ISSN 3063-8089 (Online)
Adult Health Nursing Journal
Volume 2 Issue 1, Pages: 9-23
Publish June 2025

ORIGINAL ARTICLE

Prediction Model for Low Birth Weight (LBW) in East Lombok Regency

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ARTICLE INFORMATION

Article history
Received: 2024-04-12
Revised : 2024-05-22
Accepted: 2024-06-11

Keywords
Low Birth Weight; Antenatal Care; Maternal Determinants; Prediction Model

How to cite
Nurlaili, M., Masyhurrosyidi, H., Sastrawan, & Sulaiman, L. (2025). Prediction Model for Low Birth Weight (LBW) in East Lombok Regency. *Adult Health Nursing Journal*, *2*(1), 9–23. https://doi.org/10.33650/ahnj.v1i2.11068

ABSTRACT

Introduction: *Low Birth Weight (LBW) remains a major public health concern due to its association with increased infant morbidity and mortality. Identifying maternal determinants and developing prediction models are crucial steps toward reducing LBW prevalence.* ***Objectives:*** *This study aimed to develop a prediction model for the incidence of LBW based on maternal and pregnancy-related determinants in East Lombok Regency, Indonesia.* ***Methods****: An observational cohort study was conducted using secondary data from the Maternal and Child Health (MCH) cohort records. A total of 400 pregnant and postpartum women were selected through simple random sampling from a population of 27,463 individuals. Logistic regression analysis was employed to examine the association between potential determinants and LBW, and to construct a predictive model.* ***Results:*** *Significant maternal determinants associated with LBW included maternal age (p = 0.005, RR: 1.544, 95% CI: 1.026–2.497), gestational age (p = 0.010, RR: 1.406, 95% CI: 1.058–2.159), frequency of antenatal care visits (p = 0.005, RR: 1.763, 95% CI: 1.186–2.620), and maternal nutritional status (p = 0.016, RR: 1.758, 95% CI: 1.111–2.782). The final prediction model identified antenatal care frequency as the most significant predictor (PR: 2.381, 95% CI: 1.387–4.088, p = 0.002).* ***Conclusions****: Antenatal care frequency, along with maternal age, gestational age, and nutritional status, were key predictors of LBW in East Lombok. Strengthening ANC services and promoting maternal health education are recommended strategies to reduce LBW incidence.*

Adult Health Nursing Journal is a peer-reviewed journal published by Fakultas Kesehatan, Universitas Nurul Jadid, Probolinggo, East Java.
Website: https://fkes.unuja.ac.id
E-mail: adulthealthnurse@gmail.com
DOI : https://doi.org/10.33650/ahnj.v1i2.11068

A. Introduction

The Maternal and Child Health Program (MCH) is an effort in the health sector that concerns the service and maintenance of the health of pregnant women, birth mothers, postpartum and breastfeeding mothers, infants, toddlers and preschoolers. The MCH program greatly affects the health status of mothers and children. Management of the MCH program aims to strengthen and increase the range and quality of MCH services effectively and efficiently (Ministry of Health of the Republic of Indonesia, 2018).

The Expanding Maternal and Neonatal Survival (EMAS) program is a program launched by the Indonesian Ministry of Health in 2017 which aims to reduce the Maternal Mortality Rate (MMR) and Infant Mortality Rate (IMR). As for efforts to reduce the Infant Mortality Rate (IMR) by improving the quality of emergency obstetric services, newborn services at PONED Health Centers, strengthening an efficient referral system between health centers and hospitals (Kementerian Kesehatan Republik Indonesia, 2018).

The implementation of MCH programs and services is carried out at primary and secondary level health facilities. First-level health facilities, namely puskesmas, clinics and health worker practices. Puskesmas is a health service facility that organizes public health efforts and individual health efforts at the first level, by prioritizing promotive and preventive efforts, to achieve the highest degree of public health in its working area (Permenkes 43, 2019). Improving the performance of Puskesmas through improving service quality and patient safety, increasing protection for health human resources, the community and the environment through health services that can be accessed easily (Permenkes 46, 2015).

Every pregnant woman gets standard antenatal care. District/City Level Regional Governments are required to provide standardized maternal health services to all pregnant women in their work areas within one year. Every birthing mother gets delivery services according to standards (Permenkes 4, 2019).

The increase in the target number of pregnant women is directly proportional to the number of healthy births and risks of childbirth such as maternal and infant mortality. An indicator of a country's success in improving public health is by reducing the infant mortality rate (IMR) (De Onis et al, 2019). IMR is the number of babies who die before reaching the age of 1 year expressed in 1000 live births in the same year. One of the causes of the high infant mortality rate is low birth weight (LBW) (Ministry of Health of the Republic of Indonesia, 2019).

World Health Organization data states that the prevalence of babies with LBW in the world is 15.5% or around 20 million babies are born each year, around 96.5% of them occur in developing countries (WHO, 2018). Low Birth Weight (LBW) is a baby with a birth weight of less than 2500 grams. LBW can occur in premature babies and full-term babies who experience growth retardation during pregnancy (Ministry of Health, 2018).

LBW babies have a smaller chance of survival and are more susceptible to disease until they are adults (Chamberlain, G., Morgan, M., 2010). Another impact that appears on adults who have a history of LBW is the risk of suffering from degenerative diseases that can cause an economic burden on individuals and society (Kosim, M.S., at. all, 2014).

