDATION OF THE MALAY VERSION OF PREGNANCY PHYSICAL ACTIVITY QUESTIONNAIRE (PPAQ) AND THE ASSESSMENT OF PHYSICAL ACTIVITY, DIETARY INTAKE AND GESTATIONAL WEIGHT GAIN RATE AMONG PREGNANT WOMEN IN KOTA BHARU, KELANTAN

ABSTRACT

Gestational weight gain (GWG) plays a vital role in determining pregnancy outcomes. Excessive GWG is the greatest public health concerns as it is related to postpartum weight retention and higher body mass index later in life. Therefore, the present study aimed at assessing validity of Malay Pregnancy Physical Activity Questionnaire (PPAQ-M), dietary intake and physical activity (PA) and also determined GWG predictor factors among pregnant women. Single 24-hour dietary recall was used to assess dietary intake whereas pedometer and validated PPAQ-M were used to assess PA among subjects. The study consisted of two phases, phase I was a validation of PPAQ-M which involved 60 pregnant women wherein phase II was the determination of dietary intake, PA and GWG predictor factors which involved 210 pregnant women who visited selected health clinics for an antenatal check-up in Kota Bharu. Intraclass correlation coefficient (ICC) analysis was used to assess PPAQ-M reliability. Pearson correlation coefficient between total activity value derived from PPAQ-M with step counts obtained from pedometer was used to determine the PPAQ-M validity. Multiple logistic regression was used to determine the GWG predictor factors. ICC value was 0.679 (95% CI 0.515, 0.795) for total activity and ranged from 0.542 to 0.679 for activity intensity including sedentary, light, moderate and vigorous activity. As for type of activity, the ICC value ranged from 0.236 to 0.776 which involved household and caregiving, occupational, sports

or exercise, transportation activity and inactivity. Pearson correlation coefficient showed there was significantly moderate and positive correlation between the total activity with step counts ($r = 0.394$, $p = 0.002$). There was a high proportion of inadequate (34.8%) and excessive (44.8%) GWG among subjects. Adjusted multiple logistic regression showed only household income level was a significant predictor of excessive GWG. The current study showed the PPAQ-M had a reasonable reliability and validity which could be used to assess physical activity among pregnant women. The findings on GWG predictor factors suggested pregnant women who were at risk of excessive GWG could be identified early in pregnancy and should be targeted for weight-management interventions during pregnancy or post-partum delivery.

CHAPTER ONE

INTRODUCTION

1.1 Background

Physical activity is evident to have numerous health benefits to population. Those who perform regular physical activity have less health problems such as obesity, cardiovascular disease, hypertension, diabetes mellitus type 2, cognitive disorder, osteoporosis and some forms of cancer (Friedenreich, 2001; Lee et al., 2012; Melzer, Kayser, & Pichard, 2004; Rastogi et al., 2004). Besides, pregnant women have similar benefits of regular physical activity with non-pregnant women regardless of specific physiological changes that stimulated by pregnancy (Wolfe & Weissgerber, 2003).

In addition, exercise during healthy pregnancy also give benefits to pregnant women and infants for it can improve their health and reduces the maternal complications (Prather, Spitznagle, & Hunt, 2012). Physical activity reduces gestational diabetes, preeclampsia and postpartum weight retention (Chasan-Taber et al., 2007). Furthermore, it can facilitate labour, reduce stress and discomfort throughout pregnancy (Whitney & Rolfes, 2007).

Lack of physical activity become a global problem and increasing both in developed and developing countries (World Health Organization, 2003a). Physical inactivity has adverse effects to normal population and even pregnant women. According to WHO (2003b), an individual who fail to achieve the minimum recommended physical activity was more likely to have cardiovascular disease. Besides, the reported ischemic heart disease, diabetes mellitus and cancer death cases yearly were due to physical inactivity (World Health Organization, 2003b).

Gestational weight gain (GWG) is one of the nutritional status indicators during pregnancy and plays a vital role in determining pregnancy outcomes. According to Institute of Medicine and National Research Council (Institute of Medicine & National Research Council, 2009), multiple pregnancy outcomes are related to GWG. For instance, inadequate GWG is associated with small-for-gestational-age (SGA) infants, low birth weight and preterm birth whereas excessive GWG is associated with large-for-gestational-age (LGA) infants, caesarean delivery and maternal weight retention during postpartum (Viswanathan et al., 2008).

