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Cognitive Development in Children Aged 2-3 Years with Stunting in Kediri

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ABSTRACT

Background: In the first 1,000 days of life, children are vulnerable to chronic malnutrition, known as stunting, which impacts cognitive development. An initial survey in Blabak Village, Kediri City, on several stunted children showed language delays, difficulty concentrating, motor delays and understanding commands, which means they tend to experience cognitive disorders.

Purpose: The study aim is to analyze the relationship between stunting and cognitive development in children aged 2–3 years.

Methods: This research using correlation analytical research design with cross-sectional approach. Sample of 54 children aged 2-3 years, selected using proportionate stratified random sampling. The research was conducted at 6 integrated health service post (posyandu), Blabak Village, Kediri City in September 2024. Stunting as an independent variable, while cognitive development as a dependent variable. Data were analyzed using Spearman rho test.

Results: The results of Spearman's rho between stunting and cognitive development in learning and problem solving category, logical thinking, symbolic thinking sequentially have P values of 0.000; 0.000; and 0.005. The correlation coefficient between Stunting and Cognitive Development in Learning and Problem Solving Category, Logical Thinking, Symbolic Thinking sequentially is 0.651; 0.650; 0.374.

Conclusion: There is a significant relationship between stunting and cognitive development in learning and problem solving category (strong relationship), logical thinking (strong relationship), symbolic thinking (quite strong relationship).

Keywords: Children, Cognitive Development, Stunting

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BACKGROUND

Nutrition has an important role in children's growth and development (Saavedra & Prentice, 2023) (Suharto; et al., 2023). A nutritional problem frequently faced throughout the world is stunting (Azriani et al., 2024). Stunting is a condition experienced by children due to malnutrition and repeated infections which is characterized by impaired growth and development, namely height for age that is more than 2 standard deviations below the median for standard child growth (Chibuye et al., 2024). Stunting interpreted as a condition of chronic malnutrition that inhibits a child's physical growth, usually occurring in early life, especially before the age of two (Oginawati et al., 2023).

UN statistics in 2020 recorded that more than 149 million (22%) children under 5 worldwide experienced stunting, 45.4 million were wasting, and 38.9 million were obese. (Azani & M. Afdal, 2024). According to WHO (2022), there are 148.1 million children under 5 are stunting (Mulyani et al., 2025). The Asian Development Bank (ADB) reported that the stunting prevalence in toddlers in Indonesia reached 4.7 million in 2022 (Mulyo et al., 2024). Stunting prevalence in Indonesia is 21.6% and is targeted to decrease to 14% in 2024. Based on UNICEF and WHO data (2023), globally the prevalence of stunting in Indonesia is ranked 27th out of 154 countries. This makes Indonesia ranked 5th among countries in Asia (Suryanegara et al., 2025).

Indonesian Nutritional Status Survey of the Ministry of Health result show that the prevalence of stunting in toddlers in East Java reached 19.2% or 4.5 million children (Fadilah & Subiastutik, 2025). Then the prevalence of stunting in Kediri City in 2022 was 14.3% (Luh et al., 2024). Stunting cases distribution in Kediri City is dominated by the Kota District area of 33% (258 stunted toddlers), followed by Pesantren District at 34% (263 stunted toddlers), and finally Mojoroto District at 33% (257 stunted toddlers) a total of 778 toddlers (Luthfia et al., 2023). The initial study conducted by the author in the Blabak Health Center work area, the highest prevalence of stunting was in Blabak Village as much as 18.09%, namely with 53 stunted toddlers and 254 families at risk of stunting.

The pregnancy process in mothers who experience malnutrition during pregnancy, low Early Initiation of Breastfeeding, and lack of complementary feeding causes the risk of stunting (Suyanto et al., 2024). Risk factors associated with stunting include the nutritional status of pregnant women, pregnant mothers who experience chronic energy deficiency (CED), gender of the child, children who experience low birth weight (LBW), household factors including education from the father, mother or from those who care for the child, parental income, father and mother's occupation, parenting patterns including food consumption patterns given, breastfeeding, health service factors, namely the child's immunization status, infectious diseases such as diarrhea and Upper Respiratory Tract Infections (URTIs), environmental hygiene factors, namely environmental sanitation or personal hygiene (Gusnedi et al., 2023).

