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Maternal knowledge and Determinants to Cognitive Development of Stunted Toddlers in Bantul Regency, Yogyakarta

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ABSTRACT

Background: Stunting remains a major public health issue in Indonesia, with a prevalence of 21.6% in 2021 well above the SDG target of 14% by 2030. Beyond physical growth, stunting significantly impairs cognitive development, influencing future learning ability and productivity. Contributing factors include nutritional status, age, sex, birth conditions, and maternal knowledge.

Purpose: This study aimed to examine the association between maternal knowledge and other determinants with the cognitive development of stunted toddlers.

Methods: A cross-sectional study was conducted involving 48 mothers of stunted toddlers in Bantul Regency, Yogyakarta, selected via purposive sampling. Stunting was defined as a height-for-age z-score < -2 SD. Child cognitive function was measured using the Bayley-III, and maternal knowledge was assessed through a validated questionnaire. Statistical analysis included chi-square tests and logistic regression ($p < 0.05$; 95% CI), with model fit evaluated using AIC and R^2.

Results: Maternal knowledge was significantly associated with child cognitive development. Surprisingly, children of mothers with "adequate" knowledge had better cognitive outcomes compared to those with "good" knowledge (RR = 1.53; 95% CI: 1.48–1.59; $p < 0.01$). Other significant predictors included birth order (RR = 1.50 and 1.01; $p < 0.05$), gestational age (RR = 0.71; $p < 0.01$), low maternal education (RR = 1.33; $p < 0.01$), and maternal employment (RR = 1.42; $p < 0.1$ and $p < 0.05$). Child age was not significantly associated.

Conclusion: Maternal knowledge is a key determinant of cognitive development in stunted toddlers, even when controlling for demographic and social variables. Additional factors such as birth order, gestational age, maternal education, and employment also contribute. Holistic, stage-based interventions are essential to support cognitive development in stunted children.

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INTRODUCTION

Stunting is a condition of growth failure in children caused by chronic nutritional deficiency that occurs during the first thousand days of life, covering the period from early pregnancy to two years of age. Based on the 2018 Basic Health Research (Riskesdas) report, the prevalence of stunting in Indonesia reached 21.6%, indicating that about 1 in 5 toddlers experience growth retardation (1). The 2022 Indonesian Nutrition Status Survey (SSGI) recorded a decrease in the stunting rate from 24.4% the previous year to 21.6%, although this figure is still far from the 2024 reduction target of 14% (2).

Stunting not only affects physical growth but also long-term development, especially children's cognitive functions. Data from the World Bank shows that children with a history of stunting are at higher risk of low academic achievement and social skill difficulties (3). Research by Ekholuenetale supports this finding, showing that stunted children tend to have lower cognitive abilities compared to normally growing children, which affects the learning process (4). Stunting caused by chronic nutritional deficiency is also linked to cognitive developmental disorders (5-8). Cognitive development is an essential foundation for long-term human resource quality (9). Children with growth retardation are more vulnerable to cognitive delays that impact learning ability, productivity, and health in adulthood (10-12).

Early childhood development (toddlers) is a critical phase requiring special attention, with rapid brain growth and development. Appropriate interventions are crucial to prevent the long-term impact of stunting. In efforts to reduce stunting prevalence, focusing on non-physical factors such as cognitive function is becoming increasingly relevant. One key determinant is the mother's level of knowledge (13). As the primary caregiver, the mother plays an important role in providing nutrition, early stimulation, and monitoring growth and development (14-16). Good maternal knowledge supports child growth stimulation (17) and more accurate decision-making, especially for children experiencing stunting. Other studies also show that the mother's employment status is related to maternal knowledge about stunting (18, 19).

In stunting prevention efforts, various determinant factors play important roles, with the child's nutritional status as a key factor in physical and cognitive development. Children with poor nutritional status, such as wasting, underweight, or stunting, are more vulnerable to infections and diseases that can worsen their development. Research by Lee shows that children at risk of stunting more frequently experience malnutrition (20). Long-term nutritional deficiency can disrupt brain and physical growth, as well as affect children's future learning abilities.

The child's age is also an important factor in determining the effectiveness of nutritional interventions. The 0-24 months period is known as a critical phase due to very rapid brain and physical development and high nutritional needs. Research by Black states that nutritional interventions conducted before the age of two can have a significant positive impact on cognitive abilities and academic achievement later on (21). Conversely, delay in intervention can increase the risk of cognitive developmental disorders.

