

Maternal and nutritional factors associated with early childhood development in rural Indonesia

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ABSTRACT

Introduction: Nutritional status during childhood and maternal knowledge are priority health issues. This study aimed to examine the predictive value of nutritional status and maternal knowledge on the mental and psychomotor development in toddlers.

Method: A cross-sectional study was carried out involving 106 mother-child pairs. Nutritional status was assessed using Z-scores, while maternal knowledge was categorized using a validated questionnaire. Child development data were measured using the Bayley Scales of Infant and Toddler Development, Third Edition. Data were analysed using binary logistic regression to determine the adjusted odds ratio (AOR).

Result: The findings indicated that both nutritional status and maternal knowledge were significant predictors of delays in child development. Children with stunting had increased odds of psychomotor developmental delay (AOR = 12.1) and mental developmental delay (AOR = 7.6). Moreover, mothers with poor knowledge were significantly associated with increased odds of child psychomotor delay (AOR = 5.3).

Conclusion: Both child nutritional status (stunting) and maternal knowledge were significant predictors of psychomotor delay. These findings suggest that addressing physical growth deficits and enhancing maternal awareness are equally critical to mitigating child developmental risks

Keywords: stunting; psychomotor; development; knowledge; Indonesia

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Introduction

The factors influencing child development are complex. One of the most important relationships is that between parents and children. Childhood is a crucial period, particularly the first 1,000 days of life. Adequate nutrition and environmental stimulation are vital during this period to prevent chronic malnutrition and stunting.^[1]

Stunting is associated with developmental delays in early childhood. Preventive initiatives need to be established and nutritional advice provided.^[2] Besides, child development is not only a biological process but also dependent on the household environment.^[3] Maternal knowledge is a key factor, as it will determine the quality of nutritional intake and the amount of developmental stimulation the child receives.^[4] Expanding access to health information for mothers and establishing educational programmes are imperative strategies towards reducing stunting among children below the age of two.^[5]

Healthy eating enhances brain performance and intelligence. Although the link between nutrition and growth has long been recognized,^[4] few studies have evaluated the effects of child nutritional status and maternal health literacy on child development simultaneously. This study aimed to assess the degree to which stunting and mother nutritional awareness raise the risk of mental and psychomotor impairments in children.

Method

A cross-sectional study of 106 mother-child pairs was conducted. The study population was children aged 6-22 months who had lived in the study area for at least six months. Inclusion criteria were that children lived with their biological mothers and had no history of serious illnesses that could cause developmental problems. The sample was the entire population of one village.

Toddler psychomotor and mental development were the dependent variables and were assessed using the Bayley Scales of Infant and Toddler Development, Third Edition (BSITD-III). Independent variables included child nutritional status and mothers' knowledge regarding stunting and child development (their understanding of its general meaning, causes, and prevention).

Descriptive statistics were used to summarize the data. Chi-squared tests were initially conducted to identify independent variables that were significantly associated with the dependent variable. Binary logistic regression was then employed to determine adjusted odds ratios (AORs) with 95% confidence intervals (CI). Statistical analyses were performed using SPSS Version 24.

This study received approval from the Health Research Ethics Committee of the National Research and Innovation Agency (No. 180/KE.03/SK/07/2025). All parents signed informed consent before participating.

Results

Nearly half the mothers had insufficient knowledge regarding stunting and child development. About a quarter (26.4%) had had only an elementary school education, and around a fifth of children experienced delays in psychomotor (21.7%) and mental development (19.8%) (Table 1).

There is a significant correlation between stunting and mental and psychomotor development, as well as between maternal knowledge and psychomotor development (Table 2).

As shown in Table 3, stunting significantly increased the odds of delayed mental (AOR = 7.6) and psychomotor development (AOR = 12.1) compared to the non-stunted group. Similarly, children of mothers with a lack of knowledge had increased odds of psychomotor delay compared to those with sufficient maternal knowledge (AOR=5.3).

Table 1. Sample characteristics (N=106)

Variable		n (%)
Sex	Boys	51 (48.1)
	Girls	55 (51.9)
Age (months)	< 12	58 (54.7)
	≥ 12	48 (45.3)
Mothers' knowledge of stunting and child development	Poor	46 (43.4)
	Sufficient	60 (56.6)
Mothers' education	Primary	28 (26.4)
	Secondary/higher	78 (73.6)
Nutritional status Length/Height-for-age (HAZ)	Stunted	5 (4.7)
	Normal	101 (95.3)
Nutritional status Weight-for-age (WAZ)	Underweight	13 (12.3)
	Normal	93 (87.7)
Nutritional status of Weight-for-Length/ Height) (WHZ)	Wasted	19 (17.9)
	Normal	87 (82.1)
Nutritional status BMI-for-age	Wasted	21 (19.8)
	Normal	85 (80.2)
Child mental development status	Delay	21 (19.8)
	Normal	85 (80.2)
Child psychomotor development status	Delay	23 (21.7)
	Normal	83 (78.3)

Table 2. Bivariate analysis of independent variables on mental and psychomotor development status

