MATERNAL RISK FACTORS FOR LOW BIRTH WEIGHT INFANTS AT FATMAWATI GENERAL HOSPITAL, JAKARTA, INDONESIA

EDI PRIYONO

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PRIMARY HEALTH CARE MANAGEMENT FACULTY OF GRADUATE STUDIES MAHIDOL UNIVERSITY 2008

Thesis
entitled

MATERNAL RISK FACTORS FOR LOW BIRTH WEIGHT INFANTS AT FATMAWATI GENERAL HOSPITAL, JAKARTA, INDONESIA

.....
Mr. Edi Priyono
Candidate

.....
Assoc. Prof. Sirikul Isaranurug,
M.D., Dip. Thai Board of Pediatrics
Major-Advisor

.....
Assoc. Prof. Jiraporn Chompikul,
Ph.D.
Co-Advisor

.....
Prof. Banchong Mahaisavariya,
M.D.
Dean
Faculty of Graduate Studies

.....
Assoc. Prof. Sirikul Isaranurug,
M.D., Dip. Thai Board of Pediatrics
Chair
Master of Primary Health Care Management
ASEAN Institute for Health Development

Thesis
entitled

MATERNAL RISK FACTORS FOR LOW BIRTH WEIGHT INFANTS AT FATMAWATI GENERAL HOSPITAL, JAKARTA, INDONESIA

was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Primary Health Care Management

on
March 11, 2008

.....
Mr. Edi Priyono
Candidate

.....
Lect. Nipunporn Voramongkol,
M.D., Dip. Thai Board of Pediatrics
Chair

.....
Assoc. Prof. Jirapon Chompikul,
Ph.D.
Member

.....
Assoc. Prof. Sirikul Isaranurug,
M.D., Dip. Thai Board of Pediatrics
Member

.....
Prof. Banchong Mahaisavariya,
M.D.
Dean
Faculty of Graduate Studies
Mahidol University

.....
Assoc. Prof. Sirikul Isaranurug,
M.D., Dip. Thai Board of Pediatrics
Director
ASEAN Institute for Health Development
Mahidol University

ACKNOWLEDGEMENTS

I am thankful to All Mighty Allah who blessed me with courage and health to take up this intensive course on Primary Health Care Management at the AIHD of the Mahidol University.

I wish to express my deep sense of gratitude and appreciation to my major advisor, Assoc. Prof. Sirikul Isaranurug, M.D., Dip. Thai Board of Pediatrics for her keen interest, valuable suggestion and moral support throughout my thesis preparation. I would like also to express my gratitude and appreciation to the co-advisor, Assoc. Prof. Jiraporn Chompikul, Ph.D. for her kind attention and valuable input for statistical calculation this paper. I wish to express my special thanks to external examiner, Dr. Nipunporn Voramongkol for her kind advice.

I would like to thanks to Dr. Sri Hermiyanti, M.Sc., Director of Mother's Health, MOH, Republic of Indonesia and Ir. Doddy Izwardy, M.A., for giving me opportunity and support to take master degree program.

Special thanks to Drg. Isti Ratnaningsih, M.A. (DHS-1/ADB) for my studies financially and giving me opportunity to undertake MPHM course at the AIHD, Mahidol University, Thailand.

My special thanks goes to all staffs of Fatmawati General Hospital, Jakarta, Indonesia for their cooperation in getting the data.

I wish to express my special thanks to my beloved wife (Sumarni Ibrahim,S.E) and my lovely children (M. Ghani Rasyid Priyono and Reina Amanda Maheswari) who tolerated my absence for long period bearing with the loneliness and giving me full hearted support and encouragement during my study in Thailand.

Finally, I would like to express my gratitude and all respected to all my teachers, and also thanks to AIHD staffs and all my MPHM' friends for helping me to complete my study.

Edi Priyono

MATERNAL RISK FACTORS FOR LOW BIRTH WEIGHT INFANTS AT FATMAWATI GENERAL HOSPITAL, JAKARTA, INDONESIA.

EDI PRIYONO 5037985 ADPM/M

M.P.H.M. (PRIMARY HEALTH CARE MANAGEMENT)

THESIS ADVISORS: SIRIKUL ISARANURUG, M.D., Dip., Thai Board of Pediatrics; JIRAPORN CHOMPIKUL, Ph.D.

ABSTRACT

The objective of this study was to determine the maternal risk factors of the occurrence of low birth weight infants at Fatmawati General Hospital, Jakarta, Indonesia. The sample was carried out with a sample size of 300, out of which 150 mothers with low birth weight (LBW) infants were selected as cases and 150 mothers with normal birth weight infants were selected as controls, during the period of 1st January to 31st December 2007. Secondary data from the hospital records was extracted and copied into a structured data collection form from 16th January to 5th February 2008. The study was an unmatched case control on maternal risk factors related to low birth weight infants. The maternal factors were classified into sociodemographyc factors, biological factors and pregnancy factors.

Bivariate and multiple logistic regression were done and an odds ratio with 95% confidence interval calculated to show the strength of association. In the final model of regression, the variables found most significantly associated with low birth weight were less gestational age OR 13.98 (95% CI 6.424 – 30.436), poor weight gain during pregnancy OR 7.41 (95% CI 3.402 – 16.142), hypertension OR 5.99 (95% CI 2.634 – 13.645), less ANC visits OR 2.51 (95% CI 1.130 – 5.588) and extreme maternal age OR 2.47 (95% CI 1.155 – 5.314).

The five variables have an additive effect on each other. So, programs to improve maternal and child health (MCH) should focus on all these factors together. Antenatal care for pregnant mothers is an established factor to improve pregnancy outcome, appropriate nutritional education and food supplements must be given to the mothers with poor weight gain. Teenage women should be discouraged from early pregnancy and birth control should be provided for older mothers by health education and family planning systems.

KEY WORDS: MATERNAL RISK FACTORS/ LOW BIRTH WEIGHT

70 pp.

CONTENTS

CONTENTS (Cont.)

Page

LIST OF TABLES

Page

TABLE

LIST OF FIGURES

Page

FIGURE

LIST OF ABBREVIATIONS

LBW	:	Low Birth Weight
NBW	:	Normal Birth Weight
ANC	:	Antenatal care
WHO	:	World Health Organization
UNICEF	:	United Nations Children's Fund

CHAPTER 1
INTRODUCTION

1.1 Rationale and justification of the study

Worldwide 15.5% of more than 20 million, infants are born with low birth weight (LBW) and 95.5% of them are in developing countries. In Asian countries, the incidence of LBW is ranging from 5.9% to 27.1%. The highest incidence of LBW occurs in the Sub Region of South-Central Asia (27.1%), Sub Region of South East Asia (11.6%) and Indonesia (9%). Although the incidence of LBW in Indonesia has not yet officially become available, the Indonesian Demographic and Health Survey in 1992-1997 and 2002-2003 sets, the proportion of at 7.7% to 7.6% respectively (1, 2).

The goal of reducing LBW incidence by at least one third between 2000 and 2010 is one of the major goals in "A World Fit for Children, the Declaration and Plan of Action adopted by the United Nations General Assembly Special Session on Children in 2002" (1). The reduction of LBW also forms an important contribution to the Millennium Development Goals (MDG) for reducing child mortality.

Low birth weight is defined by World Health Organization as a birth weight less than 2,500 grams (WHO, 2004) (1). A low birth weight baby is closely associated with fetal and neonatal mortality and morbidity. LBW is still one of the important public health problem particularly in the developing countries and contributes to a range of poor health outcomes. It also reflects the present and past health status of the mother. Even in the LBW infants who survive have a high incidence of malnutrition, diarrhea, acute respiratory infection and infectious diseases. LBW is one of the leading factor causing postnatal mental retardation, physical disabilities, neurological development of childhood, inhibited growth, cognitive development and chronic diseases later in life (3, 4, 5).

Low birth weight infants contribute to about 75% of death that occur in the week of life. In Indonesia Infant Mortality Rate (IMR) is 35 per 1,000 live births and Neonatal Mortality Rate is 20 per 1,000 live births and the major cause of neonatal death was low birth weight, 29 percent (6).

Many studies have identified that maternal socio-economic factors such as education, marital status, occupation and income influence the incidence of LBW. The maternal age is also an important predictor of LBW risk especially for teenage women and women aged 35 years and over. The risk of LBW for young women is associated with biological health aspects, hazardous habits and social determinants – low education, "lone mother" status and low income. Higher risk of LBW in the older age is related to chronic diseases and diverse social factors. Many publications have confirm the hypothesis on the influence of maternal hazardous habits (smoking, alcohol consumption and drug abuse) during pregnancy on newborns birth weight and increased LBW risk alone or together with other factors (7, 8, 9, 10, 11).

Birth weight is sensitive to change in the physical and socio-economic status of the mother. LBW infant is linked to maternal health and nutrition status, in adequate care during pregnancy and delivery, lack of essential care for newborn baby, infection, birth injury, asphyxia, problems relating to premature births. Women who are at high risk for poor pregnancy outcome include adolescent, unmarried women and minority women, sufferers of acute of chronic diseases. Also cigarettes, alcohol and drug use during pregnancy can have adverse effects on the developing fetus (12,13).

Women of short stature, poor pregnancy weight gain, high parity or complications such as hypertension, placenta previa abruption, diabetes can effect fetal growth development as well as the duration of pregnancy (14, 15). The nutrition status and anemia are important for the LBW risk factors. A study about the babies who were delivered by malnourished mothers weighed on average 390,9 grams lower than the normal mothers. The malnourished pregnant mothers were associated with LBW five times more than normal pregnant mothers (16). Malnutrition status of the

pregnant women contributed to the increasing of LBW in Indonesia, 350,000 babies per year, (MOH, 2004) (17). The high of prevalence of LBW is commonly a result of maternal malnutrition. From 12 to 22% women aged 15-49 years suffer from chronic energy deficiency (BMI < 18.5) (18).

Anemia is also an important risk factor of LBW and malnutrition problem in Indonesia, especially for pregnant women. More than 50% of the pregnant women 1 to 2 had anemia deficiency of iron deficiency (17, 18). Anemic iron deficiency is a risk factor of premature and low birth weight babies (19).

While it is recognized that the etiology of LBW is multiple factors, emphasis is given to maternal factors that are believed to be of greatest importance in developing countries and that some might be able to change in the short term and some factors might need long-term interventions to reduce the incidence of LBW. The modifiable risk factors which have a significant effect on IUGR or age of gestation are identified and corrected by public health intervention, many LBW deliveries can be prevented and as a result the neonatal and infant mortality can be reduced. This study aims to determine women at relative high risk of delivery low birth weight infants at the Fatmawati General Hospital, Jakarta, Indonesia, and recommend appropriate prenatal interventions.

1.2 Research question

What are the maternal risk factors for low birth weight at the Fatmawati General Hospital, Jakarta, Indonesia?

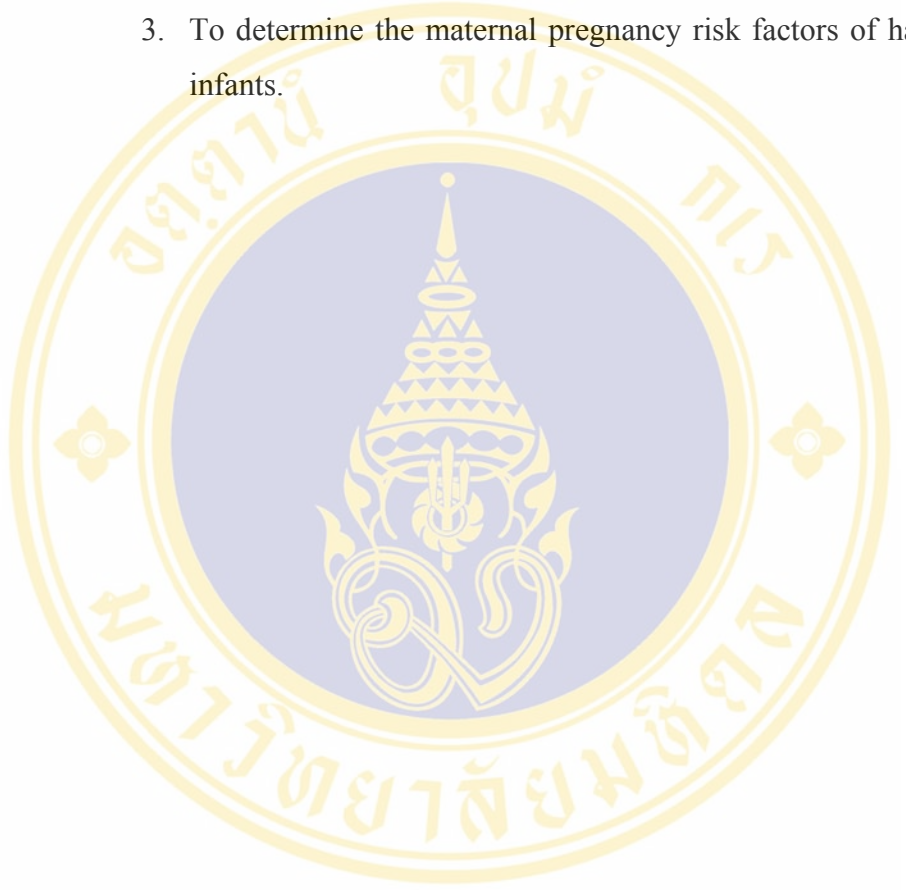
1.3 Research objectives

1.3.1 General objective

To determine the maternal risk factors of the occurrence of low birth weight infants at Fatmawati General Hospital, Jakarta, Indonesia.

