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# The Predictors, Frequency, and Quality of Antenatal Care Visits to Decrease LBW: A Systematic Review

Lisa Trina Arlym[1,2], EndangL. Achadi[3], Dwiana Ocviyanti[4]
Doctorate Student, Faculty of Public Health, University of Indonesia[1]
Lecturer, Mitra Ria Husada Institute of Health Science[2]
Department of Public Health Nutrition, Faculty of Public Health, University of Indonesia[3]
Department of Obstetricsand Gynecology Faculty of Medicine, University of Indonesia[4]

**Abstract**— Globally, low birth weight (LBW) is still being a maternal public health problem. LBW is caused by various factors, which affect shorter gestation period, fetal growth restriction or both. Adequate frequency and quality of antenatal care (ANC) visits are recommended to identify problem as early as possible and to monitor the health of the mother and baby. ANC has been proofed as determinant to reduce the incidence of LBW. This study aims to identify whether adequate frequency and quality of ANC visits decrease the incidence of LBW in developing countries. The research was using systematic literature review which performed according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. All references are managed using Mendeley software, then found 14 selected articles that meet the inclusion criteria and have high quality assessed by using critical appraisal tool from Centre for Evidence-Based Medicine (CEBM). The studies showed there were significant association between adequate frequency of ANC visits with the incidence of LBW. Other factors associated with LBW weresocio-demographic factors and maternal factors. Frequency of ANC at least 4 times during pregnancy can still give positive effect towards lowbirthweight risk, however, it should be a quality service of ANC.

**Keywords:** LBW, ANC, antenatal care, pregnancy, pregnant women

## 1. Introduction

Low birth weight (LBW) is a baby weight less than 2500g at birth(1). LBW is still a public health problem because reducing low birthweight has long been recognized as a public health priority as a global commitment that adopted the Global Nutrition Targets in 2012. It is estimated that 15-20%LBW, representing more than 20 million births a year. The global goal is to reduce 30% of the number of LBW babies born by the year 2025. To achieve intended goal, a decrease of 3% LBW rate per year between 2012 to 2025 and a reduction from about 20 million to 14 million LBW babies(2). Based on the epidemiological approach, babies with LBW are 20 times more likely to die than babies with normal birth weight (3). Globally, 60-80% of neonatal deaths occur among infants with LBW(4).

Two main factors affecting birth weight are duration of pregnancy and fetal growth. Thus, LBW can be caused by shorter gestation period or impaired fetal growth known as intra uterine growth restriction (IUGR) or a combination of both (3). Impaired fetal growth may cause long-term complications or effects such as hypertension, increased risk of metabolic diseases,cardiovascular disorders, kidney disorders and neurological disorders (1,5,6). LBW is also a risk for stunting (7–9). According to Kramer's systematic literature review in 1987, LBW risk factors can be classified as indirect and direct risk factors. Indirect factors include socio-demographic factor (i.e., race), economic factor and maternal factor (i.e., age), while direct factors include: maternal height and weight for their height before pregnancy, pregnancy weight gain, nutrition intake, perinatal morbidity, father's anthropometry, gender of the baby, maternal parity, exposure

to alcohol and cigarettes during pregnancy, and history of previous IUGR or prematurity(3). Most causes of fetal growth disorders (40%) according to Kramer are pre-pregnant body mass index (BMI), weight gain, and maternal nutritional status. Therefore, LBW can be prevented by providing antenatal care (ANC) as part of an integrated strategy (10).

ANC is essential for reducing maternal morbidity, mortality, LBW, and perinatal mortality(11). ANC is a significant determinant to reduce incidence of LBW (12,13). Inadequate or the lack of ANC visits is a risk factor for LBW(14). By implementing routine ANC visits, pregnant women are monitored intensively and risk factors can be found(15–17). Although a significant number of pregnant women in developing countries performed ANC, there is a little evidence to show quality of ANC visits' components in these countries (11,18,19)

WHO provides intervention recommendations in ANC, such as: nutritional interventions, maternal and fetal assessment, preventive measures, general physiological symptom interventions and ANC service system interventions (20). Health services must make efforts to optimize fetal development, one of which is the effectiveness of maternal and infant nutrition approaches and skilled health workers who can ensure good maternal and fetal health conditions (21,22). To detect fetal growth disorders, which have potential to cause LBW, regular weighing can be done to assess the weight gain of pregnant women (23), symphysis-fundal height (SFH) measurement (24,25), routine blood pressure checks at every pregnancy check in the second trimester to predict pre-eclampsia (26), hemoglobin (Hb) measurement to detect anemia that often occurs in pregnant women triggers LBW (27) and also giving iron tablets to prevent anemia(28).

