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Meta Analysis

Correlation between Low Birth Weigth and Stunting in Children Under Five: Meta Analysis

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ABSTRACT

Background: Stunting in children is a risk factor for increasing child mortality. The purpose of this study was to determine the relationship between LBW and the incidence of stunting based on previous primary studies.
Subjects and Method: This research was conducted using a meta-analysis study with PICO as follows: P = toddler, I = low birth weight, C = normal birth weight, O = stunting. Search articles in this study using 3 databases, namely Pubmed, Google Scholar and Springerlink. Search articles using the following keywords: Low birth weight AND Stunted OR Birth weight AND Stunted, articles were analyzed using the Review Manager 5.3 application.
Results: There are 11 articles from Rwanda, Nepal, Ethiopia, Eastern Kenya, Pakistan, China, Indonesia, and Tanzania from 2017-2022 which were analyzed using PRISMA flow diagrams. The results of this study indicate that toddlers who have a history of being born with low birth weight have a risk of experiencing stunting as much as 2.19 times compared to toddlers who have a history of birth with normal birth weight (aOR= 2.19; 95% CI= 1.77 to 2.69; p<0.001).
Conclusion: Toddlers with a history of LBW births are at risk for stunting.

Keywords: LBW, stunting, toddlers, meta-analysis.

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BACKGROUND

Stunting in children under the age of five is one of the most common nutritional problems faced by toddlers today. Stunting affected 22.2% of children under the age of five worldwide in 2017 or around 150.8 million children under five.

However, the number of stunting decreased when compared to the stunting rate in 2000 of 32.6%. In 2017 Asia accounted for the stunting of more than half of the world's children aged five years (55%) while Africa accounted for more than a third (39%) of all stunted children under the age of five. The largest portion of 83.6 million stunted children in Asia under the age of five (58.7%) came from South Asia, while the lowest proportion came from Central Asia (0.9%) (Ibrahim et al., 2021).

According to UNICEF in 2018, almost 80% of stunted children were found in 24 developing countries in Asia and Africa, then Indonesia was the fifth country with the highest frequency of stunting after

India, China, Nigeria, and Pakistan. Meanwhile, according to WHO data on the incidence of stunting in children under five, Indonesia is the third country in Southeast Asia or South East Asia Regional (SEAR) with the highest frequency. In Indonesia, the average prevalence of stunting in children under the age of five was 36.4 percent from 2005 to 2017 (Ibrahim et al., 2021).

Stunting is a disorder in which children under the age of five fail to thrive as a result of chronic malnutrition, leaving the child too short for his age. Malnutrition occurs from the baby in the womb until the first days after birth, but stunting does not appear until later when the child is two years old (TNP2K, 2017). Stunting is a child under five with body length or height according to age (PB/U or TB/U) children aged 0-60 months with a z-score <-2 SD (PERMEN-KES, 2020).

Low birth weight is associated with stunting in children under five years of age and overall body weight is strongly associated with long-term growth and development. As a result, long-term effects of LBW can manifest as growth failure (grout faltering). Early growth delay will be difficult to catch up in infants born with LBW. The growth of a child who lags behind normal growth will cause the child to experience stunting (Sukmawati et al., 2018).

Stunting is a process that does not occur easily and takes a long time to experience stunting, meaning that stunted children are more likely to suffer from disease, stress, and lack of food intake and care during their fastest growth and brain development (Sukmawati et al., 2018). Low birth weight has a direct relationship with stunting and is more likely to experience stunting than toddlers with normal birth weight. This is related to maternal health and nutritional status during pregnancy, which affects the size of the baby (Abeway et al., 2018).

This research is also in line with research conducted by Dake et al. (2019), the results showed that toddlers who had a history of birth with low birth weight were the cause of stunting, in Indonesia, toddlers who had a history of low birth weight increased the risk of stunting by 5.9 times compared to children born with normal weight (Lukman et al., 2021). Low birth weight toddlers are markers that contribute significantly to the factors that cause stunting in children (Santosa et al., 2022).

Based on the explanation above, researchers are interested in conducting research using a systematic review and Meta-Analysis approach to investigate relevant epidemiological studies to assess the relationship between LBW and the incidence of stunting in children under five. A study with a large population is very much needed to find out whether there is a relationship between LBW and the incidence of stunting, even more so until now the author has not found any research using the Meta Analysis approach with that title.