Manuaba (2012) states that LBW is caused by several factors such as maternal factors (nutritional status, age, parity, economic status), history of bad pregnancies (having given birth to LBW babies, abortion), poor antenatal care, and fetal condition. Women with low economic status tend to have inadequate food intake, poor sanitation in their homes and lack the ability to seek care during pregnancy (Leonardo, 2011).

LBW tends to experience impaired cognitive development, mental retardation, and is prone to infections which can result in illness or even death (Onis et al, 2019). LBW can be caused by 2 (two), namely premature birth or birth at a gestational age of less than 37 weeks and IUGR (Intra Uterine Growth Restriction), namely impaired fetal growth (Astria, et al, 2016). Birth weight greatly determines the prognosis and complications that affect the growth and development of the baby in order to get the attention of the health service team (doctors, midwives, nurses) so that they can help the process of growth and development of LBW babies as optimally as possible.

An important effort in management is to prevent the birth of babies with low birth weight, with maximum antenatal care, and prevent or minimize disturbances/complications that can arise as a function of the body of babies born with low birth weight (Maryunani. A, 2013). Based on the description, the problem of this study is that there is still a high incidence of LBW

which will have an impact on health in the future so it is necessary to do a prediction model research by analyzing the analysis of the determinants of the causes of the incidence of Low Birth Weight (LBW) in East Lombok Regency.

B. Methods

This research is an observational study with a cohort design. The research location is in East Lombok Regency which consists of 21 sub-districts, 254 villages and is divided into target areas by 35 Community Health Centers. Research time starts in January - December 2021.

The population of this study were pregnant and giving birth women in the East Lombok Regency as many as 27,463 people. The sample of this study were pregnant and giving birth women who met the sampling criteria. The sample is calculated using the binomial formula with the simple random sampling technique (α = 0.05) (Dahlan, M.S., 2016), from this formula a sample size of 400 samples is obtained.

The data in this study were secondary data, which were sourced from the MCH Cohort Book and PWS of the East Lombok District Health Office. The data includes maternal determinants and the incidence of low birth weight babies (LBW). Causal determinants (internal and external) consisting of age, education, occupation, parity, distance between pregnancies, gestational age, nutritional status, antenatal care, and diseases/complications experienced by pregnant women. While the incidence of low birth weight babies (LBW) consists of labor and newborns. The delivery process consists of the type of delivery, place of delivery and assistance, while for newborns it consists of the sex and birth weight of the baby.

The data is processed by performing statistical tests. Performing an analysis of the determinants of the causes of low birth weight babies (LBW) with the logistic (binary) regression test and calculating the Relative Ratio (RR) value which is shown in the Exp value (B). The test results are used to identify how much influence the determinants have on the risk of low birth weight (LBW) events in East Lombok District. Determinants that have influence will then be carried out by predictive models.

The prediction model is carried out by conducting multiple logistic regression tests simultaneously and multilevel until the determinants of the causes that have the most influence on the incidence of LBW are obtained. These determinants are used as the basis for making recommendations for improving the health service system as an effort to reduce the incidence of LBW in East Lombok. Ethical Clearance No. 011/EC/FKES-UNIQHBA/YPPQH/VIII/2022.

C. Results

Delivery and Newborn (BBL) in East Lombok District

The process of labor and delivery of babies is the result of services that have been carried out by health workers and care carried out by pregnant women and their families in maintaining health during pregnancy. The number of deliveries and newborns in East Lombok Regency is according to Table 1 below.

Based on Table 1 shows that there were 339 samples (84.8%) who delivered spontaneously, 144 samples (36.0%) delivered at the polindes, and 321 samples (80.2%) assisted births assisted by a midwife. Improving the performance of Community Health Centers, their networks and networks through improving service quality and patient safety, increasing protection for health human resources, the community and the environment through health services that can be accessed easily (Permenkes 46, 2015).

Meanwhile, there were 237 samples (59.2%) of newborns with female gender and weighing more than 2,500 grams in 206 samples (51.5%). Birth weight is the result of the interaction of various factors during the uterine process. Newborn weight is determined by genetic factors, nutritional status of the mother during conception and pregnancy as well as the socio-

economic condition of the mother during pregnancy, infectious diseases or complications of pregnancy (Manuaba, 2012).

Table 1: Delivery and Newborns (BBL) in East Lombok Regency (n=400)

Labor and Newborn		Frequency (n)	Percentage (%)
Labor:			
a. Type	Spontaneous	339	84.8
	Treatment	61	15.2
b. Place	Public health center	82	20.5
	Maternity Clinic	2	0.5
	Polindes, Poskesdes	144	36.0
	Hospitals (Government and Private)	105	26.,2
	Independent Practice Midwife	67	16.8
c. Helper	Midwife	321	80.2
	Doctor	64	16.0
	Medical specialist	15	3.8
Newborn baby:			
a. Gender	Male	163	40.8
	Female	237	59.,2
b. Baby Weight	≤2.500 gram	194	48.5
	>2.500 gram	206	51.5

Determinants of the Causes of Low Birth Weight (LBW) Babies

Several maternal determinants consisting of age, education, occupation, parity, distance and gestational age, nutritional status, antenatal care (ANC) and disease/complications may have an influence on the incidence of low birth weight babies (LBW) can be seen according to Table 2 below.