Improving nutritional status of pregnant women while strengthening the quality of nutritional education will reduce the occurrence of LBW(29). During ANC visits, pregnant women must receive nutrition education for their pregnancy health. The needs of pregnant women and foetuses can be complied with a healthy diet, adequate intake to increase daily energy and also protein intake to reduce the risk of LBW, stillbirth, and small babies according to gestational age(21). Mothers whomhave a good nutrition, maintain physical health, prevent excessive weight gain and reduce daily caffeine intake are less likely to have LBW babies,therefore optimal nutrition during pregnancy is very important(19,21). For this reason, health workers must routinely educate pregnant women during ANC to prevent LBW (30).

Hemoglobin measurement is an important factor in determining the risk associated with pregnancy outcomes (31). Low hemoglobin during the first trimester of pregnancy appears to be associated with LBW (32). Anemia during pregnancy also increases the risk of LBW (30,33,34). This is due to the poor flow of oxygen distributed to placenta which acts as an indirect indicator of maternal nutritional deficiencies(32).Pregnant women need daily iron at least 90 doses during pregnancy and folic acid to prevent anemia (21,35). Iron consumption during pregnancy is significantly related to infant's body weight where consumption of supplemental tablets (200 mg Fe and 0.25 mg folic acid) per week by pregnant women can increase the baby's weight (average 172 grams) and length (mean-average 1 cm) (36).

For this reason, it is necessary to conduct ANC visits as a routineto detect the disturbances and complications can be detected as early as possible(21). Women who do not have antenatal screening will have two times giving birth to LBW babies than normal weight babies(37). WHO recommends all pregnant women should have at least four antenatal care (ANC) assessments by a skilled attendant(34). In the new model, WHO recommends the ANC with a minimum of eight visits(21). This systematic literature review aims to identify adequate frequency of ANC visits in order to reduce incidence of LBW in developing countries. The results of this review will provide substantial evidence regarding adequate ANC visits to

reduce the prevalence of LBW.

## 2. Methods

### *2.1 Protocol and Registration*

This review has been registered to PROSPERO (International Prospective Register of Systematic Reviews) with registration number CRD42021235699.

### *2.2 Eligibility Criteria*

Inclusion criteria of articles that we consider appropriate for this systematic review are based onPICOS framework, which are population, intervention, comparison, outcomes and study design(38). Population (P) focused of this study is pregnant women. Intervention (I) in this review is number of ANC visits during pregnancy. Comparator (C) of this review are studies conducted both in rural and/or urban areas in developing as low-income and middle-income countries. Outcome (O) of this review is babies/infants with LBW. The study design (S) chosen by the author are quantitative research except randomized controlled trials and systematic literature review designs. Exclusion criteria are as follows: used language other than English, abstracts only, closed access, articles published less than 2010, study design of articles with only qualitative methods and/or quantitative in randomized control trial and systematic literature review design. Articles which are not in accordance with inclusion criteria were excluded.

### *2.3 Search Strategy*

This systematic literature review started by searching for primary literature in five databases and then filtered them by using search engine with English language studies (PubMed, EBSCO, ProQuest, Springer Link, and Science Direct) published for ten years from November 2010 to November 2020.Searching articles with scholar journal types using the keywords "low birth weight" AND "number of ANC visits" OR "number of antenatal care visits".

All references that have been found are managed using Mendeley software. The data extraction and analysis from each article were carried out by the authors. The result are 14 selected articles, which then the eligibility of selected articles is measured using the kappa statistic (kappa=0.64), so that in final, a total of 14 selected articles have eligibility. Assessment of study quality was assessed by using standard criteria for critical appraisal tool from the Centre for Evidence-Based Medicine (CEBM). This tool comprises of 12 items to verify misclassification, selection and reporting by evaluating the following factors: clearly focused on issue, research method, selection of the subject, bias anticipation, subject representative, sample size, satisfactory response rate, measurements, statistical significance, confidence intervals, confounding factors, applied results. Each item in the articles was documented as either ‘Yes’ or ‘No’. But if an item was not relevant for the study design it was scored as ‘Not Applicable/ Cannot Tell’ (39). There is no guideline to classify the quality of studies based on CEBM so it has been suggested that a score ranging 8 to 12 as high quality, 5 to 7 as medium quality, and 4 or less corresponds to low quality (40). Articles used quality assessment >8. Data analysis was carried out thematically and was arranged based on theme analysis and narrative writing.

The search results for articles are presented using Preferred Reporting Items for Systematic Review & Meta-Analysis (PRISMA) for instrument and a flowchart prepared based on the PRISMA 2009 checklist guidelines (41), sequentially eliminating articles which not relevant with identification criteria and the eligibility. At the end, articles that are relevant are downloaded. From the 1.166 articles identified, 14 articles were included in final review.The article selection process is shown in Fig. 1.

