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Meta Analysis

Correlation between Low Birthweight and Underweight in Children Under Five: A Meta-Analysis

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ABSTRACT

Background: Underweight among children results in growth disorders, and stunting. The study aims to determine the correlation between low birthweight and underweight in children under five based on primary studies previously conducted.
Subjects and Method: This study used a meta-analysis study with PICO as follows: P=chidren under five, I= low birthweight, C= normal birthweight, O= underweight. The search for articles in this study used databases, namely Pubmed, Google Scholar, and Springerlink. The article search used the following keywords: Low birth weight AND underweight OR underweight toddler AND low birthweight. The articles were analyzed by using Review Manager 5.3.
Results: There were 9 articles from Ghana, Bangladesh, East Kenya, Pakistan, Malawi, China, Ethiopia, and Rwanda from 2017-2022 analyzed by using PRISMA flow diagrams. These results indicated that children under five with a history of low birthweight had 2.21 times risk of being underweight compared to children under five who had a history of normal birthweight (aOR= 2.21; CI 95% = 1.96 to 2.49; p<0.001).

Conclusion: children under five with low birthweight history are at risk of being underweight.

Keywords: low birthweight, underweight, children under five, meta-analysis.

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BACKGROUND

Underweight among children under the age of five is one of the most common nutritional problems among toddlers today. Underweight affected 6.7% of children under the age of five worldwide in 2019 or about 45.4 million children under five.

Compared to the underweight figure in 2017 of 16.3%, however, the number of underweights decreased. South Asia is the region that has the highest percentage reaching 14.7%. The West and Central Africa regions rank second with 7.2% of underweight in children under five. Followed by the Middle East and North Africa regions with 6.3%. The percentage of underweight in children in the East and South Africa regions was recorded at 5.3%. Come after was the East Asia and Pacific region with 3.7% and the Eastern European and Central Asia

regions with 1.9%. Meanwhile, in Latin America and the Caribbean, 1.3% of children suffer from underweight (UNICEF, 2020).

A history of low birthweight is also a factor that can influence the incidence of malnutrition. It is because babies with low birthweight will experience complications of diseases due to immature organs, causing impaired physical growth and nutritional disorders during toddlerhood. Babies with low birthweight will grow and develop more slowly because babies with low birthweight have experienced intrauterine growth restriction and experience slower growth organs development in the womb and it will continue to their childhood. Low birthweight babies also experience digestive disorders such as malabsorption of fat and protein, resulting in nutritional deficiency - (Oktavia *et al.,* 2017).

Underweight is a disorder when children under the age of five fail to thrive because of chronic malnutrition, resulting in the child being too short for his age. Malnutrition occurs from the fetal stage during pregnancy to the first days after birth, but underweight does not occur until the age of two (TNP2K, 2017). Underweight is defined as a toddler with a length/height-for-age of children aged 0 - 60 months with a z-score of <- 2 SD (PERMENKES, 2020).

Low birthweight is associated with underweight in children under five and overall body weight is strongly associated with long-term growth and development. As a result, the long-term effects of low birthweight may manifest as faltering growth. Delays in early growth will be difficult to catch up in infants born with low birthweight. A child who grows below normal growth will lead to stunting (Sukmawati et al., 2018).

Infants with low birthweight are more likely to remain underweight during childhood. On the other hand, the correlation between low birthweight and child malnutrition may be explained by the increased susceptibility of children with low birthweight to infections, such as diarrhea, and lower respiratory infections, and increased risk of complications including sleep apnea, jaundice, anemia, chronic lung disorders, fatigue and loss of appetite compared to children born with normal birthweight (Rahma *et al*, 2016). Low birthweight has a direct association with underweight because low birthweight is the main risk of underweight and has four to five times risk in this study. If underweight is not treated immediately, it may generate illness or if not immediately treated with medication and nutritious feeding it will lead to diarrhea. In addition, toddlers will experience underweight, weakness, reduced immune system up to a chronic condition and it may end in mortality (Renyoet and Nai, 2019).

Based on the explanation above, the researcher was interested in conducting a study by using a systematic review and Meta-Analysis approach to investigate relevant epidemiological studies to assess the correlation between low birthweight and the incidence of stunting in toddlers. Studies with large populations are needed to find out whether there is a correlation between low birthweight and underweight incidences, moreover, until recently author had not found any study that used Meta-Analysis approach under this title.

SUBJECTS AND METHOD

1. Study Design

The study used a systematic review and meta-analysis with secondary data, which means the data were taken from the results of previous studies. The article search was conducted by using 3 databases, namely: PubMed, Google Scholar, and SpringerLink, published in the period of 2017-2022. The search was conducted by using the following keywords: "Low birthweight AND Under-

weight OR Birthweight toddler AND Underweight".