Biological and social factors, such as gender and type of delivery, also affect children's cognitive development. Research shows that boys are more vulnerable to the negative effects of malnutrition than girls, both hormonally and environmentally (22). In addition, the type of delivery affects the child's early health status. Normal delivery is more often associated with exclusive breastfeeding and early mother-child interaction that supports neurological development. Research by Polidano shows that children born naturally have better cognitive development compared to those born by cesarean section (23).

Age and education of the mother are important factors influencing child development, especially in children experiencing stunting. Research by Rokhanwati and Nuzuliana shows that most children with adolescent mothers do not experience stunting, but 56.7% have developmental delays (24). Research by Pezzuti found that children raised by mothers with secondary education or higher have better cognitive abilities and a 30% lower risk of stunting compared to children of mothers with basic education (25).
This study aims to evaluate the relationship between the mother's level of knowledge and cognitive development of stunted toddlers, as well as several other influencing variables.

METHOD

The researcher applied a quantitative approach with a cross-sectional design. The target population consisted of all mothers who have toddlers (aged 0–5 years) with stunting status in the Bantul Regency area of Yogyakarta.

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The sample size in the study was 48 mothers who have stunted toddlers. Sampling was done using purposive sampling techniques to select respondents who met the inclusion and exclusion criteria. The researcher used the following inclusion criteria: 1) mothers with stunted children aged 6–59 months; 2) mothers willing to be respondents; and 3) mothers residing in the Bantul Yogyakarta area. The exclusion criteria included: 1) children with severe disabilities; and 2) mothers experiencing cognitive impairments or communication difficulties that hinder the questionnaire filling process.

The variables in this study were: 1) independent variable: maternal knowledge level about child cognitive development; 2) dependent variable: cognitive development of stunted toddlers; and 3) control variables: child's gender, child's age, birth order, nutritional status, type of delivery, gestational age, mother's age, mother's education level, and mother's employment status.

Anthropometric measurements were performed to assess stunting (height-for-age z-score <-2 SD). Cognitive function was evaluated using the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III). Maternal knowledge level was assessed using a questionnaire. The cut-off points between the "adequate" and "good" categories in maternal knowledge scores were based on the median of each group. The median score for "adequate" was 77.5, and for "good" it was 85. The midpoint between them, 81.25, was used as the cut-off. Scores below 81.25 are labeled "adequate", while scores of 81.25 or higher are labeled "good".

Data analysis used Stata version 17 software. Analysis included: univariate analysis to describe data distribution, bivariate analysis with the chi-square test to assess relationships between variables, and multivariate analysis using logistic regression to calculate the Risk Ratio (RR), p-value < 0.05, and 95% confidence interval (CI) to determine statistical significance. The researcher evaluated the fit of the statistical model using Akaike Information Criterion (AIC) values and the coefficient of determination (R^2). This study passed the ethical feasibility test by the Research Ethics Committee of Aisyiyah University Yogyakarta with No. 3951/KEP-UNISA/VIII/2024.

RESULTS

Table 1 presents an analysis of maternal knowledge characteristics regarding various variables related to the cognitive development of stunted children. This data illustrates the distribution of maternal knowledge levels in the categories of "adequate" and "good" regarding factors such as the child's gender, age, nutritional status, type of delivery, and the mothers' own characteristics.

Table 1. Analysis of Maternal Knowledge Characteristics Regarding Variables Related to the Cognitive Development of Stunted Children

