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Meta-Analysis

The Effect of Low Birth Weight on Stunting in Children Under Five: A Meta Analysis

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ABSTRACT

Background: The main nutritional problem in children under five, which is still found in many countries in the world, is stunting. The relationship between risk factors for low birth weight (LBW) in children has been investigated in several primary studies with a number of contradictions in the results. The purpose of this study was to determine the effect of low birth weight (LBW) on the incidence of stunting in children under 60 months in various countries using the meta-analysis method.
Subjects and Method: The articles were selected from the Google Scholar, PubMed, Web of Science, Microsoft Academic, and Science Direct databases published from 2000-2021. Article collection for 2 months with search keywords ("Low Birth Weight" OR "LBW") AND "Stunting" AND ("adjusted odds ratio" OR "multivariable"). The meta-analysis step used is a PRISMA flowchart. Data analysis was carried out using the Review Manager 5.3 . program.
Results: Based on 11 primary studies conducted in Brazil, Ethiopia, and Indonesia, it was shown that in a cross-sectional study LBW could increase the incidence of stunting in children aged 0-60 months by 3.64 times compared to non-LBW (aOR = 3.64; 95% CI = 2.70). up to 4.90; p<0.001). While the case-control study showed that LBW can increase the incidence of stunting in children aged 0-60 months as much as 6.95 times compared to non-LBW (aOR = 6.95; 95% CI = 4.02 to 12.04; p<0.001).
Conclusion: Low birth weight increases the risk of stunting in the population of children under 60 months of age.

Keywords: low birth weight, stunting, meta-analysis

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BACKGROUND

The main nutritional problem in children under five, which is still found in many countries in the world, is stunting. The incidence of stunting is a serious problem, more than 25% of the number of children under the age of five or at least 165 million suffer from stunting in the world (WHO, 2009). By 2020, this figure has fallen to 22% but this prevalence is still considered high (UNICEF, 2021). Indonesia's target in 2021 is to reduce the prevalence of stunting

to 14%, but currently from the study data on the nutritional status of children under five in Indonesia, the stunting rate in Indonesia still reaches 27.7% (Sudikno, 2019).

The quality of human resources in the future is closely related to stunting because the impacts include brain development being not optimal so that it affects the decline in intelligence, inhibits the growth of body composition and body mass so as to reduce productivity and immunity. Stunting describes chronic undernutrition status during growth and development since early life.

Malnutrition since early life during growth and development can have a lifelong negative impact. Low birth weight (LBW) is one of the factors that directly affect the incidence of stunting. LBW has a risk factor for stunting of 4.24 times compared to normal birth weight and is the most dominant risk factor (Putri, 2020).

LBW is defined as a baby's weight at birth of less than 2,500 grams. According to epidemiological studies, children with birth weight less than 2,500 grams are 20 times more likely to die than babies who are heavier. The incidence of LBW generally occurs in developing countries rather than developed countries. Babies with a history of LBW have a greater risk of immune system problems than babies with normal birth weight (Nurhasana, 2021).

In 2015, an estimated 14.6% of the 20.5 million newborns suffered from low birth weight. Babies with LBW are at risk of dying during their first month of life and if they survive, they will face health consequences including stunting, lower IQ, and chronic conditions as adults such as obesity and diabetes (UNICEF, 2019).

Several primary studies that have been conducted have shown mixed results regarding the risk factors that have the most influence on the incidence of stunting. Low birth weight (LBW) is one of the risk factors that directly affect the incidence of stunting in children (Soetjiningsih, 2012). Akombi et al. (2017) also mentions that children with a history of LBW births are at risk for stunting. The purpose of this study was to analyze the risk factors for stunting in children under 60 months of age in various countries so that a summary of the previous studies with mixed results could be known.

SUBJECTS AND METHOD

1. Study Design

This study uses a systematic review study design and meta-analysis. The articles used in this study were obtained from the databases of Google Scholar, PubMed, Web of Science, Microsoft Academic, and Science Direct. Articles were collected for 2 months, with the keywords ("Low Birth Weight" OR "LBW") AND "Stunting" AND ("adjusted odds ratio" OR "multivariable").

2. Inclusion Criteria

The inclusion criteria for selecting articles in this study included the full text of the article, the research subjects were children under 60 months of age, the intervention given was low birth weight, the comparison was normal birth weight, the results of the article were stunting, observational study design, and analysis using multivariate with adjusted odds ratio.

3. Exclusion Criteria

The exclusion criteria in this study were articles that were not in English and Indonesian, the results of the articles were only bivariate.

