Innovation of Nursing Journal
Vol. 1, No. 2, July 2026, 29-36

ORIGINAL ARTICLE

Association Between Malnutrition and Cognitive Ability Among Children Under Five Years Of Age

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ARTICLE INFORMATION

Article history
Received : July 24, 2026
Revised :August 8, 2026
Accepted : August 9, 2026

Keywords
Cognitive ability; child development; children under five; malnutrition

ABSTRACT

Introduction: *Malnutrition remains a major public health concern associated with impaired cognitive development in early childhood. Objective: This study examined the association between malnutrition and cognitive ability among children aged 1–5 years.* ***Methods****: A cross-sectional study was conducted among 65 children aged 1–5 years recruited through accidental sampling. Nutritional status was assessed using anthropometric measurements based on the World Health Organization Child Growth Standards. Cognitive ability was measured using a 15-item Cognitive Development Questionnaire adapted from Huda (2013) and Virginia (2025). Data were analyzed using descriptive statistics and Pearson's Chi-square test.* ***Results****: Stunting was the most common form of malnutrition (26.2%). Good cognitive ability was observed in 35.4% of participants, while 32.3% had moderate and 32.3% had poor cognitive ability. A significant association was found between malnutrition and cognitive ability ($\chi^2 = 21.111$, $df = 6$, $p = 0.002$).* ***Conclusion****: Malnutrition was significantly associated with cognitive ability among children aged 1–5 years. Routine nutritional assessment and developmental monitoring may support the early identification of children at risk of cognitive delay. Further longitudinal studies are needed to clarify the causal relationship.*

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1. Introduction

Malnutrition remains a major global public health challenge during early childhood. According to the World Health Organization [1], an estimated 149 million children under five years of age are stunted, 45 million experience wasting, and 37 million are overweight, while undernutrition contributes to nearly half of all deaths among children younger than five years. Malnutrition remains one of the most important public health challenges affecting children under five years of age worldwide. According to the 2025 Joint Child Malnutrition Estimates published by the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), and the World Bank, an estimated 150.2 million children (23.2%) under five years of age were stunted, 42.8 million (6.6%) were affected by wasting, and 35.5 million (5.5%) were overweight in 2024. Despite gradual improvements over the past decade, global progress remains insufficient to achieve the Sustainable Development Goal (SDG) target of

ending all forms of malnutrition by 2030. Beyond impaired physical growth, malnutrition has been consistently associated with delayed neurodevelopment, poorer cognitive function, reduced educational attainment, and diminished human capital across the life course [2].

Indonesia continues to face a substantial burden of childhood malnutrition despite ongoing national nutrition programs. This persistent burden highlights the importance of identifying children who may be at risk of developmental problems associated with poor nutritional status. Understanding the relationship between malnutrition and cognitive ability in early childhood is therefore essential to support evidence-based nutritional and developmental policies [3]. Undernutrition, including stunting, wasting, and underweight, and their coexisting forms, not only impairs physical growth but also disrupts neurodevelopment, resulting in poor cognitive performance, delayed learning, and reduced productivity throughout life [4]. These consequences make childhood malnutrition a major concern for achieving optimal child development and human capital[5].

Furthermore, the first 1,000 days of life, spanning from conception to two years of age, represent the most critical period for brain growth and neurodevelopment because this stage is characterized by rapid neurogenesis, synaptogenesis, dendritic arborization, myelination, and neural network formation [6]**.** Adequate intake of energy, protein, essential fatty acids, iron, zinc, iodine, folate, and vitamin B12 during this developmental window is essential for optimal brain maturation [7]. Previous experimental and clinical evidence indicates that nutritional deficiencies during this sensitive period are associated with impaired neuronal maturation, poorer executive function, reduced memory capacity, delayed language development, and suboptimal learning outcomes [6]. Consequently, children experiencing chronic malnutrition consistently demonstrate poorer cognitive performance than their well-nourished peers, emphasizing the importance of early nutritional assessment and developmental monitoring [8].

