



The Effect of Stunting on Children's Cognitive Development : Systematic Review

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<p>Track Record Article</p> <p>Accepted : 29 Maret 2023 Received : 12 April 2023 Published : 30 April 2023</p> <p>How to cite : Rambe, N. L., Hutabarat, E. N., & Hafifah, R. (2023). The Effect of Stunting on Children's Cognitive Development : Systematic Review. <i>Contagion : Scientific Periodical of Public Health and Coastal Health</i>, 5(2), 360-372</p>	<p style="text-align: center;"><i>Abstract</i></p> <p><i>The term stunting refers to an intellectual disorder characterized by mental abilities that reflect past nutritional status and a decline in development in children caused by chronic malnutrition. This can lead to stunted growth in children. Which can have a negative impact on the physical and mental development of children and subsequent learning abilities. Stunting is caused by various interacting factors, including poor sanitation and various other factors related to health, but the main cause is inadequate diet (total calories and essential nutrients), especially in the first 1,000 days. Malnutrition is an important determinant of maternal and child health, with significant negative effects on children's brain and cognitive development. This criterion uses original articles published in English and Indonesian. Articles published within the last 10 years. The review method uses a systematic review using PRISMA (Preferred Reporting Item for Systematic Review and Meta-analysis) with Systematic Review obtained from the Pubmed database, Scient direct, Wiley. This study went through four stages, namely identification, screening, feasibility and results received. This is so that the problem of stunting in children's cognitive development can be solved.</i></p> <p>Keywords: <i>Child, Development cognitive, Stunting</i></p>
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INTRODUCTION

The term stunting refers to an intellectual property disorder characterized by the mental ability to describe nutritional status associated with the past and developmental delays in children caused by chronic malnutrition (Bharti et al., 2019). Lack of protein energy in early childhood can hinder the structural and functional development of the brain and affect cognitive function. The impact of early developmental delay on deficits Cognitive abilities can persist throughout life and are hereditary (Balehegn et al., 2019). Evidence suggests that cumulative exposure to psychosocial adversity in early-life experiences includes child abuse. This can lead to stunted growth in children, which can have a negative impact on the child's physical and mental development and further learning abilities (Gage, 2013 ; Syahputri, 2023).

Malnutrition is an important determinant of maternal and child health, with significant negative impacts on brain development and children's condition (Bassouni et al., 2022). Stunting is caused by various interacting factors, including poor sanitation and various other

factors related to health, but the main cause is inadequate diet (total calories and essential nutrients), especially in the first 1,000 days. Treatment remains challenging especially in cblC deficiency (Aguilera Vasquez & Daher, 2019). A child's development depends on a variety of interacting factors including genetics, individual (eg, temperament and personality), biological (eg, health and nutritional status), environmental (eg, stimulation, quality of mother-child interaction), and cultural influences (access to to education) (Roberts et al., 2020). Therefore, the general focus on reducing stunting reflects a growing understanding of the importance of malnutrition and its long-term consequences during childhood, the most critical period of development (Shrestha et al., 2022).

In the 2019 edition of *The State of the World's Children*, the United Nations Children's Fund (UNICEF) categorizes malnutrition in children into three categories: (1) Malnutrition causes wasting and stunting, (2) Outcomes of adverse health effects such as hidden hunger (3) Overweight and obesity (Acharya et al., 2019). Early childhood development (PAUD) consists of physical, sensorimotor, social, emotional, language and cognitive aspects (Aiga et al., 2019). Therefore, the fetal stage until the age of 3 years is very important for growth, because 80% of the total brain weight is formed at this age (Hargreaves et al., 2022).

Several studies have documented the relationship between cognitive abilities and stunting in young children, but few have explored it in school-age children, although this is important as a determinant of human capital formation, micronutrient deficiencies, especially anemia, are still widespread in many countries (B. J. Akombi et al., 2017). However, the brain undergoes tremendous growth starting from early in pregnancy and continuing into the postnatal period (Perignon et al., 2014). There is some evidence that early life impacts on health are partially reversible, supporting the view that efforts to address child nutrition can reverse, or at least reduce, some of the effects of early malnutrition (Gashu et al., 2015). nutritional deficiencies for lifelong cognitive development. In humans, brain development occurs primarily in the womb and during the early infancy, and nutrition during this period may be important for normal development and further cognition (Montenegro et al., 2022).

