COMPARISON OF NUTRITIONAL STATUS AND DIETARY PATTERN AMONG MOTHERS WHO DELIVERED TERM LOW BIRTH WEIGHT AND NORMAL BIRTH WEIGHT INFANT AT HOSPITAL UNIVERSITI SAINS MALAYSIA

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UNIVERSITI SAINS MALAYSIA

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by

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LIST OF ABBREVIATION

adj	adjusted
AGA	Appropriate Gestational Age
BMI	Body Mass Index
C.I.	Confidence Interval
EPU	Economic Planning Unit
FFQ	Food Frequency Questionnaire
FTT	Failure to Thrive
GDM	Gestational Diabetes Mellitus
HUSM	Hospital Universiti Sains Malaysia
LBW	Low Birth Weight
LSCS	Lower Segment Caesarean Section
MLgR	Multiple Logistic Regression
MUAC	Mid Upper Arm Circumference
NBW	Normal Birth Weight
OECD	Organization for Economic Co-operation and Development
OR	Odd Ratio
PIH	Pregnancy Induced Hypertension
RM	Ringgit Malaysia
SGA	Small Gestational Age
SLgR	Simple Logistic Regression
TSFT	Triceps Skin Fold Thickness
UNICEF	United Nations Children's Fund
WHO	World Health Organization

LIST OF SYMBOLS

cm	centimeter
g/dl	gram per decilitre
kg	kilogram
kg/m^2	kilogram per meter square
m	meter
m^2	meter square
mm	millimeter
n	number of subjects
RM	Ringgit Malaysia
%	percentage
>	more than
≥	more than or equal
<	less than
≤	less than or equal
±	plus and minus

TERM OF DEFINITION

Small Gestational Age	Birth weight below 10^{th} percentile (Kiess, Chernausek, & Hokken-Koelega, 2009)
Neonatal mortality	The deaths of neonate occurring during the first four weeks after birth (WHO, 2006)
Preterm birth	Infant born prior to 37 complete weeks (less than 259 days) from the first day of mothers last menstrual period (Fuchs, 1993)
Gravida	A woman who has been pregnant, irrespective of the pregnancy outcome, with the establish of first pregnancy she becomes a primigravida and with successive pregnancy a multigravida (Cunningham et al., 2005)
Parity	The numbers of pregnancy reaching 20 weeks and not by the number of fetuses delivered. Parity is not greater if a single fetus, twin or quitriplets were delivered nor lower if the fetus or fetuses were still birth (Cunningham et al., 2005)
Gestational Diabetes Mellitus	As diabetes that first developed in a pregnant women (Petry, 2014)
Primiparous	First time mother delivered a baby (Kaur & Kaur, 2012)

Nulliparous	A Woman who has not given birth to a child (Myles, 1985)
Multipleparous	Being mother for the second time onwards (Kaur & Kaur, 2012)

PERBANDINGAN PENILAIAN TARAF PEMAKANAN DAN CORAK DIET IBU YANG MELAHIRKAN ANAK KURANG BERAT LAHIR DAN BERAT LAHIR NORMAL DI HOSPITAL UNIVERSITI SAINS MALAYSIA

ABSTRAK

Kurang berat lahir (LBW) ditakrifkan sebagai berat lahir bayi kurang daripada 2500 gram tanpa mengira usia kehamilan. Kurang berat lahir merupakan masalah kesihatan awam sejagat dan ia juga merupakan punca utama kematian bayi dan morbiditi sama ada semasa neonatal atau dalam tahun pertama kehidupan bayi. Bayi kurang berat lahir juga akan membawa kepada penyakit kronik sewaktu dewasa seperti diabetes, hipertensi dan penyakit jantung koronari. Terdapat banyak faktor risiko yang berkait rapat dengan bayi kurang berat lahir, terutama ke atas status nutrisi ibu. Kajian keratan rentas ini dijalankan untuk menentukan status pemakanan, corak pemakanan dan faktor risiko lain yang mempunyai hubungkait dengan kelahiran bayi kurang berat lahir (LBW) dalam kalangan ibu-ibu yang melahirkan bayi kurang berat lahir (LBW) dan berat lahir normal (NBW). Sejumlah 408 ibu yakni 204 ibu yang melahirkan bayi kurang berat lahir (LBW) dan berat lahir normal (NBW) (n = 204) telah dikenalpasti berdasarkan kriteria kemasukan dan keluaran di Hospital Universiti Sains Malaysia, Kelantan. Data yang dikumpulkan termasuk sejarah sosiodemografi, sosioekonomi, obstetrik / perubatan, corak pemakanan ibu ditaksir menggunakan Soal selidik Kekerapan Pengambilan Makanan (FFQ) dan status pemakanan dinilai melalui ukuran antropometri. Keputusan dari kajian ini menunjukkan bahawa insiden bayi LBW sepanjang tempoh kajian ini adalah 12.1% . Dalam analisis deskriptif, terdapat perbezaan yang signifikan bagi ibu-ibu yang LBW dan bayi NBW mengikut umur, tahap pendidikan, bilangan anak, gravida, pariti dan