SUBJECTS AND METHOD

1. Study Design

This study uses a systematic review and meta-analysis using secondary data, namely data from the results of previous studies. Search articles using 3 databases, namely: Pubmed, Google Scholar and Springerlink published in 2017-2022. This is done by using the following keywords: “Low birth weight AND Stunted OR Birth weight AND Stunted”.

2. Steps of Meta-Analysis

Meta analysis is carried out through 5 steps as follows:

a. Formulate research questions in PICO format (Population, Intervention, Comparison, Outcome).

b. Search for primary study articles from various databases (Google Scholar, Pubmed and Springerlink).
c. Conducting critical appraisal (Critical appraisal).
d. Perform data extraction and enter the estimated effect of each primary study into the RevMan 5.3 application.
e. Interpret the results and draw conclusions.

The critical criteria assessment was carried out by two independents using the Checklist for critical appraisal of a cross-sectional study (Survey) sourced from the Center for evidence-based management (CEBMa) (2014) which consisted of 11 questions, the questions were answered by providing score 0: no, 1: not clear and 2: yes. Primary studies are carried out if the total score is at least 10, then input into RevMan.

3. Inclusion Criteria

The inclusion criteria in this study included articles with a cross sectional study design, full text available articles, the results of the analysis used adjusted odds ratio (aOR), the year the article used was in the 2017-2022 range and the research outcome was stunting.

4. Exclusion Criteria

Exclusion criteria in this study included not clearly describing the results, year of publication >5 years, different interventions and populations, paid or locked articles and analysis results not using the aOR (adjusted odds ratio).

5. Operational Definition of Variable

The search for articles was carried out by considering the eligibility criteria determined using the PICO model. The population of this study were toddlers, the intervention used was low birth weight, the comparison in this study was normal birth weight and stunting outcome.

LBW is a condition of newborns less than 2500 g caused by iron deficiency and complications during pregnancy, including premature neonates, neonates small for term gestational age, and a mixture of these two conditions that require special treatment to achieve the expected weight and reduce the risk of stunting.

Stunting is a condition of failure to thrive in toddlers with a z-score <-2 for HFA (height for age).

6. Instrument

The instrument in this study is a published article that analyzes the relationship between LBW and the incidence of stunting in toddlers. This study was conducted using a checklist for critical assessment of cross-sectional studies (surveys) sourced from the Center for evidence-based management (CEBMa) (2014).

7. Data Analysis

The research that has been collected is selected according to the criteria that have been set then the results of the research will be analyzed based on variations between studies with the fixed effect model analysis model and the random effects model using Revman 5.3 software. issued by the Cochrane collaboration. Revman software functions to calculate the overall OR value by describing the 95% Confidence Interval (CI) using the effects model and also the heterogeneity of the data.

RESULTS

Research on the relationship between low birth weight and stunting includes 11 articles from Rwada, Nepal, Ethiopia, East Kenya, Pakistan, China, Indonesia and Tanzania. The article review process can be seen in the article search flow using the PRISMA flow diagram as follows:

The search for articles for this study was conducted during where the researchers used article searches using the pubmed, springerlink and google scholar databases using keywords related to low birth weight

and stunting, the researchers set limits for article searches for this study, namely the period 2017-2022, where researchers get research articles not only in Indonesia but also throughout the world with the limitation of articles in English.

Searching articles for this study, researchers obtained 416 articles which were then selected in the PRISMA flow diagram in Figure 1. The initial article search process obtained 416 articles, then selected by removing duplicate data issued as many as 26 articles, then 390 articles that were successfully filtered met the requirements. to do a full text review that is included in the exclusion criteria because the article does not include AOR, Intervention is not LBW and Outcome is not stunting.

The final results of the articles filtered using the PRISMA flow diagram obtained 18 articles that were eligible for a qualitative systematic review. Then the 18 articles were reviewed using the Checklist for critical appraisal of a cross-sectional study (Survey) sourced from the Center for evidence-based management (CEBMa) (2014) which obtained 11 articles. The articles included in the quantitative systematic review (meta-analysis).

This study uses a checklist for critical assessment of cross-sectional studies (surveys). This assessment criteria consists of 12 question criteria with each given a score of 2 = if you answer yes, 1 = if you don't know, and 0 = if you answer no. This analysis comes from different populations. Thus, the estimation uses a random effects model.