Stunting is a growth and development disorder experienced by toddlers which causes stunted growth in children who are not up to standard so that it has a positive impact both short and long term (Shifera et al., 2022). We hypothesized that detection of enteropathogens in feces early in life would be negatively related to children's cognitive development. Disturbed cognitive development can affect brain development so that it can reduce children's

intelligence (de Onis & Branca, 2016). The main causes of stunting include nutrition and nutritional intake that is not sufficient for children's needs, wrong parenting, lack of knowledge and education for the community. Cognitive development is an aspect that focuses on a thought process, namely the child's ability to relate a number of events, assess and consider them (Rakotomanana et al., 2017). Please pay attention to cognitive development for child development because it can affect the mental and emotional development of children in solving a problem, besides that it can also interfere with language skills, attitudes, and actions (Khan et al., 2019). About 5 to 10 percent of children experience delays in children's cognitive development because most of them are caused by stunting (Mustakim et al., 2022). Therefore, the more the nutritional status of a child increases, the level of cognitive development of children will also be increased.

The Ministry of Finance has prepared a budget to address stunting in child growth and development which consists of budgets for ministries/agencies at the center, Physical Special Allocation Funds (DAK) and Non-Physical Special Allocation Funds (DAK)(Eshete et al., 2017). The high prevalence of stunting in Indonesia has made the government pay more attention to handling the problem of stunting, with the aim of not only reducing the rate of cognitive development delays in children with stunting prevention, the government also hopes to eliminate hunger and all forms of malnutrition and achieve the food security expected for public (Abdulahi et al., 2017).

METHODS

This study uses systematics literature review using this method PRISMA (Preferred Reporting Item for Systematic Review and Meta-analysis) through four stages, namely identification, screening, eligibility and results received. Look for literature is done by accessing online electronic database from Pubmed, Scient Direct, and Wiley Systems Overview is a review of a system that has a purpose to identify gaps knowledge, determine the research agenda, identify implications for decision making decisions and explore widely through the evidence available by charting concepts underlying research, sources of evidence and the type of evidence available. The purpose of The review system is to map evidence on a topic of discussion based on the system selected and identify the main concepts, theory, sources, and knowledge gaps (Tricco et al., 2018). The process of this review system done using guidelines Preferred Reporting Items for Systematic Reviews and Meta-Analyses for System Review (PRISMA-ScR). PRSIMA-ScR is designed to help readers (such as

researchers, publishers, commissioners, policy makers, health care providers, guideline developers, and patients or consumers) have better knowledge about related terminology, important concepts, and important elements to report for review scope. Here are 22 steps assessment in writing scoping review: title, Structured Summary, Rational, Objective, Protocol and Registration, Eligibility Criteria, Information Souch, Search, Selection of Sources (Optimal), Data Charting, Data items, Critical Appraisal Of Individual Of Evidence, Synthesis Of Result, Selection of Sources of Evidence, Characteristic of Sources of Evidence, Critical Appraisal Within Sources of Evidence, Results of Individual Sources of Evidence, Synthesis of Evidence, Limitations and Conclusions.