bilangan kehadiran untuk rawatan antenatal. Dari segi status pemakanan, ibu dengan bayi NBW mempunyai BMI yang lebih tinggi: 23.84 (5.19) berbanding dengan ibu dengan bayi LBW bermakna: 22.60 (5.29) ($p = 0.018$). Nasi, air minuman, gula, ikan laut, sayur-sayuran berdaun dan kuih tempatan tradisional sangat banyak dimakan oleh kedua-dua kumpulan kecuali biskut dan ayam, yang mana ianya banyak sangat dimakan oleh ibu-ibu dengan bayi NBW manakala dimakan secara sederhana oleh ibu-ibu dengan bayi LBW. Tiada perbezaan yang signifikan dalam jumlah kepelbagaian makanan dalam kalangan ibu yang melahirkan bayi NBW dan LBW, tetapi terdapat perbezaan yang signifikan dalam kepelbagaian pengambilan produk daging dan telur ($p <0.005$). Analisis regresi logistik berganda selepas penyelarasan, mendapati bahawa terdapat faktor yang dikaitkan dengan kurang berat lahir termasuk pendidikan (ORadj 3.30; 95% CI 1.27, 8.60, 5.97, $p = 0.015$), pariti (ORadj 0.76; 95% 0.87, 14.34, $p = <0.001$), sejarah kelahiran LBW (ORadj 0.49; 95% CI 0.25, 0.96, 4.37, $p = 0.037$), hipertensi pada kehamilan sebelumnya (ORadj 0.24; 95% CI 0.72, 0.81, , $p = 0.022$) BMI (ORADj 0.95; 95% CI 0.92, 1.00, 4.85, $p = 0.028$). Untuk penyelidikan masa depan, adalah disyorkan untuk menilai pemakanan ibu berdasarkan Pengambilan Nutrien Malaysia yang disyorkan untuk wanita hamil selain daripada skor kepelbagaian diet.

COMPARISON OF NUTRITIONAL STATUS AND DIETARY PATTERN AMONG MOTHERS WHO DELIVERED TERM LOW BIRTH WEIGHT AND NORMAL BIRTH WEIGHT INFANTS AT HOSPITAL UNIVERSITI SAINS MALAYSIA

ABSTRACT

Low birth weight (LBW) is defined as infant's birth weight less than 2500 gram regardless of gestational age. Low birth weight is a global public health problem and it is the major cause of infant's mortality and morbidity either in neonatal or in the first year of life. LBW infants will also lead to chronic diseases in adulthood such as diabetes, hypertension and coronary heart disease. There are many risk factors associated with the delivery of LBW infants especially nutritional status of mothers is one of the important risk factors. This cross-sectional study was carried out to determine the nutritional status, dietary pattern and other associated risk factors with low birth weight (LBW) among mothers who delivered low birth weight (LBW) and normal birth weight (NBW) infants. A total of 408 mothers with 204 mothers who delivered low birth weight (LBW) and normal birth weight (NBW)(n=204) infants were recruited based on the inclusion criteria and exclusion criteria at Hospital Universiti Sains Malaysia, Kelantan, Malaysia. Data collected include sociodemographic, socioeconomic, obstetric/medical history, the maternal dietary pattern was assessed by using the Food Frequency Questionnaire (FFQ) and nutritional status was assessed by anthropometric measurements. Results showed that the incidence LBW infants during this study period was 12.1% (622 of 5152 total birth). In the descriptive analysis, there were significantly different for mothers with LBW and NBW infants by age, level of education, numbers of children, gravida,

parity and number of attendance to antenatal care. In term of nutritional status, mothers with NBW infant have higher mean of BMI: 23.84(5.19) compared to mothers with LBW infants mean: 22.60(5.29) (p=0.018). Rice, drinking water, sugar, sea fish, leafy green vegetable and traditional local cake were highly consumed food items by both groups except biscuit and chicken were highly consumed by mothers who delivered NBW infants, but moderately consumed by mothers of LBW infants. There was no significant difference of total score in dietary diversity among mothers who delivered NBW and LBW infants, however, there was a significant difference in meat products and egg (p<0.005). Multiple logistic regression analysis after adjusted for the confounder, found that there factor associated significantly with low birth weight include education (OR_{adj} 3.30; 95% C.I. 1.27, 8.60, 5.97, p=0.015), parity (OR_{adj} 0.76; 95% C.I. 0.66, 0.87, 14.34, p=<0.001) , history of previous child birth LBW (OR_{adj} 0.49; 95% C.I. 0.25, 0.96, 4.37, p=0.037), hypertension in previous pregnancies (OR_{adj} 0.24; 95% C.I. 0.72, 0.81, 5.28, p=0.022) BMI (OR_{adj} 0.95; 95% C.I. 0.92, 1.00, 4.85, p=0.028). In future research, it is recommended to evaluate dietary intake based on Malaysian Recommended Nutrient Intake of pregnant women apart from the dietary diversity score.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Low birth weight (LBW) is defined as infant's birth weight less than 2500 gram regardless of gestational age (WHO, 2014). Both premature and intrauterine growth retardation are the causes of LBW infant (Ugboma and Onyearugha, 2013). Low birth weight is a global public health problem and it is the major cause of infant's mortality and morbidity either in neonatal or in the first year of life (UNICEF, 2013). LBW infants were 6 times higher risk of probable death during their development in the first year of life (Slyker *et al.,* 2014), with four fold higher risk of infant death within the birth weight between 2000gm to 2499gm (Muthayya, 2009). In Indonesia, 2.9% LBW infants lead to significant death during 28 days of life (Abdullah *et al.*, 2016). LBW will delay infant's growth and academic performance, yet to have non communicable diseases in adulthood (UNICEF, 2013). As proposed by Baker, malnourished mothers will deliver LBW infant, may lead to child malnutrition and will contribute to health problem, cognitive problem and growth delay in the first three years of life (Dover, 2009). LBW infants will also lead to chronic diseases in adulthood such as diabetes, hypertension and coronary heart disease (Dover, 2009; Muthayya, 2009; Islam, 2015; Gaiva, 2014).