Besides, the pre-pregnancy weight of women also plays a role in determination of pregnancy outcome as it is related to GWG. A study was conducted to determine an association between GWG with risk of SGA, LGA, preterm delivery, substantial maternal postpartum weight retention and child obesity. Findings showed that GWG was directly associated with risk of LGA in both normal and overweight women but, inversely associated with risk of SGA and preterm delivery among normal weight

women. In obese women, GWG was not associated with the risk of LGA, SGA or preterm birth (Oken, Kleinman, Belfort, Hammitt, & Gillman, 2009).

Moreover, weight gain during pregnancy also increased the chances of postpartum weight retention and long-term weight gain among women. Several studies were conducted to determine the association between total weight gains during pregnancy with postpartum weight retention (Amorim, Rössner, Neovius, Lourenço, & Linné, 2007; Rooney & Schauberger, 2002; Walker, Timmerman, Sterling, Kim, & Dickson, 2004). In those studies, weight retention was measured in short-term (2 days to 6 weeks), medium-term (within 2 years) and long-term. Most of the studies reported those who had excessive GWG retained more weight. For example, a previous study which measure immediate weight retention (2 days to 6 weeks) found pregnant women who gained excessive GWG retained significantly excessive weight than those who gained within IOM recommendations whereas pregnant women who gained inadequate GWG retained their body weight significantly less than those who had an adequate GWG, regardless of pre-pregnancy BMI (Walker et al., 2004). Besides, there were a number of studies that assessed weight retention within 2 years period (6 months to one and a half years). These studies found consistent results in which pregnant women who gained excessive GWG retained higher body weight compared to those who gained adequate GWG irrespective of postpartum weight retention duration (Amorim et al., 2007; Rooney & Schauberger, 2002).

Likewise, a study reported in all BMI groups, women with excessive GWG comprised of higher proportion of women with postpartum weight retention of 5 kg or more compared to adequate GWG women (Ma et al., 2015). Oken et al (2009) also found that GWG was directly associated with risk of substantial weight retention.

Besides, there were studies that showed inconsistent results of an association between GWG with weight retention among pregnant women who gained inadequate weight during pregnancy. For instance, a study found that these pregnant women retained less weight compared to those who had adequate GWG (Rooney & Schauberger, 2002) whereas another study reported there was no difference in postpartum weight retention between the two groups of pregnant women (Siega-Riz et al., 2009). Postpartum weight retention in these studies was measured within 2 years.

GWG also influences body composition in childhood and later life. A study showed that GWG was directly associated with risk of child obesity (Oken et al., 2009). Moreover, a previous study found an association between excessive GWG with overweight or obese child (Sridhar et al., 2014). The study reported excessive GWG had 46% increased in odds of having an overweight or obese child after adjusting for pre-pregnancy BMI, race or ethnicity, age at delivery, education, child age, birth weight, gestational age at delivery, gestational diabetes, parity, infant sex, total metabolic equivalents and dietary pattern. The association between maternal excessive GWG and childhood obesity was strongly associated in normal pre-pregnancy BMI women than the other BMI categories, thus proposing that the impact may not influence by genetic predictors of obesity. In addition, a prior study reported higher weight gain during pregnancy was significantly

associated with higher fat mass, greater BMI and higher waist circumference among offspring (Reynolds, Osmond, Phillips, & Godfrey, 2010). The study also concluded that early adulthood adiposity was influenced by maternal adiposity, higher GWG and parity.

GWG adequacy either inadequate, adequate or excessive was based on either IOM (1990) (Amann-Gassner & Hastreiter, 1990) or IOM (2009) (Institute of Medicine & National Research Council, 2009) guidelines. The two guidelines have several differences as shown in Table 1.1. IOM (1990) guideline was derived substantially from National Natality Survey conducted in the 1980. The main focus of the guidelines was to prevent premature births and SGA infants. On the other hand, IOM (2009) guideline is the revised form of IOM (1990). IOM (2009) guideline has been developed due to the dramatic changes of demographic and epidemiologic characteristics of US women at childbearing age. American women have a higher prevalence of pre-pregnancy overweight or obese and excess GWG. In addition, those who entering pregnancy phase were older and suffered from chronic diseases such as diabetes mellitus type 2.