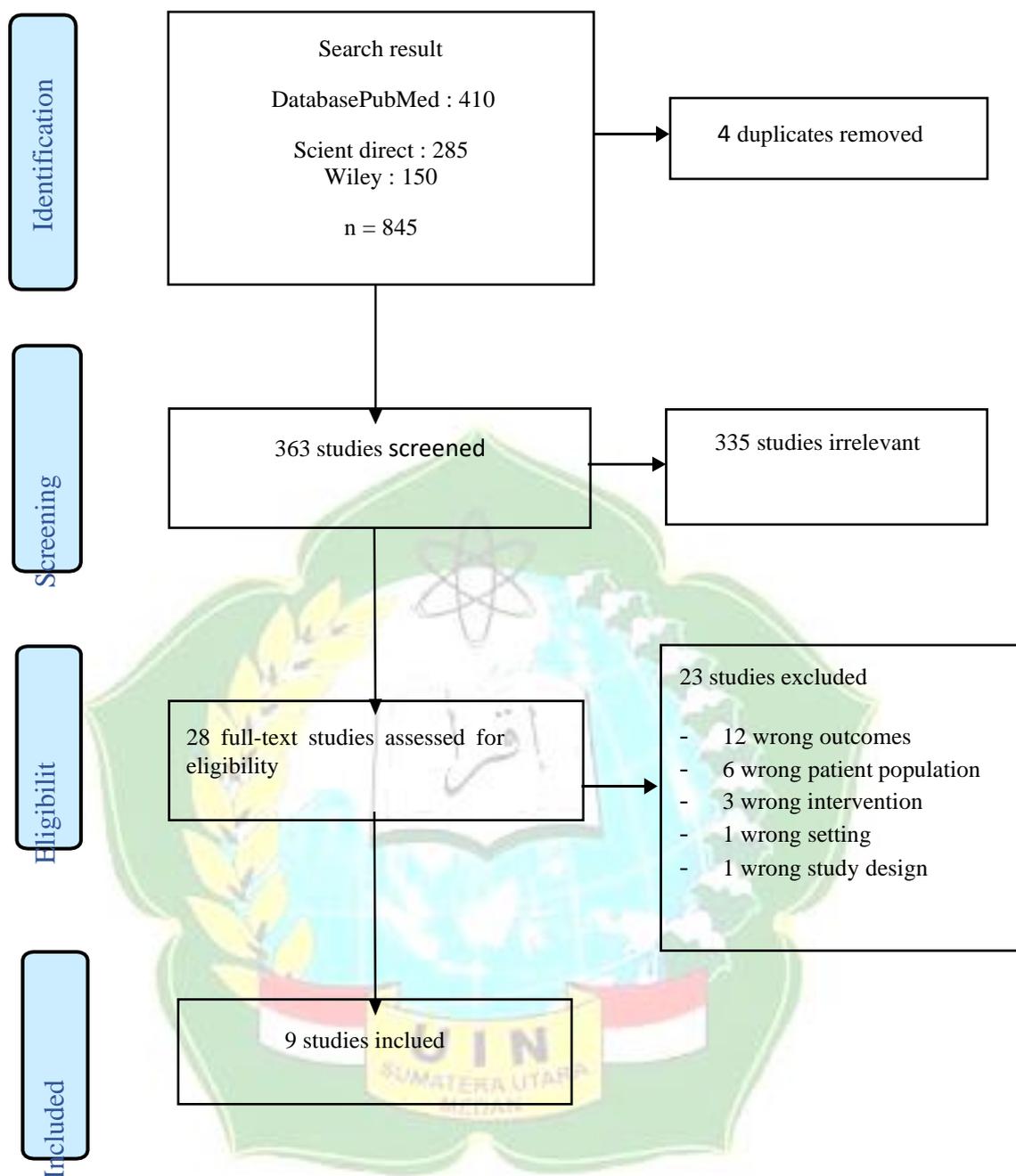
Pico Framework

In this systematic review study article search using the framework PEO (Population, Exposure and context). Where this population is related to (Toddlers), Exposure (Stunting) and Context(child development) This Framework help identify aspects of situations and populations that have the condition particulars and the associated desired results with intervention. That first step carried out to determine the inclusion criteria and exclusion from the framework that has been made with the aim that the data sought will be focused in the context you are looking for.

Inclusion And Exclusion Criteria

Article eligibility articles are specified using inclusion and exclusion criteria. The inclusion criterion used was erikel While the exclusion criteria are review/article , theses, books and theses and journals predators. Article search using Pubmed database, Scient direct, Wiley. original, published in English and Indonesian language Articles published in the last 10 years (1-jan-2012/30 october 30-10-2022) and free full text. This review uses keywords (factors) and (Stunting) OR () OR (Cognitive development).

Selected publications are included in the flow chart imported PRISMA studies for the title as well abstract filtering column, while the article which are out of sync are entered in the column irrelevant studies. The researchers using the mapping findings from the C website PRISMA Flowchart design is used because it can help researchers display the results of the selection of articles, as a result makes it easier for the reader to understand the plot article selection.



Stunting is a condition where the child is too short for his age due to growth failure caused by malnutrition and child health before and after birth. Here are some research results as a reference in this research (Luzingu et al., 2022).