Table 2 explains that the influence of maternal determinants on the incidence of low birth weight (LBW) consists of age having a significant value of 0.005 RR: 1,544 (1,026 to 2,497), education with a significant value of 0,046 RR: 1,221 (1,026 to 2,497), parity in gravida a significance value of 0.001 RR: 1.315 (1,159 to 3,623) and abortion with a significance value of 0.046 RR: 1.374 (1,142 to 2,984), gestational distance significant value 0.019 RR: 1,604 (1,080 to 2,384) and gestational age significant value 0,010 RR: 1,406 (1,058 to 2,159), anemia with a significance value of 0.028 RR: 2.105 (1,409 to 3,145), frequency of antenatal care (ANC) with a significance value of 0,005 RR: 1,763 (1,186 to 2,620) and the presence of non-communicable diseases (NCD's) with a significance value of 0,022 RR: 1,224 (1,062 to 1,807). Based on the test results, the frequency of antenatal care (ANC) visits has a significant value and the strongest influence on the incidence of LBW.

Childbirth and Newborns in East Lombok Regency

Improving the performance of Puskesmas, networks and networks through improving the quality of services and patient safety, increasing protection for health human resources, the community and the environment through easily accessible health services (Permenkes 46, 2015).

The weight of a newborn is determined by genetic factors, the nutritional status of the mother during the period of conception and pregnancy as well as the socioeconomic status of the mother during pregnancy, infectious diseases or pregnancy complications (Manuaba, 2012).

Table 2: Mother's Determinants of Low Birth Weight (LBW) in East Lombok Regency (n=400)

Determinant		Kejadian BBLR, LBW incident				
		n	(%)	RR	(CI 95%)	*p Value*
Age	≤18 or >35 years	86	(21.5)	1.544	(1.026 to 2.497)	0.050
	19-35 years	314	(78.5)			
Education	≤ High School	360	(90.0)	1.221	(1.346 to 1.294)	0.046
	≥ Diploma	40	(10.0)			
Occupation	Work	355	(88.8)	1.167	(0.340 to 4.003)	0.806
	Not Work	45	(11.2)			
Parity:						
a. Gravida	≤3 times	255	(63.8)	1.315	(1.159 to 3.623)	0.001
	>3 times	145	(36.2)			
b. Partus	≤2 times	356	(89.0)	0.679	(0.224 to 2.058)	0.494
	>2 times	44	(11.0)			
c. Abortus	Nerver	361	(90.2)	1.374	(1.142 to 2.984)	0.046
	Ever	39	(9.8)			
d. Life	No	177	(44.2)	0.611	(0.300 to 1.245)	0,175
	Yes	223	(55.8)			
Pregnancy Distance	≤2 years	213	(53.2)	1.604	(1.080 to 2.384)	0.019
	>2 years	187	(46.8)			
Gestational Age	<36 or >39 week	278	(69.5)	1.406	(1.058 to 2.159)	0.010
	37-38week	122	(30.5)			
Nutritional Status:						
a. Anemia	11-14 gr/dL	288	(72.0)	2.105	(1.409 to 3.145)	0.028
	<11 gr/dL	112	(28.0)			
b. Chronic Lack of Energy	Not any	305	(76.2)	0.762	(0.480 to 1.208)	0.248
	Exist	95	(23.8)			
Antenatal Care **(ANC):**						
a. Frequency	<7 times	204	(51.0)	1.763	(1.186 to 2.620)	0.005
	≥7 times	196	(49.0)			
b. Place	Primary	381	(95.2)	0.780	(0.330 to 1.846)	0.572
	Secondary	18	(4.5)			
c. Examiner	Midwife	395	(98.8)	1.770	(0.457 to 2.173)	0.999
	Doctor	5	(1.2)			
Diseases and Complications:						
a. Non-communicable	Not any	385	(96.2)	1.224	(1.062 to 1.807)	0.022
	Exist	15	(3.8)			
b. Infectious Diseases	Not any	392	(98.0)	2.880	(0.574 to 4.444)	0.199
	Exist	8	(2.0)			
c. Severe Preeclampsia	Not any	381	(95.2)	0.672	(0.265 to 1.708)	0.404
	Exist	19	(4.8)			
d. Hypertension in Pregnancy	Not any	396	(99.0)	0.313	(0.032 to 3.011)	0.313
	Exist	4	(1.0)			
e. Labor Complications	Not any	375	(93.8)	0.594	(0.216 to 1.635)	0.112
	Exist	25	(6.2)			
f. Bleeding	Not any	395	(98.8)	0,193	(0.026 to 2.092)	0.193
	Exist	5	(1.2)			
g. Infection	Not any	380	(99.8)	0.971	(0.481 to 1.432)	0.502
	Exist	20	(0.2)			

Determinants of Causes of Low Birth Weight (LBW)

According to Manuaba (2012), includes internal environmental factors, namely maternal age, birth spacing, parity, gestational age, hemoglobin levels, nutritional status of pregnant women, pregnancy complications, and diseases during pregnancy, external environmental factors include environmental conditions, intake of nutrients and socioeconomic level of pregnant women and factors in the use of health facilities related to the frequency of antenatal care (ANC).