Table 1.1: Differences between Institute of Medicine guidelines in 1990 with 2009

IOM (1990)	**IOM (2009)**
- Body mass index categories are derived from the Metropolitan Life Insurance tables.	- Body mass index categories are based on World Health Organization (WHO) cut-off points. - Include a specific, relatively narrow range of recommended gain for obese women.

Source: IOM (2009)

1.2 Problem statement

Generally, excessive GWG is increasing especially among pregnant women in developed country. A recent study showed that the percentage of pregnant women who gained weight within recommendations slightly decreased, (Johnson et al., 2015). The study also reported the percentage of women who gained excessive GWG was the highest (44.4%) followed by those who gained within (35.8%) and below recommendations (19.8%). Similarly, a previous study conducted among Hispanic pregnant women showed a high prevalence of excessive GWG (45.0%), 33.0% of them had adequate GWG and approximately 22.0% had inadequate GWG (Chasan-Taber et al., 2008). Weisman and colleague (2010) also found consistent results where excessive GWG was more prevalent among pregnant women (51.0%). Besides, a previous study which involved only nulliparous women reported a higher prevalence of excessive GWG (74.0%) whereas the prevalence of adequate and inadequate GWG was 17.0% and 9.0%. respectively (Restall et al., 2014). Likewise, a study among urban, low-income women found that most of the women gained excessive weight during pregnancy (41.0%). Approximately 28.0% of them had inadequate GWG and 31.0% gained weight adequately (Herring et al., 2012).

The trend of increased excessive GWG is more prevalent among overweight and obese women at pre-pregnancy phase. In pre-pregnancy BMI categories, pre-pregnancy overweight increased the risk of excessive weight gain during pregnancy about threefold (Weisman et al., 2010). A cohort study of Women and Infants Starting Healthy (WISH) found that pregnant women with high pre-pregnancy BMI were most likely to have excessive weight gain whereas those who had low pre-pregnancy BMI were most likely

to have inadequate GWG (Brawarsky et al., 2005). Similarly, Rodrigues and colleague (2010) reported the prevalence of excessive GWG was higher among obese women but inadequate GWG prevalence was greater in underweight women. The study also stated there were other variables associated with either excessive or inadequate GWG namely age, stature, age at menarche and smoking (Rodrigues, Lacerda, Schlüssel, Spyrides, & Kac, 2008). In contrast, a few studies found GWG decreased with increasing BMI. For instance, a study which included a large, population-based sample of US women who gave birth in 2004 to 2005 reported pregnant women who were obese prior to pregnancy gained the least weight. However, in term of prevalence, the study found approximately 40.0% of normal weight women and 60.0% overweight women gained excess weight during pregnancy (Chu, Callaghan, Bish, & D'Angelo, 2009). Other studies also portrayed normal pre-pregnancy BMI women had highest weight gain whereas obese women had lowest weight gain (Chasan-Taber et al., 2008; Olson & Strawderman, 2003).

The increasing trend of excessive GWG becomes a great public health concern as it has consequences on both maternal and infant. The short term consequences that closely related to excessive GWG are preterm delivery, neonatal hypoglycemia, LGA and macrocosmic infant. Long-term consequences include postpartum weight retention and excessive weight gain later in life which lead to health problems of overweight and obesity among childbearing age women.

A 18 years Northern Sweden MONICA Survey reported obesity prevalence had increased in women at childbearing age (Lilja, Eliasson, Stegmayr, Olsson, & Söderberg, 2008). Besides, a review article on obesity prevalence in Great Britain stated obesity was more prevalent in women (25.0%) than men (23.0%) in 2002 (Rennie & Jebb, 2005). In Malaysia, findings from National Health Morbidity Survey (NHMS) 2015 showed the national prevalence of overweight (30.0%), obesity (17.7%) and abdominal obesity (48.6%) among adults was higher than previous findings of NHMS 2011 with obesity and abdominal obesity observed to be more prevalent among females than males (Institute for Public Health, 2015). The report also stated the prevalence of obesity in Malaysia was higher than world prevalence in 2014 (13.3%). On the other hand, Kelantan was reported to have the highest prevalence of underweight among adults compared to other states in Malaysia (Institute for Public Health, 2015). Another study conducted in Malaysia found more women were obese (22.5%) compared to men (14.1%) (Mohamud et al., 2011). In term of age, more than 43.0% of younger (less than 30 years old) subjects in the study were overweight or obese. A systematic review on overweight and obese adults in Malaysia (1996-2009) reported women had a greater risk for overweight and obesity than men (Khambalia & Seen, 2010).