Table 1. System review findings

No	Researcher Name (Year)	Research Title (Country of origin)	Research Sites, Methods, Sample Size, Instrument	Results
1.	Woldehann, et.al., (2017) (12)	<i>The effect of early childhood stunting on children's cognitive achievements: Evidence from young lives Ethiopia</i>	<ul style="list-style-type: none"> - From Young Lives data, namely in Ethiopia, India, Peru and Vietnam - Cross Section - 1883 children 	There is a positive relationship between height based on the Z score and the math score for children who are stunted, whose math score is 2.11 lower than for children who are not stunted. ($\beta = 2.11$; 95% CI = 0.002-4,21).
2.	Ekholuen etale, et.al., (2020) (13)	<i>Impact of stunting on early childhood cognitive development in Benin: evidence from Demographic and Health Survey.</i>	<ul style="list-style-type: none"> - Nationally representative Benin Demographic and Health Survey (BDHS) data in 12 geographic areas, namely Alibori, Atacora, Atlantique, Borgou, Collines, Couffo, Donga, Littoral, Mono, Quémé, Plateau, and Zou) - Cross Sectionals - 6,573 children - Nutritional status: anthropometric measurements according to WHO criteria 2007. Cognitive assessment: measured from 8 composite statements 	Children with stunting experience a 7% decrease in cognitive development compared to children who are not stunted (RR=0.93; 95% CI=0.83,0.98). This cognitive development is influenced by geographical area, custom/religion, mother's education, mother's occupation.
3.	Probosi wi, et.al., (2017) (14)	Stunting dan perkembangan anakusia 12-60 bulan di Kalasan	<ul style="list-style-type: none"> - Desa Purwomartani Kalasan Sleman - <i>Cross sectional</i> - 106 anak 	Children with stunting experience a 7% decrease in cognitive development compared to children who are not stunted (RR=0.93; 95% CI=0.83,0.98). This cognitive development is influenced by geographical area, custom/religion, mother's education, mother's occupation.

4.	Pantaleon, et.al., (2015) (15)	Stunting is related to children's motor development in Sedayu District, Bantul, Yogyakarta	<ul style="list-style-type: none"> - Sedayu District, Bantul, Yogyakarta - Cross Sectionals - 100 children - Stunting was assessed anthropometrically according to height for age (WHO 2005). Measurement of child development with the Bayley Scales method. 	More stunted children had less cognitive development (12%) when compared to children who were not stunted (8%).
5.	Aurora, et.al., (2019) (16)	Comparison of IQ (Intellectual Question) Scores in Stunted and Normal Children	<ul style="list-style-type: none"> - Palembang city - Case control - 75 children - Nutritional status: anthropometric measurements according to WHO criteria 2007. Cognitive assessment: CPM test (Colored Progressive Matrics) 	This research show that Stunted children get an IQ score 4.57 times lower than the IQ of children who are not stunted. Where stunted children with IQ scores below the average were 48 children (64%). Whereas children who are not stunted get an average IQ score above 72% and those who get an average IQ score below are 28%.
6.	Solihin, et.al., (2013) (17)	The Relationship Between Nutritional Status, Cognitive Development , and Motor Development in Preschool Children	<ul style="list-style-type: none"> - Cibanteng Village, Bogor Regency, West Java - Survey design - 73 children - Anthropometric measurements: according to WHO criteria 2007. Children's nutritional intake: semi-quantitative food frequency method (FFQ method). Cognitive and motor development: child development instruments developed by the Ministry of National Education. 	The higher the nutritional status of toddlers, the higher the level of cognitive development of toddlers. Stunting conditions in toddlers can also reduce IQ by 5-11 points. Stunted children have a low level of cognitive (54.8%) and fine motor (68.5%) development.
7.	Haile,et.al., (2016) (9)	<i>Height for age z score and cognitive functio are associated</i>	<ul style="list-style-type: none"> - Goba town, Bale zone, Oromiya region, SoutheastEthiopia - Cross sectional 	There is a positive relationship between height based on the Z score and the math score for children who are stunted, whose math score is 2.11 lower than for children who are not stunted.

8.	Miller, et.al., (2016)(10)	<i>How consistent are associations between stunting and child development ? Evidence from a meta-analysis of associations between stunting and multidimensional child development in fifteen low- and middle-income countries</i>	<ul style="list-style-type: none"> - Countries with Multiple Indicator Cluster Survey round 4 (MICS-4) data - Meta-analysis using UNICEF's Multiple Indicator Cluster Survey round 4 (MICS-4). - 58,513 children aged 36– 59 months. 	Children who are severely stunted with a Z-score <-3SD from the index of body length or height for the child's age have an impact negative on child development (OR=0.75, 95% CI=0.67-0.83).
9.	Sandjaja, et.al., (2013) (11)	<i>Relationship between anthropometric indicators and cognitive performance in Southeast Asian school-age children</i>	<ul style="list-style-type: none"> - South-East Asian Nutrition Survey (SEANUTS) - Indonesia, Malaysia, Thailand and Vietnam - Cross sectional - 6746 children of primary school age - Nutritional status: anthropometric measurements according to WHO criteria. IQ Rating: Raven's Progressive Matrices (RPM) (for children aged 6–12 years) and Test of Non-Verbal Intelligence, third edition 	Children with low Z scores according to BMI/A and low TB/A are likely to have a non-verbal IQ <89 compared to children who are not stunted.