Previous studies have consistently reported that children experiencing malnutrition tend to demonstrate poorer cognitive performance than their well-nourished peers, particularly in domains related to learning ability, memory, language acquisition, and executive functioning [6]. Cognitive development, however, is a multidimensional process that is influenced not only by nutritional status but also by parental educational attainment, household socioeconomic conditions, home stimulation, recurrent infections, and access to quality healthcare services [9] Parental education and socioeconomic status may influence caregivers' knowledge, feeding practices, access to nutritious foods, and utilization of health services, thereby affecting both children's nutritional status and cognitive development[10] Likewise, inadequate psychosocial stimulation within the home environment and recurrent childhood infections have been associated with delayed cognitive development while simultaneously increasing the risk of malnutrition [11]**.** Furthermore, evidence suggests that interventions integrating nutritional improvement with psychosocial stimulation and parental education are associated with better developmental outcomes than nutrition-focused approaches alone [10]Because these biological, environmental, and social factors are associated with both nutritional status and cognitive development, they may act as potential confounders when interpreting the observed association [9].

Despite the growing body of evidence linking childhood malnutrition with cognitive development, important knowledge gaps remain. Previous studies have predominantly examined the association between single forms of malnutrition, particularly stunting, and cognitive outcomes, whereas fewer studies have evaluated the combined effects of multiple anthropometric deficits on children's cognitive development [6] Moreover, primary healthcare services play an important role in routine growth monitoring, nutritional assessment, developmental screening, and parental counselling, highlighting the need for further evidence

to understand better the relationship between malnutrition and cognitive ability in community-based settings [1].

Therefore, this study aimed to examine the association between different types of malnutrition and cognitive ability among children aged 1–5 years. The findings are expected to provide evidence for pediatric nursing practice and primary healthcare programs in developing integrated strategies to improve children's nutritional status and cognitive development.

2. Methods

This study employed a quantitative cross-sectional design to examine the association between malnutrition and cognitive ability among children under five years of age. The study was conducted from 04 to 30 July 2025 at a primary healthcare center in Indonesia. A cross-sectional approach was selected because it enabled the simultaneous assessment of nutritional status and cognitive ability within the study population.

The target population consisted of all children under five years of age who attended child health services during the study period, with a total population of 78 children. The minimum sample size was determined using the Slovin formula, the study population consisted of children aged 1-5 years diagnosed with malnutrition who attended the primary health care center during the study period. Malnutrition was defined based on the World Health Organization (WHO) Child Growth Standards and included stunting, wasting, underweight, and combinations of these anthropometric deficits. Participants were recruited using an accidental sampling technique, resulting in a total sample of 65 children. Eligible participants were children aged 1-5 years with at least one form of malnutrition whose parents or legal guardians provided written informed consent. Children with congenital anomalies, severe neurological disorders, genetic syndromes, or incomplete assessment data were excluded. Cognitive ability was subsequently assessed using the 15-item Cognitive Development Questionnaire to examine its association with different types of malnutrition.

Malnutrition was assessed using anthropometric measurements obtained by trained health personnel following standardized procedures. Body weight was measured using a calibrated digital weighing scale with an accuracy of 0.1 kg, while body length or height was measured using an Infantometer or portable stadiometer with an accuracy of 0.1 cm according to the child's age. Anthropometric indices were interpreted using the World Health Organization Child Growth Standards to classify nutritional status into wasting, stunting, underweight, and coexisting forms of malnutrition. Cognitive ability was assessed using a 15-item Cognitive Development Questionnaire adapted from Huda (2013) and subsequently applied by Virginia (2025). The questionnaire assesses three domains of cognitive development, namely general knowledge and science, concepts of shape, color, size, and pattern, and number and letter recognition. Each item is scored dichotomously (correct = 1, incorrect = 0), resulting in a total score ranging from 0 to 15, with higher scores indicating better cognitive ability. The instrument was administered by trained healthcare personnel following a standardized assessment procedure. The questionnaire was adopted from previously published studies; however, the original publications did not report detailed psychometric properties, including validity and reliability coefficients. Demographic characteristics, including age and sex, were also recorded using a structured data collection form.

Written informed consent was obtained from the parents or legal guardians of all participating children before data collection. Participation was voluntary, and parents or guardians were informed about the study objectives, procedures, potential benefits, and their right to withdraw at any stage without consequences. The confidentiality and anonymity of all participants were maintained throughout the study, and all data were used solely for research

purposes. As this study did not undergo review by an institutional ethics committee, no ethical approval number was available.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0. Descriptive statistics were used to summarize participants' demographic characteristics, nutritional status, and cognitive ability. Categorical variables were presented as frequencies and percentages. The association between malnutrition and cognitive ability was analyzed using the Pearson Chi-square test, with statistical significance established at $p < 0.05$.

3. Results

Characteristics of the respondents

A total of 65 children under five years of age participated in this study. Table 1 presents the demographic and anthropometric characteristics of the participants. Most participants were male (52.3%), while the remaining 47.7% were female. The distribution of age, body weight, and body height demonstrated that the participants represented various stages of early childhood growth.