1.3.2 Specific objectives

1. To determine the maternal socio-demographic risk factors of having LBW infants.
2. To determine the maternal biological risk factors of having LBW infants.
3. To determine the maternal pregnancy risk factors of having LBW infants.



1.4 Conceptual Framework

This study examined the maternal risk factors for low birth weight including socio demographic, biological and pregnancy risk factors, according to all factors involved the conceptual framework of this study as follows:

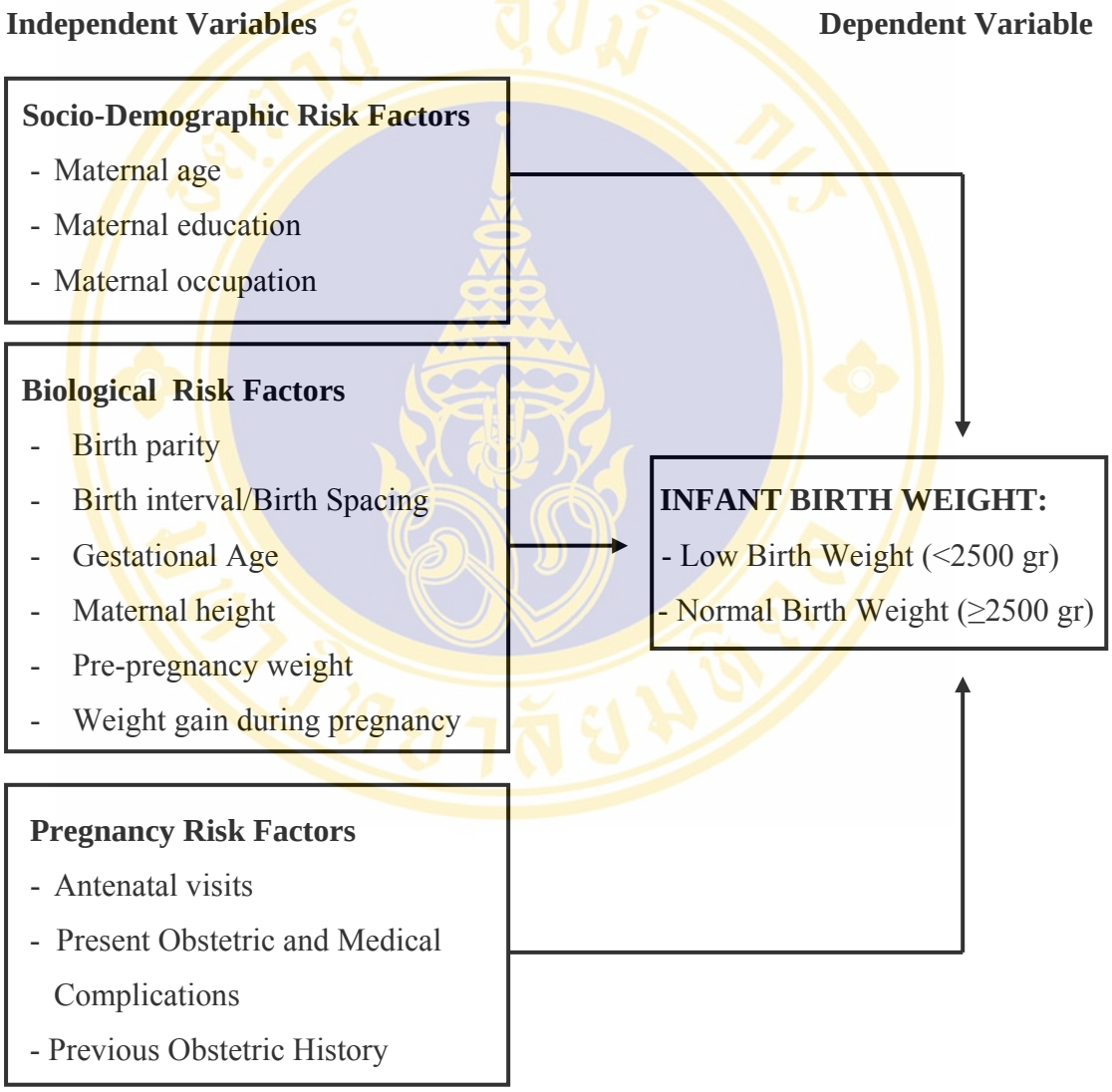


Figure 1 Conceptual framework.

1.5 Variables and operational definition

1. Infant Birth Weight : Classified into two categories:
   - Low birth weight: pertains to newborn infant with birth weight less than 2,500 grams regardless of gestational age.
   - Normal birth weight: pertains to newborn infant with birth weight ≥ 2,500 grams regardless of gestational age.

2. Socio-Demographic Risk Factors:
   - Maternal age: Refer to the age until last birthday, classified into:
     - Low risk age: Between 20 to 34 years of age
     - High risk age: Less than 20 years or more than 34 years old.
   - Maternal education: Refer to the degree of mother's education, classified into 3 groups: Primary (1-9 years), Secondary (10-12 years) and high education (≥ 13 years).
   - Maternal occupation: Refer to mother's occupation. Categorize as:
     1. Housewife or unemployed
     2. Laborer
     3. Official worker/Government official
     4. Others.

3. Biological Risk Factors:
   - Birth parity: Refer to the number of mother's deliveries in which the pregnancy had lasted 28 weeks or more including live birth and stillbirth. There are three levels: parity 1, parity 2 – 3, and parity 4 or over.
   - Birth interval: Defined as interval between the birth of previous pregnancy and the current pregnancy. Pregnancy frequent it was divided into two categories:
     - < 24 months
     - ≥ 24 months.

- Gestation: The duration of gestation is measured from the day of the last normal menstrual period up to date of delivery. Classified into:
    - Pre-term (< 37 weeks)
    - Term (≥ 37 weeks).
- Maternal height: Refer to the mother's height in cms and taken barefoot, divided into two categories: less than 150 cms and ≥ 150 cms.
- Weight gain: The difference in weight (kgs) of mothers between pre-pregnancy and pre-delivery weight/ weight gain (normally, weight increases by 1 kg/month and total pregnancy weight gain in a normal pregnancy was approximately 10-12 kgs).Classified into: < 10 kgs and ≥ 10 kgs.
- Pre-pregnancy weight refers to maternal weight before pregnant, divided into: < 45 kg and ≥ 45 kg.

4. Pregnancy Factors:

- Antenatal visit:

  Refer to the complete health supervision of the pregnant woman in order to maintain, protect and promote the health and well – being of the mother and fetus. Classified into:
    - Adequate: at least 4 antenatal visits
    - Inadequate: less than 4 antenatal visits.

- Present medical and obstetrics complications, such as:
    1) Anemia: During pregnancy, hemoglobin level is concentration of blood in gm/dl which examine at the time of admission for delivery (normal 11 gr/dl and above, anemia means hemoglobin level is less than 11 gram/dl).
    2) Hypertension: Defined as sustained blood pressure to levels of 140 mm Hg systolic or 90 mm Hg diastolic and above.
    3) Present medical/obstetrical factors, such as eclampsia, abnormal position, infection and diabetes. Classified as: present and absent.

- Previous obstetric history

  The obstetric history factors, such as still birth, abortus, premature labor will be classified as: present and absent.

1.6 Limitation of the study

- As the data collection was from an existing source and not personal interview to mothers, it was not possible to investigate other variables beyond the existing ones.
- Since it will be a retrospective study and the information will be obtained from the existing records, complete data could not be expected [20], the data was taken for 1 years (January 1, 2007 – December, 31, 2007).

CHAPTER 2
LITERATURE REVIEW

The literature review will discuss the issues below:

2.1 Incidence of Low Birth Weight (Definition of LBW, percentage of LBW in global, South East Asia and Indonesia), severity and risk factors.

2.2 Theoretical model.

2.3 Previous studies related to maternal risk factors for Low Birth Weight Infants.

2.1 Incidence of Low Birth Weight

2.1.1 Definition of low birth weight

Low birth weight (<2,500 grams) is defined by World Health Organization as a birth weight less than 2,500 grams (WHO, 2004) (1). The International Federation of Gynecology and Obstetrics (FIGO), Bernabe et.al. (21, 22) mentioned that there are three terms that are frequently used interchangeably but are not necessary synonymous for LBW:

- Low birth weight (LBW). This term refers only to infants born weighing less than 2,500 grams, regardless of gestational age and the cause of LBW. Three categories can be distinguished:
- Premature or preterm LBW babies (born before 37 complete weeks of gestation or with fewer than 259 days of gestation).
- Term LBW, that is, born between 37 and 42 complete weeks of gestation, or between 259 and 293 days of gestation.
- Post-term LBW, born be after 42 weeks or 294 days of gestation.

LBW infants can be further classified as “very low birth weight” (1,000 – 1,499 gr) and “extremely low birth weight” (500 – 999 gr).

- Small-for-gestational-age (SGA). This term is based on a statistical definition, which refers to infants whose weight is less than the lower limit of the confidence interval of the normal curve for weight by weeks of gestation.
- Intra-uterine growth retardation (IUGR). IUGR is currently defined as a process of whatever etiology that can limit the potential for intra-uterine growth of the fetus, resulting in low birth weight.

2.1.2 Percentage of low birth weight

According to the Low Birth Weight, Country, Regional and Global Estimate (UNICEF and WHO, 2004) 15.5% of all birth, or more than 20 million infants worldwide, are born with low birth weight. The level of low birth weight in developing countries (16.5 per cent) is more than double the level in developed regions (7 per cent). More than 95 per cent of low birth weight babies are born in developing countries (1).

There was significant variation in low birth weight incidence across the main geographic regions, for Asia regions ranging from 5.9% to 27.1%. In South East Asia, there was 11.6% of infants had low birth weight and Indonesia was estimated at 9% (see Table 1 and 2) (1).

Meanwhile, the Indonesia National Health Profile in 2007 reported that 7.6 percent of infants are born with low birth weight (Indonesia’s National Health Survey, 2002 - 2003) (2).

Table 1 Percentage and number of LBW Infants By United Region, 2000**.**

	% of Low Birth Weight Infants	Number of LBW Infants (1,000s)	Number of live births (1,000s).
World	**15.5**	**20,629**	**132,882**
More developed	7.0	916	13,160
Less developed	16.5	19,713	119,721
Least developed countries	18.6	4,968	26,639
Africa	**14,3**	**4,320**	**30,305**
Eastern Africa	13,5	1,440	10,649
Middle Africa	12,3	545	4,413
Northern Africa	15,3	701	4,587
Southern Africa	14,6	181	1,243
Western Africa	15,4	1,454	9,412
Asia	**18.3**	**14,195**	**77,490**
Eastern Asia	5.9	1,203	20,537
South-Central Asia	27.1	10,819	39,937
South-Eastern Asia	11.6	1,360	11,743
Western Asia	15,4	813	5,273
Europe	**6.4**	**14,195**	**7,185**
Eastern Europe	6.4	174	2,709
Northern Europe	6.5	70	1,070
Southern Europe	5.9	85	1,440
Western Europe	6,7	131	1,965
Latin America and Caribbean	**10.0**	**20,629**	**132,882**
Caribbean	13. 7	103	754
Central America	10.1	347	3,423
South America	9.6	721	7,494
Northern America	**7.7**	**343**	**4,479**
Oceania	**10.5**	**27**	**255**
Australia/ New Zealand	6.5	20	300
Melanesia	10.8	24	226
Micronesia	12.7	2	13
Polynesia	3,8	1	15

Source: UNICEF/WHO. LBW: Country, Regional & Global Estimates, 2004.

Table 2 UNICEF/WHO estimates of the Incidence of Low Birth Weight, 2000. (Sub Region South East Asia)

Country	Year	% of Low Birth Weight Infants	Number of LBW Infants (1,000s)	% of births not weighed
Brunai Darussalam	1998	10	< 1	Not available
Cambodia	2000	11	52	83
Indonesia	2002	9	411	22
Lao PDR	2000	14	28	83
Malaysia	1998	10	53	Not available
Myanmar	2000	15	179	Not available
Philipinnes	2000	20	396	34
Singapore	2000	8	4	Not available
Thailand	2001	9	95	Not available
Timor Leste	2002	10	2	90
Vietnam	2000	9	140	29

Source: UNICEF/WHO. LBW: Country, Regional & Global Estimates, 2004.

2.1.3 Severity of Low Birth Weight

Maternal and child health is one element of the primary health care program. Antenatal care provides good health for pregnant women. Low birth weight is acknowledged to be one of the most pressing problems in prenatal care. LBW infants are more likely to die early, and those who survive may suffer illness, stunted growth or even problem into adult life (23).

LBW infant has a perinatal morbidity and mortality rate that could be eight (8) times and 40 times more likely to die in the neonatal period than normal infants, and are at risk of ante-partum death, perinatal asphyxia, neonatal morbidity, later physical and intellectual development problems. The risk of mortality increases with decreasing birth weight; the risk of neonatal death is five times more likely than

normal birth weight infants to die later in the first year and account for 20 percent of post-neonatal death (24).

