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

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ABSTRACT

Hindering is one of the direct lack of healthy sustenance caused by long-term ailing health. The predominance of child hindering remains tall in spite of concerted endeavors to diminish it. Hindering can have an affect on engine and verbal advancement, expanded degenerative infections, and rate of horribleness and passing. In expansion, hindering will result in hindered development and improvement of neuron cells, hence influencing cognitive advancement in children. The affect of hindering on cognitive advancement in children shifts, hence this consider points to discover out what are the impacts of hindering on cognitive capacities in children with a audit approach. Conducting a writing audit of diaries utilizing three scholastic databases (Science Coordinate, PubMed, and ProQuest), The consideration criteria in writing thinks about are: English articles, investigate on hindering children, distributed in 2014-2024, with blend methode / quasi-experiment and cross-sectional plans. The catchphrases utilized are Hindering AND Child AND Cognitive Advancement OR Development AND Negative. Instrument: Direct in checking on diaries utilizing PRISMA. The comes about of a writing audit from 12 diaries appeared that hindered children got an IQ score 2.14 times lower than the IQ of children who were not hindered. Based on the comes about of the consider, it was found that hindering has organic suggestions for brain and neurological advancement which interprets into a decay in cognitive esteem. Serious hindering hurts child improvement. Hindering adversely influences children's cognitive capacities, such as moo IQ and scholastic execution. It needs participation from different divisions so that sound children will be shaped into solid children of the another era of quality

Keywords: Stunting; Cognitive; Child; Systematic review

INTRODUCTION

Stunting is a condition where children are too short for their age due to growth failure caused by poor nutrition and health of children before and after birth. Stunting is defined as height according to age below -2 standard deviations according to the growth curve. Stunting is considered a linear growth failure in children due to poor nutrition over a long period (Nurdin, Isa TIbrahim, & Fuadi, 2023). Stunting is still a major problem in developing countries such as Indonesia due to its high prevalence [1][2,3]. Stunting in children is a severe problem and is therefore associated with a greater risk of morbidity and disease mortality, obesity and non-communicable diseases in the future, short adult age, poor cognitive development, and lower productivity and income.[4]

Stunting is a complex problem caused by several factors, both direct and indirect. UNICEF reveals the factors that cause stunting. The immediate factors are malnutrition and disease, particularly infectious diseases. Meanwhile, family food security, parenting, family diet, health environment, and health services result in stunting indirectly. The underlying causes of all factors are education, poverty, inequality, socio-cultural, governance policies, and politics. Maternal health affects the maternal health of the children from whom they were born. The process of stunting starts from the preconception period (Director General of Public Health, Ministry of Health, 2018). As a result, the mother suffers from malnutrition and anemia, such as during pregnancy the mother's nutritional intake is insufficient [5][6,7]

According to the World Health Organization (WHO), stunting in children under five is a public health problem if the prevalence is 20 percent or more. Globally, there are approximately 162 million children under the age of five who are stunted. About 3 in 4 stunted children worldwide are in Sub-Saharan Africa, while 40 percent and 39 percent are in South Asia.

According to WHO, health problems in the community can be said to be chronic if the prevalence of stunting is more than 20 percent. This means, nationally, the problem of stunting in Indonesia. Indonesia is classified as regular, especially in 14 provinces whose prevalence exceeds the national figure. Children who are stunted have an impact on their growth, which is stunted and cannot be changed. The impact of stunting can last a lifetime and affect the next generation[3][1].

The prevalence of stunting in Indonesia fluctuates from year to year. According to WHO, public health problems can be considered chronic when the prevalence of stunting is more than 20 percent. This means that nationally the problem of stunting in Indonesia is classified as chronic, especially in 14 provinces whose prevalence exceeds the national rate. Children who are stunted have an impact on stunted and irreversible growth. The impact of stunting can last a lifetime and affect the next generation. One of the impacts of stunting is not optimal cognitive abilities of children which will affect their lives in the future. [4]

Stunting is a complex problem caused by several factors, both direct and indirect. Factors that cause stunting directly are lack of nutritional intake and the presence of diseases, especially infectious diseases. While indirect causes consist of family food security factors, parenting, and family diet as well as environmental health and health services. The underlying causes of all such factors are education, poverty, disparities, socio-cultural, government policies, and politics. Maternal health is very influential on the health of the child she gives birth to. The process of stunting starts from the preconception period where the mother experiences malnutrition and anemia when pregnant the mother's nutritional intake is insufficient Some studies show that there is a relationship between stunting and cognitive development in children. Therefore, this study aims to analyze the relationship between stunting and children's cognitive development.[8]

