



MATERNAL NUTRITIONAL KNOWLEDGE AND ITS ASSOCIATION WITH ANTHROPOMETRIC INDICES AND DEVELOPMENTAL SCREENING OUTCOMES AMONG CHILDREN AGED 6–23 MONTHS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: The first two years of life are a critical period for child growth and development. However, the association between maternal nutritional knowledge and anthropometric indices and developmental screening outcomes among children aged 6–23 months remains unclear.

Objective: This study aimed to examine the association between maternal nutritional knowledge, anthropometric indices, and developmental screening outcomes among children aged 6–23 months.

Methods: An analytical cross-sectional study was conducted at the Tuminting Community Health Center in Manado City. A total of 120 mothers with children aged 6–23 months were selected as respondents using a purposive sampling technique. Data were collected using a nutritional knowledge questionnaire, standardized anthropometric measurements, and an age-specific developmental screening instrument. The data collected were analyzed using the Fisher Freeman Halton Exact Test method.

Results: The findings indicated that the majority of mothers possessed a high level of nutritional knowledge (77.5%). Most children were classified as having normal anthropometric indices based on weight-for-age (82.5%), length-for-age (78.3%), and weight-for-length (80%), with the majority also showing age-appropriate development (87.5%). A statistically significant relationship was identified between maternal nutritional knowledge and the length-for-age indicator ($p = 0.011$). However, no significant relationships were observed between maternal knowledge and weight-for-age ($p = 0.904$), weight-for-length ($p = 0.316$), or developmental screening outcomes ($p = 0.181$).

Conclusion: Maternal nutritional knowledge was significantly associated with length-for-age category but not with weight-for-age, weight-for-length, or developmental screening outcomes among children aged 6–23 months. However, because of the cross-sectional design, temporal relationships and causal interpretations cannot be established.

Keywords: Anthropometric indices; Developmental screening; Maternal nutritional knowledge

Introduction

The first 1,000 days of life, from conception to a child's second birthday, represent a critical period for rapid physical growth and development. Adequate nutrition during this period is essential for supporting healthy growth and development, whereas inadequate nutrition is associated with adverse growth, developmental, and health outcomes later in life (Zhou & Xu, 2023; UNICEF Indonesia, 2023). Therefore, ensuring adequate maternal and child nutrition during this period remains an important public health priority.

Despite improvements in recent years, malnutrition remains a public health concern among children in Indonesia. According to the 2024 Indonesian Nutritional Status Survey (Survei Status Gizi Indonesia [SSGI]), the national prevalence of stunting, underweight, and wasting among children under five was 19.8%, 16.9%, and 7.4%, respectively. In Manado City, among children under five, 18.8% were stunted, including 4.1% who were severely stunted and 14.7% who were stunted; 14.1% were underweight, including 2.1% who were severely underweight and 12.0% who were underweight; and 8.2% were wasted, including 1.5% who were severely wasted and 6.7% who were wasted. In addition, 3.5% were classified as overweight or obese (Kementerian Kesehatan Republik Indonesia, 2025). According to the Indonesian Health Survey,

among children aged 6–23 months in Manado, 3.6% were severely underweight and 11.1% were underweight based on weight-for-age. Based on length-for-age, 7.5% were severely stunted and 14.6% were stunted. For weight-for-length, 3.5% were severely wasted, 7.7% were wasted, and 4.6% were overweight or obese (Kementrian Kesehatan Republik Indonesia, 2023). These findings indicate that multiple forms of malnutrition remain present among young children in Manado City.

Anthropometric status has also been associated with child developmental outcomes. In a cross-sectional study of children aged 6–23 months, Syahrudin et al., (2022) found a statistically significant association between stunting and developmental status ($p = 0.012$). Development classified as doubtful was observed in 61.5% of children with stunting compared with 28.3% of children without stunting. These findings suggest that growth and developmental status are related dimensions of child health, while representing distinct outcomes that may be associated with multiple biological, nutritional, and environmental factors.