A cohort study in Malawi has shown that LBW babies do not catch up in growth as reported in studies from developed countries. Malawian babies are shorter and lighter in comparison to the CDC 2000 reference values on maternal malaria delivery was negatively associated with infant growth (25).

Birth weight is a popular topic. It is a major determinant of infant survival associated with infant mortality and health outcomes later in life. Low birth weight (LBW) is predisposing factor for metabolic abnormalities such as atherosclerosis, renal disease, non insulin diabetes mellitus, asthma, low IQ, hypertension, obesity, psychological distress. LBW infants may possible association with liver diseases within the scope of 15-20 years of period (26).

Johnson EO and Breslaw N (2000) a study about low birth weight and normal birth weight children were randomly selected from the 1983-1985 newborn lists of an urban and a suburban hospital in Southeast Michigan and they found that the effect of low birth weight boys at age 11 years was associated with increased risk for reading and math disabilities in male children (odds ratio=3,3 and odds ratio= 6,5 respectively) but not for female children (27).

LBW infants may experience a range of complications, which may involve combinations of neuro-sensory, developmental or health problems that influence clinical outcomes (28). Changes in reported day-time behavioral characteristics in infants related to LBW include slow adaptability (1,2), more intense reaction to external stimuli (29, 30), low attention and diminished activity (31).

2.1.4 Risk Factors of Low Birth Weight

LBW result from intra-uterine growth retriction (IUGR), preterm birth (PTB) or both. In developed countries the major determinant of IUGR are cigarettes

smoking, low weight gain, low BMI, primiparity and short stature. In developing countries IUGR determinants are low weight gain, low BMI, short stature, malaria and pregnancy – induced hypertension (32, 33).

According to the Committee to Study the Prevention of LBW, Institute of Medicine. National Academy Press. Washington D.C., 1985 the majority of risk factors for low birth weight in U.S., include demographic characteristics, medical risk before pregnancy, identified during pregnancy, behavioral and environmental factors and health care (such as inadequate prenatal care) (Table 3) (24).

Table 3 Summary of Principal Risk Factors for Low Birth Weight

1. Demographic Risks A. Age less than 17; over 34 B. Race (Black) C. Low socioeconomic status D. Unmarried E. Low level of education	
2. Medical Risk Predating Pregnancy A. Parity (0 or more than 4) B. Low weight for height C. Genitourinary anomalies/ surgery D. Selected diseases, such as diabetes, chronic Hypertension	E. Non immune status for selected infection such as rubella. F. Poor obstetric history; multiple spontaneous abortions. G. Maternal genetic factors (such as Low maternal weight at own birth)

Table 3 Summary of Principal Risk Factors for Low Birth Weight (cont.)

3. Medical Risk in Current Pregnancy

A. Multiple pregnancy
B. Poor weight gain
C. Short inter pregnancy interval
D. Hypotension
E. Hypertension/preeclampsia/toxemia
F. Selection infections such as symptomatic bacteriuria, rubella, and cytomegalovirus
G. 1st or 2nd trimester bleeding
Placental problems such as placenta previa, abruptio placentae.
H. Hyperemesis
I. Oligohydramnios/polyhydramnios
J. Anemia/abnormal hemoglobin
K. Isoimunization
L. Fetal anomalies
M. Incompetent cervix
N. Spontaneous premature rupture of membranes

4. Behavioral and Environmental Risks

A. Smoking
B. Poor nutritional status
C. Alcohol and other substance abuse
D. DES exposure and other toxic exposures, including occupational hazards
E. High altitude

5. Health Care Risks

A. Absent or inadequate prenatal care
B. Iatrogenic prematurity

6. Evolving Concepts of Risks

A. Stress (physical and psychosocial)
B. Uterine irritability
C. Events triggering uterine contractions
D. Cervical changes detected before onset of labor
E. Selected infections such as mycoplasma and Chlamydia trachomatis.
F. Inadequate plasma volume expansion
G. Progesterone deficiency

Source: Institute of Medicine. Preventing LBW summary, Washington D.C., 1985

2.2 Theoretical Model

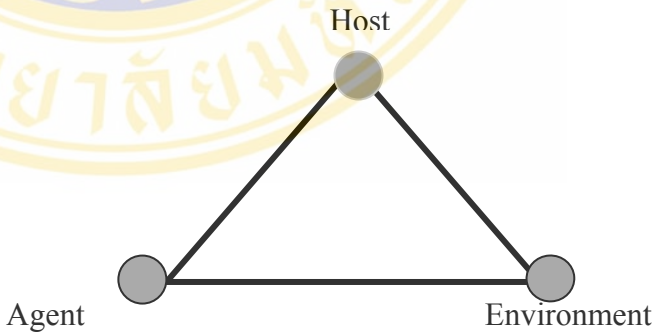
Epidemiological triangle of disease is used to determine maternal risk factors to low birth weight infants, including host (mothers), agent and environment that are factors found in leading occurrence of low birth weight infants.

The Epidemiologic Triangle of Disease

The epidemiologic triangle is a model that scientists have developed for studying health problem. The Triangle has three corner (called vertices):

- Agent, or microbe that causes the disease (the "what" of the Triangle)
- Host, or organism harboring the disease (the "who" of the Triangle)
- Environment, or those external factors that cause or allow disease transmission (the "where" of the Triangle).

A disease is the product of a human host, an infectious agent or other type of agent and the environment that promote the exposure (34).



"The Epidemiologic Triangle"

Figure 2 The Epidemiologic Triangle.

The agent – "What"

The agent is cause of the disease. For the epidemiology of most of infectious disease, the agent is a microbe – an organism too small to be seen with the naked eye. Disease-

causing microbes are bacteria, fungi, and protozoa (a type of parasite). They are what most people call “germs”. Agent could be as biological, chemical and physical (35).

The host – “Who”

Host is organisms, usually human or animals, which have been exposed to and harbor a disease. The host can be the organism that gets sick, as well as any animal carrier (including insects and worms) that may or may not get sick.

The Environment – “Where”

The environment is the favorable surrounding and condition *outside* the host that cause or allow the disease to be transmitted. Some diseases live best in dirty water. Others can survive only in blood. Many infectious disease microbes live in the mucus in nose or mouth.

Enabling environment factors refers to nutritional status, alcohol, smoking or passive smoking (second hand smoke exposure), using drugs, and psychosocial characteristics such as stress, depression, anxiety, self esteem, and poor social support (36,37,38,39).

The epidemiological triad of disease model is applied for a conceptual framework of the study as follows:

- Host susceptibility, represented by maternal characteristics that included maternal age, education and maternal height.

- The agent refers to pregnancy risk factors such as anemia, hypertension, previous obstetric history and others biological risk factors: parity, birth spacing, gestational age, weight gain during pregnancy and pre-pregnancy weight.

- Environment in this study refers to all external conditions affecting the low birth weight infants such as antenatal visits and maternal occupation.

2.3 Previous Studies related to Maternal Risk Factors for Low Birth Weight Infants.

2.3.1 Socio-Demographic Risk Factors

Maternal age

In their study of the large population of available birth in the California birth cohort, DuPlessis HM, et al (1997) analyzed more than 24,000 deliveries by mothers 18 years of age or younger, and almost 10,000 deliveries to mothers 15 years of age or younger. They found adolescent mothers are at increased risk of LBW and premature birth compared to women of "prime" childbearing age (38).

Pevalin DJ, et al (2001) studied the factors that are associated with adverse birth outcomes using a representative national sample. They found that adverse socio-economic factors, such as higher levels of family dysfunction, low social support, young age, lower levels of mother's education and income inadequacy were significantly increased the risk of an adverse birth outcome (40).

Bhuiyan SU (1999) conducted a case-control study to determine the maternal factors related to low birth weight among mothers who delivered at Maternity and Child Health Training Institute, Dhaka, Bangladesh and found that 16% of the mothers who had delivered normal birth weight babies were aged less than 20 years (41,42).

Khoshnood B, Wall S and Lee KW (2005) examined and compared the risk of low birth weight associated with delayed childbearing in four ethnic groups using national representative data in the United State, showed that for all four ethnic groups, maternal age ≥ 35 years at first birth was associated with low birth weight infant (43).

Ziedeh SM (2002) did a retrospective study to compare the maternal and perinatal outcomes of nulliparous women 35 years and older at the time of delivery with nulliparous women 25-29 years old at the Princess Badeea Teaching Hospital in North Jordan between January 1, 1996 and July 1, 2000. The result showed that women aged 35 years and older were substantially more likely to have pregnancy-induced hypertension, preterm delivery and low birth weight (44).

Maternal education

Golding J and Shenton T (1990) studied a population-based data from 10 centers in Burma, Thailand, China and Vietnam. They found a strong association between maternal education (mother illiterate and mother literate/secondary) and low birth weight (RR 1.46 $p < 0.001$) (45).

Grjibovski A. et al (2002), examined the relation between poor infant outcome (PIO) indicator such as preterm delivery and low birth weight and socio-demographic factors. They found that there is an increase risk of PIO in mothers aged 30 years or older, unmarried women, while education was found to be the most significant factor associated with PIO (OR= 1.9, 95% CI 1.2, 3.0 for secondary or less education compared with at least 3 years of university studies) (46, 47).

Li CY, Sung FC (2006) found that trend of low birth weight in Taiwan decreased by 43% during 20-years study period, with the smallest reduction (13%) for infants born to unmarried mothers and the largest reduction (49%) for infants born to well-educated mothers (48).

Maternal occupation

Chumnijarakij T, et al (1988) found that laborer and farming occupation are risk factors for LBW compared to commercial occupation. Working women without income have 1.17 times the risk of LBW as housewives. They also found that mother

has to travel one to four kilometers (kms) to work there is a 1.3 times greater risk of LBW than for mothers who do not have to travel to work (49).

2.3.2 Biological Risk Factors

Birth parity

Zimmer-Gembeck MJ and Helfand M. (1996), conducted a retrospective, observational study of 3073 low income African American, Latina, and White women receiving comprehensive prenatal care at 26 providers sites. They found that, age, race/ethnicity, behavior for smoking during pregnant, psychosocial and parity (nulliparaous) were associated with LBW (50).

Bhuiyan SU. (2000) also found an association between maternal biological factor and LBW such as antenatal visits, gestational age, maternal height and birth parity (41).

Birth interval

Oduntan S (1999) conducted a study on low birth weight and found that a short birth weight interval was associated with increased incidence of LBW. The lowest proportion of LBW babies was found in mothers who waited at least 12 months after the previous delivery before becoming pregnant again (51).

Gestational age

Mohsin M, et al (2003) identified the influenced of neonatal and maternal factors on premature birth and low birth weight in New South Wales, Australia and they found that gestational age (i.e. premature birth: < 37 weeks gestation) was one of the single most important determinant of low birth weight for both the singleton and plural births (10). The result was similar with the study of Jirojwong S and Skolnik M (52).

Wilcox AJ and Skjnerven R (1992) studied the effect of gestational age on birth weight and perinatal mortality in a retrospective hospital based study, and found that gestational age is a powerful predictor of birth weight and perinatal survival (53).

Maternal height

Chumnijarakij T, et al (1988) also found that mother whose height was under < 150 cms had 1.41 times higher risk of low birth weight than tall mothers (49).

Jirojwong S. and Skolnik M. (1990) also found that mother's height less than 150 cms have 1.41 times risk of mothers between 150-159 cms for delivering a low birth weight baby and was statistically significant at the 95% confidence level (52).

Weight gain

Wang CS, Chou P (2001) carried out a cross-sectional study in A-Lein Community Health Center, Kaohsiung County, to determine the risk factors for LBW among first-time mothers in Southern Taiwan and concluded that after controlling for covariates, the significant risk factors for LBW were low gestational weight gain (<10 kg) and low pregravid weight (<45 kg) for adolescent mothers. Infrequent prenatal visits (<10) was the only significant risk factors for adult mothers (54).

Isaranurug S, et.al, (2007) conducted a population – based cohort study of effect of maternal risk factors on low birthweight in Thailand, to determine the maternal risk factors of LBW in Thailand and to address the possible activities to reduce the incidence of LBW found that the most important factor attributed to LBW with high attributable fraction (AF) and moderate population attributable risk (PAR) was weight gain during pregnancy of less than 10 kgs (AF=40.12, PAR= 16.05). Poor pregnancy weight gain is a potentially correctable factor of LBW through a good quality of prenatal care and food supplementation to pregnant women (55).

2.3.3 Pregnancy Risk Factors

Antenatal visits

Prasad L (1995) studied the factors associated with birth weight in Zonal Hospital, Biratnagar, Nepal and found that women with ANC visit less than 4 times had 5.7 times more risk of LBW. The study also found that women with complications during pregnancy had 1.5 times more risk of LBW (56).

Koroukian SM and Rimm AA (2001) in their study to recommended the adequacy of prenatal care utilization (APNCU) index to reduce low birth weight. The results obtained through the APNCU index, showed that increasing number of prenatal visits is associated with the reduction of LBW (57).

Anemia

Verhoef FH, et al (2001) conducted a study to access the contribution of maternal health, nutritional status and obstetric history on intra uterine growth retardation (IUGR) and prematurity. It found that the risk factors significantly associated with IUGR were primiparity (RR 1.9; 95% CI 1.4 – 2.6), short maternal stature (RR 1.6; 95% CI 1.0 - 2.4) and anemia (Hb , 8 g/dl) at first antenatal visit (RR 1.6; 95% CI 1.2 – 2.2) (58).