Variable	Maternal knowledge		p-values
	Adequate n [%]	Good n [%]	
N	**24 [50.0]**	**24 [50.0]**	
Child's Gender			
Male	16 [66.7]	13 [54.8]	
Female	8 [33.3]	11 [45.8]	0.38
Child's Age			
≤ 24 months	10 [40.9]	4 [16.7]	
> 24 months	14 [59.1]	20 [83.3]	0.06
Child Number			
1 dan ≥ 3	13 [54.2]	14 [58.3]	
2	11 [45.8]	10 [41.7]	0.77
Nutritional status			
Abnormal (undernutrition and overnutrition)	4 [16.7]	6 [25.0]	
Normal	20 [83.3]	18 [75.0]	0.48
Type of delivery			
Operasi Sectio Sesarea (SC)	10 [41.7]	9 [37.5]	
Normal	14 [58.3]	15 [62.5]	0.77
Gestasional Age			
Premature	3 [12.5]	3 [12.5]	
Mature	21 [87.5]	21 [87.5]	1.00
Mother's Age			
≤ 35 years	15 [62.5]	12 [50.0]	
> 35 years	9 [37.5]	12 [50.0]	0.38
Mother's Education			
Low (Elementary and Junior High School)	7 [29.2]	4 [16.7]	
High (Senior High/Vocational school and Higher Education)	17 [70.8]	20 [83.3]	0.30
Mother's Job			
Working	11 [45.8]	13 [54.2]	
Not Working	13 [54.2]	11 [45.8]	0.56

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The analysis results show that most variables do not have a statistically significant relationship with the mother's level of knowledge. The maternal knowledge does not differ meaningfully according to the child's gender, birth order, nutritional status, delivery type, gestational age, mother's age, education, or employment status.

However, there is a practically important tendency regarding the child's age. Mothers of younger children (≤ 24 months) tend to have lower levels of knowledge compared to mothers of children older than 24 months. Although this difference has not reached statistical significance, the p-value approaches the significance threshold, indicating a potential relationship that needs further exploration.

These findings suggest that demographic and biological factors such as the child's age may play a role in shaping the mother's level of knowledge about cognitive development, while other characteristics like education or employment do not show a strong influence in this context.

Table 2. Bivariate analysis of the relationship between maternal knowledge and determinant factors with cognitive development

Variable	Cognitive development		RR	95% CI	p-values
	Low n [%]	Normal n [%]			
Maternal knowledge					
Adequate	11 [73.3]	13 [39.4]	2.8	1.02-7.43	0.03
Good	4 [26.7]	20 [60.6]			
Child's Gender					
Male	10 [66.7]	19 [57.6]	1.3	0.53-3.23	0.55
Female	5 [33.3]	14 [42.4]			
Child's Age					
≤ 24 months	8 [53.3]	6 [18.2]	2.8	1.24-6.18	0.01
> 24 months	7 [46.7]	27 [81.8]			
Anak ke					
1 dan ≥ 3	11 [73.3]	16 [48.5]	2.1	0.79-5.77	0.11
2	4 [26.7]	17 [51.5]			
Nutritional status					
Abnormal (undernutrition and overnutrition)	4 [26.7]	6 [18.2]	1.4	0.56-3.42	0.50
Normal	11 [73.3]	27 [81.8]			
Type of delivery					
Operasi Sectio Sesarea (SC)	7 [46.7]	12 [36.4]	1.1	0.76-1.73	0.51
Normal	8 [53.3]	21 [63.6]			
Gestasional Age					
Premature	1 [6.7]	5 [15.2]	0.8	0.53-1.21	0.29
Mature	14 [93.3]	28 [84.8]			
Mother's Age					
≤ 35 years	10 [66.7]	17 [51.5]	1.2	0.83-1.76	0.32
> 35 years	5 [33.3]	16 [48.5]			
Mother's Education					
Low (Elementary and Junior High School)	5 [33.3]	6 [18.2]	1.7	0.73-3.88	0.24
High (Senior High/Vocational school and Higher Education)	6 [40.0]	14 [42.4]			
Mother's Job					
Working	11 [73.3]	13 [39.4]	1.5	1.02-2.32	0.04
Not Working	4 [26.7]	20 [60.6]			

The analysis results in Table 2 show that the mother's level of knowledge has a statistically significant relationship with the cognitive development of stunted children. Children of mothers with moderate knowledge are more likely to experience cognitive developmental delays compared to children of mothers with good knowledge.

In addition, the child's age is also significantly correlated with cognitive status. Children aged ≤ 24 months are at higher risk of cognitive developmental disorders compared to older children. This finding indicates that early life is a critical period for cognitive development, especially in stunted children.

The mother's occupation is also significantly related to the child's cognitive development. Children cared for by working mothers tend to experience higher cognitive delays compared to children cared for by non-working mothers. This may be related to limited interaction and caregiving time among working mothers.