Stunting have negative effect in short and long term. Short term effect of stunting are stunting can cause growth failure, motor and cognitive development disorders that affect brain development, and educational success, as well as suboptimal physical body size and metabolic disorders (Lestari et al., 2024). Long-term effect of stunting are decreased intellectual capacity, permanent disorders in the structure and function of nerves and brain cells (impacting on decreased learning ability at school age which will affect productivity as adults), as well as increasing the risk of noncommunicable diseases such as diabetes mellitus, coronary heart disease, hypertension, and stroke (Akbar et al., 2023).

Stunting is a manifestation of growth disorders in the body, one of the organs of the body that is quickly at risk is the brain (Nisa et al., 2023). In the brain there are nerve cells that are closely related to the child's response including thinking, seeing, and hearing during the

learning process. The performance of the nervous system of stunted children often decreases which has implications for the child's low intelligence (Thomas & Sing Way, 2023).

The cognitive process explains the process of thinking, language, and intelligence of a person (Filipe et al., 2023). Children's cognitive development is the ability to think including the ability to remember, solve problems and events experienced with their reasoning (Saracho, 2023). Cognitive development is closely related to children's intellectuality in thinking and making decisions to generate ideas in learning and solving existing problems and includes developments in knowledge, both general, scientific, concepts of shape, numbers, letters, and symbols (Weber & Greiff, 2023).

Aspects of cognitive development that must be achieved by children according to Permendikbud No. 137 of 2014 include learning and problem solving which is the child's ability to solve simple problems in everyday life, logical thinking which is the child's ability to think logically about concrete events, sort and classify objects, and symbolic thinking which is the child's ability to remember, think and imagine non-existent objects using number and letter symbols (Nasution et al., 2024).

Delayed cognitive development refers to disorders in the ability to think, learn, understand, and process information at a level appropriate to the child's age (Money-Kyrie, 2023). Cognitive dysfunction is also known as cognitive impairment or intellectual disability (Ali, 2023). The causative factors include genetic factors, malnutrition, a non-stimulating environment, and certain medical conditions such as exposure to toxic substances during prenatal or postnatal development (Ali, 2023). Children with delayed cognitive development may have difficulty in various aspects of life, including school, social interactions, and the ability to adapt to everyday environments (Robinson & Dinh, 2023).

According to the Ministry of Health, 2018 based on growth and development information, around 8% of 9.4 million Indonesian children experience speech and language delays. In children aged 5 years, there are 17% of children with speech and language disorders, (6.4% experience speech delays, 6% experience language delays, and 4.6% experience speech and language delays). In addition, language development disorders, namely stuttering, occur in 4-5% of children aged 3-5 years (Suharto; et al., 2024). The results of the examination in the East Java region found language development deviations in 394 (15%) of 2,634 children aged 0-72 months (Nurjanah et al., 2023). Meanwhile, in Kediri City, 12.3% of 9,159 toddlers were detected to have developmental deviations in the form of speech delays (Nurjanah et al., 2023). The results of interviews with researchers in Blabak Village with 11 mothers regarding their children's growth and development showed that 7 of these children's cognitive development was in accordance with their age. Meanwhile, according to 4 other mothers, toddlers are a little slow in understanding commands, have difficulty concentrating on one activity and some experience delays in language, which are some indicators of cognitive development in children. Of the 4 children who experienced delays in cognitive development, 2 of them were diagnosed with stunting based on data obtained by researchers from the Pesantren Health Center. Previous research on stunting and cognitive development showed results a significant relationship between the incidence of stunting and cognitive development (Lestari et al., 2024). However, limited studies specifically examine the relationship between stunting and detailed cognitive domains (learning, logical, and symbolic thinking) in children aged 2–3 years in local community settings.