Steer PJ (2000) mentioned that the lower incidence of LBW was seen at a hemoglobin concentration of 9.5 and 10.5 g/dl. This is widely regarded as indicating anemia in the pregnant women (59).

Ticconi C, et al (2004) found that malaria, abruption placenta and anemia is an important determinant of LBW in Northern Zimbabwe (60).

Hypertension

Mohsin M, et al (2003) identified the influenced of neonatal and maternal factors on premature birth and low birth weight in New South Wales, Australia. The result showed that premature birth and LBW rate significant varied by infant sex, maternal age, marital status, Aboriginality, parity, maternal smoking behavior during pregnancy and maternal hypertension (10).

Malick A (2003) studied maternal risk factors for low birth weight in a hospital setting in Bangkok found that pregnant women with complications during pregnancy such as anemia and pregnancy induced hypertension have a higher risk of delivering LBW babies than women of uncomplicated pregnancy (61).

Previous obstetric history

Mavalankar DV, et al (1994) conducted a case control study of LBW in three teaching hospitals and a population survey in Ahmeddabad city, India in 1987-1988 to identify and quantify risk factors for small gestational age births. They found that the most important risk factor for SGA was poor maternal nutritional status (weight < 51 kg) with an attributable risk of 42 percent. Other significant risk factors were anemia, hypertension during pregnancy, primiparity, lack of antenatal care and poor obstetric history (62).

In conclusion, most studies determined that maternal risk factors contributed to low birth weight infants were extreme maternal age, education, occupation, biological risk factor such as birth parity, birth spacing, gestational age, maternal height and pre-pregnancy weight and pregnancy risk factor such as antenatal visits, present obstetrics and medical complications during pregnancy (anemia, hypertension, diabetes mellitus) and previous obstetric history such as stillbirth, abortus, premature etc.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Study design

The study design was a hospital – based retrospective unmatched case – control study. The cases are the mothers with LBW infants (< 2,500 grams) and the control are mothers who has NBW infants (≥ 2,500 grams). Both groups of mothers delivered at the Fatmawati General Hospital, Jakarta, Indonesia.

3.2 Study population

Subjects in this study included all mothers who delivered a single infant at the study hospital during January 1, 2007 to December 31, 2007.

Criteria for selection of cases and controls:

1) Inclusion Criteria :
   - Cases : Mothers who delivered a single newborn weighing < 2,500 grams.
   - Control : Mothers who delivered a single newborn weighing ≥ 2,500 grams (These controls are selected from births at the same day).
2) Exclusion Criteria :
   - Mothers who delivered twin or multiple pregnancies, and congenital malformations and stillbirths were excluded from this study.
   - The cases and controls were chosen from compile medical record only.

3.3 Sample size and sampling technique

3.3.1 Sample size:

This study was examined the sample size using the formula as follows (63):

$$n = \frac{[Z\alpha/2\ \sqrt{2PQ} + Z\beta\ \sqrt{P1Q1 + P2Q2}\ ]^2}{(P1-P2)^2}$$

Where :

- 80% CI
- P2 = 0.076 (Incidence of LBW 7.6%)
- Odds ratio = 2
- P1 = P2/(P2+(1-P2)/2 → 0.076/(0.076+0.924)/2= 0.152
- r = 1
- p = (P2+P1)/2 → (0.076+0.152)/2= 0.114
- α = 0.20 So. Zα/2 = 1.28
- β = 0.2 Zβ = 0.84 (power of study)

$$n = \frac{[Z\alpha/2\ \sqrt{2PQ} + Z\beta\ \sqrt{P1Q1 + P2Q2}\ ]^2}{(P1-P2)^2}$$

$$= \frac{[1.28\ \sqrt{2x0{,}114x0.886} + 0.84\sqrt{0.152x0.848 + 0.076x0.924}\ ]^2}{(0.152-0.076)^2}$$

$$= 150$$

Conclude that 150 cases and 150 control required for the study.

3.3.2 Sampling technique:

The study was used simple random sampling to select the cases and control group from the medical record. For low birth weight infant the cases were randomly selection from all mothers delivered single babies with low birth weight (less than 2500 grams), and the controls were chosen by pick up NBW babies next to low birth weight infant at the same period of time.

3.4 Data collecting tools and methods:

Data was collected by checking the patient's antenatal, delivery, and medical records on study variables using the collection form which consisting of 3 (three) parts:

1) Socio-Demographic Risk Factors
2) Biological Risk Factors
3) Pregnancy Risk Factors.

3.5 Method of data collection

This was a quantitative study using the secondary data from the hospital admission records. They will be extracted and copied into the data collection form.

3.6 Data analysis procedure and statistics used:

- Descriptive statistics to describe the characteristic of cases and controls
- Inferential statistics:
  - Chi square test for determining the relationship between all independent variables and the outcome variable.
  - Crude Odds ratio will be presented to show the strengthen of association and 95% confidence interval of OR to show the significance of association.
  - Multiple logistic regressions for determining the relationship between all independent variables and the outcome variable.
  - Significant level at $p < 0.05$

CHAPTER 4
RESULTS

The study was a hospital – based retrospective unmatched case – control study by analyzing the secondary data from the antenatal, delivery and patient's medical records at the Fatmawati General Hospital, Jakarta, Indonesia.

Total number of deliveries from January to December 2007 was 2333, the number of low birth weight was 480. The incidence rate of LBW was 20.5%. The 150 subjects from those LBW were selected as cases and 150 normal birth weight infants as controls. The data were collected during January 16 to February 5, 2008 by using the data recording form.

The study results have been tabulated and presented in frequency and percentage. The association between the independent variables and the low birth weight infants was statistically determined, using Chi Square and Multiple logistic regression analysis with the level of significance at $\alpha = 0.05$. Chi Square test determined the relationship between each independent variable and the outcome variable. Crude odds ratio presented to show the strength of association and 95% confidence interval of OR to show the significance of association. Multiple logistic regression was used to determine the relationship between all independent variables and outcome variable. The results of this study were divided into three parts as follows:

4.1 Characteristics of newborn infants in LBW and NBW groups

4.2 The distribution of maternal risk factors of LBW and NBW groups

4.3 The association between maternal socio demographic, biological and pregnancy factors and birth weight.

4.3.1 Bivariate analysis

4.3.1.1 The association between maternal socio demographic and birth weight.

4.3.1.2 The association between maternal biological and birth weight.

4.3.1.3 The association between pregnancy factors and birth weight.

4.3.2 Multivariate analysis

4.3.2.1 Full model of Multiple Logistic Regression

4.3.2.2 Final model of Multiple Logistic Regression

4.1 Characteristic of newborn infants in LBW and NBW groups

Table 4 Characteristics of newborn infants in LBW and NBW groups

Characteristic	**Low Birth Weight (N= 150)**		**Normal Birth Weight (N= 150)**		**Chi – Square P - value**
	n	**%**	**n**	**%**	
Gender					
Male	79	49.38	81	50.63	0.817*
Female	71	50.71	69	49.29	
Birth weight (grams)					
Range	1100.00 - 2450.00		2500.00 – 4600.00		
$\bar{X}$ (SD)	2038.00 (290.549)		3089.67 (367.391)		

* Significant at $\alpha = 0.05$

Out of total number of LBW group males were 49.38% and 50.71% were females. In the NBW group 50.71% were males and 49.29% females. There was not significant association of sex of baby in LBW and NBW (P - value > 0.05). The distribution of sexes in both the LBW and NBW groups was similar (Table 4).

4.2 The distribution of maternal risk factors of LBW and NBW groups.

Table 5 The distribution of maternal risk factors of LBW and NBW groups.

Maternal risk factors	Low Birth Weight (N= 150)		Normal Birth Weight (N= 150)		Total	
	n	%	n	%	n	%
Maternal age						
< 20 years	17	(11.3)	3	(2.0)	20	(6.7)
20 – 34 years	99	(66.0)	127	(84.7)	226	(75.3)
35 and above	34	(22.7)	20	(13.3)	54	(18.0)
Education						
Primary	82	(54.7)	54	(36.0)	136	(45.3)
Secondary	59	(39.3)	74	(49.3)	133	(44.3)
High/college	9	(6.0)	22	(14.7)	31	(10.3)
Occupation						
Housewife	119	(79.3)	100	(66.7)	219	(73.0)
Laborer	11	(7.3)	11	(7.3)	22	(7.3)
Office worker/ Gov. employee	12	(8.0)	31	(20.7)	43	(14.3)
Others	8	(5.3)	8	(5.3)	16	(5.3)
Birth Parity						
Parity 1	74	(49.3)	65	(43.3)	139	(46.3)
Parity 2-3	58	(38.7)	64	(42.7)	122	(40.7)
Parity 4 and over	18	(12.0)	21	(14.0)	39	(13.0)
Birth interval						
< 24 months	20	(22.0)	12	(12.9)	32	(17.4)
≥ 24 month	71	(78.0)	81	(87.1)	152	(82.6)
Gestational age						
Pre-Term (< 37 weeks)	91	(60.7)	12	(8.0)	103	(34.3)
Term (≥ 37 weeks)	59	(39.3)	138	(92.0)	197	(65.7)
Maternal Height						
< 150 Cm	23	(15.3)	10	(6.7)	33	(11.0)
≥ 150 Cm	127	(84.7)	140	(93.3)	267	(89.0)
Pre-Pregnancy Weight						
< 45 Kg	30	(20.0)	12	(8.0)	42	(14.0)
≥ 45 Kg	120	(80.0)	138	(92.0)	258	(86.0)

Table 5 The distribution of maternal risk factors of LBW & NBW groups (cont.)

Maternal risk factors	Low Birth Weight (N= 150)		Normal Birth Weight (N= 150)		Total	
	n	%	n	%	n	%
Weight Gain						
< 10 Kg	129	(86.0)	60	(40.0)	189	(63.0)
≥ 10 Kg	21	(14.0)	90	(60.0)	111	(37.0)
ANC Visits						
< 4 times	60	(40.0)	15	(10.0)	75	(25.0)
≥ 4 times	90	(60.0)	135	(90.0)	225	(75.0)
Anemia						
Yes (< 11 gr/dl)	54	(36.0)	38	(25.3)	92	(30.7)
No (≥ 11 gr/dl)	96	(64.0)	112	(74.7)	208	(69.3)
Hypertension						
Present	55	(36.7)	27	(18.0)	82	(27.3)
Absent	95	(63.3)	123	(82.0)	218	(72.7)
Diabetes Mellitus						
Present	3	(2.0)	4	(2.7)	7	(2.3)
Absent	147	(98.0)	146	(97.3)	293	(97.7)

Maternal age

From the Table 5, most of the mothers in this study were in 20 – 34 years age group, 66.0% in LBW and 84.7% in NBW. Distribution of other maternal age was the teenage age <20 years (6.7% in LBW and 2.0% in NBW) and aged ≥ 35 years (22.7% in LBW and 13.3% in NBW).

Maternal education

The highest educational attainment of LBW was primary educated mothers, 54.7% while 49.3% of NBW educated mothers were secondary level (Table 5).

Maternal occupation

The majority occupation of the mothers in this study were housewife, 79.3% in the LBW and 66.7% in the NBW. In the LBW and NBW groups 20.7% and 33.3% of mothers respectively were working mothers (Table 5).

Birth parity

From the Table 5, 46.3% mothers were parity 1, 40.7% mothers were parity 2 and 3 and 13% mothers were parity 4 and over. The mothers almost equally distributed in respect to parity in both LBW and NBW.

Birth interval

Birth interval is counted as the duration between this delivery and the previous delivery. Out of 91 mothers in LBW and 93 mothers in NBW group who were parity more than one, 22.0% and 12.9% respectively had birth interval less than 24 months (Table 5).

Gestational age

There was a total reversal of distribution of the subjects according to gestational age among the cases and controls, with the majority of cases (60.7%) having delivered prematurely (before 37 weeks) compared to only 8.0% of the controls (Table 5).

Maternal height

Among LBW group 15.3% of mothers were height less than 150 cms but only 6.7% in NBW group. Mother with height 150 cms and over were 84.7% in LBW and 93.3% in NBW group (Table 5).

Pre-pregnancy weight

Maternal weight before pregnancy of less than 45 kgs were 20.0% in LBW and 8.0% in NBW group. The maternal weight 45 kgs and over were 80% in LBW and 92.0% in NBW group (Table 5).

Weight gain

From Table 5 maternal weight gain during pregnancy less than 10 kgs were 86.0% in LBW and 40% in NBW groups and maternal weight gain 10 kgs and more were 14.0% in LBW and 60% in NBW groups.

ANC visits

Table 5 showed that antenatal visits less than 4 times were 60 mothers (40.0%) in LBW group but only 15 mothers (10.0%) in NBW group. Mothers who attended ANC 4 times and more than 4 were 90 mothers (60.0%) in LBW group and 135 mothers (90.0%) in NBW group.

Anemia

Mothers of the LBW group having anemia were 36.0% and 25.3% were in NBW group (Table 5).

Hypertension

There was an evident difference in the rate of occurrence of Hypertension in the case and control group with a considerable 36.7% of the cases reporting having Hypertension, compared to only 25.3% of the controls (Table 5).