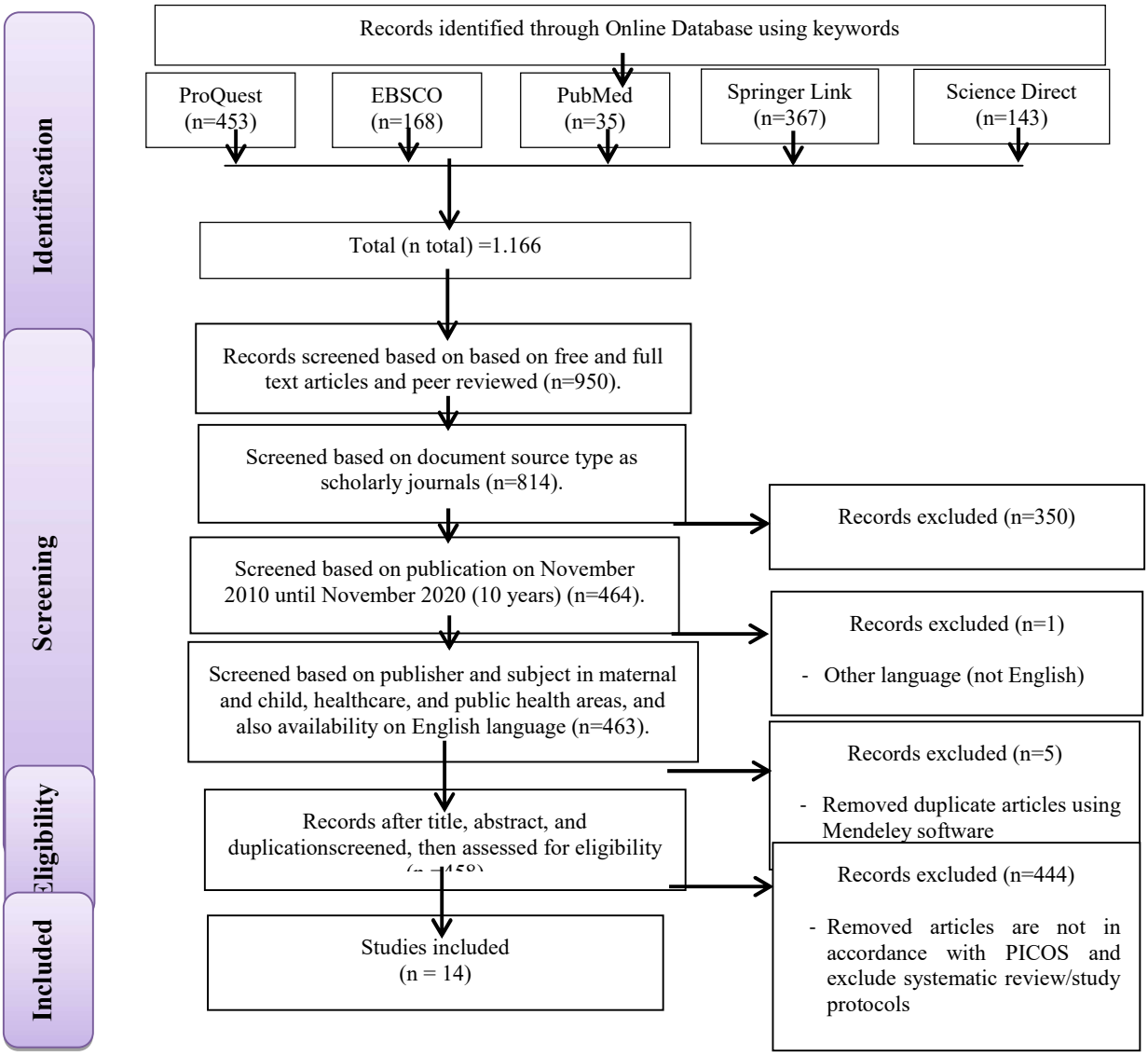


*Figure 1. Preferred Reporting Items for Systematic Review*

## 3. Results

The search results identified 14 articles with high quality method from ten countries, which were from Ghana, Nepal, Tanzania, Pakistan, Brazil, Ethiopia, Colombia, Cambodia, Cameroon and Afghanistan. The results from the studies showed a positive correlation between ANC visits with the incidence of LBW. The characteristics of the obtained articles arein Table 1. These articles used a variety of research methods. Five articles use cross sectional, three articles used case control study, and six articles used retrospective. The sampling technique that are most widely used were purposive sampling. Generally, studies quality was good/high quality.