DISCUSSION

The results of a literature review of 9 journals, Woldehann, et.al, found that stunting in early childhood was very significantly negatively related to children's cognitive development, it was estimated that children who were stunted would have cognitive development as much as 16.1% less on the Peabody Vocabulary Test Figure and 48.8% lacking in the Quantitative Assessment Test at age eight. This data is obtained from

triggering variables such as developmental failure, duration of breastfeeding, size at birth, health problems in early childhood such as acute respiratory disease and malaria, family economy, gender, parents' education, and environmental conditions (Woldehanna et al., 2018). Therefore Woldehann, et.al, gave the opinion that every community is important to realize the importance of investing from an early age in terms of child health and child nutrition until the child reaches the age of five in the process of developing children's cognitive abilities (Woldehanna et al., 2018). In addition, Ekholuenetale et al, showed a 7% decrease in cognitive development in stunted children compared to children who were not stunted (Ekholuenetale et al., 2020). According to a study by Pantaleon et al., 12% of children with possible developmental delays experienced poorer cognitive development compared to 8% of normal children (Pantaleon et al., 2016).

Probosiwi, et.al., also argues that there is a significant relationship between stunting status and children's cognitive development ($p < 0.05$) and OR 3.9 (95% CI; 1.8-8.9). It can be concluded that there is a relationship between stunting status and the development of children aged 12-60 months by paying attention to nutritional intake (Probosiwi et al., 2017). Meanwhile, according to Aurora et al., the IQ score of children with developmental delays is 4.57 times lower than that of children without developmental delays. Forty-eight (64%) stunted children have an IQ below the average. Whereas children without developmental delays have an average IQ score above 72%, while children with an average IQ score below 28% (Aurora et al., 2020).

Miller et al also found that children with severe developmental delays with a Zscore $< -3SD$ had a negative impact on the child development index based on the index of length or height of early childhood development. old children (ECDI) (OR=0.75; 95% CI=0.67-0.83). Consistent with Haile's research, the study found a statistically significant positive relationship between the correlations of all cognitive test scores and achievement, as seen in math scores ($P < 0.05$) (Miller et al., 2016).

In addition, Sandjaja, et.al. also gave his opinion about child nutrition on cognitive development. According to him, in four Southeast Asian countries, Indonesia, Malaysia, Thailand, Vietnam, overall 21% of children from the four countries are underweight and 19% of them are affected by a lack of cognitive ability. This was stated by using the z score of height for age (HAZ), z score of weight for age (WAZ), so that the data generated by children with low WAZ of 3.5 is more likely to have a non-verbal IQ of 0.89 (OR 3.53 and 95 % CI 3.52,3.54) (Sandjaja et al., 2013). The chances of having a non-verbal IQ of 0.89 also double

with low BAZ and HAZ. It can be concluded that children who are stunted in the first 2 years of life have the opportunity to achieve an IQ lower than 89 compared to children who are not stunted (Sandjaja et al., 2013).

Therefore, from the 9 reviews of journal articles above, it can be concluded that stunting can lead to suboptimal cognitive or intelligence, motor, and verbal development, increased risk of obesity and other degenerative diseases, increased health costs, and increased incidence of disease and death (B. Akombi et al., 2017). Children who have an intelligence level that is not optimal, stunting can ultimately hinder economic growth, increase poverty, and widen inequality in a country. Stunting in early childhood is significantly negatively related to cognitive performance (Thurstans et al., 2022).

Strength of systematic reviews This is done using the PRISMA SR checklist assessment to assess the quality of reviews and is done by people to minimize. The limitations of the systematic review included all included articles from developing countries. Researchers did not find articles from developed countries, so they could not get an idea of the differences in stunting factors involved in developed and developing countries. In addition, the article found research methods that did not vary, namely only limited to cross-sectional and case control studies so that there was no variation in the results in the study.

CONCLUSION

This review systematic review found Many studies have discussed factors that are relevant to young children with stunting. Developmental delay factors are divided into four major themes, namely factors that influencing, early childhood factors and factors child development. Growth delay still become a health problem for young children and requires the best treatment, it is hoped that medical personnel can do efforts to socialize and prevent developmental delays so as to prevent delays child development as early as possible. Furthermore, the next researcher must accept the results that have been done.

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