Diabetes Mellitus (DM)

There was similar distribution on subject according to the Diabetes Mellitus (DM) in both the cases group and control group. In the LBW group having DM was only 2.0% and 2.7% in the NBW group (Table 5).

Table 6 The distribution of others maternal risk factors of LBW and NBW groups.

Maternal risk factors	Low Birth Weight (N= 150)		Normal Birth Weight (N= 150)		Total	
	n	%	n	%	n	%
Others Pregnancy Risk:						
Present Pregnancy						
Eclampsia						
Present	57	(38.0)	32	(21.3)	89	(29.7)
Absent	93	(62.0)	118	(78.7)	2 11	(70.3)
Abnormal Position						
Present	27	(18.9)	33	(22.0)	60	(20.0)
Absent	123	(82.0)	117	(78.0)	240	(80.0)
Infection						
Present	22	(14.7)	2	(1.3)	24	(8.0)
Absent	128	(85.3)	148	(98.7)	276	(92.0)
Previous Obstetric History						
Stillbirth						
Present	3	(2.0)	2	(1.3)	5	(1.7)
Absent	147	(98.0)	148	(98.7)	295	(98.3)
Abortus						
Present	22	(14.7)	29	(19.3)	51	(17.0)
Absent	128	(85.3)	121	(80.7)	249	(83.0)
Premature Labor						
Present	4	(2.7)	2	(1.3)	6	(2.0)
Absent	146	(97.3)	148	(98.7)	294	(98.0)

The other maternal risk factors in present pregnancy among the LBW group were eclampsia (38.0%), abnormal position (18.0%) and infection (14.7%). Among the NBW group, the frequency occurring were eclampsia (21.3%), abnormal position (22.0%) and infection (1.3%) (Table 6).

Table 6 also showed the previous obstetric history among the LBW group, stillbirth (2.0%), abortus (14.7%) and premature labor (2.7%). Among the NBW group, the occurring were stillbirth (1.3%), abortus (19.3%) and premature labor (1.3%) (Table 6). For parity one, if the mothers do not have any complication such as abortion they will categorized in absent groups.

4.3 The association between socio demographic, maternal biological and pregnancy factors and birth weight.

4.3.1 Bivariate Analysis

4.3.1.1 The maternal socio-demographic factors and birth weight.

Table 7 The association between socio-demographic risk factors and birth weight.

Maternal risk factors	LBW (N= 150)		NBW (N= 150)		Crude OR	95% CI for OR	Chi - Square P-value
	n	%	n	%			
Maternal age							
High risk (<20, ≥35 yr)	51	(34.0)	23	(15.3)	2.845	1.628 – 4.970	<0.001**
Low risk (20-30 years)	99	(66.0)	127	(84.7)	1		

Table 7 The association between socio-demographic risk factors and birth weight (cont.).

Maternal risk factors	LBW (N= 150)		NBW (N= 150)		Crude OR	95% CI for OR	Chi - Square P-value
	n	%	n	%			
Education							
Primary	82	(54.7)	54	(36.0)	3.712	1.589 – 8.669	0.002**
Secondary	59	(39.3)	74	(49.3)	1.948	0.835 – 4.549	0.123
High/college	9	(6.0)	22	(14.7)	1		
Occupation							
Employed	31	(20.7)	50	(33.3)	1.919	1.140 – 3.232	0.019*
Unemployed	119	(79.3)	100	(66.7)	1		

** Significant at $\alpha = 0.01$

* Significant at $\alpha = 0.05$

Association of maternal age and birth weight

From Table 7, it was found that maternal age less than 20 and more 35 years were 34.0% in cases and 15.3% in controls group. The OR was 2.85 and 95% CI was 1.628 – 4.970 with statistical significant at P - value < 0.001).

Association of maternal education and birth weight

The results showed that mothers of primary education had 3.7 times of greater risk LBW babies than the mothers of higher education (95% CI 1.589 – 8.669, P – value 0.002). The mothers with secondary education had 1.94 times of higher risk LBW babies than the mothers of higher education, but there was not association statistically significant between mothers with secondary education and mothers with higher education (95% CI 0.835 – 4.549, P – value 0.123) (Table 7).

Association of maternal occupation and birth weight

The result showed that 20.7% working mothers or employed women such as labor, office worker and others had LBW infants as compared to 79.3% housewives or unemployed (Table 7). It was found that association statistically significant (95% CI 1.140 – 3.232, P-value 0.019).

4.3.1.2 The association between maternal biological and birth weight.

Table 8 The association between maternal biological risk factors and birth weight.

Maternal risk factors	LBW (N= 150)		NBW (N= 150)		Crude OR	95% CI for OR	Chi - Square P-value
	n	%	n	%			
Birth Parity							
Parity (1, ≥4)	92	(61.3)	86	(57.3)	1.180	0.744 – 1.872	0.557
Parity 2-3	58	(38.7)	64	(42.7)	1		
Birth Interval							
< 24 months	71	(78.0)	81	(87.1)	1.769	0.832 – 3.763	0.135
≥ 24 months	20	(22.0)	12	(12.9)	1		
Gestational age							
Pre-Term	91	(60.7)	12	(8.0)	17.737	9.033 –34.828	<0.001**
Term	59	(39.3)	138	(92.0)	1		
Maternal Height							
< 150 Cm	23	(15.3)	10	(6.7)	2.535	1.162 – 5.533	0.026*
≥ 150 Cm	127	(84.7)	140	(93.3)	1		
Pre Pregnancy Weight							
< 45 Kg	30	(20.0)	12	(8.0)	2.875	1.410 – 5.864	0.004**
≥ 45 Kg	120	(80.0)	138	(92.0)	1		
Weight Gain							
< 10 Kg	129	(86.0)	60	(40.0)	9.214	5.236–16.215	< 0.001**
≥ 10 Kg	21	(14.0)	90	(60.0	1		

** Significant at α = 0.01

* Significant at α = 0.05

Birth parity

From the Table 8, it was seen that 49.3% mothers with parity 1 and parity 4 and over (61.3%) and parity 2 and 3 (38.7%) in cases group, and parity 1 and parity 4 and over (57.3%) and parity 2 and 3 (42.7%) in controls group. The result showed that different parity did not have different risk of having low birth weight babies (P-value 0.557).

Birth interval

The result showed that maternal birth interval less than 24 moths (78.0%) and more than 24 month and equal (22.0%) in cases group, and 87.1% and 12.9% in controls group respectively. The result showed that different birth interval did not have different of having LBW babies (P-value 0.135) (Table 8).

Gestational age

Mothers delivered baby before 37 weeks were 60.7% in cases group and 8.0% in controls group. In this study mothers who had gestational age less than 37 weeks have the 17.74 times of greater risk to delivery LBW infants than the mothers of 37 and more weeks of gestation (P – value <0.001) (Table 8).

Maternal height

Maternal height less than 150 cms were 15.3% in cases group and more than 150 cms and equal were 6.7% in controls group, respectively (Table 7). The mothers who were less than 150 cms tall had 2.54 times of greater risk to delivery LBW babies than the mothers of more than 150 cms tall (P-value 0.026) (Table 8).

Maternal pre-pregnancy weight

Maternal weight before pregnancy less than 45 kgs were 20.0% in cases group and 8.0% in controls group (Table 8). The mothers of pre-pregnancy weight less than

45 kgs had 2.88 times of greater risk delivery LBW infants than the mothers of pre-pregnancy weight 45 and more kilograms (P – value 0.004).

Maternal weight gain

Maternal weight gain less than 10 kgs were 129 (86.0%) in cases group and 60 (40.0%) in cases group (Table 8). The maternal weight gain during pregnancy less than 10 kgs had 9.21 times of higher risk to delivery LBW infants than the maternal weight gain 10 kgs and more (P - value < 0.001).

4.3.1.3 The association between pregnancy factors and birth weight

Table 9 The association between pregnancy risk factors and birth weight.

Maternal risk factors	LBW (N= 150)		NBW (N= 150)		Crude OR	95% CI for OR	Chi - Square P-value
	n	%	n	%			
ANC Visits							
< 4 times	60	(40.0)	15	(10.0)	6.000	3.210– 11.215	< 0.001**
≥ 4 times	90	(60.0)	135	(90.0)	1		
Anemia							
Yes (<11 gr/dl)	54	(36.0)	38	(25.3)	1.658	1.009 – 2.724	0.045*
No (≥ 11 gr/dl)	96	(64.0)	112	(74.7)	1		
Hypertension							
Present	55	(36.7)	27	(18.0)	2.637	1.548 – 4.493	< 0.001**
Absent	95	(63.3)	123	(82.0)	1		
Diabetes Mellitus							
Present	3	(36.7)	4	(18.0)	0.745	0.164 – 3.387	1.000
Absent	147	(63.3)	146	(82.0)	1		

Table 9 The association between pregnancy risk factors and birth weight (cont.)

Maternal risk factors	LBW (N= 150)		NBW (N= 150)		Crude OR	95% CI for OR	Chi-Square p-value
	n	%	n	%			
Eclampsia							
Present	57	(38.0)	32	(21.3)	2.260	1.356 – 3.768	0.02**
Absent	93	(62.0)	118	(78.7)	1		
Abnormal Position							
Present	27	(18.0)	33	(22.0)	1.285	0.728 – 2.268	0.386
Absent	123	(82.0)	117	(78.0)	1		
Infection							
Present	22	(14.7)	2	(1.3)	12.719	2.935– 55.136	< 0.001**
Absent	128	(85.3)	148	(98.7)	1		
Abortus							
Present	22	(14.7)	29	(19.3)	0.717	0.391 – 1.316	0.282
Absent	128	(85.3)	121	(80.7)			

** Significant at α = 0.01

* Significant at α = 0.05

ANC Visits

From Table 9 showed that antenatal visits less than 4 times were 40.0% in cases group and 10.0% in controls group. The mothers who attended ANC less than four times had 6.0 times greater risk to deliver LBW babies than the mothers who attended ANC four and more times (P - value < 0.001).

Anemia

There was similar disparity here as well, with over a third of the cases (36.0%) having anemia, compared to only 25.3% of the control (Table 9). The mothers who

had anemia 1.66 times of higher risk to have LBW babies than the mothers who did not have anemia (P -value < 0.045).

Hypertension

There was an evident difference in the rate of occurrence of hypertension in the cases and control group with a considerable 36.7% in case group reporting having hypertension and 18.0% in controls group (Table 9). Hypertensive mothers had 2.4 times of higher risk to have LBW babies compare to the normal mothers (P-value < 0.001) (Table 9).

Diabetes Mellitus

The result showed that 36.7% mothers in cases group having diabetes mellitus and 18.0% in controls group (Table 9). The result revealed that the condition of diabetes mellitus did not have the different risk of having LBW babies (P-value > 0.05) (Table 9).

Eclampsia

There was significant association between eclampsia and low birth weight (P-value 0.02). The result showed that mothers with eclampsia had 2.3 times of higher to delivery LBW babies compare to the normal mothers (Table 9).

Abnormal Position

There was not significant difference in an occurrence of LBW between mothers who delivery with abnormal position and normal position. (P – value 0.386) (Table 9).

Infection

There was significant association between mothers who had infection during pregnancy and low birth weight (P – value < 0.001). The result showed that mothers had infection during pregnancy had 12.7 times of higher risk to delivery LBW babies compare to normal mothers (Table 9).

Abortus

The most of LBW and normal birth weight mothers did not have history of abortion (85.3% and 80.7% respectively). There was no significant association between the history of abortion and low birth weight (P – value 0.282).

4.3.2 Multivariate analysis

4.3.2.1 Full model of Multiple Logistic Regression

For further analyzing which maternal risk factors influencing LBW babies, multiple logistic regression was applied.

Bivariate analyses were conducted to investigate the relationships between each of the maternal risk factors and the outcomes (LBW and NBW babies). Variables with p-value from bivariate equal to or less than 0.25 were considered in the next stage of the model building process. Correlations between these variables were then examined. If there were high correlations between some variables, one of the variables in each pair would be considered to be omitted. The more relevant variables (found in the literature or viewed by researcher as to be more important) would be chosen to represent the other. Stepwise selection technique was used in the model building process. The exclusion value for P was ≥ 0.10.

All variables were included in the initial full models. The results of full model analysis are reported in Table 10.

Table 10 Full model of multiple logistic regression

Maternal Risk Factors	Crude OR	95% CI for OR		P- value
		Upper	Lower	
Maternal age (< 20, ≥ 35 years old vs 20-34 years old).	2.668	1.159	6.138	0.021
Education (primary school vs Secondary and High/college).	0.843	0.492	1.447	0.536
Occupation (employed mothers vs unemployed mothers).	0.557	0.256	1.212	0.140
Birth interval (< 24 months vs ≥ 24 months).	0.921	0.230	3.680	0.907
Gestational age (< 37 weeks vs ≥ 37 weeks)	13.509	5.919	30.831	< 0.001
Maternal Height (< 150 cms vs ≥ 150 cms)	1.064	0.305	3.711	0.922
Pre- pregnancy weight (< 45 kgs vs ≥ 45 kgs)	1.379	0.695	2.738	0.358
Weight gain (< 10 kgs vs ≥ 10 kgs)	7.299	3.148	16.924	< 0.001
ANC visits (< 4 times vs ≥ 4 times)	2.111	0.889	5.013	0.090
Anemia (Hb level < 11 gr % vs Hb level ≥ 11 gr %)	1.088	0.517	2.290	0.824
Hypertension (> 140/90 mm Hg vs < 140/ 90 mm Hg)	4.119	0.632	26.826	0.139
Eclampsia (Present vs absent)	1.509	0.231	9.865	0.667
Infection (Present vs absent)	4.105	0.828	20.359	0.084
Abortus (Present) vs absent	0.509	0.177	1.463	0.210

Note: The first figure in bracket is a risk group, the second figure is reference group.