*Table 1. Summary of Articles Characteristics on LBW and ANC Systematic Review*

| No | Author(s)/ Year | Location | Research Methods | Sampling | Number of Samples | Data Source | Quality Assessment (0-12 point) |
|---|---|---|---|---|---|---|---|

| No | Author(s)/ Year | Location | Research Methods | Sampling | Number of Samples | Data Source | Quality Assessment (0-12 point) |
|---|---|---|---|---|---|---|---|
| 1 | Asundep et.al (2013) | Kumasi, Ghana | Cross sectional | Purposive sampling | 629 participants | Questionnaire | 11 (High) |
| 2 | Mohammed et al. (2019) | Brong Ahafo Region, Ghana | Retrospective cross-sectional | Cluster random sampling | 931 birth records | Birth records (2018) | 9 (High) |
| 3 | Bhaskar et al. (2015) | Eastern Nepal | Case control | Purposive sampling | 159 cases and 159 controls | Interview | 11 (High) |
| 4 | Kamala et al. (2018) | Muhimbili National Hospital, Tanzania | Descriptive retrospective | Purposive sampling | 39,099 deliveries | Delivery book recorded (2010-2015) | 10 (High) |
| 5 | Betew and Muluneh (2014) | Ethiopia | Cross sectional | Purposive sampling | 7,358 women | Ethiopian Demographic and Health Survey 2011 | 9 (High) |
| 6 | Ahmed et al. (2012) | Chitral District, Pakistan | Mixed-methods design, using retrospective. | Purposive sampling | 1,316 women (quantitative), 30 FGDs and 40 in-depth interviews | Quantitative secondary data and qualitative | 11 (High) |
| 7 | Habermann and Gouveia (2014) | Sao Paulo, Brazil | Cases Control | Purposive sampling | 5,772 cases LBW and 5,814 controls | Population Census | 8 (High) |
| 8 | Khanal et al. (2014) | Nepal | Retrospective | Total sampling | 5,240 mothers | Nepal Demographic and Health Survey 2011 | 10 (High) |
| 9 | Gizaw and Gebremedhin (2018) | Central Ethiopia | Case control | Purposive sampling | 376 controls and 94 cases | Interviews and medical records | 12 (High) |
| 10 | Rondon et al (2015) | Columbia | Cross sectional | Multistage, stratified sampling procedure | 10,692 children | Colombian Demographic and Health Survey 2010 | 11 (High) |
| 11 | Chhea et al (2018) | Cambodia | Cross sectional | Two-stage stratified cluster sampling design | 3,522 and 4,991 data 2010 dan 2014 CDHS | Cambodia Demographic and Health Survey 2010 and 2014 | 11 (High) |
| 12 | Njim et al | Buea Health | Retrospective | Purposive | 4,941 records | Medical records | 11 (High) |

| No | Author(s)/ Year | Location | Research Methods | Sampling | Number of Samples | Data Source | Quality Assessment (0-12 point) |
|---|---|---|---|---|---|---|---|
| | (2015) | District, Cameroon | register and prospective phase | sampling | | from Buea Health District | |
| 13 | Shrestha et al (2020) | Lumbini Provincial Hospital, Nepal | Case control | Purposive sampling | 105 cases and 210 controls | Questionnaire | 11 (High) |
| 14 | Gupta et al (2015) | Afghanistan | Cross-sectional | Two-stage sampling strategy | 2,773 children | Afghanistan Demographic and Health Survey 2015 | 11 (High) |

### *3.1 Prevalence of Low Birth Weight (LBW)*

The results of systematic literature review are summarized in Table 2. Overall, the prevalence rate of low birth weight ranged from 7.0 to 32.1%.

### *3.2 Maternal Age*

Maternal ages varied across studies, averaging between 15 and over 35 years. Most of the age groups were classified according to <20 years, 20-35 years, and> 35 years. The results of this review showed that the prevalence increases at the mothers' age of 20-35 years due to the large parity of mothers giving birth in this age group.

*Table 2. Attributes of Studies Evaluation of Adequate Frequency of ANC Visits to Decrease LBW Prevalence*

| No | Author(s) Year | Frequency of ANC | Antenatal Services | Results | Conclusion |
|---|---|---|---|---|---|
| 1 | Asundep et al. (2013) | • <4<br>• 4-7<br>• 8-13 | • Treatment:<br>1. Malaria<br>2. Intestinal helmints<br>3. Nutritional supplement<br>4. TT vaccination<br>5. Treated bednets<br>• Screenings<br>1. Intestinal helmints | - 20% of women with LBW also attended <4 visits, 9.4 % attended >8 visits, 7.5% attended >4-7 visits<br>- Adverse pregnancy outcome: LBW, preterm, stillbirth, and small for gestational age<br><br>Association with LBW:<br>• Number of ANC<4 visits (p=0.0202, AOR 2.55) | Attending <4 visits associated to LBW |