Maternal nutritional knowledge may be associated with anthropometric outcomes and developmental screening outcomes through its relationship with infant and young child feeding practices. Knowledge of age-appropriate complementary feeding, including dietary diversity, meal frequency, minimum acceptable diet, and the inclusion of animal-source foods, may inform maternal feeding decisions. However, knowledge alone may not necessarily translate into appropriate feeding practices. Maternal education, household socioeconomic resources, access to health services and nutrition information, food availability, and caregiving arrangements may also be associated with feeding practices and child outcomes and therefore represent important contextual factors and potential confounders when examining the relationship between maternal nutritional knowledge and child health outcomes (UNICEF, 2021; Widad, 2024)

Despite existing studies on maternal nutrition knowledge, infant and young child feeding practices, and child anthropometric indices, evidence remains limited regarding the association of maternal nutritional knowledge with multiple anthropometric indicators—weight-for-age (WAZ), length-for-age (LAZ), and weight-for-length (WLZ) together with developmental screening outcomes among children aged 6–23 months in Manado City. This study therefore aimed to examine the association between maternal nutritional knowledge, anthropometric indices, and developmental screening outcomes among children aged 6–23 months.

Methods

Study Design

This study employed an analytical cross-sectional design to examine the associations between maternal nutritional knowledge and anthropometric and developmental screening outcomes at a single point in time.

Setting

This study was conducted at the Tuminting Community Health Center in Manado City in August 2025. The study population consisted of mothers with children aged 6–23 months. This specific age group was selected because this period represents a crucial stage in a child's growth and development. The study included 120 participants. Participants were recruited using purposive sampling technique. The inclusion criteria were mothers with children aged 6–23 months who resided within the catchment area of the Tuminting Community Health Center. Children were required to be clinically stable at the time of data collection. Children with congenital anomalies, chronic diseases, acute febrile illness, acute diarrhea, or conditions requiring hospitalization were excluded. Anthropometric indices were not used as an eligibility criterion; therefore, children with underweight, stunting, or wasting remained eligible for inclusion.

Instruments

Data included maternal nutritional knowledge scores, anthropometric measurements, and developmental screening scores. Nutritional knowledge was assessed using a knowledge

questionnaire developed by Malihatunnisa et al., (2025). The questionnaire comprised 30 items covering four domains: nutritional requirements of children under five (5 items), exclusive breastfeeding (7 items), appropriate complementary feeding (14 items), and signs and consequences of malnutrition (4 items). Each correct response was scored 1 and each incorrect response 0, yielding a total score ranging from 0 to 30. Maternal nutritional knowledge scores were categorized into percentages and classified as high knowledge (80–100%, equivalent to 24–30 points), moderate knowledge (50–79%, equivalent to 15–23 points), and low knowledge (<50%, equivalent to 0–14 points) from a maximum possible score of 30. The questionnaire was previously tested for reliability by Malihatunnisa et al. (2025), demonstrating excellent internal consistency with a Cronbach's alpha coefficient of 0.993 in the original instrument assessment.

Anthropometric assessment was conducted by measuring body weight and recumbent length using standardized equipment and procedures in accordance with the Indonesian Ministry of Health standards (Kementerian Kesehatan Republik Indonesia, 2020). Body weight was measured using a calibrated digital scale, and recumbent length was measured using a length board. Age- and sex-specific z-scores for weight-for-age (WAZ), length-for-age (LAZ), and weight-for-length (WLZ) were calculated using the WHO Child Growth Standards. Anthropometric categories were defined according to the Indonesian Child Anthropometry Standards based on WHO growth reference cut-off points.

Developmental screening outcomes were assessed using the Kuesioner Pra Skrining Perkembangan (KPSP), an age-specific developmental screening instrument consisting of 9–10 items. Each item was scored as “yes” or “no.” A total score of 9–10 “yes” responses was classified as development appropriate for age, 7–8 as doubtful development, and ≤6 as possible developmental deviation (Kementerian Kesehatan RI, 2022). The assessment was conducted directly by the researchers through observation of the child's responses in accordance with the KPSP guidelines. The KPSP was used as a developmental screening tool rather than a diagnostic assessment.

Data Analysis

Data were analyzed using univariate and bivariate analyses. Univariate analysis was used to summarize participant characteristics, maternal nutritional knowledge scores, anthropometric indicators, and developmental screening outcomes. Bivariate analysis was performed to assess the association between maternal nutritional knowledge and child anthropometric indices and developmental screening outcomes using the Fisher–Freeman–Halton exact test.