LBW affects growth and development of infant and childhood due to poor mental development, lack of concentration in classroom and poor academic performance, hyperactive in few cases, delayed speech and thinking ability, failure to thrive (FTT),

death and morbidity (Islam, 2015). Mental development index and psychomotor development index among LBW Bangladeshi infants were significantly low compared to normal birth weight (NBW) infant (Tofail, 2012). According to the United Health Foundation report, mortality rate of infant will decrease with the increased of infant's birth weight (United Health Foundation, 2015). In conjunctions with all the consequences, World Health Organization had set a global nutrition targets 2025 on LBW policy aims to reduce delivery of LBW infants by 30% during year 2025 and this policy emphasizes on intervention of pregnant women in order to increase nutritional status of mothers and decrease delivery of LBW infants (WHO, 2014).

1.1.1 Prevalence of low birth weight

LBW contribute the highest burden globally with 60%-80.0% of neonatal deaths occurred among LBW infant (WHO, 2017). There were 131 million infants born worldwide every year; however, 22 million of them were born LBW with prevalence of 16.0% (UNICEF, 2013). Out of LBW infants born 96.5% of them were from developing countries (WHO, 2017). Recent data showed significant different in the incidence of LBW in developed countries compared to developing countries by 7.0% and 15.0%, respectively (Dahlui *et al.*, 2016). Although America is well known as a developed country, currently 8.0% of the deliveries occurred with LBW infants and higher among black mothers with the prevalence of 13.6% (United Health Foundation, 2015). Prevalence of LBW infants in developed countries such as United Kingdom was 7.0%, 8.0% in United State and 6.0% in Australia, respectively (UNICEF, 2014). Another estimation data from World Health Organization (WHO) show that prevalence of LBW in South Asia was 28.0%, sub-Saharan Africa 13.0%

and Latin America 9.0% (UNICEF, 2014). WHO also reported that the highest prevalence of LBW was Pakistan and India with 32.0% and 28.0% , respectively (WHO, 2011). In Asian region, the prevalence of LBW in Philippines was 21.0% followed by Myammar (15.0%) and Malaysia was the third highest of LBW incident which was 11.0% (WHO, 2011).

Trend analysis showed that the prevalence of LBW in Malaysia was 9.7%, by National Health and Morbidity Survey 2016 (Institute of Public Health, 2016). According to the prevalence by state, the highest prevalence was in Sarawak 16.2% followed by Kelantan 14.3%, while by races the highest were other Bumiputra (O*rang Asli*) with 14.5% followed by Indian 12.2% (Institute of Public Health, 2016). This may due to low household income with poor maternal nutrition and single (separated/divorced). (Institute of Public Health, 2016). A hospital based study in Seremban found that the prevalence of LBW infants in Malaysia was 12.6% (Boo *et al.,* 2008). Interestingly, the incidence of LBW infants among women with periodontitis was 14.2% compared to 3.3% without periodontitis in Kelantan (Saddki *et al.,* 2008). Periodontitis is an inflammatory disease affecting the supporting tissues of the tooth. This oral bacteria porphyromonas gingivalis can spread to the foetal by systemic circulation through placental to cause chorioamniotic infection which lead to smaller foetuses (Varadan, 2015).

1.1.2 Maternal nutritional status

Nutritional status of mothers is one of the important risk factors to the occurrence of LBW infants. Maternal nutritional status of mother during and before pregnancy is considered to be strongly related with pregnancy outcomes. Poor nutritional status

and poor intake of diet in pregnancy will affect birth weight and development of infant. (Sharma & Mishra, 2014). However, it is also affected by biological, socioeconomic and demographic factors (Abu-Saad and Fraser, 2010). Malnourished women have higher risk to deliver LBW infant compared to their counterparts who had adequate nutritional status (Verma and Shrivastava, 2016). During pregnancy the fetus is nourished directly by the mother through placenta, and due to the nutrient needs of fetus totally depends on mothers' intake therefore, mothers' food intake should be adequate and well-balanced diet in order to give birth to a normal and healthy infant (Bentum, 2011).

Similar to pregnant women in Ethiopia who were undernourished had a higher chance to deliver LBW infant (Assefa *et al.*, 2012). Poor maternal nutritional status has a relationship with body mass index (BMI) less than 18.5kg/m^2 and had 1.5 times higher risk to deliver LBW infant (Kader and Perera, 2014). In India, 30.0% of mothers with BMI less than 18.5kg/m^2 were at higher risk to deliver LBW infants (Dharmalingam *et al.*, 2010). Similarly in Brazil, underweight mothers was one of the factors associated with infant outcome (Coutinho *et al.*, 2009).