| No | Author(s) Year | Frequency of ANC | Antenatal Services | Results | Conclusion |
|---|---|---|---|---|---|
| | | | 2. Anemia<br>3. Screen STI's<br>4. Insecticide bednet<br>5. Others | | |
| 2 | Mohammed et al (2019) | • ≤4 visits<br>• >4 visits | Not mentioned | Prevalence of LBW=9.56%<br>Association with LBW:<br>1. Maternal sociodemographic:<br>• Mother's age (p=0.364)<br>• Education (p=0.267)<br>• Occupation (p=0.754)<br>• Residence (rural) (p=0.006)<br>2. Obstetric factors:<br>• Number of ANC visits (p <0.001), LBW decreased with every additional visit (OR 0.71)<br>• Gravida (p=0.092)<br>• Parity (p<0.001)<br>• Gestational age (p<0.001)<br>• Hb (p=0.002) | Factors of LBW: education, living area, gestational age, Hb level, parity, ANC visits |
| 3 | Bhaskar et al. (2015) | • 1-2 visits<br>• 3-4 visits<br>• >4 visits | • Fulfillment Iron and Calcium | LBW prevalence=14 to 32%<br>Association with LBW:<br>• Maternal age ≥30 (p<0.003)<br>• Maternal weight ≤45kg (p=0.473)<br>• Number of ANC Visits 1-2 (p=0.001, OR= 16.74), 3-4 (p=0.001)<br>• Maternal height≤1.45 m (p<0.001)<br>• Time of 1st ANC visit (p<0.015)<br>• Iron ≤90 (p<0.001)<br>• Calcium 1-90 days (p=0.02)<br>• Maternal education illiterate (p=0.003)<br>• BMI normal (p=0.013)<br>• HB level <12gm/dl (p=0.534)<br>• Per-capita income (p=0.691) | Determinants of LBW: maternal education and nutrition, iron and calcium supplementation |

| No | Author(s) Year | Frequency of ANC | Antenatal Services | Results | Conclusion |
|---|---|---|---|---|---|
| 4 | Kamala et al. (2018) | • <4 visits<br>• ≥4 visits | Not mentioned | Prevalence of LBW=20.5%<br>Association with LBW:<br>Socio-demographic:<br>• Maternal age <20 (p=0.089)<br>• Primigravida (p=0.002)<br>• ≤4 ANC visits (p=0.001)<br>Maternal:<br>• Anemia (p=0.012)<br>• PROM (p=0.001)<br>• Preterm (p<0.001)<br>• Residence semi-urban (p=0.188)<br>• Education primary (p<0.001)<br>• Never married (p=0.684) | Factors of LBW: maternal age, grand multiparity, low education, low ANC visits |
| 5 | Betew and Muluneh (2014) | • None<br>• Only one<br>• 2 to 4<br>• ≥5 | Not mentioned | 32.1% of 7,358 births were LBW<br>Association with LBW:<br>• Mothers' age (p=0.014)<br>• Region (p=0.000)<br>• Mothers without education (p=0.040)<br>• Wealth index poor (p=0.000)<br>• Child sex female (p=0.000)<br>• Age at first birth (p=0.036)<br>• BMI (p=0.034)<br>• Anemia (p=0.001)<br>• Number of ANC visits (p=0.001), LBW decreased with every additional visit (OR 0.71) | Factors of LBW: education,socio-economic, parity, child's sex, birth type, age, BMI, anaemia and number of ANC visits |
| 6 | Ahmed et al. (2012) | • ≥4 visits<br>• 1-3 visits | a. Check baby position<br>b. Treat morning sickness symptoms<br>c. Symptom treatments<br>d. Check blood pressure<br>e. Check SFH and fetus age<br>f. Examine date of delivery<br>g. TT vaccination | Prevalence of LBW=16%<br>Association with LBW:<br>• Age of mothers ≥35 (p=0.05)<br>• Mothers' education no school (p=0.01)<br>• Mothers' occupation (p=0.63)<br>• No received ANC (p<0.001, OR=4.3)<br>• ANC visits 1-3 (p<0.001, OR=5.54)<br>• Parity multigravida (p=0.89)<br>• Household income <3000 Rs (p=0.001) | Determinants of LBW: age, ANC visits, household income |

| No | Author(s) Year | Frequency of ANC | Antenatal Services | Results | Conclusion |
|---|---|---|---|---|---|
| 7 | Haberman n and Gouveia (2014) | • No visits<br>• 1-3<br>• 4-6<br>• ≥7 | Not mentioned | Prevalence of LBW=8.3%<br>Association with LBW:<br>• ANC (p≤0,001), no ANC visits (OR=2.35)<br>• Maternal education 0-12 years (p≤0.001)<br>• Multigravida (p≤0.001)<br>• Marital (p≤0.001)<br>• Maternal age (p≤0.001)<br>• Neighborhood-level income low (p≤0.001)<br>• Gender (p≤0.001) | Mothers with higher exposure to traffic-related air pollution more likely have LBW |
| 8 | Khanal et al. (2014) | • 0<br>• 1-3<br>• ≥4 | Iron supplements | Prevalence of LBW=17.8%<br>Association with LBW:<br>1. Maternal factors:<br>• Age (p=0.724)<br>• No education (p=0.008)<br>• Occupation working (p=0.048)<br>• Number of ANC visits (p<0.001), no ANC (OR 1.315), 1-3 visits (OR 1.831)<br>• Took iron low (p=0.002)<br>• Tobacco smoking (p=0.001)<br>2. Child factors:<br>• Child's sex (p<0.001)<br>• Birth order (p=0.120)<br>• Birth interval (p=0.117)<br>3. Socio-demographic factors:<br>• Middle-poor status (p=0.001)<br>• Residence rural/urban (p=0.785) | Less ANC visits more likely to have small babies |
| 9 | Gizaw and Gebremed hin (2018) | • No ANC<br>• 1-3<br>• ≥4 | Not mentioned | Prevalence of LBW=20%<br>Association with LBW:<br>Socio-demographics:<br>• Maternal age (p=0.027)<br>• Residence (p=0.776)<br>• No formal education (p=0.002)<br>• Occupation (p=0.376)<br>• Wealth index (p=0.911)<br>• Marital (p<0,001)<br>Reproductive:<br>• Gestational age (p<0,001)<br>• Parity (p=0.167) | Predictors ofLBW: education, marital, household food insecurity, exposure to nutrition counselling |