Meanwhile, other variables such as the child's gender, birth order, nutritional status, type of delivery, gestational age, mother's age, and mother's education do not show statistically significant relationships with

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cognitive development. Nevertheless, some variables such as birth order and mother's education show trends that are practically relevant, although they have not reached statistical significance.

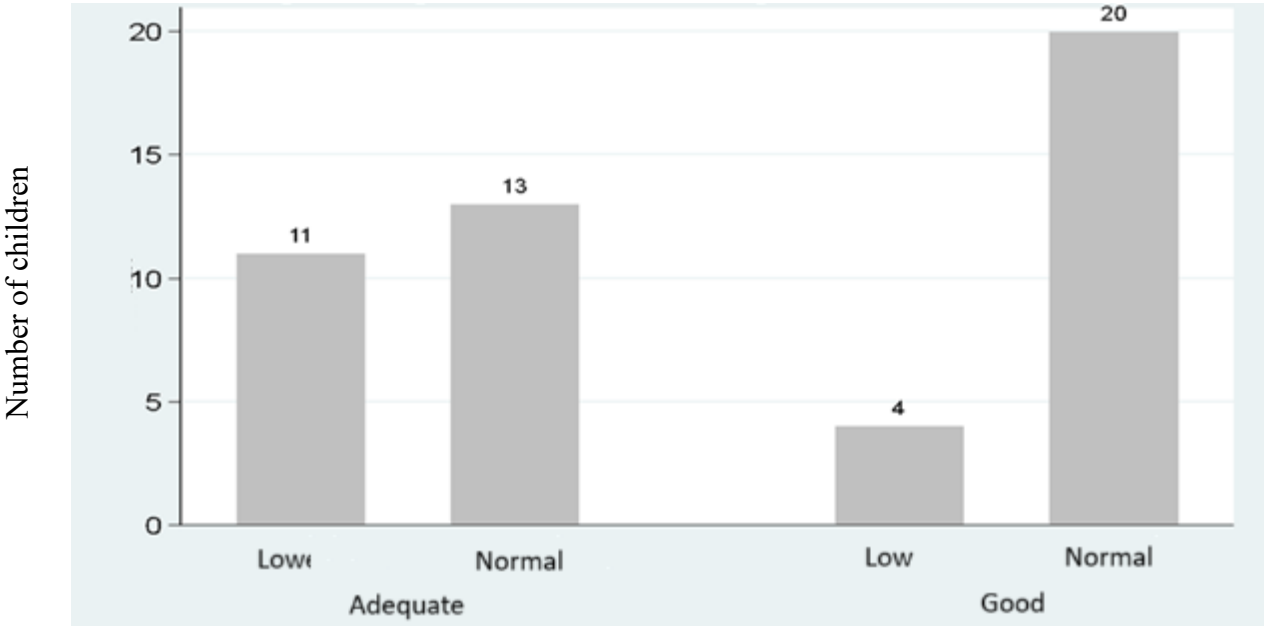

Figure 1. Cognitive development of stunted children based on maternal knowledge

Figure 1 shows a higher proportion of children with normal cognitive development in the group of mothers who have good knowledge levels, compared to mothers with adequate knowledge. Meanwhile, among mothers with adequate knowledge, the distribution between children with normal and low cognitive development appears more balanced. These findings indicate that a good level of maternal knowledge can contribute to a greater likelihood of children achieving optimal cognitive development.

Table 3. Multivariate analysis of the relationship between maternal knowledge and cognitive development in stunted children

Cognitive Development	Model 1 RR [95% CI]	Model 2 RR [95% CI]	Model 3 RR [95% CI]	Model 4 RR [95% CI]	Model 5 RR [95% CI]	Model 6 RR [95% CI]	Model 7 RR [95% CI]
Maternal knowledge							
Adequate	1.54** [1.02, 2.33]	1.31 [0.88, 1.89]	1.62*** [1.12, 2.34]	1.56* [1.05, 2.31]	1.49* [0.99, 2.24]	1.61* [1.14, 2.28]	1.53*** [1.48, 1.59]
Good	1 [1, 1]	1 [1, 1]	1 [1, 1]	1 [1, 1]	1 [1, 1]	1 [1, 1]	1 [1, 1]
Child's Age							
≤ 24 months		1.63 [0.88, 3.04]					1.41 [0.88, 2.27]
> 24 months		1 [1, 1]					1 [1, 1]
Anak ke							
1 dan ≥ 3			1.50** [1.00, 1.65]				1.01*** [1.00, 1.05]
2							1 [1, 1]
Gestasional Age							
Premature				0.81*** [0.63-0.94]			0.71*** [0.67, 0.75]
Mature				1 [1, 1]			1 [1, 1]
Mother's Education							
Low					1.21 [0.71, 2.05]		1.33*** [1.25, 1.42]
High					1 [1, 1]		1 [1, 1]
Mother's Job							
Working						1.61* [1.14, 2.28]	1.42** [1.05, 1.92]
Not Working						1 [1, 1]	1 [1, 1]
N	**48**	**48**	**48**	**48**	**48**	**48**	**48**
R^2	**0.08**	**0.15**	**0.14**	**0.10**	**0.09**	**0.19**	**0.30**
AIC	**123.3**	**122.3**	**125.1**	**120.9**	**120.1**	**127.5**	**114.9**