2. Stages of Meta-analysis

Meta-analysis was conducted through five steps as follows:

a. Formulate research questions in PICO format (Population, Intervention, Comparison, Outcome).
b. Search for primary study articles from a wide variety of electronic databases including Google Schoolar, SpringerLink, PubMed, and Non-electronic databases.
c. Conduct screening and critical assessment (Critical Appraisal) toward primary study articles.
d. Perform data extraction and synthesis of effects by using RevMan 5.3.
e. Interpret and sum up the results.

3. Inclusion Criteria

The inclusion criteria in this study included articles with cross-sectional study design, articles available in full text, the results of the analysis were presented in adjusted odds ratio (aOR), the articles were published between 2017 and 2022 and the outcome of the studies was underweight.

4. Exclusion Criteria

The exclusion criteria in this study included did not clearly describe the results, the year of publication >5 years, interventions and populations carried out differently, paid or locked articles, and the results of the analysis were not presented in aOR (adjusted odds ratio).

5. Operational Definition of Variables

The search for articles was carried out by assessing eligibility criteria determined by using the PICO model. The population of this study was children under five years of age, the intervention used was low birthweight, the comparison in this study was normal birthweight and the outcome was underweight.

Low Birthweight was a state of newborns weighing less than 2,500 g generated by iron deficiency and complications during pregnancy, including premature neonates, small neonates for a fairly month of gestation, and a combination of these two circumstances that require special treatment to achieve the expected weight and reduce the risk of underweight.

Underweight was the body weight of children under five that was below the average weight.

6. Instrument

The instrument in this study was published articles that analyzed the correlation between low birthweight and underweight in toddlers. This study was conducted by using checklists for the critical review of cross-sectional studies (surveys) sourced from the Center for evidence-based management (CEBMa) (2014).

***7.* Data Analysis**

The collected studies were screened by using the determined criteria, subsequently, the studies' results were analyzed based on variations between studies with a fixed effect model and a random effect model by using revMan 5.3 software issued by Cochrane collaboration. RevMan software serves to calculate the overall OR value by describing the 95% of Confidence Interval (CI) by using the effect model and the heterogeneity of the data.

RESULTS

The search for articles for this study was carried out online in which researchers used pubmed, springer-link, and google scholar databases by using keywords related to low birthweight and underweight. Researchers set limitations for the article search of this study, such as between the period of 2017-2022, not restricted only in Indonesia but also around the world with a qualification only articles in English.

The article search of the study obtained 373 articles subsequently screened out in

the PRISMA flow diagram as shown in figure 1. The initial article search obtained 373 articles and subsequently screened out by removing duplicated data with 53 excluded articles. 320 articles were successfully screened to meet the criteria for the full-text review. Some of the articles met exlusion criteria since they did not state aOR, the intervention was not low birthweight, and the outcome was not underweight.