RESEARCH METHODS

Search strategy

This literature study through searching scientific publications ranges from 2014-2024. The databases used are Pubmed, Science Direct, and Proquest. A literature search was conducted with four groups of keywords based on *Medical Subject Heading* (MeSH) and combined with Boolean operators AND, OR, and NOT, the keywords Stunting AND Child AND Cognitive Development OR Growth AND Negative, found 815 articles. From these results, 27 articles were found, but as a final process, all articles were adjusted back to the inclusion criteria based on the title of the literature, as for the results obtained by 12 articles.

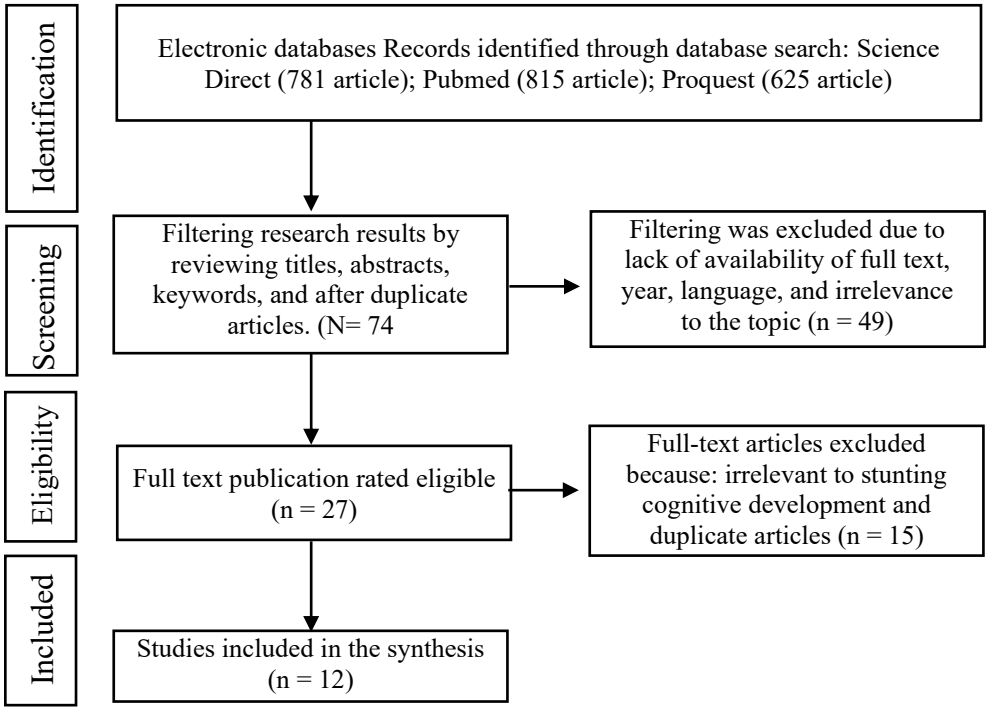

Figure 1. Flow chart and article selection

Review articles through systematic review with *The Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA)* approach. After obtaining articles based on the database, the author will independently check each title and abstract to exclude irrelevant reports. After removing duplicate results, data is extracted based on inclusion and exclusion criteria. There were 12 selected articles from 74 articles found.

RESULT

Table 1.
The Effect of Stunting on Cognitive Development

Not	Research Title	Methods (design, samples, variables, instruments, analysis)	Result
1	Height for age z scores and cognitive function are associated with academic performance among school children aged 8-11 years [9]	D: Penampang S: 131 elementary school-age students in the city of Goba. V: Socio-demographic character I: structured questionnaire. Food intake: a qualitative method of re-calling food for 24 hours. Cognitive assessment: Kaufman Assessment Battery for Children (KABC-II) and Raven's Colored Progressive Matrices (RCPM). A: Descriptive statistics and bivariate and multivariable linear regression are used in statistical analysis.	Nutritional status (Z, height, according to age) and wealth can be modifiable factors to improve the academic achievement of school-age children. In addition, interventions to improve maternal and child nutrition may be important contributors to academic success and national economic growth in Ethiopia. More research is needed with a robust design and large sample size.
2	How consistent is the relationship between stunting and child development? Evidence from a meta-analysis of the relationship between stunting and child	D: Cross section S: 58,513 children aged 36–59 months. V: Stunting, maternal education, family wealth, books at home, parenting and gender of children I: fifteen Multiple Indicator Cluster	Severely stunted children with a Zscore of <-3SD of the child's age or height index harmed child development (OR=0.75; 95% CI=0.67-0.83). Stunting is associated with many but not all development domains in different countries and cultures. However, the relationship varies