4. Operational Definition of Variables

The search for articles was carried out by considering the eligibility criteria determined using the PICO model. The population in this study were children under 60 months of age with low birth

weight intervention, with normal birth weight comparison, and the outcome was stunting.

Low birth weight is when a child is born weighing less than 2,500 g. Stunting is length or height according to age with z-score between -3 SD to less than -2 SD.

5. Data Analysis

The data is processed using Review Manager (RevMan 5.3) by calculating the Adjusted Odds Ratio and heterogeneity to determine which research models are combined and form the final results of the meta-analysis.

RESULTS

The process of searching for articles by searching through the database according to the PRISMA flow diagram can be seen in Figure 1.

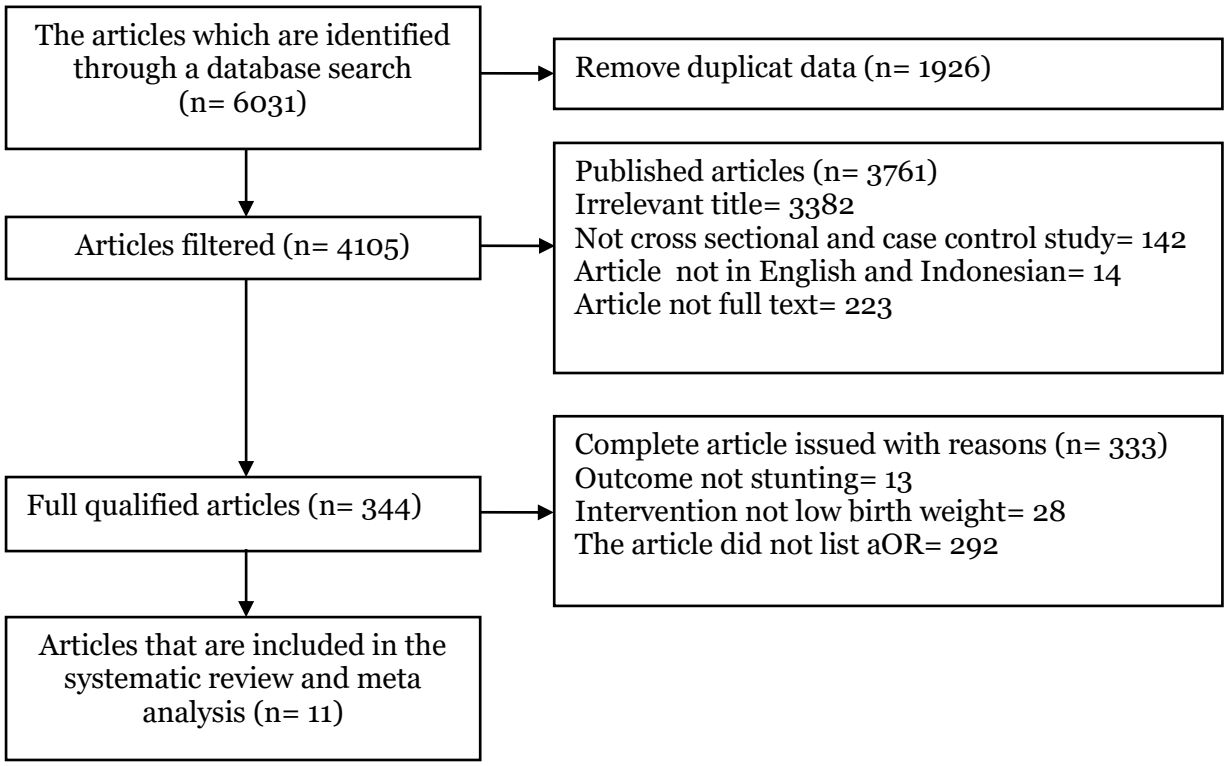

Figure 1. PRISMA flow diagram

Studies related to LBW on the incidence of stunting in children aged 0-60 months consisted of 11 articles and the initial search process yielded 6031 articles. Can be seen in Figure 2 shows the area where the articles were taken according to the inclusion criteria. Articles obtained from 3 continents namely Asia, Africa, and South America. Furthermore, in Table 1 and Table 2 the researchers conducted an assessment of the quality of the research articles. Table 1 shows that there are 6 case-control study articles as evidence of the relationship between the effect of LBW on the incidence of stunting in children aged 0-60 months. Table 2 shows that there are 5 cross-sectional study articles as evidence of the relationship between the effect of LBW on the incidence of stunting in children aged 0-60 months.