| No | Author(s) Year | Frequency of ANC | Antenatal Services | Results | Conclusion |
|---|---|---|---|---|---|
| | | | | • Birth to birth interval <2 years (p<0.001)<br>• ANC (p<0.001), no ANC (OR=2,35)<br>• First ANC (p<0.001)<br>• Maternal complications (p=0.403)<br>• Babies' sex (p=0.781)<br>Nutritional:<br>• Restriction of diet (p=0.091)<br>• Nutrition counselling (p=0.019)<br>• Use iron (p=0.009)<br>• MUAC (p=0.283)<br>• Household food security status (p<0.001) | |
| 10 | Rondon et al (2015) | No ANC and doing ANC | • Education,<br>• Mothers' examination: weight, height, SFH, blood pressure<br>• Immunization: TT<br>• Test: blood and urine<br>• Nutritional supplements: iron and folic acid. | Prevalence of LBW=11%<br>Association with LBW:<br>• ANC<br>• Quality of ANC (p=0.033)<br>• Number of ANC (p<0.001)<br>• First ANC (p=0.045)<br>• Gestational age (p<0.001)<br>• Multiple pregnancy (p<0.001)<br>• Childs' sex (p<0.001)<br>• Mothers' age (p=0.157)<br>• Mother no education (p=0.002)<br>• Mother height (p<0.001)<br>• BMI low (p<0.001)<br>• Parity (p=0.002) | A comprehensive prenatal care to reduce incidence of LBW |
| 11 | Chhea et al (2018) | • No ANC<br>• Once<br>• 2-3<br>• ≥4<br>• Missing | Nutritional counseling | Prevalence of LBW=7%<br>Association with LBW:<br>• Age (p=0.142)<br>• Marital (p=0.447)<br>• No schooling (p=0.073)<br>• Employment status (p=0.493)<br>• Smoking (p=0.937)<br>• Problems accessing health services (p=0.989)<br>• Number of ANC visits (p<0.001), attending <4 ANC (OR=1.8)<br>• Nutritional counseling (p=0.45)<br>• Anemia (p=0.864)<br>• BMI (p=0.159)<br>• Primigravida (p<0.001)<br>• Birth interval (p<0.001) | Predictors of LBW: number of ANC visits, primigravida |

| No | Author(s) Year | Frequency of ANC | Antenatal Services | Results | Conclusion |
|---|---|---|---|---|---|
| | | | | • Sex of babies (p=0.348)<br>• Rural (p=0.0370)<br>• Wealth index (p=0.069) | |
| 12 | Njim et al (2015) | • <4<br>• ≥4 | Not mentioned | Prevalence of LBW=25%<br>Association with LBW:<br>• Marital (p=0.47)<br>• Occupation (p=0.17)<br>• Education (p=0.11)<br>• Gravidity (p=0.07)<br>• Gestational age (p<0.01)<br>• Number of ANC visits (p=0.03; OR=2.2)<br>• Malaria (p=0.13)<br>• Anemia (p=0.26)<br>• Hypertensive (p<0.01)<br>• HIV infection (p=0.02) | One out of every five babies are born with LBW |
| 13 | Shrestha et al (2020) | • <4<br>• ≥4 | Not mentioned | Prevalence of LBW= 9.4% to 21.6%<br>Association with LBW:<br>• Mother's age (p>0.05)<br>• No education (p<0.05)<br>• Occupation (p<0.05)<br>• Wealth index (p>0.05)<br>• Gestational age (p<0.05)<br>• Parity (p>0.05)<br>• Maternal weight (p<0.05)<br>• ANC visits≥4 (p>0.05; OR 0.61)<br>• Hb level (p>0.05) | Predictors of LBW: educational, occupational, delivery, gestational age, maternal weight |
| 14 | Gupta et al (2015) | • No (0 visits)<br>• Inadequate (1-3)<br>• Adequate (≥4) | Not mentioned | Prevalence of LBW=15,5%<br>Association with LBW:<br>• Age (p>0.05)<br>• Sex child male (p<0.01)<br>• Education primary (p<0.01)<br>• Occupation (p>0.05)<br>• Parity (p>0.05)<br>• Iron pills (p>0.05) | Determinants: female children, lower education, urban residence, poor wealth index |

| No | Author(s) Year | Frequency of ANC | Antenatal Services | Results | Conclusion |
|---|---|---|---|---|---|
| | | | | • Number of ANC (p>0.05), 1-3 ANC visits with LBW (AOR 2.3)<br>• Richer (p<0.001)<br>• Residence rural (p<0.001) | |