Maternal age showed a significant value to the incidence of LBW. The highest maternal age during pregnancy was pregnancy at the age of <20 years or more than 35 years. Age will affect

the anatomical and physiological development that occurs in the human body (Dorland, 2010). Getting pregnant at a young age can change mentally and physically in a mother. Psychologically, in general, teenagers are not completely ready to be a mother for their baby later. In addition to being unprepared, her pregnancy did not get enough attention and care. The physical risk is also quite large because many of the reproductive organs of young adolescents such as the uterus are not mature enough to accept a fairly heavy burden such as pregnancy (Leveno, K.J., at.all, 2009). In the reproductive period which is considered healthy, the age that is very safe for the process of pregnancy and childbirth is 20-35 years (Manuaba, 2014). The same thing happens at the age of the mother who is quite old and prone to frequent complications during pregnancy and childbirth. In addition, they are susceptible to disease and their reproductive organs have changed their function, not as good as in fertile ages (Ekawaty, L.H., 2015). The same thing happens at the age of the mother who is quite old and prone to frequent complications in pregnancy and childbirth. In addition, they are susceptible to disease and their reproductive organs have changed their function as good as fertile ages (Takziah, 2013).

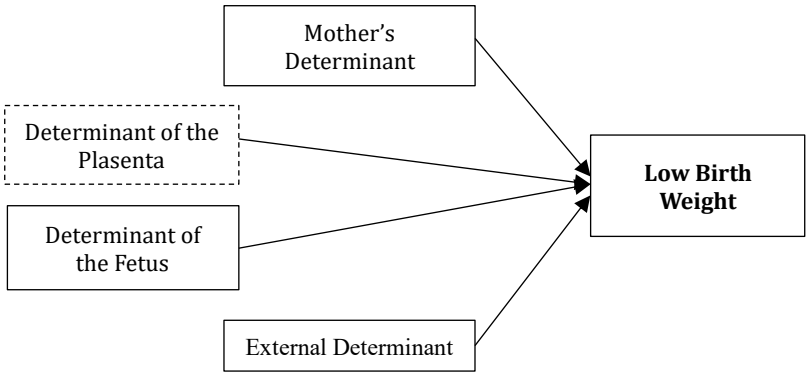

Figure 1 Model and Research Results

The level of education of women, especially in low-resource countries, remains a challenge. The higher the level of education, the higher the opportunity to learn about health risks and therefore attend for initial screening. This helps identify pregnancy complications early and therefore creates strategies to minimize adverse outcomes in mothers presenting earlier and more regularly for antenatal care (Ngonzi et al., 2016). The most frequent occurrence is in less socioeconomic conditions. Because the supervision and care of pregnancy is very less. Excessive physical activity can also affect the baby's condition. Try if you are pregnant do not do extreme activities. Illegal marriage can also affect the physical and mental (Proverawati, A., 2010).

Parity in gravida and abortion. The parity that can cause LBW in mothers most often occurs is first parity and parity of more than 4. The parity factor can also be associated with the incidence of LBW babies. LBW occurs because the mother's reproductive system is not ready because there has been depletion as a result of the mother's frequent delivery. High parity status can lead to an increased risk of low birth weight and stillbirth, this can happen because the higher the parity status, the ability of the mother's organs, namely the uterus, is difficult to provide nutrition for pregnancies that are too frequent so that it can result in impaired distribution of nutrients from the mother and fetus. which can cause LBW babies (Leveno, K.J., at. all, 2009).

Birth spacing that is too close or short from one child to another child to be born (less than 1 year). The distance between a mother's pregnancy that is less than two years can cause impaired fetal growth, prolonged labor and bleeding during delivery, abortion, premature birth of the baby, because the uterus has not recovered properly, which can result in the possibility of complications in childbirth (Prawirohardjo, 2014). Grande multipara are women who have given birth to 5 or more children. Usually, if you give birth to too many children, you can experience complications in the process of pregnancy and childbirth (Manuaba, 2014).

Nur (2016) conducted an analysis of risk factors for the incidence of LBW, it was found that the distance between pregnancies (<2 years) and the OR (3.231), which means that the distance between pregnancies (<2 years) was 3.23 times greater for giving birth to babies with low birth weight compared to those with low birth weight. gestational interval (≥2 years). Many factors may lead to cases of low birth weight babies, so there must be special attention to the fetus being conceived, especially the attention of pregnant women.

Gestational age has an influence on the incidence of LBW, the lower the gestational age, the smaller the baby born, and the higher the morbidity and mortality. Babies born prematurely (<37 weeks) do not have perfect organs like mature babies (≥37 weeks), therefore they have more difficulty living outside the mother's womb. The shorter the gestational age, the less perfect the internal organs of the body, which results in more complications and a higher mortality rate. In this case, the majority of neonatal deaths occur in premature babies (Hasan, 2000 in Prawirohardjo, 2014).

Poor nutritional status, such as anemia, which is a complication during pregnancy, will have a bad influence on pregnant women and can affect the rapid and slow growth of the fetus, the perfection of the structure of the fetus, and the function of the organs that are formed, so it is possible to give birth to a baby weighing less than 2500 grams (Badriah, D. L., 2011). Giving 90 tablets of iron during pregnancy, providing counseling about self-care, talking about childbirth to pregnant women, husbands/families in the third trimester, and recording all findings in the KMS (Diniya, 2015).