Exponentiated coefficients; 95% confidence intervals in brackets
* p<0.1, ** p<0.05, *** p<0.01

The multivariate analysis results in Table 3 show that the mother's level of knowledge is consistently significantly related to the cognitive development of stunted children. Children of mothers with "adequate"

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knowledge have a higher chance of better cognitive development compared to children of mothers with "good" knowledge, with risk ratios (RR) ranging from 1.49 to 1.62 across several models. This relationship is statistically significant in Models 1, 3, 4, 6, and 7 ($p < 0.05$), and is strongest in Model 3 (RR = 1.62; 95% CI: 1.12–2.34; $p < 0.01$) and Model 7 (RR = 1.53; 95% CI: 1.48–1.59; $p < 0.01$).

Birth order (1st or 3rd child) is significantly related to cognitive development, especially in Models 2 and 7 (RR = 1.50 and 1.01; $p < 0.05$), although the effect size is small. Gestational age shows a protective effect; children born full term has a lower risk of cognitive delay, as shown in Models 4 and 5 (RR = 0.81 and 0.71; $p < 0.01$). Low maternal education significantly increases the risk of cognitive impairment in children (Model 6: RR = 1.33; $p < 0.01$).

Mother's employment also contributes significantly to the child's cognitive development. Children of working mothers show a higher likelihood of cognitive development, as seen in Models 6 and 7 (RR = 1.61 and 1.42; $p < 0.1$ and $p < 0.05$, respectively). Meanwhile, the child's age (≤ 24 months) does not show a significant relationship in any model, meaning age is not a main predictor in the multivariate model when other variables are controlled.

Model 7 is the best model both statistically and practically. This model explains 30% of the variation in cognitive development ($R^2 = 0.30$) and has the lowest Akaike Information Criterion (AIC) value (114.9), indicating high model efficiency compared to the others.

DSCUSSION

Stunting is a chronic nutritional problem that affects growth indicators. Stunting is a physical growth disorder characterized by a slowed growth rate caused by inadequate nutritional intake in children during the first 1000 days of life.

1. The Relationship Between Maternal knowledge and Cognitive Development in Stunted Toddlers

The research results show that there is a significant relationship between maternal knowledge and cognitive development (p-value 0.03) with an RR value of 2.8 (95% CI 1.02-7.43), indicating that mothers with inadequate knowledge have nearly three times the risk of having children with low cognitive development compared to those with good knowledge. A person's knowledge can be influenced, among other things, by their level of education. Findings from this study indicate that mothers with higher education levels are significantly more likely to be in the group with good knowledge. This aligns with Hanifah who stated that education is one of the important and significant factors affecting maternal knowledge about stunted toddlers (18). Mothers with higher education find it easier to receive information and improve their understanding of the cognitive development of stunted children. Halim also reported in their literature review that maternal knowledge can influence stunting in toddlers (26).

A maternal knowledge plays a significant role in daily decision-making related to parenting styles, nutrition fulfillment, early stimulation, and monitoring a child's growth and development. Providing education about child development stimulation influences a mother's behavior in delivering developmental stimulation to the child, making it routine and focused (27). When a mother has a good understanding of the importance of nutrition and stimulation during the golden period of brain development, the chances for the child to achieve optimal cognitive development increase (13, 15). Conversely, limited knowledge can hinder the fulfillment of a child's basic needs, especially in the context of stunting, which requires extra attention in terms of nutrition and developmental interventions.