The high prevalence of obesity among women especially those who are in childbearing age increases the risk of pre-pregnancy obesity in pregnant women. For instance, one in five pregnant women who gave birth in the US during 2004-2005 was obese (Chu, Callaghan, Bish, & D'Angelo, 2009) and nowadays, this health problem becomes a common obstetrical condition (The American College of Obstetricians and Gynecologists, 2013). This situation may cause the increase in the prevalence of

pregnancy complications related to high pre-pregnancy weight such as miscarriage, stillbirth, congenital anomalies, preeclampsia, GDM, foetal macrosomia and cesarean section delivery. Moreover, pregnant women who themselves were born LGA had a higher risk of being overweight or obese and more likely to give birth to LGA infants (Cnattingius, Villamor, Lagerros, Wikström, & Granath, 2012) and thus, continue the intergenerational obesity cycle. The incident of intergenerational obesity cycle was parallel to Barker hypothesis which stated most of the nutritional events that occur during the intrauterine life and early infancy will influence the development of disease during adulthood (Barker, 1986). Pre-pregnancy obesity and excessive gestational weight gain are the consequences of high energy intake and low energy expenditure (Institute of Medicine & National Research Council, 2009) and might therefore, relate to dietary intake and physical activity.

Although there are various health benefits of physical activity, pregnant women tend to reduce their physical activity during pregnancy (Pereira et al., 2007) and the majority did not reach recommended level of physical activity (Borodulin, Evenson, Wen, Herring, & Benson, 2008). In addition, the decreased pregnancy physical activity was found to be related to excessive GWG (Olson et al., 2003). Besides, the majority of women stop exercising once they discovered they are pregnant (Katarina Melzer, Schutz, Boulvain, & Kayser, 2010). The practice of inactive lifestyle during pregnancy leads to certain adverse health effects such as hypertension, maternal and childhood obesity, gestational diabetes mellitus (GDM) and pre-eclampsia (Wolfe & Weissgerber, 2003).

1.3 Research question

1. Does Pregnancy Physical Activity Questionnaire (PPAQ) Malay version is a reliable instrument to assess physical activity level among pregnant women attending health clinics in Kota Bharu?
2. What are the predictor variables of gestational weight gain among pregnant women attending health clinics in Kota Bharu?

1.4 Rationale of study

As described earlier, excessive GWG is the greatest public health concern due to adverse outcome of GWG includes postpartum weight retention and importantly higher BMI later in life. Therefore, it is important to ensure pregnant women gain weight within recommended by IOM (2009) as the recommendations of weight gain are specified to pre-pregnancy BMI of women. According to the IOM (2009), those who have higher pre-pregnancy BMI must gain lesser weight than those who have lower pre-pregnancy BMI throughout pregnancy. Even though IOM recommendation is provided as a guide to health practitioners in managing pregnant women, many of pregnant women fail to gain weight in the range based on the recommendation, either inadequate or excessive.

There are a lot of factors that associate with pre-pregnancy obesity and excessive GWG such as maternal height, pre-pregnancy weight and parity which could not be modified by prenatal intervention (Nohr et al., 2009; Olson & Strawderman, 2003). Nevertheless, high pre-pregnancy weight and excessive GWG can be prevented through health

behaviours such as dietary intake and physical activity (Institute of Medicine & National Research Council, 2009).

Diet compositions of daily maternal intake are important as it may influence the pregnancy outcomes. Thus, there were various studies had been conducted to assess dietary intake among pregnant women such as systematic reviews on energy, macronutrient and micronutrient intakes during pregnancy in developed countries (Blumfield, Hure, MacDonald-Wicks, Smith, & Collins, 2012, 2013) and dietary intakes of women during pregnancy in low- and middle-income countries (Lee, Talegawkar, Merialdi, & Caulfield, 2012). Theoretically, pregnant women are at higher risk of nutrient deficiency than non-pregnant women as the requirement for certain nutrient increases during pregnancy in order to support the development of the foetus and at the same time to maintain their own health. Association between deficiency of nutrient during pregnancy with negative pregnancy outcomes were reported in various studies (Abu-Saad & Fraser, 2010; Kramer, 2003). In Malaysia, the largest nutrition and representative of Malaysian adults population study is Malaysia Adults Nutrition Survey (MANS) (Mirnalini et al., 2008; Norimah et al., 2008). However, MANS did not cover large scale studies on dietary intake among pregnant women in Malaysia, particularly to investigate the association of dietary intake with GWG.