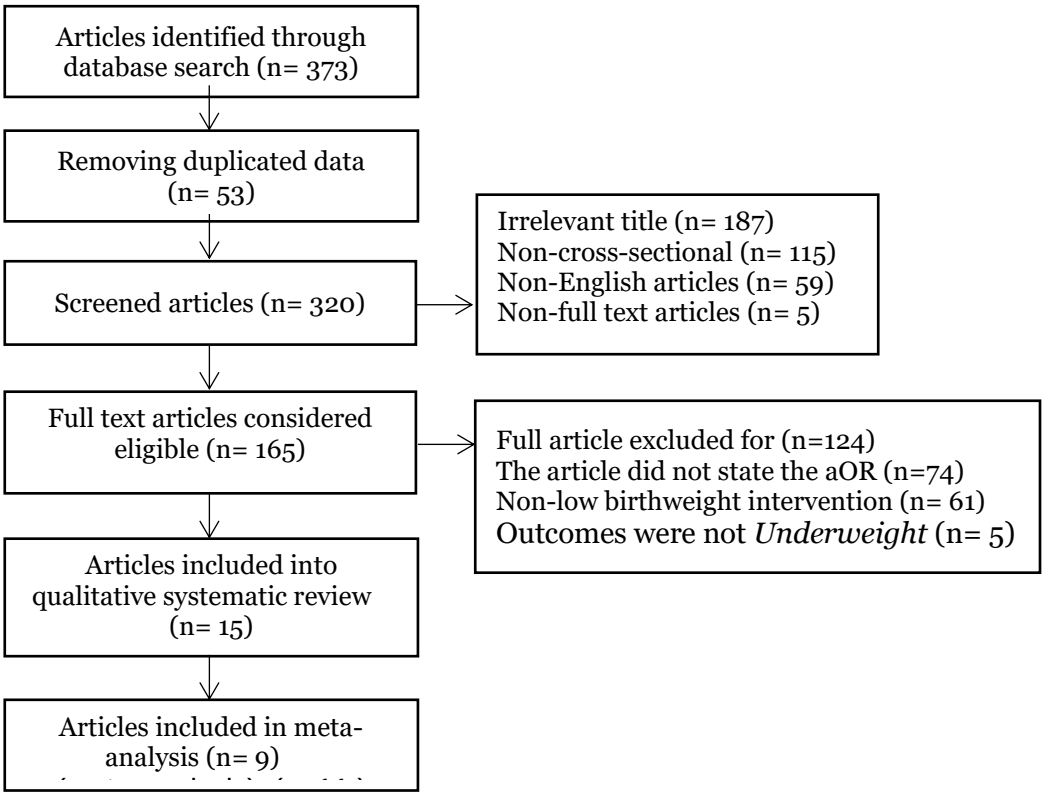

Figure 1. PRISMA flow diagram

Figure 2. Map of Research Locations of low birthweight correlation studies

This study used checklists for the critical assessment of cross-sectional studies (surveys). The criteria for this assessment consisted of 9 questions criteria, each was

given a score of 2= for answering "yes", 1= for answering "do not know", and 0= for answering "no". Thus, the estimation used the random effect model. Figure 2 shows the correlation between low birthweight and the incidence of underweight in children under five in which children under five with a low birthweight history had 2.21 times risk of underweight compared to children under five with normal birthweight history.

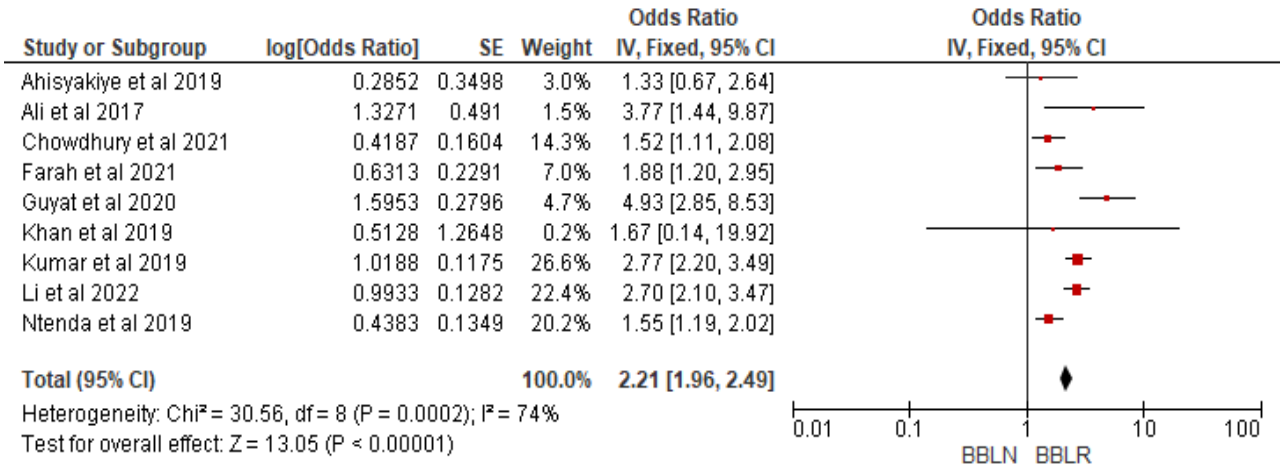

Figure 2. Forest plot of correlation between low birthweight and underweight incidences in children under five

The final result of the articles screened by using PRISMA flow diagram was 9 articles that met the qualification of the qualitative systematic review. Subsequently, the 9 articles were reviewed by using the Checklist for critical appraisal of a cross-sectional study sourced at the Center for evidence-based management (CEBMa) (2014) in which 11 articles were obtained and included in the quantitative systematic review (meta-analysis).