The health condition of the mother during pregnancy must always be monitored by making ANC visits to health workers, visits by pregnant women to midwives or doctors as early as possible since she feels she is pregnant to get antenatal care. At each antenatal care (ANC) visit, the officer collects and analyzes data regarding the mother's condition through history taking and physical examination to obtain a diagnosis of intra uterine pregnancy and the presence or absence of problems or complications. (Saifuddin, 2014).

The results of Diniya's research (2015), regarding the risk factors associated with low birth weight babies in the working area of the Martapura Health Center, Banjar Regency, that there is a significant relationship between the status of antenatal care visits and LBW, the OR result is 3.73 which means that the status of antenatal care visits is incomplete had a 3.73 times greater risk of giving birth to a low birth weight baby compared to mothers who had complete antenatal care visits.

The presence of non-communicable diseases (NCD's). Chronic disease is a disease that occurs for a very long time and usually the occurrence can be severe illness experienced by the mother during pregnancy or during childbirth. Chronic diseases in mothers that can cause LBW are chronic hypertension, preeclampsia, diabetes mellitus and heart disease (Leveno, K.J., at. all, 2009).

Demelash, (2015) stated that there was an effect of complications during pregnancy on the incidence of LBW which was 6.3 times greater than those who did not experience complications during pregnancy. Suriani's research (2010), concluded that there was an effect of pregnancy complications on the incidence of low birth weight babies with (p= 0.003, OR = 1.53; CI=1.16–2.02. Complications about signs and symptoms experienced during child pregnancy the latter include seizures, pre-eclampsia, eclampsia, headache, edema, anemia, premature rupture of membranes (PROM), heart, based on the results of the diagnosis that occurred during pregnancy, thus affecting the pregnancy. These complications can have an impact on the health of the mother, the health of the baby at birth, or both (Prawirohardjo, 2014).

Based on the description, it can be concluded that there are two determinants or factors, namely internal (mother and fetus) and external. Internal determinants consist of maternal age, birth spacing, parity, gestational age, hemoglobin level, nutritional status of pregnant

women, pregnancy complications, and disease during pregnancy. External determinants include environmental conditions, nutrient intake and socio-economic level of pregnant women and factors related to the use of health facilities related to the frequency of antenatal care (ANC). These maternal, fetal and external determinants can be explained according to Figure 1.

Based on Table 3, it can be concluded that the prediction model that has a better level of simultaneously testing the determinants of the causes of LBW in East Lombok Regency is the number of Antenatal Care (ANC) visits with PR: 2,381, 95% CI between 1,387 to 4,088 and a significance of 0.002, so ANC becomes the main concern of services at health care facilities both at first level health facilities and advanced level health facilities.

The prediction model for the incidence of LBW in East Lombok Regency is maternal age, gestational age, ANC and nutritional status. These determinants can be explained as follows:

Table 3: Influence of Maternal and External Determinants on the Incidence of LBW in East Lombok Regency in 2020

No.	Determinant	Birth Weight		
		B	CI 95%	*p Value*
1.	Mother's Age	2,152	(1,202 to 3,850)	0,010
2.	Gestational Age	1,726	(1,005 to 2,964)	0,048
3.	*Antenatal Care* (ANC)	2,381	(1,387 to 4,088)	0,002
4.	Nutristion Status	1,758	(1,111 to 2,782)	0,016
5.	*Constanta*	-2,358		

D. Discussion

Model for Predicting Low Birth Weight (LBW) Babies in East Lombok Regency

The prediction model will be carried out on maternal determinants consisting of age, education, parity, gestation interval, gestational age, anemia, ANC and non-communicable diseases. These determinants are divided into maternal determinants, namely age, education, parity, pregnancy interval, gestational age, anemia and non-communicable diseases, while external determinants are antenatal care (ANC).

Simultaneous test of maternal and external determinants with multiple regression tests and simultaneously to obtain which factors have a strong influence on the incidence of LBW in East Lombok District. The prediction model for LBW events based on simultaneous tests can be seen according to Table 3 below.

Mother's Age

Mother's age has an important role in LBW babies. Getting pregnant at a young age can change a mother's mental and physical. Psychologically, in general, adolescents are not fully ready to become mothers for their babies later. Besides there was no preparation, the pregnancy did not get enough attention and care. The physical risk is also quite large because many of the reproductive organs of young adolescents, such as the uterus, are not mature enough to accept quite heavy loads, such as pregnancy (Kusparlina, 2016). In the reproductive period that is considered healthy, it is known that the age that is very safe for pregnancy and childbirth is 20-35 years (Manuaba, 2012).

In the prediction model, it is found that the age of the mother during pregnancy is less than 18 and more than 35 years or an age that is not recommended for undergoing the pregnancy process. In East Lombok District, early marriage still occurs which contributes greatly to the incidence of LBW, maternal and child mortality.

Prawirohardjo (2014) added that being over 35 years old is considered dangerous, because both the reproductive organs and the mother's physique have been greatly reduced and decreased, besides that there can be congenital risks for the baby and can also increase difficulties in pregnancy, childbirth and postpartum. Pregnancy that occurs at the age of under 20 years or above 35 years has a tendency of not fulfilling adequate nutritional needs for fetal growth which will have an impact on the baby's birth weight.

According to Proverawati & Ismawati (2010), the highest LBW incidence rate is pregnancy at the age of <20 years or more than 35 years. Pregnancy that occurs at the age of under 20 years or above 35 years has a tendency of not fulfilling adequate nutritional needs for fetal growth which will have an impact on the baby's birth weight.