4.3.2.2 Final model of Multiple Logistic Regression

Stepwise regression is used in the exploratory phase of research or for purposes of pure prediction. Table 11 presents the reduced multivariate logistic regression model.

Table 11 Final model of multiple logistic regression

Predictors	Adjusted OR	95% CI for OR		P - Value
		Lower	Upper	
Maternal age (< 20, ≥ 35 years old vs 20 – 34 years old)	2.477	1.155	5.314	0.020*
Gestational age (< 37 weeks vs ≥ 37 weeks)	13.983	6.424	30.436	< 0.001**
Weight gain (< 10 kgs vs ≥ 10 kgs)	7.411	3.402	16.142	< 0.001**
ANC visits (< 4 times vs ≥ 4 times)	2.513	1.130	5.588	0.024*
Hypertension (> 140/90 vs < 140 mm Hg)	5.995	2.634	13.645	< 0.001**

Note: The first figure in bracket is a risk group, the second figure is reference group.

The most significantly associated maternal risk factors related to the low birth weight were gestational age less than 37 weeks (OR 13.983, 95% CI = 6.424 – 30.436), weight gain during pregnancy less than 10 kgs (OR 7.411, 95% CI = 3.402 – 16.142), hypertension (OR 5.995, 95% CI 2.634 – 13.645), antenatal visits less than 4 times (OR 2.513, 95% CI 1.130 – 5.588) and maternal age less than 20 and more than 35 years old (OR 2.477 95% CI 1.155 – 5.314).

The mothers of gestational age less than 37 weeks had 13,9 times to delivery LBW babies more than the mothers of gestational age 37 weeks or more and the mothers who had weight gain less than 10 kgs during pregnancy had more chance to deliver LBW babies 7.4 times than the mothers of weight gain 10 kgs and more. The hypertensive mothers had 5.9 times to deliver LBW babies more than the mothers without hypertension, the mothers who attended antenatal care less than 4 times was 2.5 times to deliver LBW babies more than the mothers who attended antenatal care 4 times and more. Finally the mothers aged less than 20 years and more than 35 years old had 2.4 times to deliver LBW babies more than the mothers aged 20 – 34 years old.

CHAPTER 5
DISCUSSION

A retrospective unmatched case control study was carried out in a hospital setting at the Fatmawati General Hospital, Jakarta, Indonesia, using secondary data from the hospital records. Total number of deliveries from January to December 2007 was 2333, the number of low birth weight was 480. The incidence rate of LBW was 20,5%. One hundred and fifty subjects from those LBW were selected as cases and 150 normal birth weight infants as controls. The data were collected during January 16 to February 5, 2008 by using the data recording form.

This study aims to determine women at relative high risk of delivery low birth weight infants, in terms of socio-demographic (maternal age, maternal education, maternal occupation), biological (parity, birth interval, gestational age, maternal height, pre-pregnancy weight, maternal weight gain) and pregnancy risk factors (antenatal visits, anemia, pregnancy induced hypertension, diabetes mellitus, eclampsia, abnormal position, infection and abortus) and recommend appropriate prenatal interventions.

As data collection was from the routine hospital records, it was not possible to investigate further into any particular point of interest. There might have been some selection bias in selection of controls as incomplete record were discarded and no data collected from them. As for the design of the study, a prospective study would be much more useful as the main of this study is to prevent low birth weight from occurring, not merely identifying the risk factors retrospectively. Hence we need to identify the high risk groups prior to delivery and alleviate the modifiable risk factors such as gestational age, maternal weight gain during pregnancy, hypertension, ANC

visit and maternal age so as to favorably influence the pregnancy outcome and prevent low birth weight from the occurring.

1. Socio-Demographic factors

Maternal age

The maternal age less than 20 and more than 35 were found as a risk factor of LBW. The maternal age of less than 20 years old was still growing age and the mother of 35 years old and more were more prone to develop pregnancy complications. The risk of LBW babies for young women is associated with biological health aspect, hazardous habits, low education and low income. Higher risk of LBW in the older age is related to pregnancy complications. The result was similar to the study of Duplessis HM, et al (38), they found that adolescent mothers are at increased risk of LBW and premature birth compared to women of childbearing age and the study of Khoosnood B (43), showed that maternal age ≥ 35 years at the first birth was associated with LBW infant.

Mohsin M, et al (10), identified the influenced of neonatal and maternal factors on premature birth and low birth weight in New South Wales, Australia found that the incidence of premature birth was significantly ($P < 0.001$) higher in teenage mothers and those aged 35 years or older than those aged 20-34 years.

Maternal education

The study found that an association between maternal education and low birth weight by crude OR. The result was similar to Grijbowski A (46) and Li CY, et al (48), they found that education was the most significant factors associated with poor infant outcome included LBW compared to the well educated mothers at least 3 years of university studied. Education cannot, it self, prevent LBW delivery. Hence education level must be indicating some feature of the mothers that actually has protective effect and a beneficial effect on their pregnancies. Educated mothers tend

to have different forms of behavior particularly health in various countries of the world. The result was similar to the study of Golding J and Shenton T (45). However, by logistic regression analysis adjusted OR was not significant. This means that maternal education is not direct factor influencing LBW babies.

Maternal occupation

This study found an association between maternal occupation and infant's birth weight (P – value 0.019) by crude OR. The working women had risk of giving LBW about 1.92 times higher than mothers who were housewives. The result was similar to the study of Chumnijarakij T. et al (49, 64), found that farmer and laborer were risk factors for LBW. Working women without income have 1.17 times the risk of LBW over mothers who were housewives. They also found that mothers who travelled one to four kilometers (kms) to work had 1.3 times greater risk of LBW than mothers who not have to travel to work. By multiple logistic regression maternal occupation was not a risk factor of LBW because it was not direct risk to LBW.

2. Biological factors

Birth parity

In many studies birth parity 1 and ≥ 4 were risk factor of LBW infants compared to parity 2-3. Birth parity in this study was not a risk factor of LBW babies. This result was not similar to study of Bhuiyan SU (25) in Bangladesh, found that the mothers of parity one had 1.44 times and parity more than 3 had 1.19 times higher risk of having LBW babies compared to mothers who were parity two. According to Chumnijarakij T (34) in the study in Thailand, found that the mothers of parity one or parity four and above had 1.72 times greater risk of LBW babies than mothers of parity three.

Birth interval

A short birth interval since previous birth might lead to poor pregnancy outcome. This study showed no significant association between LBW and birth interval. The result was not similar to the study of Oduntan S (51), found that a short birth weight interval was associated with increased incidence of LBW.

Gestational age

In this study gestational age variable strongly significant associated with LBW by bivariate analysis and multiple logistic regression (P – value 0.001). Age of gestation less than 37 weeks had 13.98 times (95% CI 6.424 – 30.436) higher risk of low birth weight than gestational age more than 37 weeks. Babies with less gestational age do not grow enough that effect their birthweight.

The gestational age was an important indicator of LBW babies, Jirajwong S and Skonik M (52), found that the infants born before 37 weeks of gestational period had risk 3 times higher than infants with gestational age of 37 weeks more and similar study of Chumnijarakij T (49). Maternal gestational age 28 – 37 weeks had risk 8 times higher than mothers with gestational age 37 weeks or more to delivery LBW babies. Mohsin M, et al (10) confirmed that premature birth < 37 weeks gestation was one of the single most important determinant of low birth weight for both singleton and plural births.

Maternal height

The maternal body height less than 150 cm were identified as risk factor for LBW compared to mothers with height more than 150 cm. In this study mothers height less than 150 cm had a risk 2.53 times (P – value 0.026) higher than mothers whose height 150 cm or more and there was an association between mothers height and LBW. Jirojwong S. and Skolnik M. (52) also found that mother's height less than 150 cm have a risk 1.41 times higher than mothers height between 150-159 cm for

delivering low birth weight babies and Chumnijarakij T (49) also found that the mothers whose height under 150 cms had 1.41 times higher risk of low birth weight babies than tall mothers. However, by multiple logistic regression maternal height was not direct risk of low birth weight babies.

Pre-pregnancy weight

By crude OR there was a significant relationship between maternal pre-pregnancy weight of less than 45 and LBW infants (P – value 0.004). The result was similar to the study of Chumnijarakij T (49), found that the mothers whose pre-pregnancy weight less than 45 kgs had 1.32 times higher risk of LBW than mother whose weight 45 – 55 kgs. However, by multiple logistic regression maternal pre-pregnancy weight was not a direct risk factors of LBW.

Maternal Weight gain

In this study maternal pregnancy weight gain was significantly associated with LBW both by bivariate analysis (P-value 0.004) and multiple logistic regression (p – value 0.001). Maternal pregnancy weight gain less than 10 kgs had 9.36 times of adjusted OR (95% CI 4.335 – 20.205) higher risk of low birth weight than mothers who gained more than or equal to 10 kgs. The result was similar study of Wang CS and Chou P (54). Inadequate weight gain during pregnancy had effect an increased risk of preterm birth and also associated with reduced fetal growth. Inadequate weight gain during pregnancy the most serious outcome associated with poor maternal nutrition (14, 15). Laura AM, et al (65) also found that women with low pregnancy weight gain were at increased risk of preterm delivery, particularly if women were underweight or of average weight pre-pregnancy weight.

Isaranurug S, et al (55), mentioned that maternal weight gain during pregnancy is the most feasible and potential factor because it is a direct factor contributed to LBW that can be improved by health personnel during prenatal care. Babies who were delivered by malnourished mothers weight were on average 390.9

grams in weight lower than babies of normal mothers. The malnourished pregnant mothers were associated with LBW five times more than normal pregnant mothers (16).

3. Pregnancy risk factors

Antenatal visit

Women who attended fewer than 4 antenatal visit had greater chance to deliver low birth weight babies (crude OR= 6.0, 95% CI 3.210 – 11.215) compared to women who attended more than 4 visits. Antenatal care provides good health for pregnant women. A good quality of prenatal care may help to reduce the LBW incidence (55). The result was similar to the study of Balcasar H, et al (66), found a greater risk for LBW among those pregnant women who had poor ANC than who had an adequate care. Another study by Prasad L (60) who studied the factors associated with birth weight at Zonal Hospital, Biratnagar, Nepal found that women with ANC visit less than 4 times had 5.7 times more risk of having low birth weight babies. Number of antenatal visit was a significant risk factor to deliver LBW babies by multiple logistic regression.

Present obstetric and medical complications

Anemia

By crude OR, anemia was a risk factor factor of LBW babies. The result was similar to the study of Ticconi C, et al (60), found that anemia to be important determinant of LBW in Northern Zimbabwe and also the study of Gillespie S (19) and Malick A (61). However, by multiple logistic regression maternal anemia was not a direct risk factor influencing LBW.

Hypertension

Hypertension was significantly associated with low birth both after bivariate analysis and multiple logistic regression (P – value 0.001). Women who had hypertension during their pregnancy had 5.99 times of the adjusted OR (95% CI 2.634 – 13.645) of delivering low birth weight babies compared to women with no hypertension. The hypertensive women can effect fetal growth development as well as the duration of pregnancy (14, 15). This finding was similar to study of Mohsin M, et al (10) who conducted maternal and neonatal factors influencing premature birth and LBW in Australia, showed that premature birth and LBW rate significantly varied by infant sex, maternal age, parity and maternal hypertension.

Malick A (61), studied maternal risk factors for low birth weight in a hospital setting in Bangkok found that pregnant women with complications during pregnancy such anemia and pregnancy induced hypertension have a higher risk of delivering LBW babies than women uncomplicated pregnancy.

Other present obstetric and medical complications

Eclampsia

Preeclampsia/eclampsia was significantly associated with low birth weight (p – value 0.002) in this study by bivariate analysis. The odd of having low birth weight of the mothers 2.26 times compared to the normal mothers (95% CI 1.356 – 3.768). Hypertension in pregnancy is associated with pre-tem birth and LBW (67.68).

Abnormal Position

Kusiako T, et al (69), confirmed that the prevalence of perinatal mortality rate associated with childbirth complications. More than half of the women in Matlab, Bangladesh diagnosed with obstructed labor or abnormal fetal position loss their babies during or shortly after pregnancy although such complications were rarely

reported by midwife (0.9 and 0.3%). In this study abnormal position was not a risk factor of having LBW babies.

Infections

Numerous microorganisms can cross the placenta and cause infection in the foetus such as taxoplasma, rubella, cytomegalovirus and herpes simplex. In addition, different studies conclude that there is an association between LBW and such maternal infections as Chlamydia, b – hemolytic Streptococcus, Ureoplasma urealyticum, Myocoplasma, Trichomonas, Stapilococcus aureus and other vaginal infections, as well as untreated gonorrhea and syphilis (70, 71). This study found that mothers with infective had more chance to deliver LBW babies.