Table 1. The demographic characteristics of the respondents

Gender	Frequency (n)	Percentage (%)
Male	34	52.3
Female	31	47.7
Age (Year)	**Frequency (n)**	**Percentage (%)**
1 – 3	44	67.7
4 – 5	21	32.2
Weight (Kg)	**Frequency (n)**	**Percentage (%)**
1 – 5	5	7.7
6 – 10	37	56.9
11-15	23	35,4
Height (cm)	**Frequency (n)**	**Percentage (%)**
50 – 75	22	33.8
76 – 100	43	66.2

Distribution Malnutrition

Table 2 shows the distribution of malnutrition among the participants. Stunting was the most common nutritional disorder, accounting for 26.2% of the children. Wasting, wasting with stunting, and stunting with underweight each represented 24.6% of the study population, indicating that various forms of malnutrition were relatively equally distributed among the participants.

Table 2: Distribution of malnutrition

Malnutrisi	Frequency (n)	Percentage (%)
Wasting & stunting	16	24.6
Stunting & Underweight	16	24.6
Stunting	17	26.2
Wasting	16	24.6
Total	65	100

Distribution of cognitive ability

The distribution of cognitive ability is presented in Table 3. Good cognitive

ability was identified in 23 children (35.4%), whereas moderate and poor cognitive ability were each observed in 21 children (32.3%). These findings indicate that approximately two-thirds of the participants demonstrated moderate to poor cognitive performance

Table 3. Distribution of cognitive ability

Cognitive Ability	Frequency (n)	Percentage (%)
Poor	21	32.3
Moderate	21	32.3
Good	23	35.4
Total	65	100

Association between malnutrition and cognitive ability.

The association between malnutrition and cognitive ability is presented in Table 4. Children with coexisting stunting and underweight demonstrated the highest proportion of poor cognitive ability (75.0%), whereas children with wasting showed the highest proportion of good cognitive ability (56.3%). Pearson's Chi-square analysis revealed a statistically significant association between malnutrition and cognitive ability (χ^2 = 21.111; p = 0.002), indicating that different forms of malnutrition were significantly associated with variations in cognitive performance among children under five years of age

Table 4: Association between malnutrition and cognitive ability (n=65)

Malnutrisi	Cognitive Ability								p	α
	Poor		Moderate		Good		Total			
	n	%	n	%	n	%	n	%		
Wasting & Stunting	2	3.1	7	10.8	7	10.8	16	24.6		
Stunting & Underweight	12	18.5	2	3.1	2	3.1	16	24.6	0.002	0.05
Stunting	4	6.2	8	12.3	5	7.7	17	26.2		
Wasting	3	4.6	4	6.2	9	13.8	16	24.6		
Total	21	32.3	21	32.3	23	35.4	65	100		

Pearson's Chi-square (χ^2) = 21.111; df = 6; p = 0.002

4. Discussion

The present study identified a statistically significant association between different types of malnutrition and cognitive ability among children aged 1–5 years. Specifically, children with combined stunting and underweight tended to demonstrate poorer cognitive ability than children with other forms of malnutrition. These findings are consistent with previous studies reporting that chronic malnutrition is associated with less favorable cognitive outcomes during early childhood rather than establishing a direct causal link [6]. Previous experimental and longitudinal studies have suggested that inadequate intake of essential nutrients during the first 1,000 days of life may be associated with alterations in neurogenesis, synaptogenesis, myelination, and neuronal maturation, processes that are important for optimal cognitive development [10]. In addition, neurodevelopment is influenced by multiple biological, environmental, and social

factors, including parental education, household socioeconomic status, psychosocial stimulation, recurrent infections, and access to healthcare, all of which may contribute to both nutritional status and cognitive development [12]. Therefore, the association observed in the present study should be interpreted cautiously. Because this research employed a cross-sectional design, it cannot determine temporal relationships or establish causality between malnutrition and cognitive ability. Instead, the findings support previous evidence suggesting that poorer nutritional status may be associated with less favorable cognitive development, while longitudinal and intervention studies are required to clarify the causal pathways underlying this relationship.[11]

The present findings are consistent with previous studies demonstrating that chronic malnutrition disrupts normal brain development during the first 1,000 days of life [6]. Deficiencies in protein and essential micronutrients, including iron, zinc, iodine, and folate, interfere with neurogenesis, synaptogenesis, myelination, and neuronal maturation, thereby reducing children's cognitive capacity. Recent evidence has further shown that growth faltering is associated with alterations in brain functional connectivity and neural network organization, suggesting that malnutrition influences not only physical growth but also structural and functional brain development [7] . These biological mechanisms provide a plausible explanation for the lower cognitive performance observed among malnourished children [14]