Based on the results of the forest plot (figure 3) in a cross-sectional study, it was shown that LBW could increase the incidence of stunting by 3.64 times compared

to non-LBW (aOR 3.64; 95% CI 2.70 to 4.90; p<0.001). While the case-control study showed that LBW can increase the incidence of stunting by 6.95 times compared to non-LBW (aOR 6.95; 95% CI 4.02 to 12.04; p<0.001). The heterogeneity of research data in cross-sectional and case-control studies shows I^2= 0% so that the distribution of data is declared homogeneous (fixed effect model).

The funnel plot (figure 4) shows a publication bias which is indicated by the asymmetry of the right and left plots where 8 plots are on the right and 2 plots are on the left. The plot on the left of the graph appears to have a standard error between 0 and 2 and the plot on the right has a standard error between 0.5 and 1.5.

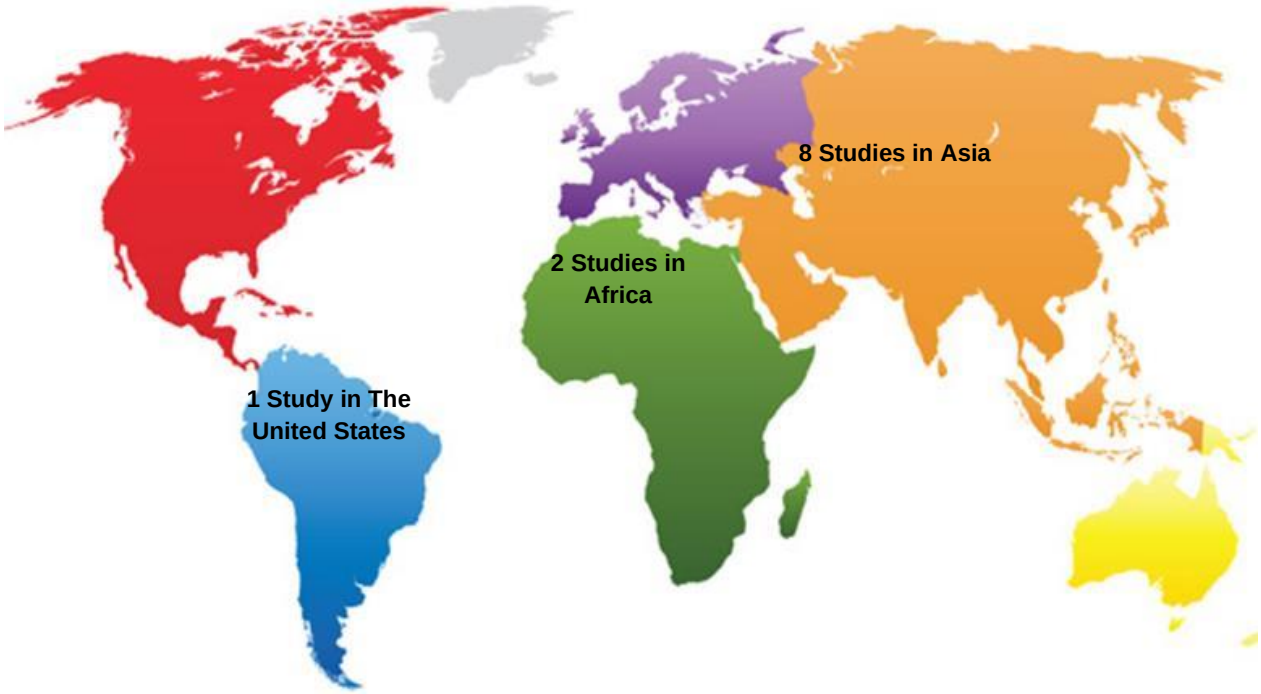

Figure 2. Map of the research area

1. LBW to the incidence of stunting in children aged 0-60 months

a. Forest Plot

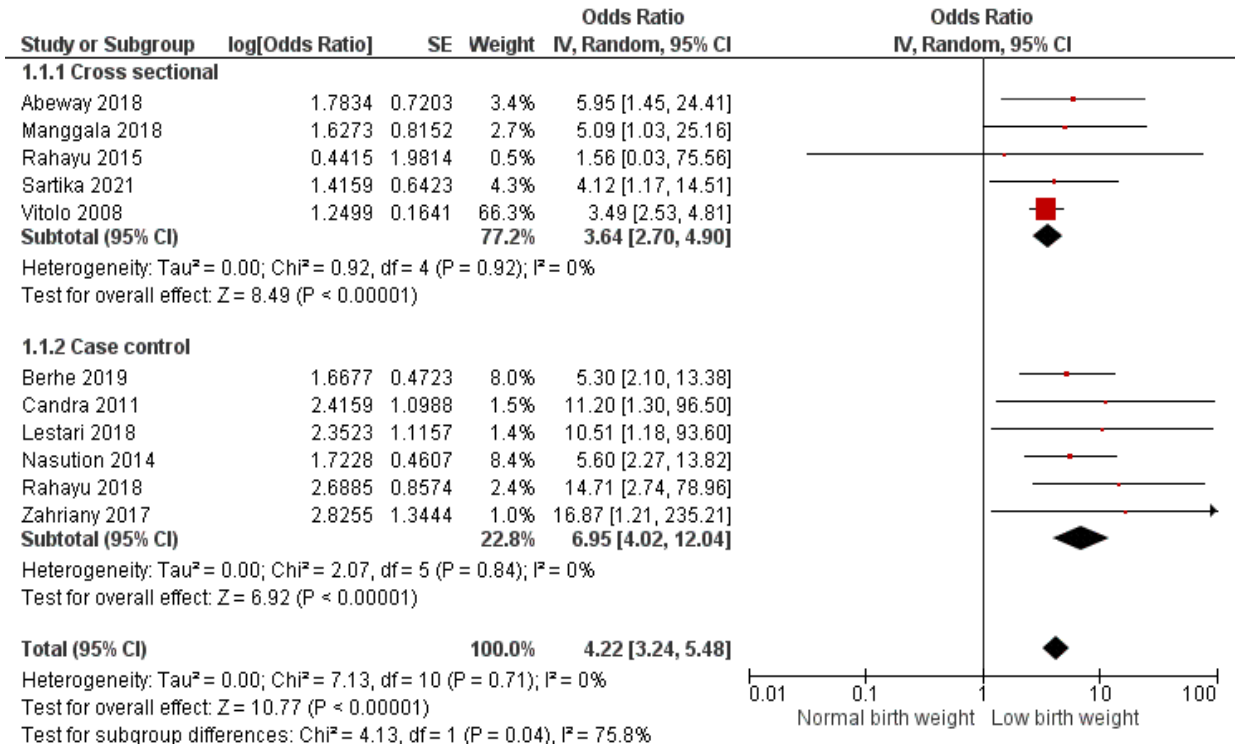

Figure 3. Forest plot of the effect of LBW on the incidence of stunting in children aged 0-60 months

b. Funnel Plot

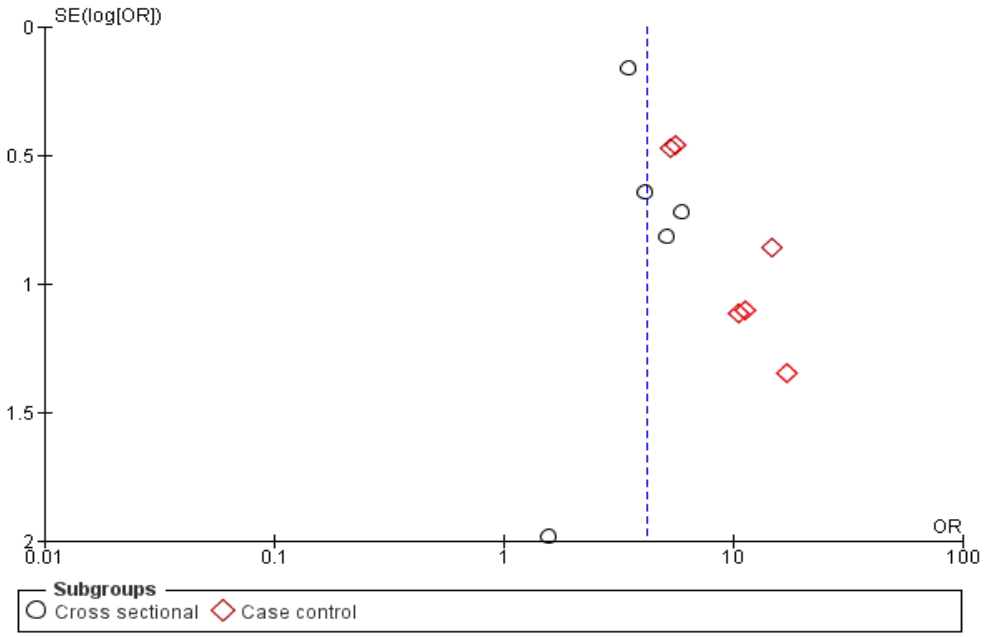

Figure 4. Funnel plot of the effect of LBW on the incidence of stunting in children aged 0-60 months