Mothers aged <20 years can be said to be very at risk of giving birth to premature babies because they have a uterus that has not yet developed properly so that its function cannot work optimally. Mothers aged <20 years also have a short cervix, thereby increasing the risk of infection. Young mothers usually tend to give birth to babies that are smaller than normal babies in general because young mothers are still in a period of growth and development, so that not only babies need nutrition but mothers and babies compete with each other for nutrition (Dessy. A, 2014).

In Mahayana research, S. A. S., (2015) explained that respondents were categorized as <20 years old or > 35 years old and 20-35 years old. The results of the bivariate statistical test showed a significant relationship (p = 0.01) between the age of the mother and the incidence of LBW with OR = 1.36 (95% CI: 1.08 – 1.73), meaning that the risk of respondents aged <20 years or >35 years the possibility of giving birth to LBW is 1.36 times greater than respondents aged 20-35 years (95% CI = 1.08-1.73). This is supported by research by Atriyanto (2006) that mothers aged <20 years or >35 years have a risk of giving birth to LBW by 1.98 times greater than mothers aged 20-35 years. This happens because physiologically young women are still experiencing growth and psychologically it is an unplanned or unwanted birth, while the mother's age is more than 35 years, the possible cause is due to intrauterine disorders (Kramer, 2012).

Gestational Age

Maternal gestational age less than 37 or more than 39 weeks can affect fetal maturity at birth. From the results of the interviews, there were 8 (eight) experts who stated that gestational age had an influence on the incidence of LBW. Based on these results, gestational age is a factor that has an influence on the incidence of LBW.

Gestational age is distinguished by pure prematurity and dysmaturity. Pure premature is a baby born with a gestation period of less than 37 weeks and the body weight is according to the weight for the gestational age. Meanwhile, dysmature babies are born with a weight less than the normal weight for their gestational age. The weight of the baby has intrauterine growth retardation and is a small baby for its gestation.

In addition, there is a relationship between gestational age and the physiological maturity level of neonates. Premature babies are babies born with a gestational age between 28-36 weeks. Premature babies with less months category, their organs and organs cannot function optimally when living outside the mother's womb. The younger the gestational age, the more vulnerable the baby's organs and the poorer the prognosis.

Meanwhile, in mature babies, the baby's organs and organs are mature and function better than preterm babies. Meanwhile, according to Utomo (1985) in a study (Karmanto, Bambang. 2002), LBW babies with birth weight according to gestational age are usually associated with the incidence of uterine inability to sustain the fetus. Effective contraction of the uterus before birth that has not reached gestational age is caused by disturbances in the course of birth. Preterm birth is caused by an infection by bacteria in the amniotic fluid and amniotic fluid.

Bacterial products can stimulate local cytokinin production with resultant local rupture of membranes.

This is in line with the results of Farika's study (2018), mothers who gave birth at less than 37 weeks' gestation have a 10 times greater risk of experiencing LBW compared to mothers who gave birth at ≥37 weeks' gestation. This research is also supported by research by Mahayana, S. A. S., (2015), it is known that out of 298 cases of LBW there were 229 (76.8%) affected by the gestational age of the mother giving birth with a p value of 0.04 < 0.05 which indicates that there is a significant relationship between the gestational age of the mother delivery with LBW events. This research is also in accordance with the theory written by (Pantiawati, 2010), stating that determining gestational age is very important because it reduces mortality and morbidity.

Nutritional status

Maternal nutritional status during pregnancy can be determined by observing Basal Metabolic Rate (BMR), iron deficiency (anemia) and diet. BMR of pregnant women increases up to 15-20% which is generally found in the third trimester and requires a lot of calories to meet their needs (Wiknjosastro, 2007).

In the 2nd and 3rd trimesters, women with good nutrition are recommended to gain weight per week by 0.4 kg, while women with malnutrition or excess are recommended to gain weight per week, respectively 0.5 kg and 0. 3 kg (Saifuddin, 2010) so balanced nutrition counseling is very important for pregnant women.

Based on the research results of Mahayana, S. A. S., (2015) it was found that, of the respondents who experienced LBW events, there were 24 respondents (80%) with malnutrition status. Meanwhile, in the group of respondents who did not experience LBW, there were 43 respondents (47.8%) with malnutrition status. From these results, as a percentage, mothers with less nutritional status gave birth to babies with LBW babies compared to mothers who gave birth to babies not LBW (BBLN). The results of the statistical test for the relationship between the nutritional status of the mother and the incidence of LBW obtained a value of p=0.004. It can be concluded that there is a significant relationship between the nutritional status of the mother and the incidence of LBW. From the analysis, the value of OR = 4,372 (95% CI; 1,632 – 11,714) was also obtained. It can be interpreted that mothers with poor nutritional status have 4,372 times the chance of giving birth to babies with LBW babies compared to mothers with good nutritional status.

The results of this study are in line with the results of research (Shanklin, 1979) in research (Karmanto, Bambang. 2002) which states that pregnant women with malnutrition will give birth to LBW babies 10 times greater than mothers who are well nourished. This poor nutritional intake was also found in a study in Ciawi where the incidence of LBW was 16.1%, in this area there is a belief not to eat much to avoid large babies so that labor can run smoothly.