Stunting and delayed cognitive development are often interrelated and can worsen each other's conditions. Therefore, the approach, prevention and handling must be holistic and involve various stakeholders including the government, health institutions, education, and the general public. Early intervention is very important in helping children affected by stunting or delayed cognitive development to minimize negative impacts and improve their quality of life.

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Based on that description, the researcher intends to conduct research on Cognitive Development in Children Aged 2-3 Years with Stunting.

OBJECTIVE

This study aims to analyze the relationship between stunting and cognitive development in children aged 2–3 years.

METHODS

Research Design

This research using correlation analytical research design with cross-sectional approach.

Population and Sample

The population were children aged 2-3 years with stunting and non-stunting at 6 integrated health posts in Blabak Village, Kediri City in 2024 whose attendance predictor had been calculated at 80%, namely 62 children with a sample size of 54 children who were calculated using the Slovin formula. Sampling in this study was carried out using the probability sampling technique where each population has an equal chance of being selected as a sample, namely using the proportionate stratified random sampling method which is a method of taking samples proportionally from each strata/region determined in a balanced manner with the number of subjects in each strata/region.

Instrument

To obtain data on toddlers with stunting incidents, researchers collected toddler age data then measured height and weight, which would then be calculated as Height/Age, and determine the stunting category with the help of the Z-score table. Data collection on cognitive development indicators in toddlers in this study used an Observation Sheet. There are 24 indicators on the cognitive development observation sheet for children aged 24-35 months consisting of 11 indicators for the learning and problem-solving category, 9 indicators for the logical thinking category and 4 indicators for the symbolic thinking category. While there are 27 indicators on the sheet for ages 36-47 months consisting of 19 indicators for the learning and problem-solving category, 5 indicators for the logical thinking category, and 3 indicators for symbolic thinking.

Research Procedure

The data collection process begins with the researcher submitted a research permit application letter to the Dean of the Faculty of Health Sciences, Kadiri University. Furthermore, the researcher completed the licensing requirements at the Kediri City Investment Office. After obtaining permission, the researcher submitted the research permit letter to the Blabak Village, Kediri City. The researcher collected primary data to obtain data on the cognitive development of stunted and non-stunted children in Blabak Village, Kediri City, starting by explaining the objectives, benefits and research process to the parents of prospective respondents. If they are willing to become respondents, parents are asked to fill out an informed consent sheet. Furthermore, the researcher measured cognitive development in stunted and non-stunted children. After the data collection was complete, editing, coding, scoring, tabulating and analyzing the collected data were carried out according to the researcher's needs.

Data Analysis

After the data is collected, the data is processed by editing, coding, scoring, and tabulating. The analysis was conducted using SPSS 26.0 software. To determine the relationship between stunting and cognitive development in children aged 2-3 years in Blabak Village, Kediri City, the Spearman rank correlation test was used. This is because the type of data correlated is ordinal data.

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Ethical Clearance

This study was approved by the ethics committee of Kadiri University (Ethical code 176/Etik/FIK-UNIK/VIII/2024). Written informed consent were obtained from all participants. Participants were informed about the study, such as purpose, procedure, risk, and benefit before providing written consent. Anonymity and confidentiality were assured, and data were used solely for academic purposes

RESULTS

Respondent characteristics are presented in table 1. Respondent characteristics include gender, age, birth weight, delivery complications, maternal education, maternal occupation, parental income, screen time, nutritional status, stunting classification, and cognitive development (learning and problem solving, logical thinking, symbolic thinking).