Table 1. Critical Appraisal of a Case-Control Study

No	Checklist Questions	Publication Author and Year					
		Rahayu et al (2018)	Candra et al (2011)	Lestari et al (2018)	Nasution et al (2014)	Zahriany (2017)	Berhe et al (2019)
1	Did the study address a clearly focused question / issue?	1	1	1	1	1	1
2	Is the research method (study design) appropriate for answering the research question?	1	1	1	1	1	1
3	Were there enough subjects (employees, teams, divisions, organizations) in the study to establish that the findings did not occur by chance?	1	1	1	1	1	1
4	Was the selection of cases and controls based on external, objective and validated criteria?	0	1	1	1	1	1
5	Were both groups comparable at the start of the study?	0	1	1	1	0	1
6	Were objective and unbiased outcome criteria used?	1	1	1	1	0	1
7	Is there data-dredging?	1	0	0	0	0	0
8	Are objective and validated measurement methods used to measure the outcome? If not, was the outcome assessed by someone who was unaware of the group assignment (i.e. was the assessor blinded)?	1	0	1	1	1	1
9	Is the size effect practically relevant?	1	1	1	1	1	1
10	How precise is the estimate of the effect? Were confidence intervals given?	1	1	0	1	0	1
11	Could there be confounding factors that haven't been accounted for?	0	0	0	0	0	0
12	Can the results be applied to your organization?	1	1	1	1	1	1
	Total	9	9	8	9	7	10

Note: Yes = 1, No = 0

Tabel 2. Critical Appraisal of a Cross-Sectional Study

No	Checklist Questions	Publication				
		Abeway et al (2018)	Manggala et al (2018)	Rayahu et al (2015)	Sartika et al (2021)	Vitolo et al (2008)
1	Did the study address a clearly focused question / issue?	1	1	1	1	1
2	Is the research method (study design) appropriate for answering the research question?	1	1	1	1	1
3	Is the method of selection of the subjects (employees, teams, divisions, organizations) clearly described?	1	1	1	1	1
4	Could the way the sample was obtained introduce (selection)bias?	0	1	0	0	0
5	Was the sample of subjects representative with regard to the population to which the findings will be referred?	1	1	1	1	1
6	Was the sample size based on pre-study considerations of statistical power?	1	1	1	1	1
7	Was a satisfactory response rate achieved?	1	1	1	1	1
8	Are the measurements (questionnaires) likely to be valid and reliable?	1	1	1	1	1
9	Was the statistical significance assessed?	1	1	1	1	1
10	Are confidence intervals given for the main results?	1	1	1	1	1
11	Could there be confounding factors that haven't been accounted for?	0	0	0	0	0
12	Can the results be applied to your organization?	1	1	1	1	1
	Total	10	11	10	10	10

Note: Yes = 1, No = 0

Table 4. Description of the primary studies included in the meta-analysis

Author (year)	Country	Study Design	Sample	Population	Intervention	Comparison	Outcome	aOR (95% CI)
Sartika *et al.* (2021)	Indonesia	Cross sectional	559	Toddler aged 0-11 months	Low birth weight	Normal birth weight	Stunting	4.12 (1.17 – 9.91)
Manggala *et al.* (2018)	Indonesia	Cross sectional	166	Toddler aged 24-59 months	Low birth weight	Normal birth weight	Stunting	5.09 (1.03 - 25.31)
Abeway *et al.* (2018)	Ethiopia	Cross sectional	410	Children aged 6-59 months	Birth weight of <2.5 kg	Normal birth weight	Stunting	5.95 (1.450-17.309)
Rahayu *et al.* (2015)	Indonesia	Cross sectional	117	Children under 2 years	Low birth weight	Normal birth weight	Stunting	1.555 (0.032 – 0.762)
Vitolo *et al.* (2008)	Southern Brazil	Cross sectional	3957	Children under five years	Less than 2,500 g	2,500 g or more	Stunting	3.49 (2.53-4.80)
Candra *et al.* (2011)	Indonesia	Case control	106 (Case 58, Control 58)	Children aged 1-2 years	Low birth weight	Normal birth weight	Stunting	11.2 (1.3 - 96.3)
Lestari *et al.* (2018)	Indonesia	Case control	60 (Case 30, Control 30)	Children aged 24-59 months	Low birth weight	Normal birth weight	Stunting	10.510 (1.180-93.572)
Rahayu *et al.* (2018)	Indonesia	Case control	150	Children aged 12-48 months	Low birth weight	Normal birth weight	Stunting	14.71 (2.74 – 79.06)
Zahriany *et al.* (2017)	Indonesia	Case control	62	Children aged 12 – 60 months	Low birth weight	Normal birth weight	Stunting	16.87 (1.21 – 234.9)
Nasution *et al.* (2014)	Indonesia	Case control	242	Children aged 6-24 months	Low birth weight	Normal birth weight	Stunting	5.60 (2.27 - 15.70)
Berhe *et al.* (2019)	Ethiopia	Case control	110 case 220 control	Children 6 to 24 month-age	Low birth weight	Normal birth weight	Stunting	5.3 (2.1-19.l8)