In addition, underweight mothers has a strong relationship with LBW outcome compared with mothers who were overweight (De Alencar Britto *et al*., 2013). Both maternal weight and height below 50 kg and 150 cm, respectively, were significantly contributed factors to LBW infant (Agarwal Kiran, 2011). In Malaysia, mothers with lower gestational age, lower pre-pregnancy weight and nulliparity have increased the risk of delivered LBW infants (Boo *et al.*, 2008). Maternal mid upper

arm circumference (MUAC) lower than 23cm has a strong predictor to give birth to a LBW infant (Assefa *et al.*, 2012).

1.1.3 Dietary pattern of mothers

Vegetables are nutrient-dense foods, it was the main sources which contain potassium, magnesium, dietary fibre, folate, and vitamins A and C that improve health. Mothers who consumed green leafy vegetables throughout their pregnancy have lower risk to deliver LBW Infants. Pregnant women who did not consume fish during third trimester had high risk to deliver LBW infant as fetus need high protein to growth (Durrani and Rani, 2011). In addition, mothers who consumed outside food were at 1.6 times increased risk of delivering LBW infants compared to mothers who regularly prepared their meal at home during their pregnancy, due to take away meals were less nutritious than home cooked food (Abubakari, 2016). Risk of LBW occurrence was lower among pregnant women who consumed health-conscious diet (vegetables, fruits, cereals legumes, roots and tubers) compared to those who consumed high sugar and energy dense snacks (Abubakari and Jahn, 2016). Meanwhile, in Brazil, pregnant mothers who consumed snacks (sandwich cookies, salty snacks, chocolate, and chocolate drink mix) were highly correlated to birth weight of infant due to snack pattern consists of foods with high concentrations of simple carbohydrates, lipids and low amounts of protein and micronutrients with high-energy density which increase gestational weight gain (Coelho *et al.*, 2015).

1.2 Problem Statement

LBW is a global public health problem, which estimated about 15.0% (20 million) infants were born with low birth weight annually. Association of maternal risk factors and LBW has been established in India, Pakistan, Nigeria, Philippine and Bangladesh. These five countries were considered as the LBW burden countries due to high prevalence of LBW in the world (WHO, 2014). Previous literatures have indicated maternal factors associated with incidence of LBW infant. Factors include sociodemographic, income, medical illness, medical obstetric illness, poor nutritional status and smoking. Based on Boo *et al*., (2008), prepregnancy weight, nulliparous, maternal hypertension and eclampsia were significantly associated with LBW among Malaysian mothers who delivered LBW infant. Similar study in predicting LBW among mothers, in Kuala Lumpur demonstrated that mothers aged above 35 years were 1.3 times higher risk to deliver LBW infant compared with mothers age between 20 to 30 (Sutan *et al*., 2016). Parity more than 4, pre-pregnancy BMI less than 20kg/m^2 and pregnancy induced hypertension were also had significantly risk factor for mothers to deliver LBW infant (Yadav and Lee, 2012).

The global prevalence of LBW was 15-20 % (more than 20 million) yearly, mainly in India, Bangladesh, Pakistan, Nigeria and Philippine which represent more than half of global burden of LBW infants (UNICEF, 2013). Report from National Health and Mobility Survey revealed that the prevalence of LBW in Malaysia was 9.7% (Institute of Public Health, 2016). In Malaysia, many studies have investigated the maternal factors associated with LBW but none of the study has made an attempt to look into the dietary pattern or dietary diversity of nutrient intake of pregnant women

who delivered NBW and LBW infant. There are still lacking of data in terms of study design, which compared LBW and NBW although there were many studies had only investigated on the associated factors of LBW.

1.3 Justification of the study

Low birth weight is a public health problem and is a main cause of mortality, morbidity and disability in neonates, infants and children. LBW is a result of preterm birth, intrauterine growth restriction or a combination of both pathophysiologic conditions. Infant's weight is directly influenced by nutritional status of the mother. However, there are many maternal risk factors associated with the delivery of LBW infant. The maternal risk factors are biologically and socially interconnected such as sociodemographic, socio-economic, medical illness, obstetric factors, nutritional status and dietary pattern.

The morbidity and mortality of LBW can be decrease by earlier detection of the maternal risk factors and early intervention provided more intensive care to those at risk, thus reducing the magnitude of low birth weight. In view of LBW is one of the public health problem globally; many measures have been recommended by WHO for pregnant women in order to decrease delivery of LBW infant such as: education, improve clean and adequate water, sanitary, hygiene, food distribution for population with food insecurity group and pregnant women, pre conceptional daily supplement folic acid to prevent abnormalities and fetal growth moitoring (WHO, 2014). In this study, statistic from Ward 1 Nilam Hospital Universiti Sains Malaysia, Kelantan, Malaysia stated total admission of infant weight equal or less than 2500gm admitted

to the ward from 2007, 2008 and 2009 were 439(31.2%), 491(33.3%) and 571(33.0%), respectively and showed increasing trend of LBW in Hospital USM (HUSM, 2009).

A match case control study design conducted in Universiti Kebangsaan Malaysia (UKM), out of 3,214 infants delivered in UKM from January 2012 to June 2012, 11.1% of infants were LBW (Sutan *et al.*, 2014). A study carried out in Pusat Ibu dan Anak, Kota Bharu found that there was an association between maternal periodontitis with LBW infants. Out of respondents studied, the incidence of LBW was 8.7%, those mothers with periodontitis has 4 times higher risk to deliver LBW infants (Saddki *et al.*, 2008). All those limited studies have confirmed that there was still high prevalence of LBW in Malaysia in particular, Kelantan with 14.3% by National Health and Morbidity Survey 2016.