Ethical Consideration

Ethical approval was obtained from the Health Research and Development Ethics Committee of the Sint Carolus College of Health Sciences (Reference No. 152/KEPPKSTIKSC/VII/2025) on 18 July 2026, and administrative permission was obtained from the Tuminting Community Health Center. Written informed consent was obtained from all participating mothers after receiving information regarding the study procedures, risks, and benefits. Participation was voluntary, confidentiality was maintained through coded data, and participants had the right to withdraw at any time. Children identified with severe undernutrition or suspected developmental concerns were provided counseling and advised to seek further evaluation at the Tuminting Community Health Center.

Result

Table 1. Respondent Characteristics (n: 120)

Respondent Characteristics	f	%
Child's sex		
Male	63	52.5

Female	57	47.5
Child's age (months)		
Mean $\pm$ SD	12.62 $\pm$ 5.07	
Maternal's age (years)		
Mean $\pm$ SD	28.49 $\pm$ 6.95	
Maternal educational attainment		
Primary school	4	3.3
Junior high School	11	9.2
Senior high School	73	60.8
Diploma (D3)	5	4.2
Bachelor's degree	27	22.5
Maternal occupation		
Housewife	97	80.8
Civil Servant	3	2.5
Entrepreneur / Self-employed	2	1.7
Others	18	15.0
Parental monthly income (IDR)		
>3,824,264	60	50
< 3,824,264	60	50
Primary caregiver		
Mother	100	83.3
Grandmother / Other Family Member	20	16.7
Nanny	0	0
Source of nutrition information		
Family	12	10
Healthcare Workers	13	10.8
Community Health Center	32	26.7
Electronic Media	43	35.8
Never Received Information	20	16.7

Note: n = sample size; f = frequency; % = percentage

Based on Table 1, the mean age of children was 12.62 $\pm$ 5.07 months (range: 6–23 months), and the mean maternal age was 28.49 $\pm$ 6.95 years (range: 16–47 years). The majority of children were male (52.5%). Most mothers were housewives (80.8%), and half of the participants had a monthly household income above IDR 3,824,264 (50.0%). Most children were primarily cared for by their mothers (83.3%), and electronic media was the most commonly reported source of nutrition-related information (35.8%).

Table 2. Distribution of Anthropometric Indices, Developmental Screening Outcomes, and Maternal Nutritional Knowledge Among Children Aged 6–23 Months (n:120)

Variabel		f	%
Anthropometric indices			
Weight-for-Age (WAZ)	Severely Underweight	8	6.7
	Underweight	13	10.8
	Normal	99	82.5
Length-for-Age (LAZ)	Severely Stunted	10	8.3
	Stunted	16	13.3
	Normal	94	78.3
Weight-for-Length (WLZ)	Severely Wasted	15	12.5
	Wasted	9	7.5
	Normal	96	80
Developmental Screening Outcomes			
Age-Appropriate		105	87.5
Doubtful Development		11	9.2

Maternal Nutritional Knowledge	Possible Developmental Deviation	4	3.3
	High	93	77.5
	Moderate	27	22.5

Note: n = sample size; f = frequency; % = percentage

Table 2 shows that most children had normal anthropometric indices based on weight-for-age (WAZ) (82.5%), length-for-age (LAZ) (78.3%), and weight-for-length (WLZ) (80%). Regarding developmental screening outcomes, the majority of children demonstrated age-appropriate development (87.5%). Furthermore, most mothers had a high level of nutritional knowledge (77.5%).

Table 3. Association Between Maternal Nutritional Knowledge and Anthropometric Indices and Developmental Screening Outcomes Among Children Aged 6–23 Months (n:120)

Variable		Maternal Knowledge		P-value
		High f	Moderate f	
Anthropometric indices				
Weight-for-Age (WAZ)	Severely Underweight	6	2	0.904
	Underweight	11	2	
	Normal	76	23	
Length-for-Age (LAZ)	Severely Stunted	7	3	0.011
	Stunted	8	8	
	Normal	78	16	
Weight-for-Length (WLZ)	Severely Wasted	14	1	0.316
	Wasted	7	2	
	Normal	72	24	
Developmental Screening Outcomes				
	Age-Appropriate	84	21	0.181
	Doubtful Development	7	4	
	Possible	2	2	
	Developmental Deviation			

Note: n = sample size; f = frequency; % = percentage; p = p-value. Statistical analysis was performed using the Fisher–Freeman–Halton Exact Test.