	development is multidimensional in fifteen low- and middle-income countries [10]	Survey (MICS). Physical, learning, literacy/numeracy, and socio-emotional development domains: ten-item Early Childhood Development Index (ECDI) A: Multivariate logistical setbacks	according to the prevalence of breastfeeding in each country and the domain of development
3	Effects of early childhood stunting on children's cognitive achievement: Evidence from the lives of young Ethiopians [11]	D: Ross Section S: 1883 children T: Status Tipu Daya I: pengukuran antropometri sesuai kriteria WHO 2007. Penilaian kognitif: The Peabody Picture Vocabulary Test (PPVT), the Cognitive Developmental Assessment Quantitative (CDA-Q) dan Tes Matematika A: hierarchical regression analysis	Stunting in early childhood is significantly negatively associated with children's cognitive performance. Stunted children scored 16.1% lower on the Peabody Image Vocabulary Test and 48.8% lower on the Quantitative Assessment test at age eight, both statistically significant at P <0.01
4	Impact of stunting on early childhood cognitive development in Benin: evidence from the Demographic and Health Survey [12]	Nationally representative Benin Demographic and Health Survey (BDHS) data in 12 geographical regions, namely Alibori, Atacora, Atlantique, Borgou, Collines, Couffo, Donga, Littoral, Mono, Quémé, Plateau, and Zou) D :P enampang S: 6,573 children V : Nutritional status, Cognitive development I: anthropometric measurements according to WHO 2007 criteria. Cognitive assessment: measured from 8 composite statements A: Uji bivariate chi-square	Results: About two-thirds (64.3%) of children under five achieved optimal cognition. Children who are stunted have 7% optimal cognitive development decline, compared with non-stunted children (RR = 0.93; 95%CI 0.83, 0.98). Among the covariates, geographic region was significantly associated with optimal cognitive development. Inside In addition, children who are Muslim, cultural/other religious, and irreligious experience significant optimal cognitive decline development, compared to children who adhere to Christian beliefs. Children of mothers who have secondary and tertiary education Education, listening to the radio, and watching television experienced an increase in optimal cognitive development, compared to the child of an uneducated mother. In addition, children of working mothers have 8% optimal cognitive development improvement (RR = 1.08; 95%CI: 1.02, 1.14)
5	Nutritional status as a determinant of cognitive development among preschoolers in Southwestern Nigeria [13]	D : Penampang S: 220 children V: Anthropometric nutritional status of children (weight, height, and circumference of the middle arm). The children's cognitive function was assessed using a developmental checklist developed by the American Academy of Pediatrics and their performance was rated good, moderate, and poor. A: partial least squares regression structural equation modeling (PLS-SEM)	The results of the study showed a relationship between cognitive children and stunting, where stunted children had worse cognitive development (16.7%) than children who were not stunted (4.5%)
6	Stunting prediction model in Peru's Central Andes region based on socioeconomic and agri-food determinants [6]	D : Case control, cross section S: 50 stunted children. 50 normal assessment V: socioeconomic and agroproductive predictors. I: Bayley Scales Infant Development method II 3. A: Chi-square test and bivariate logistic regression	The stunting percentage is 40.3. Based on Hosmer and Lemeshow's test, the most suitable model is one that considers maternal education level, timely colostrum consumption, birth weight and guinea pig maintenance, has high reliability (P <0.05)
7	Height for age z scores and cognitive function are associated with academic performance among school children aged 8-11 years [9]	D: Penampang S: 539 SD V: Socio-demographic I: kognitif: Kaufman Assessmen Battery for Children (KABC-II) dan Raven's Colored Progressive Mat-rices (RCPM).	His study found a statistically significant positive association between all cognitive test scores and average academic performance except for remembering numbers (p = 0.12) and hand movements (p = 0.08). The correlation between all cognitive test scores and math scores was found to be positive and statistically