In view of the burden and implication of the future life among LBW infant, therefore this study is important to determine mother's nutritional status, dietary pattern and factors associated with LBW, so that the health care provider will give good antenatal care and improve the quality of health care for pregnant women in order to decrease deliveries of LBW infant.

1.4 Research question

1.4.1 What are the different of socio-demographic and economic status, medical illness, nutritional status and dietary pattern between mothers who delivered low birth weight (LBW) and normal birth weight (NBW) infants at Hospital Universiti Sains Malaysia?

1.4.2 What are the nutritional status of mothers who delivered lower birth weight (LBW) and normal birth weight (NBW) infant at Hospital Universiti Sains Malaysia?

1.4.3 What are the associated factors of low birth weight (LBW) among pregnant women who delivered at Hospital Universiti Sains Malaysia?

1.4.4 What are the dietary pattern and dietary diversity among mothers who delivered low birth weight (LBW) and normal birth weight (NBW) infant at Hospital Universiti Sains Malaysia?

1.5 Research hypotheses

1.5.1 Null hypotheses (H_0)

1.5.1(a) There is no significant difference of nutritional status (BMI, MUAC, TSFT) between mothers who delivered low birth weight (LBW) and normal birth weight (NBW) infant at Hospital Universiti Sains Malaysia

1.5.1(b) There is no association between sociodemographic and nutritional status of mothers with infant's birth weight at Hospital Universiti Sains Malaysia

1.5.2 Alternative hypotheses (H_a)

1.5.2(a) There is a significant difference of nutritional status (BMI, MUAC and TSFT) between mothers who delivered low birth weight (LBW) and normal birth weight (NBW) infants at Hospital Universiti Sains Malaysia

1.5.2(b) There is an association between sociodemographic, nutritional status with infant's birth weight at Hospital Universiti Sains Malaysia

1.6 Objectives

1.6.1 General objectives

To assess the nutritional status, others associated factors and dietary pattern among mothers who delivered low birth weight (LBW) and normal birth weight (NBW) infants at Hospital Universiti Sains Malaysia.

1.6.2 Specific Objectives

To compare socio-demographic, economic status and medical illness of mothers who delivered low birth weight (LBW) and normal birth weight (NBW) infants at Hospital Universiti Sains Malaysia.

1.6.2(a) To compare the nutritional status of mothers who delivered lower birth weight (LBW) and normal birth weight (NBW) infants at Hospital Universiti Sains Malaysia.

1.6.2(b) To identify the associated factors of low birth weight (LBW) among pregnant women who delivered at Hospital Universiti Sains Malaysia.

1.6.2(c) To assess the dietary pattern of mothers who delivered LBW and NBW infants at Hospital Universiti Sains Malaysia.

1.6.2(d) To compare the dietary diversity score among mothers who delivered low birth weight (LBW) and normal birth weight (NBW) infant at Hospital Universiti Sains Malaysia.

1.7 Conceptual framework

The development and foetus growth depend on the level of mother's nutritional status before and during pregnancy. The conceptual framework shown in Figure 1.1 explained how birth outcome was associated with various maternal risk factors during pregnancy. The risk factors of maternal nutritional status affect the nutritional status of infants while in utero, therefore mothers with low nutritional status may deliver low birth weight infant as proposed by Theory of Barker (Dover, 2009). This framework also indicates few factors groups related to maternal nutritional status such as sociodemographic, dietary pattern, history of previous pregnancy and medical illness which are interrelated variables and could affect the birth outcomes. Variables being studied in this study were as below include independent and dependent variables such as:

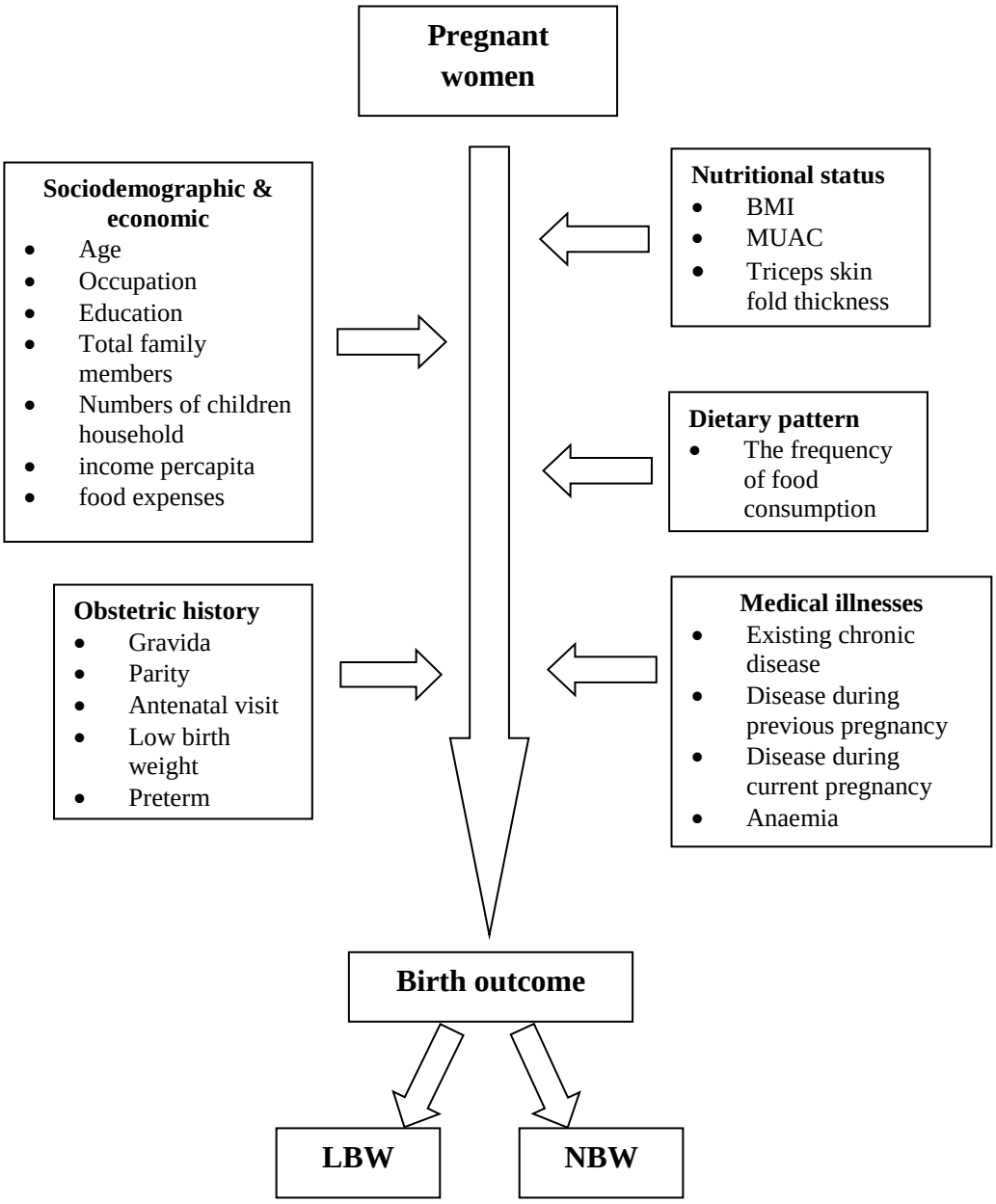

Figure 1.1 Conceptual framework of the study

1.7.1 Socio-demographic characteristic (Independent variables)

a. Age

b. Occupation

c. Education

d. Total family members

e. Numbers of children in household

f. Income percapita

g. Food expenses

1.7.2 Previous pregnancy (Independent variables)

a. Gravida

b. Parity

c. Antenatal visit

d. Low birth weight

e. Preterm

1.7.3 Medical illness (Independent variables)

a. Existing chronic disease

b. Disease during previous pregnancy

c. Disease during current pregnancy

d. Anaemia

1.7.4 Maternal nutritional status (Dependent variables)

a. Body Mass Index (BMI)

b. MUAC

c. Tricep Skinfold Thickness (TSFT)

1.7.5 Birth outcome (Dependent variables)

a. Birth weight

b. Length

c. Head circumference

d. Chest circumference

1.8 Operational definition

1.8.1 Low birth weight (LBW)

LBW is defined by the World Health Organization (WHO) as weight at birth less than 2500 gm (5.5 lb) (WHO, 2014). In this study infant delivered with full term but the birth weight less than 2.5kg were studied (WHO, 1995).

1.8.2 Small gestational age (SGA)

Infant's birth weight less than 10 percentile at any gestational age. In this study, LBW infant was focused on full term delivery (at or more than 37 weeks gestational age) birth weight less than 2500 gm (WHO, 1995).

1.8.3 Nutritional status

Stages of a person in food intake, the body's condition as it related to the intake and use of nutrients. All members of health care team have roles in the effective evaluation of a client's nutritional status (Ruth, 2011). In this study, the researcher assessed the nutritional status of mothers who delivered LBW and NBW infants. Infant's nutritional status was assessed by length of the infant and birth weight.

1.8.4 Anthropometric measurement

Anthropometric is the measurement of the physical dimensions and gross composition of the body. Anthropometry measurement included height, weight, head circumference, skinfold thickness, body density, air-displacement plethysmography and bioelectrical impedance (Lee and Nieman, 2007). In this study, anthropometry measurement of mothers included height, weight, MUAC and triceps skinfold thickness while for infants include length, weight, head circumference and chest circumferences.

1.8.5 Maternal nutritional status

Maternal nutritional status was based on BMI, MUAC and Triceps Skin Fold Thickness (TSFT) assessment. BMI measurement was recorded from the antenatal record during antennal visit and MUAC and Triceps Skin Fold Thickness (TSFT) were measured after 24 hours of post-delivery. BMI was calculated and classified based on WHO (2006) reference as below:

BMI = Weight in kilogram (kg) divides by Height in meter (m) square

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

Table 1.1: Body Mass Index (BMI) classification

BMI classification	BMI cut-off point kg/m^2
Underweight	< 18.5
Normal	18.5–24.9
Overweight	≥ 25.0-29.9
Obese	≥ 30.0

Classification of Body Mass Index (BMI) based on WHO (2006)

1.8.5(a) Mid Upper Arm Circumference (MUAC)