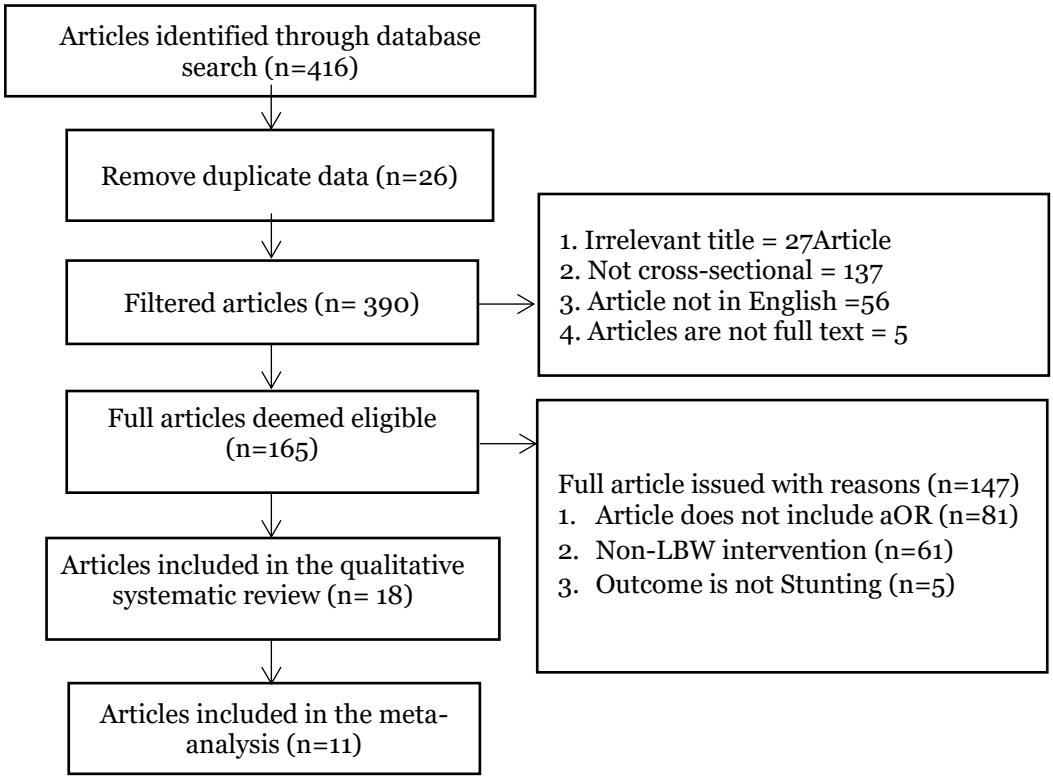

Figure 1. PRISMA Flowchart

Table 1. Critical Appraisal Checklist for Cross-Sectional study (CEBM)

No	Indicator	Author and Year										
		Ahisyakiye et al. (2019)	Ardikari et al. (2020)	Badriyah et al. (2017)	Farah et al. (2021)	Gonetel et al. (2020)	Guyatt et al. (2020)	Khan et al. (2019)	Li et al. (2022)	Makori et al. (2018)	Mtongwa et al. (2021)	Sartika et al. (2021)
1	Does the study address clearly focused questions/problems?	2	2	2	2	2	2	2	2	2	2	2
2	Is the research method (research design) appropriate to answer the research question?	2	2	2	2	2	2	2	2	2	2	2
3	Is the subject selection method clearly explained?	2	2	2	2	2	2	2	2	2	2	2
4	Can the way in which the sample is obtained give rise to selection bias?	2	2	2	2	2	2	2	2	2	2	2
5	Is the sample of subjects representative of the population to which the findings will be referred?	2	2	2	2	2	2	2	2	2	2	2
6	Was the sample size based on pre-study considerations of statistical power?	2	2	2	2	2	2	2	2	2	2	2
7	Was a satisfactory response rate achieved?	2	2	2	2	2	2	2	2	2	1	2
8	Are questionnaire measurements possible valid and reliable?	2	2	2	2	2	2	2	2	2	1	2
9	Was statistical significance assessed?	2	2	2	2	2	2	2	2	2	0	2
10	Is a confidence interval given for the main outcome?	2	2	2	2	2	2	2	2	2	2	2
11	Could there be a confounding factor that hasn't been noted?	2	2	2	2	2	2	2	2	2	2	2
12	Can the results be applied in your organization?	2	2	2	2	2	2	2	2	2	2	2
	Total	24	24	24	24	24	24	24	24	24	20	24

Note: Ya= 2; Not tell= 1; No= 0

Table 2. Description of Primary Studies included in the meta-analysis.