		A: hierarchical regression analysis	significant (p <0.05). In multivariable linear regression models, a better wealth index was significantly associated with higher mathematical scores (ß = 0.63; CI 95%: 0.12-0.74). Similarly, a change in the unit of height to the age of the z score resulted in a change in the unit math score of 2.11 (ß = 2.11; 95% CI: 0.002-4.21). A change in one unit of wealth index resulted in a change in the average score of all subjects in school-age children of 0.53 units (ß = 0.53; CI 95%: 0.11-0.95). A change in one age unit resulted in a change in the average score of all subjects in school-age children of 3.23 units (ß = 3.23; 95% CI: 1.20-5.27).
8	How consistent is the relationship between stunting and child development? Evidence from a meta-analysis of the relationship between stunting and child development is multidimensional in fifteen low- and middle-income countries [10]	D: Penampang S: 58.513 anak Stunting V: stunting and cognitive development In: Questionnaire A: T-word	Severe stunting (Z-score height per age <-3) was negatively associated with planned progress (OR=0·75; 95% CI 0·67, 0·83). Each stunting (Z-score <-2) was negatively associated with planned development in countries with high BF prevalence (OR=0.82; 95% CI 0.75, 0.89). Severe stunting and any stunting were negatively associated with physical development (OR=0.77; 95% CI 0.66, 0.89 and OR=0.82; 95% CI 0.74, 0.91, respectively) and literacy/numeracy development in countries with high BF (OR=0·45; 95% CI 0·38, 0·53 and OR=0·59, 95% CI 0·51, 0·68, respectively), but not in countries with low BF (OR=0·93; 95% CI 0.70, 1·23 and OR=0·95, 95% CI 0.79, 1·12, respectively). Each stunting was negatively associated with learning (OR=0.79; 95% CI 0.72, 0.88). There is no clear link between stunting and socio-emotional development
9	Stunting and Underweight, but not Wasting Linked to Child Development Delays in Southwest Ethiopia [14]	D: Community-based surveys S: 507 randomly selected mother-child pairs in the Guragahe Zone, Southwestern Ethiopia V: malnutrition and delayed child development I: Pre-tested tools and validated anthropometric measurements are used. Anthropometric indices (WFH, WFA, and HFA) are calculated in Anthros A: PLS software A: Bivariable and multivariable binary logistic regression	A total of 507 mother-child pairs (12-59 months) were included in the survey (97% response rate). The average ASQ-3 score is 150 (± 23.4), with minimum and maximum scores of 45 and 270 respectively. A total of 149 (29.4%; 95% CI: 25.4-33.4) children had developmental delays, of which 17.2%, 16.8%, 13.4%, 10.8%, and 10.1% had delays in gross motor, communication, problem-solving, and personal. -social skills, and fine motor skills, respectively. Children of working mothers (AOR=2.9; 1.8, 4.8), preterm birth (AOR=3.2; 1.4, 7.0), early complementary food initiation (AOR=2.5; 1.37, 4.6), stunting (AOR=3.0; 1.9, 4.7), underweight (AOR= 2.3; 1.1, 4.7) and low dietary diversity scores (AOR=3.1; 1.3, 7.5), are predictors of developmental delay.
10	Effects of Low Linear Growth and Poor Psychosocial Aspects on Toddler Cognitive Development [15]	D: Case Control S: 75 stunted children Nutritional status: This study showed that stunting and 75 were normal V: linear growth and psychosocial aspects of parenting on toddler cognitive development I: anthropometric measurements of height at birth, age six months, and twelve months were measured using a body length measuring instrument with a precision level of 0.10 cm. A: Multiple logistic regression	Toddlers who are born stunted and continue to be stunted until the age of three have lower cognitive development than stunted newborns who can reach normal height at the age of three. In addition, children who received poor psychosocial care had lower cognitive development compared to children who received good care. This study highlights the importance of efforts to improve children's nutritional status and provide good care for them

11	The link between stunting and early childhood development among 36-59 months olds in South Asia >[16]	D: Penampang S: 31,037 children V: literacy-numeracy, physical, learning/cognition and social-emotional I: MICS-Presentasi 4 A: logistic regression analysis	Development of the appropriate social-emotional domain path Not associated with Z scores or indicators of malnutrition. In some In South Asian countries, stunted children are less likely to develop a track" for learning/cognition. Interventions that prevent stunting may provide benefits for child development, thus providing significant benefits to individuals and society The huge burden of stunting on children in regions such as South Asia.
12	Early childhood development and stunting: Findings from a MAL-ED birth cohort study in Bangladesh[17]	D: Group S: 265 children V: *Early Childhood Development (ECCE) between stunted (*z-score [LAZ] < −2) and nonstunting (LAZ ≥ −2) I: Bayley Scales of Infant and Toddler Development-third version (BSID-III; Bayley, 2005) In: chi-squared test	Bayley Scales stunted children experienced significant Development III; lower child development scores: length and weight using cognitive (95% CI ="0.16 ("0.31, standard procedure. 0.0], P= 0.049)