A national study found that Malaysian adults were sedentary with women were less active compared to men (Poh et al., 2010). Thus, Malaysian pregnant women are hypothesized to perform less physical activity but there is no large scale study among Malaysian pregnant women to prove this statement. Other national studies were

conducted to assess the prevalence of physical activity in National Health and Morbidity Survey 2011 (NHMS 2011) (Teh et al., 2014) and in NHMS 2015 (Institute of Public Health, 2015). However, the study did not include pregnant women. Only few studies on physical activity among pregnant women are available and the studies did not represent Malaysian pregnant women. Besides, the lack of physical activity measures specified to Malaysia population might contribute to a limited study on physical activity among pregnant women. Therefore, the association between physical activity with GWG among Malaysian pregnant women still unknown.

In general, study reporting dietary intake and physical activity during pregnancy and their association with GWG is lacking in Malaysia especially in epidemiological data. Furthermore, there are discrepancies whether total energy or macronutrient intake is related to GWG. Likewise, little is known on whether total energy expenditure, activity intensity or type of activity plays a vital role in GWG. Due to these reasons and increasing prevalence of pre-pregnancy obesity, excessive GWG and chronic diseases related to obesity, it is important to determine dietary intake and physical activity among Malaysian pregnant women and their associations with GWG. Besides, determination of contributing factors of GWG other than dietary intake and physical activity also can provide a better understanding of the complex interaction between the factors and GWG which will help health practitioners to implement an appropriate intervention for pregnant women in order to improve their health status during pregnancy and postpartum period.

1.5 Objectives of study

1.5.1 General objectives

To assess validity and reliability of PPAQ Malay version (PPAQ-M), pre-pregnancy body mass index, gestational weight gain rate, dietary intake and physical activity using validated PPAQ-M among pregnant women in Kota Bharu district, Kelantan.

1.5.2 Specific objectives

i. To evaluate the reliability and validity of PPAQ Malay version among pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.
ii. To identify pre-pregnancy body mass index (BMI) and gestational weight gain (GWG) of pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.
iii. To determine dietary intake of pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.
iv. To determine the level of physical activity among pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.
v. To determine socio-demographic characteristics, medical history, dietary intake and physical activity as predictor factors contributing to gestational weight gain among pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.

1.6 Research hypotheses

H_0: There is no significant association between socio-demographic characteristics, with GWG among pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.

H_0: There is no significant association between medical history with GWG among pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.

H_0: There is no significant association between dietary intake with GWG among pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.

H_0: There is no significant association between physical activity with GWG among pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.

H_1: There is significant association between socio-demographic characteristics, with GWG among pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.

H_1: There is significant association between medical history with GWG among pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.

H_1: There is significant association between dietary intake with GWG among pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.

H_1: There is significant association between physical activity with GWG among pregnant women attending antenatal check-up at selected health clinics in Kota Bharu district, Kelantan.

1.7 Conceptual framework

According to Institute of Medicine, GWG is influenced at multiple levels such as societal or institutional, environmental, neighbourhood or community, interpersonal or family and individual.