Previous Obstetric History

Abortion

Some studies found that abortion associated with LBW such as the study of Chumnijarakij T. (49), found that a history of two or more induced abortion was associated with LBW. This study showed that abortion was not a risk factor of LBW.

Logistic regression

After analyzing the variables by logistic regression to determine which maternal risk factors could be significant for low birth weight babies. Only 5 variables remained maternal risk factors of low birth weight babies. The final model consisted of gestational age less than 37 weeks (OR 13.983, 95% CI = 6.424 – 30.436), weight gain during pregnancy les than 10 kgs (OR 7.411, 95% CI = 3.402 – 16.142), hypertension (OR 5.995, 95% CI 2.634 – 13.645), antenatal visits less than 4 times (OR 2.513, 95% CI 1.130 – 5.588) and maternal age less than 20 and more than 35 years old (OR 2.477 95% CI 1.155 – 5.314). This shows that these five variables, namely, gestational age, weight gain during pregnancy, hypertension, antenatal visits and maternal age have an additive effect on each other.

CHAPTER 6
CONCLUSION AND RECOMMEDATIONS

6.1 Conclusion

The study was a hospital – based retrospective unmatched case – control study by analyzing the secondary data from the antenatal, delivery and patient's medical records at the Fatmawati General Hospital, Jakarta, Indonesia.

The aim of this study was to determine maternal risk factors of occurrence of low birth weight infants. Data was collected from the hospital from January 16, 2008 to February 5, 2008. The sample size was 300, with a case – control ratio of 1:1.

Data analysis used bivariate analysis (mean, standard deviation, frequency and percentage) to provide description in the descriptive part of the study. Chi-square test and Person's Product Moment Correlation were used to asses significant association between each independent variable of maternal risk factors and low birth weight infants. The statistics used were Odds ratio to show the strengthen of association and 95% confident interval of OR to show the significant association. Multiple logistic regression and stepwise regression procedure was used in the exploratory phase of research for purposing of pure prediction.

Total number of deliveries from January to December 2007 was 2333, the number of low birth weight was 480. The incidence rate of LBW was 20,5%.

By bivariate analysis the result found that the variables of maternal risk factors for low birth weight (LBW): maternal age (p-value < 0.001), maternal education (p-value 0.002), maternal occupation (p-value 0.019), gestational age (p-value < 0.001),

maternal height (p-value 0.026), pre-pregnancy weight (p-value 0.004), weight gain (p-value < 0.001), ANC visits (p-value < 0.001), anemia (p-value 0.045), hypertension (p-value < 0.001), eclampsia (p-value 0.02) and infections (p-value <0.001). Others factors such as birth parity, birth interval, DM, abnormal position and abortus were failed to find an association with delivering LBW babies.

When the stepwise multiple regression analysis was used, it was found that five factors were significant risk factors: gestational age less than 37 weeks OR 13.98 (95% CI 6.424 – 30.436), weight gain during pregnancy less than 10 kgs OR 7.41 (95% CI 3.402 – 16.142), hypertension OR 5.99 (95% CI 2.634 – 13.645), ANC visits less than 4 times OR 2.51 (95% CI 1.130 – 5.588) and maternal age less than 20 and more than 35 years old OR 2.47 (95% CI 1.155 – 5.314). The five variables have an additive effect on each other. So, programs to improve maternal and child health (MCH) should focus on all these factors together.

6.2 Recommendations

In this study the significant associated with LBW were gestational age less than 37 weeks, weight gain during pregnancy less than 10 kgs, hypertension, antenatal visit less than 4 times and maternal age less than 20 and more than 35 years old, the following public health activities are recommended.

a) Recommendation for MCH program

1. Antenatal care for pregnant mothers is an essential factor to improve pregnancy outcome An appropriate nutritional educational pregnancy care and food supplement must be given to the mothers with poor weight gain.
2. High risk groups should be identified, education and well communicated by the health personnel. Health personnel should be trained properly with latest treatment ideas.
3. Maternal age less than 20 and more than 35 years old were found to be more having low birth weight babies. The teenage women should be delayed the early

pregnancy and birth control for older mothers by health education and family planning.

4. The health education campaign about high risk approach on the importance attending the ANC clinic through mass media and appropriate advertisement.

5. ANC should be basic right for pregnant mothers, so high quality ANC in adequate quantity should be promoted and made available, accessible and acceptable by strengthening MCH activities. So, encouraging more mothers to attend prenatal care in the first trimester is a key factor in preventing LBW babies, especially in high risk mothers.

6. Encouraging community involvement and empowerment in maternal and perinatal issues, included socially disadvantage population and low educated mothers.

7. Participation with empathic prevention and promotion program, which included more active movement of the private sectors.

b) Recommendation for Data Monitoring

1. All health personnel should write down and fill the information of the patient' health status completely in hospital record for future analysis.

2. It would be useful if the data could be analyzed not only as a routine hospital record, but also could be read as health information. Therefore, the essential data of patients should be included for further analysis.

3. Medical professional can periodically set or arrange hospital record to support future analysis of health problems and prospective studies.

c) Recommendation for future studies

1. It would be useful to collect primary data to ensure the completeness of study variables, although it might be costly.

2. A prospective study would be much more useful as the main of this study is to prevent low birth weight from occurring, not merely identifying the risk factors retrospectively.

3. As weight gain during pregnancy is the most second risk factor of birth weight, the intervention study of improving weight gain during pregnancy should be conducted to ensure the reduction of LBW babies.

4. Conduct the study on the effectiveness on quality of ANC visit.

REFERENCES

1. UNICEF, WHO. Low birth weight: country, regional and global estimates. NewYork: UNICEF : WHO; 2004.
2. Ministry of Health, Rep. Of Indonesia. Indonesia's national health profile 2007. Jakarta, Indonesia: MOH; 2007.
3. Barker DJP. (ed). Fetal and infant origin of disease. BMJ Books. London; 1992.
4. World Health Organization. WHO Technical Consultation, Towards the development of a strategy for Promoting Optimal Fetal Growth, Report of a meeting (draft). Geneva : World Health Organization; 2004.
5. Johnson EO, Breslau N. Increased risk of learning disabilities in low birth weight boys at age 11 years. Society of Biology Psychiatry 2000; 47: 490-500.
6. World Health Organization. Health: A Key to Prosperity success stories in developing countries. Geneva: WHO; 2000.
7. Karanika VL, Bakoula CT, Matsaniotis NS. Sociodemographic determinants of LBW in Greece: a population study. Paediatric and perinatal epidemiology. 1999; 13: 65-77.
8. Dickute J, Pandaiga Z, Grabauskas V, Nadisauskiene RJ, Basys V, Gaizauskiene A.Maternal socio-economic factors and the risk of low birth weight in Lithuania. Medicina (Kaunas). 2004; 40 (5): 475-82.
9. Dickute J, Pandaiga Z, Grabauskas V, Gaizauskiene A, Basys V, Obelenis. Do maternal socio factors, health behavior and working conditions during pregnancy increase of low birth weight in Lithuania?. Medicina (Kaunas). 2002; 38 (3): 321-32.
10. Mohsin M, Wong F, Bauman A, Bai J. Maternal and neonatal factors influencing premature birth and low birth weight in Australia. Journal Biosoc. Science. 2003; 35: 161-74.

11. Tought S, Svenson L, Schopflocher D. Maternal risk factors in relationship to birth outcome. Canada : Albertha Health and the Neonatal Research Unit, University of Calgary; 1999.
12. Kramer MS. Determinants of Low Birth Weight: Methodological Assessment and meta-analysis. Bulletin of the WHO. 1987; 65 (5): 663-737.
13. Indonesia Ministry of Health. Acceleration Operation Policy for Reducing Maternal Mortality Rate. Jakarta, Indonesia: The Ministry; 2007.
14. Madan A, Palaniappan L, Urizar G, Wang Y, Fortmann SP, Gould JB. Sociocultural factors that affect pregnancy outcomes in two dissimilar immigrant groups in United States. Journal of Pediatric. 2006; 148: 341-46.
15. Deshmukh JS, Motghare DD, Zodpey SP, Wadhva SK. Low birth weight and associated maternal factors in an urban area. Indian Pediatric. 1998; 35: 33-36.
16. Hidayati M. Chronic Energy Malnutrition and Anemic pregnant mothers for LBW in Mataram, NTB, Indonesia. (Thesis in Community Nutrition, Public Health] Yogyakarta: Gadjah Mada University, Indonesia; 2004.
17. Ministry of Health, Rep. Of Indonesia. Challenging and Trends in the Next Future. Jakarta,Indonesia : The Ministry; 2004.
18. Atmarita. Nutrition problem in Indonesia. In: An integrated international seminar and workshop on lifestyle-related diseases. Gadjah Mada University. Yogyakarta-Indonesia; 2005.
19. Gillespie S. Major issues in the control of iron deficiency. The micronutrient initiative. Ottawa, Canada : Unicef; 1999.
20. Isaranurug S, Prasertchoung C, Hokyindee T, Supaoath C, Bangorn Leingnimitramas B, Burestbumrongkarn P. Use of model mothers as indicators of community health problems. Thailand : World Health Organization.; 1990.
21. Bernabe JV, Soriano T, Albaladejo R, Juarranz M, Calle ME, Martinez D, Rojas VD. Risk factor for low birth weight; a review. European Journal of Obstet. & Gynecology and Reproductive Biology. 2004; 116 (issue 1): 3-15.
22. World Health Organization. Meeting of advisory group on maternal nutrition and low birth weight. Geneva: WHO; 2002.

23. World Health Organization. Fifty facts from the World Health Report 1998: Global Health Situation and Trends 1955-2025. (cited 2007Aug 3). Available from: http//www.who.int/

24. Brown SS. Preventing low birth weight. In: Maternal and child health practice. 3rd Ed. Oakland, California : Third party publishing; 1988. p.307-23.

25. Kalanda BF, Buuren SV, Verhoeff FH, Brabin BJ. Catch up growth in Malawian babies, a longitudinal study of normal and low birthweight babies born in a malarious endemic area. Early human development. 2005; 81: 841-850.

26. Donma MM, Donma O. Low birth weight: a possible risk factor also for liver diseases in adult life?. Medical hypotheses. 2003; 61 (4): 435-438.

27. Johnson EO, Breslau N. Increased risk of learning disabilities in low birth weight boys at age 11 years. Society of biology psychiatry. 2000; 47: 490-500.

28. Kelmanson IA, Adulas EI. Massage therapy and sleep behavior in infants born with low birth weight. Complementary Therapies in clinical practice. 2006; 12: 200-05.

29. Kelmanson IA. Low birth weight and behavior features in infants under one year old. Early child dev. Care. 1999; 135: 61-70.

30. Medoff-cooper B. Temperament in very low birth weight infants. Nurs. Res. 1986; 35: 139-43.

31. Oehler JM, Thompson RJ, Goldstein RF, Gustafson KE, Brazy JE. Behavioral characteristics of very low birth weight infants of varying biologic risk at 6, 15, and 24 months of age. Journal Obst Gynecol Neonatal Nurs.1996; 25: 233-39.

32. Peterson RM. Prevention of mental retardation and related disabilities. In: Maternal and child health practice.3rd ed. Oakland,California: Third party publishing ; 1988: 619-40.

33. Wallace HM. Infant mortality. In: Maternal and child health practice . 3rd Ed. Oakland-California : Third party publishing ; 1988: 411-26.

34. Understanding the epidemiologic triangle through Infectious Disease. Available from: www.bam.gov/teachers/activities/epi_1_1triangle.pdf.(Accessed 2007 Oct 25).

35. National Healthy Home Training Center and Network. Start with people – Essentials for Healthy Homes Practitioner Course. Available from: www.healthyhomestraining.org. (Accessed 2007 Oct 25).

36. Spinillo A, Capuzzo E, Iasci A, Nicola S, Piazzi G, Baltaro. Sociodemographic and clinical variables modifying the smoking-related risk of low birth weight. International Journal of Gynecology & Obstetrics. 1995; 51: 15-23.

37. Mariscal M, Palma S, LLorca J, Iglesias RP, Crespo RP, Rodriguez MD. Pattern of alcohol consumption during pregnancy and risk for low birth weight.AEP. 2006 June ; 16 (6): 432-38.

38. DuPlessis HM, Bell R, Richards T. Adolescent pregnancy: Understanding the impact of age and race on outcome. Journal of Adolescent Health. 1997; 20: 187-97.

39. Agudelo AC, Belizan JM, Lammers C. Maternal-perinatal morbidity and mortality associated with adolescent pregnancy in Latin America. American Journal of Obstetric and Gynecology. 2005; 192: 342-49

40. Pevalin DJ, Wade TJ, Branigan A, Sauve R. Beyond biology: the social context of prenatal behavior and birth outcomes. Social Preventive. 2001; 46 (6): 233-39.

41. Bhuiyan SU. Maternal Risk Factors Related To Low Birth Weight Baby Among Mother Delivered at Maternity and Child Health Training Institute. Dhaka, Bangladesh.(M.P.H. Thesis in Primary Health Care). Bangkok: Faculty of Graduate Studies, Mahidol University; 2000.

42. Yoder BA, Young MK. Neonatal outcome of teenage pregnancy in a military population . Obstectrics and Gynecology. 1997; 90 (4) part 1: 500-06.