DISCUSSION

The results of a literature review of the 12 journals showed that in the results of Miller's research, et.al, it was found that children who were severely stunted with a Z-score of <-3SD from the index of body length or height according to the child's age harmed child development based on the Early Childhood Development Index (ECDI) (OR=0.75; 95% CI=0.67-0.83). [10] In line with Haile's research which found a statistically significant positive association between the correlation of all cognitive test scores and academic achievement seen from math scores (P (P<0.05). Supported by research from Ekholuenetale, et al that children with stunting experience a 7% decline in cognitive development compared to children who are not stunted. In line with research conducted by Pantaleon, et al, 12% of stunted children are more likely to have less cognitive development than 8% of children who are not stunted [9][12][18]

Research results of Sandjaja, et al. show that children with low Z scores according to BB/U are likely to have a non-verbal IQ of < 89 compared to children who are not stunted. It can be concluded that children who are stunted in the first 2 years of life have the opportunity to have a non-verbal IQ of <89. It can be concluded that children who are stunted in the first 2 years of life have an IQ of <89 compared to children who are not stunted. Meanwhile, according to Aurora, et al children who are stunted 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 as many as 48 children (64%). Meanwhile, in children who are not stunted, the average IQ score and above is 72% and those who get an average IQ score below is 28% [19]

Other studies have shown that the development of the appropriate social-emotional domain pathway is not associated with z scores or indicators of malnutrition. In some South Asian countries, stunted children are less likely to develop a "developmental track" for learning/cognition. Interventions that prevent stunting may benefit child development, thus providing significant benefits to individuals and communities with the large burden of child stunting in regions such as South Asia.[16]. Children who experienced wasting had poor motor skills (P = 0.006 for fine motor skills; P <0.001 for gross motor and total motor development) compared with children who were not wasted. Stunting in early childhood and underweight is associated with poor developmental outcomes in Bangladesh [17]

Effective policies are needed to improve feeding practices in pregnant women, improve breastfeeding encourage the rearing of guinea pigs for self-consumption, and improve the nutritional status of children.[6]. Nutritional status (Z, height, according to age) and wealth can be modifiable factors to improve the academic achievement of school-age children. In addition, interventions to improve maternal and child nutrition may be important contributors to academic success and national economic growth.[9]

Stunting is associated with many factors but not all development domains in different countries and cultures. The relationship varies by country, prevalence of breastfeeding, and domain of development. [10]. Delayed child growth and development is a public health problem and it is strongly associated with stunting, underweight, undiversified food consumption, and suboptimal infant and child feeding practices.[14]

Stunting has biological implications for brain and neurological development that translate into cognitive impairment that results in lack of learning achievement. Stunting is a long process that starts from the preconception period where maternal health greatly affects the health of the child she gives birth to Stunting is not only a problem of malnutrition but is a multi-factor and multi-sector problem. To prevent stunting, parents need to meet the nutritional needs of children, provide exclusive breastfeeding for six months, conduct early detection by consulting and routinely measure the child's weight and height. So that healthy children are formed and become a quality next generation. In addition, cooperation from various sectors is needed so that healthy children will be formed and become qualified next generations

CONCLUSION

From all the literature that has been reviewed, it can be concluded that stunting harms children's cognitive abilities, such as low IQ, low intelligence of children, and low IQ., and academic achievement. The results of a literature review from 12 journals showed that stunted children experienced lower I.Q. scores compared to the IQ of children who were not stunted. There needs to be cooperation from various sectors to form healthy children to become the next generation of a quality nation.

RECOMMENDATIONS

To prevent stunting, parents must meet the nutritional needs of children, provide exclusive breastfeeding for six months, and conduct early detection by routinely consulting and measuring children's weight and height. For further researchers, it is recommended to develop stunting detection instruments early so that prevention can be provided early and cognitive decline does not occur in children.

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