No	Author (Year)	Country	Study Design	Sample	Population (P)	Intervention (I)	Comparison (C)	Outcome (O)	aOR (95 % CI)
1	Ahisyakiye et al. (2019)	Rwanda	Cross-sectional	884	Children aged 24-36 months obtained secondary data from two studies conducted in rural communities in 11 of 30 districts in Rwanda with anthropometric measurements	Babies born weighing under 2.5kg or LBW	Babies born with normal weight	Stunting	1.68 (0.75-3.78)
2	Ardikari et al. (2020)	Nepal	Cross-sectional	5083	Children aged between 24-59 months using data from the 2006 NDHS, 2011, and 2016 with interviews and anthropometric measurements	The size of the child at birth is less than 2500gram or LBW	Size of the child at birth with an average weight or greater	Stunting	1.60 (1.25- 2.04)
3	Badriyah et al. (2017)	Indonesia	Cross-sectional	9.688	Children under the age of 2 years from 33 provinces of Indonesia using secondary data from Research	Children born with low birth weight or less than 2500g.	Children born with normal birth weight	Stunting	2.03 (1.72- 2.41)
4	Farah et al. (2021)	Ethiopia	Cross-sectional	8714	Indonesian Basic Health conducted in 2013 and anthropometric measurements.	Child size at birth is small or low birth weight less than 2500g.	The size of the child at birth with an average normal birth weight or more than the average	Stunting	1.73 (1.52-1.97)
5	Gonetel et al. (2020)	Ethiopia	Cross-sectional	422	Children under 5 years old used a data collection from the EDHS from 2016 using a questionnaire and anthropometric measurements.	Babies born with small weight for gestational age (SGA) or LBW	Babies born with a weight according to gestational age or normal birth weight	Stunting	3.15 (1.64-6.06)
6	Guyatt et al. (2020)	Kenya Timur	Cross-sectional	1062	Live newborns born at the Gondar University Comprehensive Special Referral Hospital in 2019 and during the study period using a face-to-face interview-based questionnaire and anthropometric measurements.	Birth weight less than 2500g	Normal birth weight	Stunting	4.93 (2.85-8.53)

No	Author (Year)	Country	Study Design	Sample	Population (P)	Intervention (I)	Comparison (C)	Outcome (O)	aOR (95 % CI)
7	Khan et al. (2019)	Pakistan	Cross-sectional	3071	Children aged 0-23 months were taken from those who met the inclusion criteria	Child size at birth smaller than average or less than 2500g	Body size at birth average or larger	Stunting	1.48 (1.02-2.16)
8	Li et al. (2022)	Hunan, Cina	Cross-sectional	5529	(CT-OVC recipients) obtained through face-to-face interviews with caregivers and anthropometric measurements.	Birth weight less than 2500g.	Normal birth weight	stunting	3.44 (2.23-5.31)
9	Makori et al. (2018)	Tanzania	Cross-sectional	394	Children aged 0-59 months using secondary survey data from PDHS 2012-2013, with interviews and anthropometric measurements.	Birth weight less than 2500g	Normal birth weight	Stunting	0.1 (0.01-0.9)
10	Mtongwa et al. (2021)	Tanzania	Cross-sectional	15.238	Children aged 0-60 months from the Hunan countryside were studied between August and November 2019 using a questionnaire and anthropometric measurements.	Low birth weight less than 2500g	Normal birth weight	Stunting	2.40 (1.80-3.20)
11	Sartika et al. (2021)	Indonesia	Cross-sectional	559	Children aged 6-23 months using socio-demographic data with a structured questionnaire that has been tested previously.	Infants with low birth weight less than 2500g	Normal birth weight	stunting	4.11 (1.71-9.91)