Malnutrition has a negative impact on the fetus such as prematurity, stillbirth or early noental death and impaired fetal growth. Maternal nutritional status has little effect on fetal growth during embryogenesis. Malnutrition during pregnancy will have negative consequences for the fetus such as prematurity, impaired fetal growth, stillbirth or early neonatal death. During embryogenesis the nutritional status of the mother has little effect on fetal growth. This is in accordance with the estimate that most women have sufficient nutrient stores for slow-growing embryos. However, in the growth phase of the third trimester when fetal cell hypertrophy begins, the nutritional needs of the fetus can exceed the mother's supply if nutritional input is lacking. The influence of nutrition on pregnancy is very important. Improving education on nutrition and obtaining adequate nutrition in terms of menu composition as well as quantity and quality are things that need to be considered for pregnant women with malnutrition. Due to malnutrition in pregnant women, causing blood volume to decrease, blood flow to the uterus and placenta is reduced, the size of the placenta is reduced

and the transfer of nutrients through the placenta is reduced so that the fetus grows slowly or is disrupted. Pregnant women with malnutrition tend to give birth prematurely or LBW (Romauli, 2011).

Anemia in pregnant women will increase the risk of having a LBW baby, the risk of bleeding before and during delivery, and can even cause death for the mother and her baby if the pregnant woman suffers from severe anemia. This is due to a lack of blood supply of nutrients and oxygen to the placenta which will affect the function of the placenta to the fetus (Ministry of Health RI, 2002). According to the results of this study, 39% of the Hb status of women with anemia gave birth to LBW babies, whereas only 32.8% of normal ones gave birth.

The results of the research by Mahayana, et al (2015), one of the causes of LBW is low Hb levels or anemia. A decrease in Hb levels caused by increasing gestational age will form a joint factor that affects the baby's birth weight so that pregnant women will experience anemia which can cause hypoxia. Reduced blood flow to the uterus which will disrupt the flow of oxygen and nutrients to the placenta and fetus. Less blood flow to the uterus will cause asphyxia and obstruct fetal development so that the fetus is born with LBW (Kalaviani, 2009). During pregnancy additional iron is needed to increase the number of red blood cells and form red blood cells of the fetus and placenta. The decrease in Hb concentration will be smaller in pregnant women who consume iron. The increase in blood volume serves to meet the perfusion needs of the uteroplacental (Kozuma, 2009).

Antenatal Care (ANC)

Antenatal Care Examination (ANC) is a pregnancy examination to optimize the mental and physical health of pregnant women, so that they are able to deal with childbirth, the postpartum period, preparation for breastfeeding and the return of reproductive health normally (Manuaba, 2012). Standard antenatal check-up according to the Guidebook for Integrated Antenatal Care Services. Antenatal Care (ANC) at posyandu/facilities as many as 6 (six) times can be used as a basis to determine the level of activity of health services for mothers in checking their pregnancies.

Based on the research results of Mahayana, S. A. S., (2015) showed that, of the respondents who experienced LBW events, there were 25 respondents (83.3%) with less frequency of ANC examinations. Whereas in the group of respondents who did not experience LBW events, there were 44 respondents (69%) with less frequency of ANC examinations. From these results, as a percentage, mothers with less frequency of ANC examinations gave birth to babies with LBW babies compared to mothers who gave birth to babies without LBW (BBLN). The results of the statistical test for the relationship between the frequency of antenatal care checks and the incidence of LBW were obtained p = 0.002. It can be concluded that there is a significant relationship between the frequency of antenatal care checks (ANC) and the incidence of LBW.

The results of this study are in line with research conducted by (Sistiarani, 2008) which stated that the frequency of Antenatal Care examinations had a significant relationship with the incidence of LBW, indicated by a value of p = 0.001 and OR: 5.85, which means that mothers who do not carry out ANC examinations have a 5.85 chance experienced low birth weight (LBW) events.

In the Mahayana study, S. A. S., (2015) the quality of Antenatal Care (ANC) services is said to be poor if during pregnancy it does not fulfill all the conditions including: > 4 visits, namely; at least 1 time in the 1st and 2nd quarters, and 2 times in the 3rd quarter, get a complete minimum service standard of "5T" for antenatal care consisting of; first, weighing and measuring height, second, measuring blood pressure, third, measuring fundal height, fourth, giving complete tetanus toxoid immunization (TT) and fifth, giving iron tablets at least 90 tablets during pregnancy, and being told signs signs of pregnancy complications If all of these conditions have been met, it is categorized as good.

Bivariate analysis has weaknesses in analyzing multicausal causes of health problems, such as the incidence of LBW is not only caused by the quality of antenatal care but also influenced by other related factors, so it is necessary to carry out a multivariate analysis by including all other risk variables that are thought to also have a relationship with LBW events. The multivariate analysis used is multiple logistic regression. Modeling risk factors through the modeling stages includes selecting interaction candidate variables and confounding candidate variables, conducting complete modeling, confounding assessments, and making the final model (Hastono, 2001).