An important finding of this study is that children experiencing coexisting forms of malnutrition, particularly the combination of stunting and underweight, demonstrated poorer cognitive ability than children with a single anthropometric deficit. The present study identified a statistically significant association between different types of malnutrition and cognitive ability ($\chi^2 = 21.111$, df = 6, $p = 0.002$). Although the current analysis did not estimate effect size measures such as odds ratios or Cramer's V, the observed pattern indicates that children with concurrent forms of malnutrition, particularly stunting combined with underweight, tended to exhibit poorer cognitive ability than those with a single anthropometric deficit. This finding is consistent with the study by [15], which demonstrated that children with multiple anthropometric failures experienced a greater developmental disadvantage than those presenting with only one nutritional deficit. Similarly, [16] reported that concurrent anthropometric failure was associated with markedly poorer cognitive performance, suggesting that the cumulative burden of chronic and acute nutritional deficiencies may be greater than the effect of isolated malnutrition.

Although the direction of the association observed in the present study is comparable with previous findings, direct comparison of the magnitude of the association should be interpreted cautiously because differences in study design, sample characteristics, nutritional classifications, developmental assessment instruments, and statistical methods may influence the reported estimates.[6]. Nevertheless, the consistency of findings across studies strengthens the evidence that children experiencing multiple forms of malnutrition are more likely to demonstrate less favorable cognitive development than children with a single anthropometric deficit. Future longitudinal studies using standardized developmental assessment instruments and effect size estimation are warranted to quantify the strength of this association better.

Although nutritional status plays an important role in early childhood cognitive development, it should not be interpreted as the sole determinant of cognitive outcomes. Previous studies have demonstrated that children's cognitive development is influenced by the interaction of nutritional status with parental education, household socioeconomic conditions, home stimulation, recurrent infections, and access to healthcare services [6] Responsive parenting and cognitively stimulating home environments have also been reported to support language development, executive functioning, and learning capacity, potentially reducing the negative consequences associated with poor nutritional status [17]). Therefore, the findings of the present study suggest that routine nutritional assessment should be complemented by developmental monitoring and parental education to strengthen early childhood development programs in

primary healthcare settings [18]. The present findings suggest that routine nutritional assessment and developmental screening in primary healthcare settings may facilitate the early identification of children who are at risk of cognitive delay. Integrating nutritional monitoring with parental education may further support child health programs and contribute to improved developmental outcomes.

This study has several limitations. First, the cross-sectional design identifies an association but does not establish a causal relationship between malnutrition and cognitive ability. Second, the use of accidental sampling may have introduced selection bias and limited the generalizability of the findings. Finally, cognitive development is influenced by multiple environmental and socioeconomic factors that were not measured in this study. Therefore, future longitudinal studies using probability sampling and standardized developmental assessment instruments are recommended to provide stronger evidence.

5. Conclusion

This study demonstrated that malnutrition was associated with cognitive ability among children under five years of age. Children experiencing multiple forms of malnutrition, particularly concurrent stunting and underweight, were more likely to exhibit poorer cognitive performance than those with a single nutritional deficit. These findings reinforce the importance of optimal nutrition during early childhood as a fundamental component of brain development and cognitive function.

The study contributes to the growing evidence that improving child cognitive development requires an integrated approach that extends beyond nutritional rehabilitation alone. Early identification of nutritional problems should be accompanied by developmental screening, parental education, and psychosocial stimulation through primary healthcare services. Strengthening these integrated interventions has the potential to enhance child development outcomes and support the achievement of better health and human capital in the future.

Future research should employ longitudinal or intervention designs with larger and more diverse populations to clarify causal relationships and evaluate the effectiveness of comprehensive strategies that combine nutritional improvement, family-based stimulation, and community health interventions.

Author's Contribution Statement:

Magfirah: composed the draft research, data collection, data analysis, and compilation of research and articles for external: Mikawati and Rizky Pratiwi: supervision and revision; Makkasau and Evi Lusiana: Supervision

Conflicts of Interest:

The authors declare that there are no conflicts of interest regarding the publication of this article. The authors have no financial or personal relationships with any entities that could inappropriately influence or bias the content of this study.