The Fisher–Freeman–Halton exact test showed that maternal nutritional knowledge was significantly associated with LAZ category ($p = 0.011$). In contrast, no statistically significant associations were observed between maternal nutritional knowledge and WAZ ($p = 0.904$) or WLZ ($p = 0.316$). No statistically significant association was detected between maternal nutritional knowledge and developmental screening outcomes ($p = 0.181$). However, the developmental finding should be interpreted cautiously as imprecise due to low statistical power, given that only four children were classified as having possible developmental delay.

Discussion

This study found a statistically significant association between maternal nutritional knowledge and length-for-age (LAZ) category among children aged 6–23 months ($p = 0.011$). This finding is in line with previous studies (Venkatesh et al., 2026; Nugroho et al., 2026). However, no significant associations were observed between maternal nutritional knowledge and weight-for-age (WAZ), weight-for-length (WLZ), or child developmental screening outcomes. Most mothers in this study had high nutritional knowledge (77.5%), and most children had normal

anthropometric indices based on WAZ (82.5%), LAZ (78.3%), and WLZ (80%). The relatively high maternal educational attainment, with most mothers completing senior high school (60.8%) or higher education (26.7%), and the availability of nutrition-related information, primarily through electronic media (35.8%), may reflect the characteristics of the study population. However, these factors may also act as potential confounders because maternal education, socioeconomic conditions, access to information, and caregiving characteristics may influence both maternal nutritional knowledge and child nutritional outcomes.

Previous studies have suggested that maternal nutritional knowledge may be related to infant and young child feeding practices, including dietary diversity, meal frequency, minimum acceptable diet, and consumption of animal-source foods (Starkweather et al., 2020). These feeding practices may represent potential pathways through which maternal knowledge is associated with child nutritional outcomes. However, feeding practices were not assessed in the present study; therefore, the role of these factors as mechanisms explaining the observed association between maternal nutritional knowledge and LAZ could not be confirmed.

The absence of significant associations between maternal nutritional knowledge and WAZ ($p = 0.904$) and WLZ ($p = 0.316$) suggests that the relationship between maternal nutritional knowledge and anthropometric indicators may differ depending on the type of anthropometric indicator assessed. WAZ reflects body weight relative to age and represents a composite indicator influenced by body mass and linear growth. WLZ reflects body proportionality relative to length and is commonly used to assess wasting and excess weight status (WHO, 2018). Both indicators may be influenced by various other factors, including dietary intake, socioeconomic conditions, and caregiving environments (Victora et al., 2021).

LAZ is an indicator of linear growth and is commonly used to assess cumulative growth faltering and stunting (Leroy & Frongillo, 2019). Linear growth reflects a long-term process influenced by multiple factors, including prenatal conditions, birth length and weight, maternal characteristics, infection history, dietary intake, and socioeconomic circumstances (Victora et al., 2021; Danaei et al., 2016). In this study, maternal nutritional knowledge was associated with LAZ category; however, both maternal knowledge and child length were measured at the same point in time. Therefore, the temporal sequence of this association cannot be established, and maternal nutritional knowledge cannot be interpreted as a determinant of prior linear growth. Future longitudinal studies are needed to clarify the potential pathways through which maternal nutritional knowledge may relate to feeding practices and subsequent child growth outcomes.

No significant association was observed between maternal nutritional knowledge and child developmental screening status ($p = 0.181$). This finding suggests that developmental outcomes may involve multiple interacting factors beyond maternal nutritional knowledge alone, including environmental, genetic, and hormonal factors, as well as stimulation and parenting practices (Mollon et al., 2021; Soetjiningsih & Ranuh, 2017; Pinto, 2023). However, this result should be interpreted cautiously because child development was assessed using the KPSP, which is a screening instrument rather than a diagnostic assessment, and only a small number of children were classified as having possible developmental deviation. Further studies using comprehensive developmental assessments and considering environmental and caregiving factors are needed.