Figure 2. Map of Research Locations in LBW

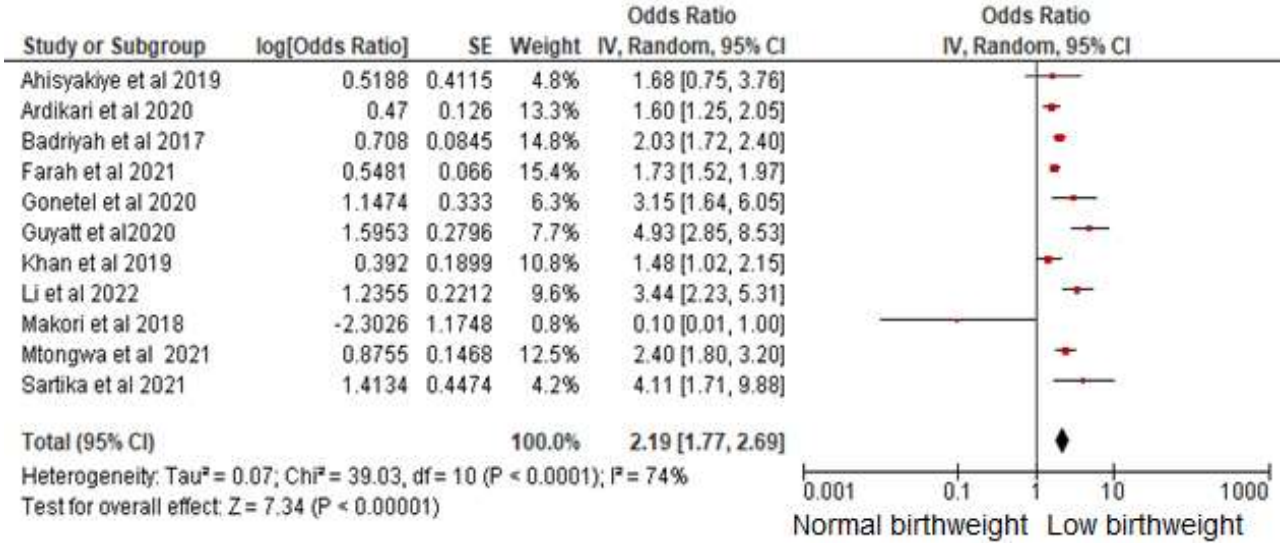

Figure 3. Forest plot of the relationship between LBW and the incidence of stunting in toddlers

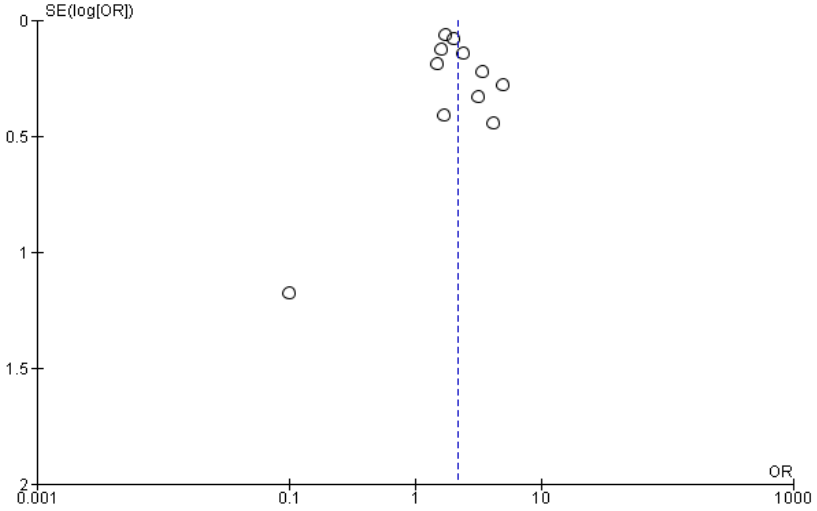

Figure 4. Funnel plot of the relationship between LBW and the incidence of stunting

Figure 4 shows that the distribution of effect estimates tends to be more located on the left of the average vertical line of effect estimates than on the right. Thus, this funnel plot shows the existence of publication bias. Because the distribution of the estimated effect lies to the left of the mean vertical line, which is opposite to the diamond shape in the forest plot image, the publication bias tends to increase the effect of LBW on the actual risk of stunting in children under five (underestimate).

A total of 5 plots are on the left with SE values ranging from 0 to 1.5, a total of 4 plots are on the right, and 2 plots touch the vertical line with a range of 0 to 0.5.

Figure 3 shows the relationship between LBW and the incidence of stunting in toddlers, where toddlers with a history of LBW births have a 2.19 times risk of experiencing stunting compared to toddlers with a history of normal birth weight (aOR= 2.19; 95% CI= 1.77 to 2.69), and statistically significant $p < 0.001$. Statistical heterogeneity among studies was I^2= 74% indicating a heterogeneous distribution of data (random effect model).