Table 1. Frequency Distribution of Respondent Characteristics

Characteristics	Amount	Percentage
Gender		
Boys	28	51,9 %
Girls	26	48,1 %
Age		
24-35	21	38,9 %
36-47	33	61,1 %
Birth Weight		
Low Birth Weight	12	22,2 %
Normal	40	74,1 %
High Birth Weight	2	3,7 %
Delivery Complications		
Without Complications	36	66,7 %
With Complications	15	33,3 %
Maternal Education		
Lower Education	27	50 %
Higher Education	27	50 %
Maternal Occupation		
Housewife	42	77,8 %
Working Mother	12	22,2 %
Parental Income		
<Rp.2.415.363	16	29,6 %
Rp.2.415.363	31	57,4 %
>Rp.2.415.363	7	13 %
Screen Time		
Low	25	46,3 %
Hight	29	53,7 %
Nutritional Status		
Severely Deficient Nutritional	1	1,9 %
Status	12	22,2 %
Deficient Nutritional Status	40	74,1 %
Normal Nutritional Status	1	1,9 %
Overweight Nutritional Status		
Stunting		
Severely Stunted	6	11,1%

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Moderately Stunted	16	29,6%
Normal	32	59,3%
Cognitive Development (Learning and Problem Solving)	0	0 %
Not Yet Developing	12	22,2 %
Starting to Develop	27	50 %
Developing As Expected	15	27,8 %
Developing Very Well		
Cognitive Development (Logical Thinking)		
Not Yet Developing	3	6,5 %
Starting to Develop	18	33,3 %
Developing As Expected	25	46,3 %
Developing Very Well	8	14,8 %
Cognitive Development (Symbolic Thinking)		
Not Yet Developing	2	3,7 %
Starting to Develop	21	38,9 %
Developing As Expected	25	46,3 %
Developing Very Well	6	11,1 %

Based on the table, most of them are male, namely 28 (51.9%), most are 36-47 months old, namely 33 (61.1%), most are born with normal weight, namely 40 (74.1%), most are not accompanied by labor complications, namely 36 (66.7%), high and low education are balanced, almost all respondents are housewives, namely 42 (77.8%), most of their parents earn the same as the Kediri City UMR (Rp. 2,415,363), namely 31 (57.4%), most have high screen-staring intensity, namely 29 (53.7%), most of the nutritional status (BW/A) is in the normal category, namely 40 (74.1%). The table also shows that 11.1% of children are severely stunted and 29.6% of children are moderately stunted. Cognitive development in the learning and problem-solving categories shows half of them are Developing As Expected, which is 27 (50%), in the logical thinking and symbolic thinking categories almost half show Developing As Expected, which is 25 (46.3%).

Table 2. Spearman Rank Test Results

	Stunting	
	P-Value	Correlation coefficient
Cognitive Development (Learning and Problem Solving	0.000	0.651
Cognitive Development (Logical Thinking)	0.000	0.650
Cognitive Development (Symbolic Thinking)	0.005	0,374

Based on Spearman Rank correlation test, there was a significant relationship between stunting and cognitive intelligence in the categories of learning and problem solving, logical thinking, and symbolic thinking. The strength of the relationship between stunting and cognitive intelligence in the categories of learning and problem solving and logical thinking is strong (correlation coefficients of 0.651 and 0.650), while the strength of the relationship

between stunting and cognitive intelligence in the category of symbolic thinking is quite strong (correlation coefficient 0.374). The direction of the positive correlation can be interpreted that the more severe the category of stunting in children, the lower the cognitive development in children (in all categories).

DISCUSSION

Cognitive development in the learning and problem-solving category is the ability to solve simple problems in everyday life (Wu & Molnár, 2022). The level of achievement of cognitive development of 2-year-old children in the learning and problem-solving category according to Regulation of The Minister of Education and Culture of The Republic of Indonesia No. 137 of 2014 includes being able to see and touch objects shown by others, imitate the way adults or friends solve problems, concentrate on doing something without parental help, explore cause and effect, and follow daily habits (Ministry of Education and Culture of Indonesia, 2014). While at the age of 3 years, children should be able to understand if there is a missing part of a picture pattern, mention various names of food and their tastes, mention various uses of objects, understand the similarities between two objects, understand the differences between two things of the same type, experiment with materials using new methods, complete tasks until finished, answer what will happen next from various possibilities, mention numbers 1-10, and recognize certain letters or alphabets from A-Z that they have seen (Makhmudova Oybarchin, 2023). However, the reality that is seen in respondents aged 2-3 years who experience stunting in Blabak Village, Kediri City, the severe stunting and moderate stunting categories with cognitive development (learning and problem solving) are in the Starting to Develop category, with 4 and 8 respondents respectively. Compared to children with normal height, whose cognitive development in the learning and problem solving categories is mostly in the Developing As Expected category.