From the results of the bivariate test on the dependent variable (p value <0.05), there are 4 covariate variables that qualify as interaction candidates and confounder candidates in the multivariate model, namely: maternal age, gestational age, ANC and nutritional status. The results of the interaction test between the main independent variables and all interaction candidate variables found no significant results, so the next model does not include interaction variables. From the results of the confounding assessment it was found that the age of the mother was not a confounder in seeing the relationship with the quality of antenatal care, so that maternal age did not cause a shift in the OR value away from zero (OR full model = 2.301 and OR reduced = 2.583), it can be said that if the variable maternal age is not controlled it will cause a distortion effect that is greater than the actual value. From the results of the percentage distribution of service quality, there is a tendency that the more ideal the age of the mother, the better the quality of antenatal care. In the final model of the relationship between the quality of Antenatal Care (ANC) services and the incidence of LBW, there is no interaction variable and has 1 confounder variable, with OR = 2.22 (95% CI: 1.58 – 3.12), meaning that pregnant women who receiving poor quality antenatal care is likely to have 2 times the risk of giving birth to LBW compared to pregnant women who receive good quality antenatal care after being controlled by maternal education. Several previous studies have also provided results that are in line with this study, although the operational definitions of the variables for antenatal care are not exactly the same (Hastono, 2001).

Whereas Karmanto (2002) with a case-control study in Cirebon obtained OR crude = 2.92, meaning that mothers who use services with poor quality, namely not fulfilling at least 4 times the service and 5T have a chance of giving birth to LBW 2.92 times compared to mothers who use quality antenatal care. This was also reinforced by Hastono's case-control study, (2006) with the 2002-2003 IDHS data source, which obtained OR = 2.71, meaning that mothers who received poor antenatal quality were likely to be 2.71 times more likely to give birth to LBW babies than mothers who receive good antenatal care.

According to Mahayana, S. A. S., (2015), antenatal care aims to maintain the physical/mental health of the mother and baby by providing education on nutrition, personal hygiene, and the delivery process, detecting abnormalities in the mother and fetus early and immediately managing medical complications. surgery, or obstetrics during pregnancy and overcoming it. It also aims to prepare pregnant women, both physically, psychologically and socially in dealing with complications.

It is understood that good quality antenatal care by fulfilling the above conditions will provide sufficient opportunities to deal with high-risk cases that are found, as well as help mothers recognize the conditions of pregnancy they are facing and determine solutions or efforts to overcome these problems so as to reduce the risk of LBW events.

The relationship between the quality of Antenatal Care (ANC) services and the incidence of LBW is proven in this study with the assumption that antenatal care is mainly three important activities (weighing and measuring height, measuring the height of the uterine fundus, and administering iron tablets at least 90 tablets during pregnancy). "10T" services that are directly related to the prevention of LBW incidents have been carried out. The good quality of antenatal care should be able to change the behavior of the mother so that the mother can achieve optimal health during pregnancy and childbirth, because at every antenatal visit apart

from examination the mother will also receive education/counseling. Counseling materials are problems felt by mothers related to their pregnancy, thus health workers are invited to understand mothers individually and learn to listen to everything that is said by pregnant women. So that there is no gap between the two parties, pregnant women do not feel afraid/reluctant towards officers.

Implication and limitation

In this study, the data were categorized or become nominal data so that a multiple logistic regression test was performed on the determinants of the mother, fetus, and external factors on the incidence of LBW, but did not consider other influencing determinants such as placental determinants. These determinants were not fully measured. The study was conducted with secondary data in the village area assisted by the Public Health Center in East Lombok Regency.

Relevance for Practice

This study provides important practical implications for maternal and child health services by highlighting the role of key maternal determinants—particularly antenatal care (ANC) frequency—in predicting and preventing low birth weight (LBW). Healthcare providers, especially midwives and nurses at primary healthcare facilities, should prioritize strengthening ANC services through regular monitoring, early risk detection, and comprehensive maternal education. Implementing the prediction model developed in this study can assist healthcare workers in identifying high-risk pregnancies early and delivering targeted interventions, such as nutritional support, counseling, and closer clinical supervision. By improving the quality and frequency of ANC, healthcare systems can reduce the incidence of LBW, enhance neonatal outcomes, and contribute to lowering infant morbidity and mortality rates.

E. Conclusion

This study concludes that maternal determinants, particularly the frequency of antenatal care (ANC), play a significant role in predicting the occurrence of low birth weight (LBW) in East Lombok Regency. Maternal age, gestational age, and nutritional status were also identified as important contributing factors. The prediction model developed in this study highlights ANC frequency as the most dominant determinant, indicating that inadequate antenatal care increases the risk of LBW. Strengthening the quality and accessibility of ANC services, along with improving maternal health education and nutritional support, is essential to reduce LBW incidence. These findings provide valuable evidence to support targeted interventions and policy strategies aimed at improving maternal and neonatal health outcomes.

Acknowledgment

The authors would like to express their sincere gratitude to all parties who supported the completion of this study. The authors also extend their appreciation to the health institutions and respondents who contributed their time and data to this research.

Author Contribution

Mustika Nurlaili contributed to the study conceptualization, data collection, and initial manuscript drafting. Hadi Masyhurrosyidi contributed to the study design, data analysis, and interpretation of the results. Sastrawan and Lalu Sulaiman contributed to manuscript revision, critical review, and final approval of the manuscript. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Funding

This research received no external funding.

Declaration of Conflicting Interest

The authors declare no conflict of interest.

Declaration of Use of AI in Scientific Writing

The authors declare that generative AI and AI-assisted technologies were used to support language editing and grammatical refinement of the manuscript.

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