Maternal knowledge level does not stand alone but is influenced by various socio-demographic factors, especially the level of education. This study also reveals that mothers with secondary to higher education tend to have better knowledge. This finding is consistent with previous studies showing that mothers with a higher educational background have wider access to health information and are able to process and apply that information more effectively in caregiving practices (9, 14).

According to Pezzuti, factors contributing to stunting include maternal nutritional status, maternal education, and good feeding practices (25). The study shows that mothers with good knowledge of nutrition have a lower risk of stunting occurrence in children. This research supports the findings of Hurun that maternal knowledge is the most dominant factor contributing to stunting

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compared to other factors such as low birth weight history, complementary feeding, and infection disease history (28).

Factors such as education and maternal age within the healthy reproductive category also contribute to the quality of knowledge possessed. In this study, most mothers (56%) were within the ideal productive age, biologically and psychologically enabling them to carry out caregiving functions more optimally. Healthy reproductive age is associated with physical and emotional readiness to raise children, including in applying parenting patterns that support the child's overall development (16).

The implications of this research are very important in the context of efforts to combat stunting in Indonesia. Focusing on nutrition interventions alone is not enough; a comprehensive approach that also includes education and empowerment of mothers as the primary caregivers is needed. Integrated nutrition and parenting counseling programs can be an effective strategy to improve maternal knowledge, especially in areas with high stunting prevalence.

In addition, community-based approaches such as Posyandu and health cadres can also be maximized to continuously disseminate relevant information. These interventions must consider cultural aspects, language, and accessibility of information to ensure their effectiveness. By broadly and evenly increasing maternal knowledge, it is hoped that the cognitive development quality of toddlers, especially those experiencing stunting, can be significantly improved.

2. The Relationship of Maternal and Child Determinant Factors with the Cognitive Development of Stunted Toddlers

Cognitive development is an important foundation in supporting the quality of life and long-term learning for children. The analysis results in Table 2 show that the age of the child has a significant relationship with cognitive development in stunted toddlers ($p = 0.01$). Stunted children under two years old are more vulnerable to cognitive delays compared to older children, emphasizing the importance of intervention during the first 1,000 days of life (11, 21). Other studies have shown that the age of the child significantly affects cognitive development, especially in children aged 0-3 years in areas with a high prevalence of stunting (29). The results of the study by Alam also reinforce these findings, showing that children who have experienced early stunting have lower cognitive scores compared to those who have never been stunted (5).

The early life period is a critical phase of brain development, where malnutrition can cause permanent structural and functional disorders. As a result, children become more at risk of cognitive deficits that impact academics, productivity, and mental health in the future (10). Abdelkarim found that children's cognitive development is influenced by age, with cognitive abilities improving proportionally with increasing age (30). This result aligns with the views of Schott, who stated that younger children have a higher risk of stunting, which can affect cognitive ability (31). Meanwhile, the regression analysis results showed that children's age did not have a significant relationship with cognitive development. This means that age is not a primary predictor of cognitive development in this study. Cross-cultural research also indicates that variations in cognitive achievement are not always related to age (32). A longitudinal study by Linberg showed that a child's age does not affect cognitive development (33).

Based on the analysis results, birth order affects the cognitive development of stunted toddlers. The second child tends to show better cognitive development compared to the first child. This is possibly due to more mature parental experience and sibling interaction enriching social and language stimulation (20, 34, 35). However, this factor is also influenced by the family's nutritional and socio-economic conditions. The first child in a family with limited resources may receive less optimal care, whereas the second child might get better care due to increased parental readiness. Growth disturbances at ≤ 24 months are consistently associated with low cognitive scores (6). These results differ from the findings in this study where the child's age (≤ 24 months) was not a main predictor in this multivariate analysis when analyzed alongside birth order, gestational age, and the mother's education and employment.

These results do not align with the research of Bleske-Rechek and Roper, which found that firstborn children often excel more in academic achievement, related to cognitive ability, compared to

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younger siblings (36). This may also be a factor because, based on multivariate analysis results, birth order is significantly associated with delayed cognitive development.

The analysis results in Table 2 show that the child's sex, nutritional status, type of delivery, gestational age, mother's age, and education are not significantly related to cognitive development. These factors do not directly affect the cognitive development of stunted toddlers. This finding is consistent with Moore, who stated that sex differences do not significantly determine early childhood cognitive function, as environmental stimulation plays a more dominant role than biological factors (37).