Variable	Child mental development status		p-value	Child psychomotor development status		p-value
	Delay	Normal		Delay	Normal	
Sex						
Boys	11 (52.4)	40 (47.1)	0.662	13 (56.5)	38 (45.8)	0.362
Girls	10 (47.6)	45 (52.9)		10 (43.5)	45 (54.2)	
Age (months)						
< 12	10 (47.6)	48 (56.5)	0.466	16 (69.6)	42 (50.6)	0.106
≥ 12	11 (52.4)	37 (43.5)		7 (30.4)	41 (49.4)	
Nutritional status Length/ Height-for-Age (HAZ)						
Stunted	3 (14.3)	2 (2.4)	0.022	3 (13.0)	2 (2.4)	0.034
Normal	18 (85.7)	83 (97.6)		20 (87.0)	81 (97.6)	
Nutritional status Weight-for-Age (WAZ)						
Underweight	5 (23.8)	8 (9.4)	0.072	4 (17.4)	9 (10.8)	0.397
Normal	16 (76.2)	77 (90.6)		19 (82.6)	74 (89.2)	
Nutritional status of Weight-for-Length/ Height) (WHZ)						
Wasted	6 (28.6)	13 (15.3)	0.155	5 (21.7)	14 (16.9)	0.590
Normal	15 (71.4)	72 (84.7)		18 (78.3)	69 (83.1)	
Nutritional status BMI-for-Age						
Wasted	6 (28.6)	15 (17.6)	0.261	4 (17.4)	17 (20.5)	0.742
Normal	15 (71.4)	70 (82.4)		19 (82.6)	66 (79.5)	
Mothers' education						
Primary	8 (38.1)	20 (23.5)	0.175	8 (34.8)	20 (24.1)	0.304
Secondary/Higher	13 (61.9)	65 (76.5)		15 (65.2)	63 (75.9)	
Mothers' knowledge of stunting and child development						
Poor	10 (47.6)	36 (42.4)	0.663	16 (69.6)	30 (36.1)	0.004
Sufficient	11 (52.4)	49 (57.6)		7 (30.4)	53 (63.9)	

p-values calculated using the chi-squared test

Discussion

Approximately 25% of mothers were elementary school-educated (Table 1). Lack of knowledge is linked to low maternal education. Previous studies have shown that maternal education is also linked to a child's cognitive development.^[6] Almost half of the mothers were not aware of the meaning of stunted children (Table 1). Knowledge about a child's growth and development can be useful for everyday communication, stimulation, and understanding dietary requirements.^[7] A mother's understanding of child growth and development can provide appropriate care.^[4]

Approximately 20% of children had delays in psychomotor

and mental development (Table 1). Delayed child development is a public health issue and is closely linked to stunting, low birth weight, low dietary diversity, and suboptimal infant and early childhood feeding practices.^[8]

Table 2 indicates that developmental delays were prevalent in both groups, regardless of whether the children had normal nutritional status or were stunted. In children of normal nutritional stature (not stunted), 17% were mentally delayed, and 19% were psychomotor delayed. This suggests that not only stunted toddlers have developmental delays. Even children with normal height (not stunted) are prone to developmental delays.

Table 3. Logistic regression analysis of stunting and maternal knowledge on delayed mental and psychomotor development status

Variable	Child mental development delayed		Child psychomotor development delayed	
	p-value	AOR (95%CI)	p-value	AOR (95%CI)
Nutritional status Length/ Height-for-Age (HAZ)				
Stunted	0.035	7.6 (1.15, 50.67)	0.016	12.1 (1.59, 92.22)
Normal	Ref	-	-	-
Mothers' knowledge of stunting and child development				
Poor	0.483	1.4 (0.527, 3.875)	0.003	5.3 (1.779, 15.99)
Sufficient	Ref	-	-	-

In this study, malnutrition (stunting) was associated with an increase in the odds of psychomotor delay compared to healthy nutritional status (AOR=12.1) (Table 3). These results are consistent with previous studies that have established a significant correlation between psychomotor development and stunting in children.^[9]

We also revealed that stunted children had significantly higher odds (AOR = 7.6) of experiencing mental delay than their non-stunted counterparts (Table 3). A similar study carried out in Bangladesh reported that malnourished children were less able to perform motor activities compared to non-malnourished ones.^[10]

Good knowledge of child development is necessary to parent them properly. Studies have found that good parenting in the first three years of children's lives is effective in promoting early childhood development.^[11]

Table 3 demonstrates that children raised by mothers with poor knowledge had higher odds of psychomotor developmental delays than those whose mothers possessed sufficient knowledge (AOR=5.3). This finding is consistent with other research on intervention programmes that improve maternal knowledge, as such programmes contribute to child growth and development.^[12]

The wide confidence intervals observed in our models indicate lower precision in some estimates, likely due to the limited sample size and high variability in mothers' backgrounds. Despite this limitation, the adjusted odds ratios still provide valuable directional insights into the factors influencing.

Finally, this study acknowledges some limitations

regarding unmeasured confounding factors. We did not evaluate socio-economic indicators, as socio-economic status can influence both maternal knowledge levels and a child's nutritional status. Future longitudinal studies incorporating socio-economic parameters are warranted to more precisely isolate the independent effects of growth deficits and mothers' cognitive factors on early childhood development.

Conclusion

This paper highlights the importance of improving nutrition for children under two years of age and mothers' education programmes. Therefore, to reduce the risk of long-term developmental delays in children, integrated interventions that improve both nutrition and mothers' education on child development are crucial.

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