DISCUSSION

Meta-analysis is a type of epidemiological study in which results from different independent primary studies are combined statistically on the same test and in the same way to obtain quantitative results. The steps in the meta-analysis followed normal research procedures. The researcher first selects the research problem of the current study, then collects and analyzes the data and finally reports the findings (Murti, 2018).

In the cross-sectional study of previous primary studies used in this study, it was explained that these primary studies were obtained from the results of socio-demographic surveys, from secondary TDHS data, face-to-face interviews using structured questionnaires conducted on caregivers and mothers of toddlers. accompanied by anthropometric measurements of height according to age to measure and determine the occurrence of stunting in children. In addition, the independent variable analyzed in this study was LBW.

This research was processed using the RevMan 5.3 application, then the results in this meta-analysis were presented in the form of forest plots and funnel plots. Forest plots show visually the magnitude of variation (heterogeneity) between study results.

Forest plots are usually used to display epidemiological data which are often used in systematic reviews to summarize the results of previously published studies (Murti, 2018).

While the funnel plot shows the effect size of the study and the sample size or standard error of the effect sizes of various studies. Then the diagram showing the symmetrical plot position shows no publication bias (Murti, 2018).

This study uses a random effect statistical model because the heterogeneity in this study was I^2 = 74%, which means the heterogeneity in this study is high, besides that it can also be interpreted that there are studies used in this study from populations from different countries. These include Rwanda, Nepal, Ethiopia, eastern Kenya, Pakistan, China, Indonesia and Tanzania. In addition to the population of different countries, heterogeneity in this study is influenced by the size and age of the sample used in this study, which is shown to be a $p < 0.05$.

The results of a meta-analysis of the relationship between LBW and the incidence of stunting in children under five showed that there was a relationship between LBW and the incidence of stunting. Toddlers who have a history of being born with low birth weight have a 2.19 times risk of experiencing stunting compared to toddlers who

have a history of birth with normal birth weight (aOR= 2.19; 95% CI= 1.77 to 2.69; p<0.001). The results of this study are supported by research from Dwijayanti et al (2020) which states that toddlers born with a history of low birth weight have a 4.47 times greater risk of stunting than toddlers with normal birth weight.

The results of this study also indicate the existence of publication bias which can be seen in the funnel plot in Figure 4.4 which shows that the distribution of effect estimates tends to be located on the left of the average vertical line of effect estimates than on the right. Thus, this funnel plot image shows the existence of publication bias. Because the distribution of the estimated effect lies to the left of the average vertical line, which is opposite to the diamond shape in the forest plot image, the publication bias tends to increase the effect of LBW on the actual risk of stunting in children under five (underestimate).

LBW is the proportion of live births with birth weight less than 2500 grams. In addition, the prevalence of low birth weight (LBW) is currently 15.5 percent, making it a major public health problem per year (Guruge et al., 2017). The results of this study are also in line with research conducted by Mtongwa et al (2021) where babies born with low birth weight have twice the chance of experiencing stunting. LBW can cause stunting because babies born with LBW have intrauterine growth retardation, which can last until the next age after birth and cause slower growth and development than babies born normally and often result in a growth rate that is less than what should be achieved at the age of 15. after birth (Novianti et al., 2020). Besides the result from a low body weight, the body experiences a reduction in nutrients, which to meet the body's needs use the stored nutrients. If this condition lasts for a long time, the supply of nutrients in the body will run out which will eventually cause the tissue to deteriorate, hemoglobin levels fall, serum levels of vitamin A and carotene, as well as increased lactic and pyruvic acids, at this stage the child is said to be stunted (Nainggolan et al., 2019).

Based on several statements made by several researchers who have conducted previous studies regarding LBW with normal birth weight comparisons in accordance with research conducted by researchers that LBW has a relationship with the incidence of stunting in toddlers. With the increase in studies examining the relationship between LBW and the incidence of stunting in children under five, if it can help experts in taking some policies and prevention according to the right theory or foundation.

AUTHOR CONTRIBUTION

Diana Ode is the principal researcher who selects the topic, searches for and collects research data.

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This study is self-funded.

CONFLICT OF INTERESTS

There is no conflict of interest in this study.

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