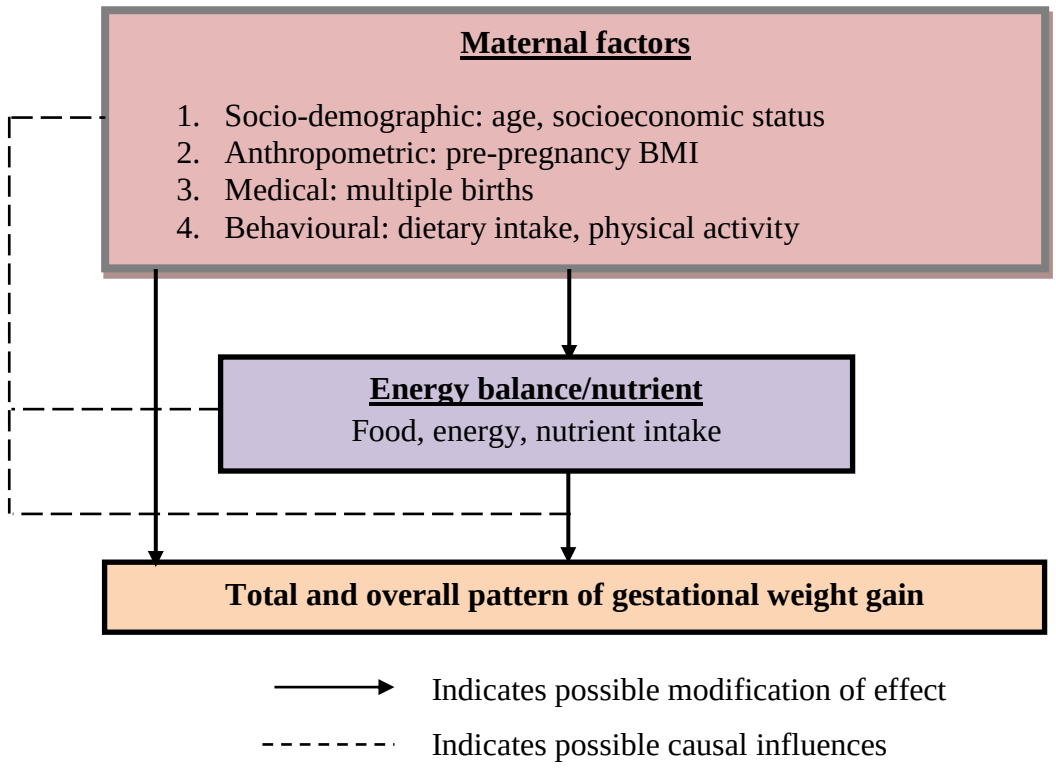

Figure 1.1: Conceptual framework of study adopted by Institute of Medicine, 2009

Societal or institutional determinants that related to GWG are media, culture or acculturation, health services and policy. Besides, the potential determinants at environmental level include altitude, environmental toxicants, natural and man-made disasters. On the other hand, neighbourhood or community level involves access to healthy foods and opportunities for physical activity whereas interpersonal or family level, the determinants are family violence, marital status, partner and family support. At individual level which consists of genetic predisposition, developmental programming, epigenetics, socio-demographic, anthropometric or physiological, medical, psychological and behavioural characteristics. These determinants interact with each other to influence GWG.

However, the present study only interested in assessing the association between maternal factors (individual level) in predicting GWG of pregnant women in Kota Bharu (Figure 1.1). The maternal factors involved were socio-demographic characteristics, biological, medical and behavioural factors. These factors can influence GWG directly or indirectly. Direct interaction does not need to influence other factors to determine GWG but indirect interaction occurs if the determinants influence other factors at first level in order to determine GWG. For instance, dietary intake and physical activity influence energy balance, then later energy balance will determine GWG. In order to improve GWG, contributing factors of GWG need to be modified and most of the modifiable contributing factors are related to behavioural factors such as dietary intake and physical activity.

1.8 Operational definition

1.8.1 Pregnancy

Pregnancy is defined as the period from conception to childbirth (Whitney & Rolfes, 2007).

1.8.2 Trimester

Trimester is a period of three months and particularly used to show one of the three three-month periods of pregnancy. It includes first, second and third trimester (Whitney & Rolfes, 2007).

1.8.3 First trimester

First trimester is the time from the first day of the last menstrual period to the end of the twelfth week of gestation (0-12 week).

1.8.4 Second trimester

The second trimester begins from the thirteenth week of gestation until at the end of a twenty-seven week of gestation (13-27 week).

1.8.5 Third trimester

The third trimester begins from the twenty-eight week and extends to the time of delivery (28-40 week).