43. Khoosnood B, Wall S, Lee KS. Risk of Low Birth Weight Associated with Advanced Maternal Age Among Four Ethnic Group in The United States. Maternal and Child Health Journal. 2005; 9 (1): 3-9.

44. Ziedeh SM. Maternal and Perinatal Outcome in Nulliparous Women Aged 35 and Older. Gynecol Obstet Invest. 2002; 54 (1): 90-2.

45. Golding J, Shenton T. Low birth weight and preterm delivery in South East Asia. The WHO international collaboration study of hypertensive disorder of pregnancy. Soc. Sci. Med. 1990; 30 (4): 497-502.

46. Grjibovski AM, Bygren LO, Svartbo B. Socio-demographic determinants of poor infant outcome in North-West Rusia. Paediatric and Perinatal Epidemiology. 2002; 16: 255-62.
47. Grijbovski AM, Bygren LO, Svartbo B, Magnus P. Social variation in fetal growth in a Russian setting: An analysis of medical record. (Online) Available from : www.elsevierhealth.com/journals/pubh. AEP. 2003; 13 (9): 599-605.[Accessed 2007 Nov 12]
48. Li CY, Sung FC. Socio-economic inequalities in low birth weight, full-term babies from singleton pregnancies in Taiwan. Journal of the Royal Institute of Public Health.. Available from : www.elsevierhealth.com/journals/pubh (Accessed 2007 Jan 8)
49. Chumnijarakij T, Dusitsin N, Thassanee N, Chitnand S, Onthuam Y, Ouamkul N. Maternal risk factors for low birth weight newborns in Thailand 1998. Bangkok : Faculty of Medicine, Chulalongkorn University;1998. p. 28-30
50. Zimmer-Gembeck MJ, Helfand M. Low birth weight in a public prenatal care program: behavioral and psychosocial risk factors and psychosocial in intervention. Soc. Sci. Med. 1996; 43 (2): 187-97.
51. Oduntan SO. Low birth weight. In Wales HM and Giri K, editors. Health care of women and children in developing countries. 1st ed. Oakland, California: Third Party Publishing; 1999. p.292-300.
52. Jirojwong S, Skolnik M. Type of Antenatal care and other related factors associated with low birth weight in Sothern Thailand. Asia Pacific Journal of Public Health 1990; 243 (4): 132-41.
53. Wilcox AJ and Skjnerven R. Birth weight and perinatal morbidity, the effect of gestational age. American Journal of Public Health 1992; 82 (3): 378-82.
54. Wang CS, Chou P. Risk factors for low birth weight among first-time mothers in Southern Taiwan. Journal Formos Medical Assoc. 2001; 100 (3): 168 –72.
55. Isaranurug S, Mo-suwan L, Choprapawon C. A population-based cohort study of effect of maternal risk factors on low birth weight in Thailand. J Med Assoc Thailand. 2007; 90 (12): 2559 –64.

56. Prasad L. Maternal factors related to low birth weight at Zonal Hospital, Birat Nagar, Nepal. [M.Sc. Thesis in Public Health Program) Bangkok: Faculty of Graduate Studies, Mahidol University; 1995. p. 56-8.
57. Koroukian SM, Rimm AA. The "Adequacy of prenatal care utilization" (APNCU) index to study low birth weight: is the index biased?. Journal of clinical epidemiology. 2002; 55: 296-305.
58. Verhoeff FH, Brabin BJ, van Buuren S, Chimsuku L, Kazembe P, Wit JM.. An analysis of intra uterine growth retardation in rural Malawi. Eur J Clin Nut. 2001; 55 (8): 682-89.
59. Steer PJ. Maternal hemoglobin concentration and birth weight. Am J Clin Nutr. 2000; 71 (Suppl 5): 1285 –87.
60. Ticconi C, Arpino C, Longo B, Mapfumo M. Prevalence and risk factors for low birth weight in Northern Zimbabwe. International Journal of Clinical Epidemiology. 2002; 55: 296-97.
61. Malick A. Maternal risk factors for low birth weight in a hospital setting in Bangkok. [M.P.H. Thesis in Health Education & Behavioral Science] Bangkok: Faculty of Public Health, Mahidol University; 2003.
62. Mavalankar DV, Gray RH, Trivedi CR, Parikh VC. Risk factors for small for gestational age births in Ahmeddabad, India. Journal of tropical pediatrics. 1994; 40 (5): 285-90.
63. McNeil D. Epidemiological research methods. Chichester, England : John Wiley & Sons; 1996. p.265-89.
64. Lekea-Karanika V, Tzoumaka-Bakoula C, Matsaniotis N.S. Sociodemographic determinants of low birthweight in Greece: a population study. Paediatric and perinatal epidemiology. 1999; 13: 65–77.
65. Laura AM, Kelley EC, Scanlon S, Perry G, Ferre C, Blackmore C, Prince S, Yu M, Rosenberg D. The NMIHS collaborative working group. Pre-pregnancy body mass index and pregnancy weight gain; association with pre-term delivery.The American College of Obstetricians and Gynecologist. 2000; (96): 194 – 200.

66. Balcazar H., Cole G, Hartner J. Mexican-Americans use prenatal care and its relationship to maternal factors and pregnancy outcome. Ann J prev Med. 1992; (Jan – Feb): 1–7.

67. Easterling TR, Carr DB, Brateng D, Diederichs C, Schmuker B. Treatment of hypertension in pregnancy: effect of atenolol on maternal disease. Obstet Gynecol. 2001; 98 (3): 427 - 33.

68. Leung TN, Roach VJ, Lau TK. Incidence of preterm delivery in Hongkong Chinese. Aus NZ J Obstet Gynecol. 1998; 38 (2): 138 –41.

69. Kusiako T, Ronsmans C, Van der Paal L. Perinatal mortality attributable to complication of childbirth in Matlab, Bangladesh. Bulletin WHO. 2000; 78 (5).

70. Alfa MJ, Embree JE,Degagne P, Olson N, Lertzman J, Mcdonald KS. Transmission of Ureaplasma urealyticum from mothers to full and preterm infants. Pediat Infec Dis J. 1995; 14 (5): 341-45.

71. Donders GC, Desmyster J, De wet DH, van Assche FA. The association gonorrhoe and syphilis with premature birth and low birth weight. Genitourin Med. 1993; 69 (2): 98 – 101.

APPENDIX

APPENDIX A

QUESTIONNAIRE (DATA RECORD FORM)
MATERNAL RISK FACTORS FOR LOW BIRTH INFANTS
AT FATMAWATI GENERAL HOSPITAL, JAKARTA, INDONESIA

Number of Record: [ ][ ][ ][ ][ ][ ] Type of Sample: [ ] 1. Case

Number dentification [ ][ ][ ] [ ] 2. Control

Mother's name : …….

Address: …….

I. Data of Newborn:

1. Birth's date: ……

2. Sex: 1. Male [ ]
   2. Female [ ]

3. Birth weight: …… grams

II. Socio-Demographic of Mother

4. Mother's age : ……. years old
   1) < 20 years old [ ]
   2) 20-34 years old [ ]
   3) ≥ 35 years old and above [ ]

5. Mother's education: …….....
   1) Primary school (1-9 years) [ ]
   2) Secondary school (10-12 years) [ ]
   3) High/College (≥ 13 years) [ ]

6. Mother's occupation: ……..
   1) House wife [ ]
   2) Laborer [ ]
   3) Office worker/ Civil/Army/Government official [ ]
   4) Others, specify ……..

III. Biological Factors

7. Birth parity (include this pregnancy): ….. parity
   1) Parity 1 [ ] 2) Parity 2-3 [ ] 3) Parity 4 and over [ ]
   (if the mother has the first child or parity 1, skip to question no. 9)
8. Birth interval between this pregnancy and previous one: …….. months
   1) < 24 months [ ] 2) ≥ 24 months [ ]
9. Gestational age of this birth: …….. weeks
   1) Pre-term (<37 weeks) [ ] 2) Term (≥ 37 weeks) [ ]
10. Maternal height (cms): …….. Cms
    1) < 150 cms [ ] 2) ≥ 150 cms [ ]
11. Maternal weight (kgs) pre-pregnancy: ..... Kgs.
    1) < 45 kgs [ ] 2) ≥ 45 kgs [ ]
12. Maternal weight (kgs) at delivery: ……. kgs.
13. Maternal weight gain (maternal weight at delivery times minus pre-pregnancy weight [No. 12 – No. 11]: …. … Kgs, 1) < 10 kgs [ ] 2) ≥ 10 kgs [ ]

IV. Pregnancy Risk

<u>Present Pregnancy</u>

14. Number of ANC visits: …… visits
    1) < 4 times [ ] 2) ≥ 4 times [ ]

15. Hemoglobin level of the mother at the delivery: ……. Gr/dl
    1) < 11 gr/dl [ ] 2) ≥ 11 gr/dl [ ]

16. Hypertension:
    1) Yes [ ] 2) No [ ]
17. Eclampsia:
    1) Yes [ ] 2) No [ ]
18. Abnormal position:
    1) Yes [ ] 2) No [ ]
19. Diabetes:
    1) Yes [ ] 2) No [ ]
20. Infection:
    1) Yes [ ] 2) No [ ]

Previous obstetric history

21. Stillbirth:
    1) Yes [ ] 2) No [ ]
22. Abortus:
    1) Yes [ ] 2) No [ ]
23. Premature:
    1) Yes [ ] 2) No [ ]

APPENDIX B
SAMPLE SIZE

3.3.1. Sample size:

$$n = \frac{[Z\alpha/2\ \sqrt{2PQ} + Z\beta\ \sqrt{P1Q1 + P2Q2}\ ]^2}{(P1-P2)^2}$$

Alternative 1

Where :

- 95% CI
- P2 = 0.076 (Incidence of LBW 7.6%)
- Odds ratio = 2
- P1 = P2/(P2+(1-P2)/2 → 0.076/(0.076+0.924)/2= 0.152
- r = 1
- p = (P2+P1)/2 → (0.076+0.152)/2= 0.114
- α = 0.05 So. Zα/2 = 1.96
- β = 0.2 Zβ = 0.84 (power of study)

$$n = \frac{[Z\alpha/2\ \sqrt{2PQ} + Z\beta\ \sqrt{P1Q1 + P2Q2}\ ]^2}{(P1-P2)^2}$$

$$= \frac{[1.96\ \sqrt{2x0{,}114x0.886} + 0.84\sqrt{0.152x0.848 + 0.076x0.924}\ ]^2}{(0.152-0.076)^2}$$

= 262,8222 → 263

Conclude that 263 cases and 263 control required for the study.

Alternative 2

Where :

- 90% CI
- P2 = 0.076 (Incidence of LBW 7.6%)
- Odds ratio = 2
- P1 = P2/(P2+(1-P2)/2 → 0.076/(0.076+0.924)/2= 0.152
- r = 1
- p = (P2+P1)/2 → (0.076+0.152)/2= 0.114
- α = 0.10 So. Zα/2 = 1.645
- β = 0.2 Zβ = 0.84 (power of study)

$$n = \frac{[Z\alpha/2\ \sqrt{2PQ} + Z\beta\ \sqrt{P1Q1 + P2Q2}\ ]^2}{(P1-P2)^2}$$

$$= \frac{[1.645\ \sqrt{2x0{,}114x0.886} + 0.84\sqrt{0.152x0.848 + 0.076x0.924}\ ]^2}{(0.152-0.076)^2}$$

= 206.90 → 207

Conclude that 207 cases and 207 control required for the study.

Alternative 3

Where :

- 80% CI
- P2 = 0.076 (Incidence of LBW 7.6%)
- Odds ratio = 2
- P1 = P2/(P2+(1-P2)/2 → 0.076/(0.076+0.924)/2= 0.152
- r = 1
- p = (P2+P1)/2 → (0.076+0.152)/2= 0.114
- α = 0.20 So. Zα/2 = 1.28
- β = 0.2 Zβ = 0.84 (power of study)

$$n = \frac{[Z\alpha/2\ \sqrt{2PQ} + Z\beta\ \sqrt{P1Q1 + P2Q2}\ ]^2}{(P1-P2)^2}$$

$$= \frac{[1.28\ \sqrt{2x0{,}114x0.886} + 0.84\sqrt{0.152x0.848 + 0.076x0.924}\ ]^2}{(0.152-0.076)^2}$$

= 150,45 → 150

Conclude that 150 cases and 150 control required for the study.

BIOGRAPHY

NAME	Edi Priyono
DATE OF BIRTH	January 3, 1964
PLACE OF BIRTH	Purbalingga, Central Java, Indonesia
INSTITUTION ATTENDED	Academy of Nutrition, MOH, Rep.of Indonesia, Jakarta, Indonesia Bachelor of Science in Nutrition 1983 - 1987 University of Indonesia, Indonesia Bachelor of Public Health 1995 - 1997 Mahidol University, Thailand ASEAN Institute for Health Development M.P.H.M. (Master of Primary Health Care Management) 2007 - 2008
FELLOWSHIP/ RESEARCH GRANT	Asian Development Bank Loan/District Health Services-1 (DHS-1)
PRESENT POSITION	Health Administration Officer, Directorate of Mother's Health, DG of Public Health, MOH, Republic of Indonesia Jakarta, Indonesia