### *3.3Frequency of Antenatal Care (ANC) visits*

Eight of the 14 articles classified the number of ANC visits into <4 visits and ≥4 visits (42–50). ANC visits were also classified as one visit, 2-4 visits, ≥5 visits (51), 1-3 visits, 4-6 visits, ≥7 visits (52), 1-2 visits, 3-4 visits,>4 visits (53), <4 visits, 4-7 visits, 8-13 visits(54).

### *3.4Antenatal Care Services*

During ANC visits, health services provided nutritional interventions, maternal and fetal examinations, preventive measures and general physiological symptom interventions. Nutritional interventions are perform in the form of supplementation (54), iron (43,53,55), calcium (53), folic acid (55), and nutritional counselling(50). Examination of mother and fetus includes measurement of body weight and height (55), examination of symphysis-fundal height (SFH) (44), blood pressure (56), blood and urine tests (55), Hb test (54), examination of fetal position (44). Preventive measures during ANC visits include counseling and education for pregnant women (55), tetanus toxoid immunization (44,54,55), screening for sexually transmitted infections (STIs) (54), and other screenings such as malaria (54). Physiological symptom intervention are perform in the form of handling symptoms of nausea, vomiting and other symptoms (44).

### *3.5Factors Associated with Low Birth Weight (LBW)*

Twelve articles stated that the number of ANC visits were significantly associated with LBW (p<0.05) (42,43,54,55,44,47–53). Whereas, two articles showed that the number of ANC visits were not significantly related to incidence of LBW (p>0.05) (45,46). Pregnant women who did ANC visits <4 times have a risk of between 1.3-16.74 times causing LBW(42,43,53,54,44,46–52). Every time an ANC visit is added, the likelihood of LBW occurring decreases (42). Number of ANC visits and first ANC visits was associated with LBW (p<0.05) (55). Earlier ANC visitwas associated with the incidence of LBW. Pregnant women who did the first ANC in third trimester had three times the chance of giving birth to LBW compared to pregnant women who had first ANC visit in first trimester (53).

From 14 articles found, the most consistent factors or predictors of LBW were socio-demographic factors, maternal factors, and nutritional factors. Socio-demographic factors include marital status, occupation, education level, maternal age, wealth index, and place of residence. Unmarried status was positively associated as a predictor of LBW (p<0.05) (48,52). Working mothers were associated with the incidence of LBW (p<0.05) (43,45). Low education level of mothers who only received basic education was positively associated with LBW (p<0.01) (46,49,52). Mothers who were un-educated or illiterate and did not take a school were positively associated with LBW (p<0.05) (43–45,48,51,53,55). Maternal age ≥30 years was associated with LBW (p<0,05) (51,53). Middle to lower wealth index indices were associated with LBW (p≤0.001) (43,44,51,52).On the other hand, rich families were associated with LBW (p<0.001) (46). Mothers' residence who living in rural were associated with incidence of LBW (p<0.05) (42,46,50).

Maternal factors include maternal health problems, smoking, parity, maternal weight, height, body mass index (BMI), gestational age, sex of newborns, pregnancy spacing, multiple pregnancies, and number of

ANC visits. Mothers who have health problems such as anemia (43,49,51), hypertension (47,49), human immunodeficiency virus (HIV) infection(47)were associated with LBW ($p < 0.05$). Mothers who smoke were associated with LBW ($p=0.001$)(43). Maternal parity ≥5 was associated with LBW ($p<0.05$)(42,52). On the other hand, primigravida mothers were also associated with LBW ($p<0.05$)(49,50). Maternal body weight ≤45kg was associated with LBW ($p<0.05$)(45,53). Short mothers who have a height ≤1.45m was associated with the incidence of LBW ($p<0.001$) (53,55). Low BMI was associated with LBW ($p<0.05$)(51,55). Preterm gestational age was associated with LBW ($p<0.05$) (42,45,47–49,55). The sex of the baby born was related to LBW ($p<0.05$) (43,46,51,52,55). Gestation interval <2 years was associated with LBW ($p<0.05$)(48,50). Multiple pregnancies were associated with LBW ($p<0.05$) (55).

Nutritional factors included vitamin supplementation, iron pills/tablets during pregnancy, dietary restrictions due to dietary restrictions, nutrition education during pregnancy and household food security status. Low calcium supplementation(53), iron tablets (43,48,53)≤90 days were positively associated with LBW ($p<0.05$). Dietary restriction due to abstinence was positively associated with LBW (48). Mothers who did not receive nutritional counseling were associated with low birth weight ($p=0.019$) (48). Low household food security status was positively associated with LBW ($p<0.001$) (48).