Acknowledgments:

The authors would like to express their sincere gratitude to the Head of the Tamamaung Health Center and all staff for the permission and support provided in the implementation of this research. The authors also extend their appreciation to the research supervisor for valuable academic guidance and support throughout the research process

References

[1] WHO. Guideline on the complementary feeding of infants and young children aged 6 – 23 months 2023 : A multisociety response. 2024; 181–188.
[2] UNICEF. Levels and trends child malnutrition: UNICEF/WHO/World Bank Group Joint Child Malnutrition Estimates. *Geneva: WHO* 2020; 24: 1–16.
[3] Sri Hartati; dkk. *STUNTING*. Jakarta: PT Nuansa Fajar Cemerlang, 2024.
[4] Kirolos A, Goyheneix M, Kalmus Eliasz M, et al. Neurodevelopmental, cognitive, behavioural and mental health impairments following childhood malnutrition: A systematic review. *BMJ Global Health* 2022; 7: 1–14.
[5] Suryawan A, Jalaludin MY, Poh BK, et al. Malnutrition in Early Life and Its Neurodevelopmental and Cognitive Consequences: A Scoping Review. *Nutrition Research Reviews* 2021; 35: 136–149.
[6] Georgieff M, Ramel SE, Cusick SE. Nutritional Influences on Brain Development. *Acta Paediatrica* 2018; 107: 1310–1321.
[7] Hartjen B, Rahman N, Greaves G, et al. The Association Between Malnutrition and Cognitive Development in Infancy as Manifest in EEG Functional Connectivity and Power Spectral Density. *medRxiv Advance online publication*. Epub ahead of print 2024. DOI: https://doi.org/10.1101/2024.09.11.24313505.
[8] Turesky TK, Xie W, Kumar S, et al. Relating Anthropometric Indicators to Brain Structure in 2-Month-Old Bangladeshi Infants Growing Up in Poverty: A Pilot Study. Epub ahead of print 2019. DOI: 10.1101/655068.
[9] Turesky TK, Shama T, Kakon SH, et al. Brain Morphometry and Diminished Physical Growth in Bangladeshi Children Growing Up in Extreme Poverty: A Longitudinal Study. Epub ahead of print 2021. DOI: 10.1101/2021.02.24.432797.
[10] Obradović J, Yousafzai AK, Finch JE, et al. Maternal Scaffolding and Home Stimulation: Key Mediators of Early Intervention Effects on Children's Cognitive Development. *Developmental Psychology* 2016; 52: 1409–1421.
[11] Shama T, O'Sullivan JM, Rahman N, et al. Multidimensional Evaluation of the Early Emergence of Executive Function and Development in Bangladeshi Children Using Nutritional and Psychosocial Intervention: A Randomized Controlled Trial Protocol. Epub ahead of print 2023. DOI: 10.1101/2023.12.16.23300075.
[12] Turesky TK, Shama T, Kakon SH, et al. Brain morphometry and diminished physical growth in Bangladeshi children growing up in extreme poverty: A longitudinal study. *Developmental Cognitive Neuroscience* 2021; 52: 101029.
[13] Xie W, Jensen SKG, Wade M, et al. Growth Faltering Is Associated With Altered Brain Functional Connectivity and Cognitive Outcomes in Urban Bangladeshi Children Exposed to Early Adversity. *BMC Medicine*; 17. Epub ahead of print 2019. DOI: 10.1186/s12916-019-1431-5.
[14] Xie W, Jensen SKG, Wade M, et al. Child Growth Predicts Brain Functional Connectivity and Future Cognitive Outcomes in Urban Bangladeshi Children Exposed to Early Adversities. Epub ahead of print 2018. DOI: 10.1101/447722.
[15] Khaliq A, Wraith D, Nambiar S, et al. A Review of the Prevalence, Trends, and Determinants of Coexisting Forms of Malnutrition in Neonates, Infants, and Children. *BMC Public Health*; 22. Epub ahead of print 2022. DOI: 10.1186/s12889-022-13098-9.
[16] Mireku MO, Cot M, Massougbodji A, et al. Relationship Between Stunting, Wasting, Underweight and Geophagy and Cognitive Function of Children. *Journal of Tropical Pediatrics* 2020; 66: 517–527.
[17] Camerota M, Willoughby MT. Applying Interdisciplinary Frameworks to Study Prenatal Influences on Child Development. *Child Development Perspectives* 2021; 15: 24–30.
[18] Lebov J, Hamad APA, Kousa YA. Social Determinants Impact Both Viral Infections and Brain Development. *Pediatric Research* 2025; 98: 2545–2553.