DISCUSSION

This systematic study and meta-analysis raised the theme of the effect of low birth weight on the incidence of stunting in children aged 0-60 months. The independent variable analyzed was LBW. The dependent variable studied was stunting. The results of the primary study conducted by a systematic review and meta-analysis showed an epidemiological study design with a larger sample, different demographic characteristics, thus providing a basis for concluding that LBW has a statistical effect on the incidence of stunting. The results of the analysis of primary studies conducted by systematic studies and meta-analyses show that studies that meet the analysis criteria are mostly found in Asia (Indonesia), Africa (Ethiopia), and South America (Brazil).

The analysis was carried out with an observational study design and subgroup analysis. The results of a meta-analysis in a cross-sectional study showed that LBW can increase the incidence of stunting in children aged 0-60 months by 3.64 times compared to non-LBW (aOR 3.64; 95% CI 2.70 to 4.90; p<0.001). While the case-control study showed that LBW can increase the incidence of stunting in children aged 0-60 months as much as 6.95 times compared to non-LBW (aOR 6.95; 95% CI 4.02 to 12.04; p<0.001).

Aryastami et al., (2017), in their study stated that LBW is a factor that influences the achievement of infant growth and development after birth. Evidence also suggests that early growth retardation is associated with suboptimal cognitive development and stunted growth of internal organs can result in low cognitive abilities and an increased risk of chronic disease later in life.

Ntenda (2019) states that there is a positive relationship between LBW and malnutrition among preschool age children in Malawi. The risk of children becoming stunted is (57%), thin (15%) and wasting (51%) is greater in children born with LBW. Thus, children born with LBW are at risk for continuing to be malnourished during childhood.

While the results of the meta-analysis in case-control studies showed that LBW can increase the incidence of stunting in children aged 0-60 months as much as 6.95 times compared to non-LBW (aOR= 6.95; 95% CI= 4.02 to 12.04; p<0.001). In line with the results of research conducted by Taguri et al., (2008), that LBW is associated with the incidence of stunting in preschool children in Libya. Based on the results of the multivariate analysis, it was shown that LBW increased the incidence of stunting by 1.68 times compared to non-LBW (aOR= 1.68; 95% CI= 1.17 to 2.40; p= 0.005).

In the study of Nshimyiryo et al., (2019), it was shown that children with low birth weight (<2,500 g) were more likely to be stunted than children weighing 2,500 grams at birth. The results showed that LBW increased the incidence of stunting in children under 5 years of age by 2.12 times compared to those who were not LBW (aOR= 2.12; 95% CI= 1.39 to 3.23; p<0.001).

Gonete et al., (2021) also stated that the probability of stunting among newborns with low birth weight was 3.1 times compared to normal weight, which is in accordance with studies conducted in low- and middle-income countries (aOR= 3.16; CI 95%= 1.65 to 6.06; p<0.001).

Lukman et al., (2021) stated that the birth weight of a child cannot be separated from the health and nutritional status of the mother before and during pregnancy. Teenage nutrition before pregnancy needs to be considered as a preparation during pregnancy. In Tampy et al., (2020) it is

explained that babies with LBW will have slower growth and development while in the womb. After birth, children also experience digestive disorders where babies with low birth weight cannot absorb fat and digest protein, causing a shortage of reserve nutrients in the body which, if not addressed immediately, can lead to chronic nutritional problems, namely stunting.

AUTHOR CONTRIBUTION

The first author contributed in finding articles, processing data and methods. The second author contributed in reading the results and making discussions. The third author contributed to the background and abstract. All authors do critical appraisal.

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None

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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