Child nutritional status also does not show a significant relationship with cognitive development, unlike the findings of Sharma, who reported a significant correlation. This difference is likely due to the influence of other factors, such as home stimulation and parental involvement, which can mitigate the negative effects of malnutrition (38).

The type of delivery, whether vaginal or cesarean, does not have a significant effect on the child's cognitive development. This result supports the view of Slee and Shute that the mode of delivery does not impact neurological development as long as the process is safe and free from complications (39).

Gestational age is significantly related, suspected because most respondents gave birth at full-term gestational age, making the data homogeneous and not showing significant differences. Gestational age directly affects cognitive ability, including in children born at 37–38 weeks gestation (40). A longitudinal study on 414 children born at <28 weeks showed IQ scores 7-12 points lower compared to the normal gestational age control group (41). Children born prematurely, that is before 28 weeks gestation, tend to have lower thinking and learning abilities, including lower IQ scores and needing longer time to process information (42).

This research found no significant relationship between the mother's age and the child's cognitive development. A study in 15 countries found that the cognitive development of children aged 3-5 years is not directly correlated with the mother's age. This aligns with the findings of von Hinke, which showed that the biological age of the mother does not affect cognitive development (43). Researchers observed no significant cognitive differences between children of teenage mothers versus young adult mothers when environmental factors were controlled.

Education factors also showed a significant relationship with the cognitive development of stunted toddlers. This is consistent with Hanifah, who stated that education has a positive contribution to the cognitive development of stunted children (18). Lanjekar explained that the quality of parenting and emotional interaction are more decisive than the mother's age and formal educational background (44). Suryawan explained that the mother's education has a significant impact on the cognitive development of stunted toddlers (8).

Interestingly, stunted children raised by working mothers show a higher risk of cognitive delay compared to stunted children from non-working mothers. Jeong emphasize the importance of intensive caregiving during the first 1,000 days of life (15). Research by Stephiana and Wisana shows that children of mothers who work long hours have a higher risk of stunting and lower cognitive development outcomes (45). They receive less attention and care needed, which directly contributes to developmental delays. A mother's work can affect the amount of time available to care for the child as well as the family income that can be used for the child's nutritional needs. These findings reinforce the role of the mother's direct involvement in providing cognitive stimulation, especially for children in vulnerable conditions such as stunting.

According to Pradana and Rong, parenting styles influence parental strategies in preventing and managing stunting (46). Therefore, stunting intervention strategies should not only focus on nutritional improvements but also include parenting education that considers the child's age, birth status, and family social conditions. Research by Rokhanawati et al shows that peer education programs in parenting enable young mothers to share experiences regarding their children's growth and development, as well as provide psychological support to those mothers (47). Overall, this program affects parenting self-efficacy, young mothers' parenting behavior, and their children's growth and development. An integrated intervention approach involving the roles of mothers, children, and the

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environment is necessary to reduce the long-term impact of stunting on children's cognitive development.

3. Limitations of the Research

This research has several limitations. The small sample size may limit the statistical power to detect significant relationships, especially for variables with small effects, and the limited sample may not be fully representative of the larger population. In addition, the population studied consisted of mothers with stunted children, a vulnerable group, so the results of this study are more relevant to similar populations and cannot be generalized to other groups. Therefore, further research with larger, more diverse samples and longitudinal approaches is highly needed to strengthen and expand these findings.

Conclusion

Maternal knowledge is a key determinant in the cognitive development of stunted children, even after controlling for other demographic and social variables. Other factors such as birth order, gestational age, occupation, and mother's education also make important contributions. These results support a multidimensional intervention approach that not only focuses on the child's nutritional status but also on enhancing parenting capacity and maternal education to optimize child growth and development, especially for vulnerable groups such as those with stunting. These findings confirm that addressing stunting in toddlers requires holistic health education interventions to optimize the cognitive development of stunted children.

Author Contributions

Dewi Rokhanawati: Conceptualization, Methodology, Data collection, Writing - Original draft preparation.
Nidatul Khofiyah: Conceptualization, Methodology, Data collection, Writing - Original draft preparation.
Elika Puspitasari: Data collection, Writing - Original draft preparation.

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