Cognitive development of the logical thinking category is the ability to think logically about concrete events, sort and classify objects (Fakaruddin et al., 2024). The level of achievement of children cognitive development with aged 2 years in the logical thinking category according to Regulation of The Minister of Education and Culture of The Republic of Indonesia No. 137 of 2014 includes being able to name parts of a picture, recognize body parts, understand the concept of size, recognize three types of shapes, begin to recognize patterns and understand number symbols and their meanings (Ministry of Education and Culture of Indonesia, 2014). While at the age of 3 years children should be able to place objects in order of size, begin to follow clapping patterns, recognize the concept of many and few, recognize the reasons why something is not included in a certain group, and explain the models or works they have made (Veldman et al., 2021). However, the results of a study on stunted children aged 2-3 years in Blabak Village, Kediri City from the severe stunting and moderate stunting categories, respectively, 2 and 1 respondents whose logical thinking cognitive development was in the Not Yet Developing category. While in children with normal height, most of them were in the categoy Developing As Expected.

Cognitive development of the symbolic thinking category is the ability to remember, think and imagine objects that do not exist using number and letter symbols (Lanjekar et al., 2022). The level of achievement of cognitive development of children aged 2 years in the symbolic thinking category according to The Republic of Indonesia No. 137 of 2014 includes being able to imitate the behavior of others in using goods, giving names to the work created and, carrying out activities like real conditions (Ministry of Education and Culture of Indonesia, 2014). While at the age of 3 years children should be able to, mention their roles and tasks, draw or form something that describes something specific, and carry out activities with friends in a planned manner (Veldman et al., 2021). The results of the study in Blabak Village, Kediri

City showed 2 stunting respondents in the medium stunting category, their symbolic thinking cognitive development was in the Undeveloped category. While in children with normal height, most of them were in the Developing As Expected category. The ability to think symbolically about recognizing number and letter symbols is included in the scope of cognitive development, namely the pre-operational stage, this is important because it is the initial stage in the process of reading, writing and calculating which of course has an impact on school levels to facilitate the learning process (Demetriou et al., 2022).

Based on the study results, there were 15 children with a history of delivery complications and 12 children with low birth weight. Delivery complications and birth weight in the study of Oktavianisya et al., 2021, were stated to have an effect on the stunting incidence with a p-value of 0.015. Of course, this is related to the nutritional status of children in the first 1000 days of life34. There were 16 children with parental income below IDR 2,415,363 and 13 children with nutritional problems. Economic limitations often hinder families' access to nutritious food, causing an unbalanced diet and a lack of nutritional variety needed for optimal child growth. According to the results of the study by Oktavianisya et al., 2021, it also showed that children with low economic status have a 1.7 higher risk of stunting than children with high economic status (p-value = 0.008) (Oktavianisya et al., 2021).

There are 29 children with high screen time intensity. The negative impacts of excessive screen time on children's cognitive development include decreased attention, loss of concentration, laziness in learning and writing, and decreased learning according to Adiwisastra & Basjaruddin, (2019) (Adiwisastra et al., 2019). The results showed that there was a relationship between the intensity of smartphone use and cognitive development in children aged 4-6 years at Bina Insani Kindergarten Jombang with a p value = 0.000 (Ikhsan, 2022). However, proper use of electronic media can actually help stimulate children's growth and development, including their cognitive development. This means that parental supervision is very much needed to control and limit screen time habits and the use of its features to minimize negative impacts on children.

CONCLUSION

The conclusion of this study is there is a relationship between stunting and cognitive development in children aged 2–3 years.

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CONFLICTS OF INTEREST

In this research, there was no conflict of interest.

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