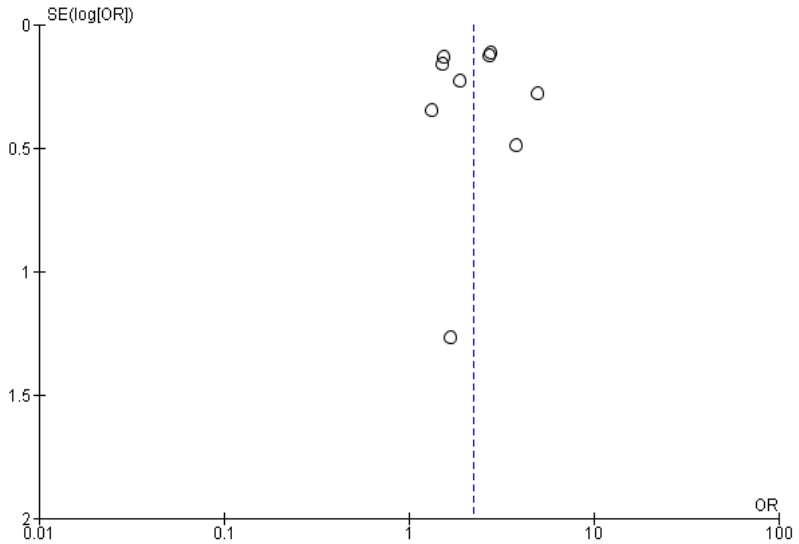

Figure 4. Funnel plot of relationship between low birthweigth and underweight

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

No.	Indicator	Author and Year								
		Ali et al. (2017)	Choddbury et al. (2021)	Guyatt et al. (2020)	Khan et al. (2019)	Ntenda et al. (2019)	Kumar et al. (2019)	Li et al. (2022)	Farah et al. (2021)	Ahisyakiye et al. (2021)
1	Did the study address a clearly focused question/problem?	2	2	2	2	2	2	2	2	2
2	Was the study method (study design) appropriate to answer the research question?	2	2	2	2	2	2	2	2	2
3	Was the method of the selection of the subjects clearly explained?	2	2	2	2	2	2	2	2	2
4	Could the way the samples obtained lead to selection bias?	2	2	2	2	2	2	2	2	2
5	Did the sample of subject represent the population to which the findings would be referred?	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
7	Was a satisfactory response rate achieved?	2	2	2	2	2	2	2	2	2
8	Were the questionnaire measurements possible and reliable?	2	2	2	2	0	1	2	2	1
9	Was statistical significance assessed?	2	2	0	2	0	0	2	2	2
10	Was the confidence interval given for the main result?	2	2	2	2	2	2	2	2	2
11	Is it possible there were unrecorded intruding factors?	2	2	2	2	2	2	2	2	2
12	Can the results be implemented in your organization?	2	2	2	2	2	2	2	2	2
	Total	24	24	22	24	20	21	24	24	23

Description: Yes=2; Hesitation= 1; No= 0

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

Authors (Years)	Countries	Study Design	Sampel	Population (P)	Intervention (I)	Comparison (C)	Outcome (O)
Ali et al (2017)	Ghana	Cross-sectional	4,047	Children between the age of 6-59 months.	Low birthweight (<2.5kg)	Normal birth-weight (≥2.5 kg)	Underweight
Chowdhury et al (2021)	Bangladesh	Cross-sectional	7,661	Children under 5 years old	Low birthweight (<2.5kg)	Normal birth-weight (≥2.5 kg)	Underweight
Li et al (2022)	Hunan, China	Cross-sectional	5,529	Children aged 6-23 months	Low birthweight (<2.5kg)	Normal birth-weight (≥2.5 kg)	Underweight
Kumar et al (2019)	Pakistan	Cross-sectional	24,042	Children under the age of 5 years	Low birthweight (<2.5kg)	Normal birth-weight (≥2.5 kg)	Underweight
Guyyat et al (2020)	Kenya	Cross-sectional	6,033	Children under the age of 5 years	Low birthweight (<2.5kg)	Normal birth-weight (≥2.5 kg)	Underweight
Ntenda et al (2019)	Malawi	Cross-sectional	6,033	Children under the age of 5 years	Low birthweight (<2.5kg)	Normal birth-weight (≥2.5 kg)	Underweight
Khan et al (2019)	Pakistan	Cross-sectional	3,071	Children aged 0-59 months	Low birthweight (<2.5kg)	Normal birth-weight (≥2.5 kg)	Underweight
Farah et al (2021)	Ethiopia	Cross-sectional	8,714	Children under the age of 5 years	Low birthweight (<2.5kg)	Normal birth-weight (≥2.5 kg)	Underweight
Ahisyakiye et al (2019)	Rwanda	Cross-sectional	445	Children aged 0-36 months	Low birthweight (<2.5kg)	Normal birth-weight (≥2.5 kg)	Underweight

RESULT

Figure 3 shows that the distribution of effect estimates was more likely to be on the left hemisphere of the vertical line of the average estimated effect than on the right. Therefore, this plot funnel indicated the presence of a publication bias. Because the distribution of these effect estimates was located in the left hemisphere of the average vertical line, which was in the opposite direction to the diamond shape in the forest plot image, the publication bias was more likely to increase the effect of low birth weight toward the risk of actual underweight in children under five (underestimate).