**4. Discussion**

Overall, the prevalence rate of LBW is still high in developing countries. It was accordance with the UNICEF-WHO report that the prevalence of LBW varies throughout the world, starting from 7.2-26.4%. Globally, babies with LBW reached 14.6% (20.5 million babies with LBW). In developing countries, the prevalence reaches 7.2%, indicated by the Asian region, which one is more, reaching 17.3%, even in South Asia it is 26.4%(2).

ANC services include time of visit (preferably first consultation during first trimester), frequency (≥4 visits by qualified staff provider), and content or quality of service (should be based on standard guidelines and clinical protocols) (57). Quality of ANC services should be in line with WHO's Quality of Care Framework guidelines (58). There was a significant positive relationship between the quality and use of ANC in rural areas (11). Poor quality ANC will reduce benefits for pregnant women therefore policies and programs were very necessary to improve ANC quality, especially for the poor and other disadvantaged population groups in order to improve maternal health (11). Necessary components during routine ANC visits include measurement of body weight and height (19), blood pressure measurement (19,59), urine tests (19,59), blood tests (19,59), tetanus toxoid vaccination (59,60), ultrasound examination (19), iron supplementation (59,60)and counseling as an information/education on maternal health and pregnancy danger signs/potential complications (19,59,60).

Poor nutrition may increase the possibility of pregnant women to deliver LBW babies, especially in developing countries (28). Effect of maternal nutritional status before and during pregnancy reached >50% as the cause of LBW cases in many developing countries (61). Maternal weight gain during pregnancy was the most commonly used indicator to determine the nutritional status of the mother and fetus during pregnancy (62). Mothers with low nutritional status (underweight) with BMI <18.5 (kg/m2) during pre-pregnancy have insufficient nutritional savings during pregnancy, therefore they must have a greater weight gain than mothers with a normal BMI (63). Mid upper arm circumference (MUAC) was used to screen for the possibility of mothers with chronic energy deficiency (64). Research by Sebayang et al. showed that mothers with MUAC <23.5cm have a 47% chance of giving LBW babies, while short mothers (<145m) have a two times risk of giving LBW babies(65). Pregnant women with MUAC <23.5cm and a short stature have three times the risk of giving LBW babies and two times the risk of giving birth to a small baby during

pregnancy(65). Other study showed that MUAC was not associated with LBW incidence (48), and short mothers have 20 times risk of delivering LBW babies(53). The nutritional status of pregnant women as measured by anthropometry and Hb levels were associated with incidence of LBW (66). Improved nutritional status with provision of iron, folic acid, and vitamin A supplements to pregnant women were positively associated with a lower incidence of LBW (28,67,68).

This systematic literature review showed that there was a positively significant relationship between number of ANC visits and LBW. By conducting ANC visits ≥4 times can reduce the incidence of LBW (42,43,53,54,44,46–52). WHO recommends four ANC visits (FANC) for uncomplicated pregnancies (69). New model of WHO recommends ANC visits with a minimum of eight ANC visits, pregnant women should make the first ANC contact during the first 12 weeks of pregnancy, with the following contacts occurring at 20, 26, 30, 34, 36, 38 and 40 weeks of maternal gestation (21,70). However, for some countries that have not been able to implement the new ANC model, this review is still relevant and can be useful as long as the quality of services includes nutritional interventions, maternal and fetal examinations, preventive measures and general physiological symptom interventions. ANC visits are carried out in the form of active relationships and communication between pregnant women and health workers so that it must be an opportunity to provide quality care for pregnant women (21).

### *4.1 Limitation*

The limitation of this review was search strategy only based on online databases such as PubMed, EBSCO, ProQuest, Springer Link, and Science Direct which were published in the last ten years, then only 14 journals were found. On the other hand, WHO has recommended ANC visits at least eight contacts since 2016, however we are still collecting research before 2016 in this systematic literature review. As a result, the number of ANC visits in this review is still using the old WHO recommendation as at least four ANC visits. In addition, most of the articles did not state clearlystate thesample size calculations. This systematic literature review does not proceed to a detailed meta-analysis to combine and see variations on statistical results of the study.

## 5. Conclusion

Review of research in the last ten years, shown that adequate ANC visits with complete ANC services and beginning in the first trimester appears to be very important to reduce LBW and to prevent pregnancy complications. This study identified several determinants of LBW such as socio-demographic factors, maternal factors, antenatal care visits which are important factors associated with LBW. Therefore, ANC visits still need to be strengthened as an effort to reduce the prevalence of LBW. This paper is still relevant for countries that have not been able to perform 8 times ANC visits as long as the implementation pays attention to the quality of ANC services. We suggest future research to identify the adequate of minimal eight ANC visits and its benefits for pregnant women as a new model recommendation by WHO.

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