1.8.6 Gravidity

Frequency of pregnancies in which:

Primigravida is a first pregnancy whereas *multigravida* is defined as second pregnancy and above

1.8.7 Parity

Number of pregnancies > 24 weeks

1.8.8 Nutritional status

Nutritional status is the condition of a population's or individual's health as influenced by the intake and utilization of nutrients and non-nutrients (Boyle & Holben, 2006). Direct assessment of nutritional status can be conducted through several methods namely dietary, laboratory, anthropometric and clinical measurements of individuals. However, this study only involved dietary assessment and anthropometric measurements consisted of pre-pregnancy BMI and GWG. Both BMI (Dinh, To, Vuong, Hojer, & Persson, 1996) and GWG (Thorsdottir, Torfadottir, Birgisdottir, & Geirsson, 2002) are simple methods for monitoring the nutritional status of pregnant women.

Dietary methods are used to determine usual nutrient intake of an individual or population and to identify potential dietary inadequacy whereas anthropometric measurements are used to identify moderate and severe degrees of malnutrition and chronic imbalances in energy and protein intakes (Boyle & Holben, 2006).

1.8.9 Pre-pregnancy body mass index (BMI)

BMI is one of the anthropometric measurements and it is defined as body weight in kilogram divided by height in meters squared (World Health Organization, 2004). It is commonly used as an indirect measure of overweight and obesity in adults (Boyle & Holben, 2006) BMI is classified into four categories namely underweight, normal, overweight and obese based on WHO (2004) recommendations as shown in Table 1.2. According to WHO (2004), BMI of less than 18.5kgm^{-2} is underweight, 18.5 to 24.9kgm^{-2} is normal, 25.0 to 29.9kgm^{-2} is overweight and 30.0kgm^{-2} and above is obese.

In a study, obtained pre-pregnancy BMI was calculated from the maternal weight recorded in the maternal health card if their first prenatal visit was before 13 weeks of gestation as weight does not change in first trimester whereas those who exceed 13 weeks of gestation at first prenatal visit were excluded from the study in order to avoid errors in measurement of pre-pregnancy BMI (Al-Hinai, Al-Muqbali, Al-Moqbali, Gowri, & Al-Maniri, 2013). Thus, pre-pregnancy BMI definition was used based on Al-Hinai and colleague (2013) in this study.

Table 1.2: Classification of BMI

BMI classification	BMI cut-off points
Underweight	<18.5
Normal	18.5-24.9
Overweight	25.0-29.9
Obesity (class I)	30.0-34.9
Obesity (class II)	35.0-39.9
Extremely obese	>40.0

Source: WHO (2004)

1.8.10 Gestational weight gain (GWG)

GWG is an anthropometric measurement to measure nutritional status of pregnant women. The recommendation of weight gain during pregnancy was proposed by IOM (Institute of Medicine & National Research Council, 2009). According to IOM (2009), GWG is determined by maternal pre-pregnancy BMI. Those who have higher pre-pregnancy BMI should gain less than those who had lower pre-pregnancy BMI. The recommended GWG was showed in Table 1.3. Throughout pregnancy, underweight pregnant women should gain weight 12.5kg to 18.0kg, normal pregnant women should gain 11.5kg to 16.0kg weight whereas overweight and obese pregnant women should gain weight in the range of 7.0kg to 11.5kg and 5.0kg to 9.0kg, respectively. IOM (2009) also proposed recommendations for mean weekly weight gain but only in second and third trimester of pregnancy as there is no significant weight gain in first trimester. During 2^{nd} and 3^{rd} trimester, underweight, normal, overweight and obese pregnant women should have weight gain rates of 0.51kg, 0.42kg, 0.28kg and 0.22kg per week respectively.

Table 1.3: Classification of GWG

Pre-pregnancy BMI	**BMI (kg/m²) (WHO)**	**Total Weight Gain Range (kg)**	**Rates of Weight Gain[a] 2nd and 3rd Trimester (Mean Range in kg/wk)**
Underweight	<18.5	12.5-18.0	0.51 (0.44-0.58)
Normal weight	18.5-24.9	11.5-16.0	0.42 (0.35-0.50)
Overweight	25.0-29.9	7.0–11.5	0.28 (0.23-0.33)
Obese (includes all classes)	≥30.0	5.0–9.0	0.22 (0.17-0.27)

[a]Calculations assume a 0.5–2 kg (1.1–4.4 lbs) weight gain in the first trimester (Abrams, Carmichael, & Selvin, 1995; Carmichael, Abrams, & Selvin, 1997; Siega-Riz, Adair, & Hobel, 1994)
Source: IOM (Institute of Medicine & National Research Council, 2009)