DISCUSSION

Meta-analysis is a type of epidemiological study in which the results of various independent primary studies are statistically combined in the same test and utilizing the same method to obtain quantitative results. The steps in the meta-analysis follow the normal research procedure. Researchers first select the current study problems, then collect and analyze the data and eventually report the findings (Murti, 2018).

In cross-sectional studies in previous primary studies used in this study, it was explained that the primary studies were obtained from the results of socio-demographic surveys, from TDHS secondary data, face-to-face interviews using structured questionnaires conducted on caregivers and mothers of children under five supplemented by anthropometric measurements of height for age to measure and find out the occurrence of underweight in children. In addition, the independent variable analyzed in this study was low birthweight.

The data processed by using the RevMan 5.3 application, then the results in this meta-analysis study were presented in the form of forest plots and funnel plots. Forest plots visually estimate the magnitude of the variation (heterogeneity) between the study results. Forest plots are typically used to display epidemiological data that are often used in systematic reviews to summarize the results of previously published studies (Murti, 2018).

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

This study used a random effect statistical model because the heterogeneity obtained in this study was I^2= 74% which meant that the heterogeneity in this study was high, in addition, it could also be interpreted that the studies used in this study came from populations of different countries including Ghana, Bangladesh, East Kenya, Pakistan, Malawi, China, Ethiopia and Rwanda. In addition to the population of different countries, the heterogeneity in this study was influenced by the size and age of the sample used in this study which was shown in the value of $p<0.05$.

The results of a meta-analysis study on the correlation between low birthweight and underweight incidences in children under five showed that there was a correlation between low birthweight and underweight incidences. Children under five with who low birthweight history had a 2.21 times risk of being underweight compared to children under five with normal birthweight (aOR= 2.21; CI 95%= 1.96 to 2.49; $p<0.001$). The results of this study are supported by a study by Dwijayanti et al (2020) which shows that children under five born with history of low birthweight have a 4.47 times greater risk of underweight than children under five with normal birth weight.

The results of this study also show the

occurrence of a publication bias which could be seen in the plot funnel in figure 4.4 in which the figure showed that the distribution of effect estimates was more likely to be located on the left side of the vertical line of the average estimated effect than on the right. Thus, this plot funnel image indicated the occurrence of publication bias. Because the distribution of these effect estimates was located to the left of the average vertical line, which was in the opposite direction to the diamond shape in the forest plot image, the publication bias was more likely to increase the effect of low birthweight risk of actual underweight incidences in children under five (underestimate)

Low birthweight is the proportion of live births with a body weight at birth less than 2500 grams. In addition, the prevalence of low birth weight is currently 15.5 percent, each year being a major public health problem (Guruge et al., 2017). The results of this study are also in line with a study conducted by Mtongwa et al (2021) that states infants born with low birthweight have twice as high chance of stunting. Low birthweight may cause stunting because infants born with low birthweight experience intrauterine growth retardation, which can last until the subsequent ages after birth and cause slower growth and development than infants born with normal birthweight and often result in inadequate growth for their age (Novianti et al., 2020).

Furthermore, as the result of lacking body weight, the body experiences a reduction in nutrients, since to meet the needs, the body uses nutrients that have been absorbed. If this condition lasts for a long time, nutrients supplies in the body will be depleted which will eventually cause the tissue to deteriorate, declined hemoglobin levels, serum levels of vitamin A and carotene, as well as increased lactic acid and pyruvic acid, at this stage the child is stated to be underweight (Nainggolan et al., 2019).

Several statements stated by several researchers who have conducted previous studies on low birthweight with normal birth weight as the comparison are in line with the study conducted by the researcher that low birthweight has a correlation with the incidence of underweight in children under five. With the escalating numbers of studies that investigate the correlation between low birthweight and the incidence of stunting in children under five, it is expected to help experts in taking several policies and preventions according to the right theory or foundation.

AUTHOR CONTRIBUTION

Adilla Misi Nurfitris was the main researcher who selected topics, searched and collected study data. Setyo Sri Raharjo and Hanung Prasetya analyze and checking in this manuscript.

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This study was self-funded.

CONFLICT OF INTERESTS

There is no conflict of interest in this study.

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