MUAC is the circumference of the left upper arm, measured at the mid-point between the tip of the acromial process and the tip of the olecranon process by using a measuring tape to measure muscle area of subjects (WHO, 1995). In general, lower MUAC of mothers would lead to 64.1% probability to deliver LBW infants compared to mother who delivered NBW infants (Tang *et al.*, 2016). MUAC <23cm is considered malnutrition and ≥23cm is considered normal, (Assefa *et al.*, 2012; Jeminusi and Sholeye, 2015)

1.8.5(b) Tricep Skin Fold Thickness (TSFT)

Another indicator to measure pregnant women's nutritional status was triceps skin fold thickness (TSFT), to determine the subcutaneous fat area as a nutritional status indicator. Adequate or optimal nutritional status of mothers throughout the pregnancy is important to reduce the risk of LBW (Ricci *et al.*, 2010). The tricep skinfold thickness was measure in the midline of the posterior aspect of the arm, over the tricep muscle, at a level midway between the lateral projection of the acromion process at the shoulder and the olecranon process of the ulna. With the elbow flexed to 90^0, a vertical fold of

skin and subcutaneous tissue is pick up gently with the left thumb and index finger, approximately 1cm proximal to the marked level, and the tips of the Harpenden callipers are applied to the skinfold at the mark level measurement are recorded to the nearest 0.5mm (WHO, 1995)

1.8.6 Nutritional status of infant

Indicators for infants' nutritional status include weight, length, head circumference and chest circumference.

1.8.6(a)Weight (kg)

Infant's weight at birth, the infant was weight within first hour of life by expertise nurse in labour room. Weights of the children were measured to the nearest 0.01 kg (WHO, 1995).

1.8.6(b)Length (cm)

New born length is measured on infant lying in supine position on a recumbent measuring board. The crown of the head touches the stationary, vertical headboard. The subject's head is held with the line of vision aligned perpendicular to the plane of the measuring surface. The shoulders and buttocks are flat against the table top, with the shoulder and hips aligned at right angle to the long axis of body. The legs are extended at the hips and knees and lie flat against the table top with the arm rest against sides of the trunk. Make sure the legs remain flat on the table and shift the movable board against the heels. The length is recorded to the nearest 0.1cm. (WHO, 1995).

1.8.6(c) Head circumference (cm)

Head circumference or occipital frontal circumference is measured over the largest circumference of the head, above eyes and ears. The infant is lying down when measured. Measurement tape is positioned just above ears and eyebrows and around the biggest part of the back of the head. It should be assured that tape is straight and it is pulled affectionately to compress hair and soft tissues. Measurement is recorded to the nearest 0,1cm (WHO, 1995).

1.8.6(d) Chest circumference (cm)

Chest circumference was measured by placing the non-stretchable measuring tape under the new-born's chest at the level of the four rib joints. The measurement is made in a horizontal plane to the nearest 0.1cm at the end of a normal expiration (WHO, 1995).

1.8.7 Dietary pattern

The dietary pattern is defined as the quantities, proportions, variety or combination of different foods, drinks, and nutrients in diets, and the frequency with which they are habitually consumed. Maternal dietary pattern through type of food and consumption could influence their nutritional status during delivery (WHO, 1995). In this study, dietary pattern was evaluated by using Food Frequency Questionnaire (Norimah *et al*., 2008).

1.8.8 FFQ (Food Frequency Questionnaire)

Malaysian Food Frequency Questionnaire consisted of list of food items was used based on Malaysian food items. The FFQ was developed by Technical Working Group of Nutrition, Malaysia (Norimah *et al*., 2008). This FFQ consisted of 126 food items which were listed into 13 food groups. It was administered by guided interview at post-delivery within 24 hours for normal delivery and 48 hours for caesarean section, respectively. The mothers were asked about the frequency of intake of each food item either ‘per day, two to three times per week, per week, per month or never for the past one month.

CHAPTER TWO

LITERATURE REVIEW

2.1 Consequences of low birth weight

Low birth weight (LBW) is one of the risk factors for infant mortality and morbidity, increased risk of chronic diseases such as type 2 diabetes mellitus, hypertension and hearth diseases during adult hood (Abubakari *et al.*, 2015). Low birth weight is an important predictor of child's physical, emotional, psychological and educational development in their later life (WHO, 2014).

Low birth weight infant had a higher incident of mortality during their neonatal life, which is a major public health problem especially in developing countries, for instance in India 85% of newly born infants were with low birth weight (Amosu and Degun, 2014). Prematurity was one of the causes of LBW in new born (WHO, 2017). Prematurity is one out of three major cause of neonatal death beside complications during birth and infection (Lawn *et al.*, 2014). Premature infants were one of the top five causes of neonatal mortality in Malaysia (United Nation Malaysia, 2016). LBW infant have higher risk of asphyxia, hypoglycaemia, polycythaemia, hyper viscosity and hypothermia during birth and developed impaired neurodevelopment cognitive disabilities and a lower IQ, affecting their academic performance in school which eventually affected their job opportunities during adulthood (Temple *et al*., 2010). LBW and SGA infant have higher risk of death and morbidity, low school performance and thinking process (Islam, 2015). These vulnerable infants also had

higher risk of impaired immune function, medical illness such as diabetes and heart disease. (Pahari and Mishra, 2014).