However, there is no standard approach on how to measure GWG. Some studies determined total GWG by calculating the difference between pre-pregnancy weight and the last weight recorded before delivery (Asbee, Jenkins, & Butler, 2009; Guelinckx, Devlieger, Mullie, & Vansant, 2010; Polley, Wing, & Sims, 2002; Shirazian, Monteith, Friedman, & Rebarber, 2010). Other studies calculated GWG based on the difference between weight during early pregnancy and weight at delivery (Claesson et al., 2008; Olson, Strawderman, & Reed, 2004). In the present study, mean weekly weight gain was used to indicate adequacy of GWG. The mean weekly weight gain in the current trimester was estimated using the difference between the first and last weight record in the trimester divided by the number of weeks between the two observations (Nucci et al., 2001). The adequacy of GWG classification was based on IOM (2009) recommendations as shown in Table 1.3.

1.8.11 Income per capita

Income per capita is a total household income divided by household members living together (Economic Plan Unit, 2014). Both household income and income per capita are commonly used as an indicator to classify socioeconomic status (SES) of the individual in a population. However, income per capita provides a better comparison of income between households as it incorporates household size (Doocy & Burnham, 2006).

In the present study, household income was estimated monthly by inquiring subjects on active economically members in the household and the money- or product-generating activities they engaged during the year of survey conducted.

1.8.12 Poverty line income (PLI)

PLI defined as the minimum income needed by a household to meet the basic needs of food and non-food for each of its members to enable them to have a healthy and comfortable life (Economic Plan Unit, 2014).

The concept of poverty takes into account food PLI and non-food PLI for each household. A household is considered poor if their household income is below the PLI. Household income below PLI means lacking resources to meet the basic needs of food and non-food for each of household members (Economic Plan Unit, 2014).

1.8.14 Dietary intake

Dietary intake is the consumption of chemical substances in food and beverages and used in the body to provide energy, structural materials and regulating agents to support growth, maintenance and repair of the body's tissues (Whitney & Rolfes, 2007). Dietary intake during pregnancy may differ from prior pregnancy due to several factors such as food craving and higher nutrient requirement. Generally, the quantity of dietary intake of women during pregnancy and lactation should be higher than the non-pregnant period in order to support infant growth and maternal health. Thus, it is important to ensure pregnant women acquire adequate nutrient throughout pregnancy course.

In the present study, the 24-hour dietary recall was used to estimate the amount of dietary intake among pregnant women. Then, adequacy of dietary intakes was assessed by comparing estimated dietary intakes with recommended dietary intake. The present study used Recommended Nutrient Intake (RNI) for Malaysia (National Coordinating

Committee on Food and Nutrition Malaysia, 2005) as reference whereas Dietary Reference Intakes: Recommended Dietary Allowance (DRI: RDA) (Institute of Medicine of the National Academies, 2002) was used as a reference for nutrients which do not provide by RNI (2005).

1.8.15 Recommended Nutrient Intake (RNI)

Recommended nutrient intake (RNI) is defined as the daily intake corresponding to recommended dietary allowance (RDA), which meets the nutrient requirements of almost all (97.5%) apparently healthy individuals (National Coordinating Committee on Food and Nutrition Malaysia, 2005).

RDA is the average daily dietary intake level that is sufficient to meet the requirement of nearly all healthy individuals in a particular life-stage and gender group (National Coordinating Committee on Food and Nutrition, 2005). RNI for Malaysia (2005) and RDA (2002) for pregnant women are shown in Table 1.4, 1.5 and 1.6.

Table 1.4: Daily total energy and macronutrient intake recommended for 2nd trimester pregnant women according to age

Pregnancy	Age (years)	Total energy intake (kcal)	Carbohydrate (g/d)	Protein (g/d)	Fat (g/d)
2nd trimester	16-18	2410	175[a]	61.5	54-82
	19-29	2360	175[a]	62.5	54-82
	30-50	2540	175[a]	62.5	54-82

Source: RNI for Malaysia (National Coordinating Committee on Food and Nutrition, 2005), [a]Reference dietary intakes (RDI, 2002/2005): Recommended dietary allowance (RDA) (Institute of Medicine of the National Academies, 2002)