LBW infant will also increase burden to the countries if the infant develop neurological complication in low attention duration in adult life (Ugboma and Onyearugha, 2013). There was an increased risk of immediate life-threatening health problems, complications and delayed growth in infant who were born preterm and LBW (Child Health USA, 2014). Apart from that, increased risk of neonatal mortality and morbidity such as impaired cognitive function if the infant born with low birth weight was also high (Dahlui *et al.*, 2016). LBW occurrence increased inflammatory process in adulthood which would increase the incident of chronic diseases such as diabetes, heart disease, altered immune system and other diseases in adult life (The Endocrine Society, 2009).

LBW infants also have lower IQ and cognitive disabilities which may influence their school performance and job option during adult life (Fosu *et al.*, 2013). Higher survival rate will lead to the increased costs of health care and extended hospitalization (Fosu *et al.*, 2013). LBW infant was associated with retarded physical and cognitive development, increased risk of respiratory and diarrhoeal disease, impaired growth and mental development, and poor outcomes in later life (Sicuri *et al.*, 2011).

2.2 Prevalence of low birth weight

There were 20 million of infants born LBW annually with estimation of 15.0% to 20.0% of total births globally (WHO, 2014). About 95.0% of LBW infant were from developing countries (De Alencar Britto, 2013). The incidence of LBW worldwide 20 million, India 7.5 million, Pakistan 1.5 million, Nigeria 0.8 million, Bangladesh 0.7 million, Philippines 0.5 million and 9.5 million rest of the world (UNICEF, 2013). The global prevalence of LBW infant was 15.0%, in developed countries such as United States, Australia, United Kingdom, Iceland, Japan and China the prevalence was 8.0%, 7.0%, 8.0%, 4.0%, 8.0% and 3.0%, respectively. In developing countries such as India, Pakistan, Nepal, Ethiopia and Philippine were 28.0%, 32.0%, 21.0%, 20.0% and 21.0% respectively (WHO, 2011).

Reflected as a developing country, Malaysia, the prevalence of LBW is 9.7% (Institute of Public Health, 2016) compared to our neighbourhood namely Thailand 9.4% (NSO & UNICEF, 2016) and Singapore 8% (WHO, 2011). In a case control study conducted by Boo *et al*., (2008) at the Hospital Tuanku Jaafar, Seremban, Malaysia concluded there were 12.6% of LBW from the study which shown that the prevalence of LBW in our country remine high compared to the above countries.

Locality of mothers resided was an important associated factor in birth weight of infant, mothers who lived in urban area were 4 times decrease to delivered LBW infant compared to mothers who lived in rural area. This was compatible with the prevalence of LBW in urban which Ethiopia was 11.0% compared to South West Ethiopia Jimma and North-West Ethiopia Gondar with the prevalence of 22.5% and

17.1%, respectively. This might be due the numbers of expert in medical services, health information/services and nutrition education were easily approachable in urban area compared to the rural area (Gebremedhin *et al.*, 2015).

2.3 Determinants associated with low birth weight

Factors influenced low birth weight such as social demographic, social economic status, medical illness, obstetric factors, poor nutritional status and young age mothers (Ganesh *et al*., 2010).

2.3.1 Sociodemographic characteristics

2.3.1(a) Maternal age

Maternal age was one of the important to determinant of LBW infant. Age below than 20 years had double risk significantly to deliver LBW infants (De Alencar Britto, 2013; Ganesh *et al.*, 2010). About 11.0% of all births worldwide yearly were delivered by mothers aged between 15 to 19 years old (Gibbs, Wendt, Peters, & Hogue, 2012). Younger age or age below 19 years of mothers were associated with delivered LBW infant compared with mothers who delivered NBW infant (Sutan *et al*., 2014; Kandhasamy and Singh, 2015). De Alencar Britto *et al.*, 2013 analysed that maternal age less than 20 years old were twice higher risk gaving birth to LBW infant. This might due to young age pregnancies are unexpected, undesirable or discovered late and also were more likely than others had lower socio-economic status, undereducated, or live in areas with restricted resources of health services (Aras, 2013).

However, a study in India reported that risk of delivery of LBW infant increased with the advanced maternal age (Moghaddam Tabrizi and Saraswathi, 2012). This might due to a reduced latent for fetal growth, possibly reflecting biological aging of maternal tissues and systems or the collective effects of illness (Aras, 2013).

2.3.1(b) Level of education

Mothers who had primary level of education or without education has been observed to have a highly significant association with delivery of LBW infant (Prudhivi and Bhosgi, 2015). Pregnant women with higher level of education has higher birth weight of infant compared to mothers who had low level of education. In Brazil, mothers who had level of education equal or below 7 years were 1.3 times higher risk to give birth to LBW infant (Coutinho *et al.*, 2009). Study conducted in Malawi, demonstrated that illiterate mothers were 1.2 times higher risk to give birth to LBW infant (Muula *et al.*, 2011). In Sudan, 13.7% of LBW infants were delivered by mothers who attended school less than 8 years old (Elshibly & Schmalisch, 2008). Another study did in Vientiane, demonstrated that mothers who had never schooling had ten time higher risk to deliver LBW compared to the other counterpart (Viengsakhone *et al.*, 2010).

On the other hand, a cross sectional study was carried out in China to analyse factors influencing delivery of LBW, they concluded that as maternal level of education decreased the risk of delivering LBW infant also increase (Chen *et al.*, 2013). Mothers without schooling were 4 times higher risk to deliver LBW infant compared to mothers who experienced schooling. Mothers who earned higher education would decrease the chances of LBW deliveries (Agarwal Kiran, 2011; Siza, 2008). This