Limitation

This study has several limitations. The cross-sectional design limits the ability to establish temporal relationships and causal inferences between maternal nutritional knowledge and child outcomes; therefore, the possibility of reverse causation cannot be excluded. The use of purposive sampling from a single community health facility may limit the representativeness of the sample and the generalizability of the findings to other populations or settings. Potential confounding factors that may influence the observed associations were not fully controlled in the analysis. Furthermore, child development was assessed using the Kuesioner Pra Skrining Perkembangan (KPSP) as a screening tool rather than a diagnostic instrument; therefore, the findings should be interpreted as developmental screening results and not as confirmed developmental disorders.

Conclusion

Maternal nutritional knowledge was significantly associated with length-for-age category but not with weight-for-age, weight-for-length, or developmental screening outcomes among children aged 6–23 months. However, given the cross-sectional design, causal relationships cannot be established, and developmental screening outcomes may be influenced by multiple biological, environmental, and caregiving factors.

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DECLARATION OF INTEREST

The authors declare that they have no conflict of interest

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References

- Danaei, G., Andrews, K. G., Sudfeld, C. R., Mccoy, C., Peet, E., Sania, A., Fawzi, M. C. S., Ezzati, M., & Fawzi, W. W. (2016). Risk Factors for Childhood Stunting in 137 Developing Countries : A Comparative Risk Assessment Analysis at Global , Regional , and Country Levels. *PLoS Med*, 13(11), 1–18. <https://doi.org/10.1371/journal.pmed.1002164>.
- Kementerian Kesehatan Republik Indonesia. (2020). *Peraturan Menteri Kesehatan Republik Indonesia Nomor 2 Tahun 2020 tentang standar antropometri ana*. Kementerian Kesehatan Republik Indonesia.
- Kementerian Kesehatan Republik Indonesia. (2025). *Survei Status Gizi Indonesia (SSGI) 2024 Dalam Angka*. Kementerian Kesehatan Republik Indonesia
- Kementerian Kesehatan RI. (2022). *Buku Bagan Stimulai, Deteksi, dan Intervensi Dini Tumbuh Kembang (SDIDTK)*. Kementrian Kesehatan Republik Indonesia.
- Kementrian Kesehatan Republik Indonesia. (2023). *Survei Kesehatan Indonesia (SKI) 2023 Dalam Angka*. Kementrian Kesehatan Republik Indonesia.
- Leroy, J. L., & Frongillo, E. A. (2019). *Perspective : What Does Stunting Really Mean ? A Critical Review of the Evidence*. 196–204. <https://doi.org/10.1093/advances/nmy101>
- Malihatunnisa, S., Setiyaningrum, Z., Puspitasari, D. I., Kisnawaty, S. W., Mardiyati, N. L., & Muwahidah. (2025). *Pengembangan Instrumen Penelitian Kuesioner Pengetahuan Ibu Tentang Balita*. Universitas Muhammadiyah Surakarta
- Mollon, J., Knowles, E. E. M., Mathias, S. R., Gur, R., Peralta, J. M., Weiner, D. J., Robinson, E. B., Gur, R. E., Blangero, J., Almasy, L., & Glahn, D. C. (2021). Genetic influence on cognitive development between childhood and adulthood. *Molecular Psychiatry*, 26(2), 656–665. <https://doi.org/10.1038/s41380-018-0277-0>
- Nugroho, H., Yusvita, F., & Gunita. (2026). *Hubungan pengetahuan ibu terhadap kejadian stunting di puskesmas sepatan, kabupaten tangerang* . 20(1), 55–62. <https://doi.org/10.36082/qjk.v20i1.3124>
- Pinto, J. (2023). The Role of Nutrition in Children's Growth and Development at Early Age: Systematic Review. *International Journal of Research in Science and Technology*, 13(4), 23–30. <https://doi.org/10.37648/ijrst.v13i04.004>
- Soetjiningsih, & Ranuh, I. N. G. (2017). *Tumbuh Kembang Anak* (2nd ed.). EGC.
- Starkweather, C., Guarino, A., Bennion, N., Cottam, M., Mcghie, J., Dearden, K. A., Santika, O., Jusril, H., Hall, C., Crookston, B. T., Linehan, M., Torres, S., Bennett, C., & West, J. H. (2020). *An interpersonal nutrition campaign and maternal knowledge and childhood feeding practices :*

- a case study from mothers in rural Indonesia. International Journal of Environmental Research and Public Health*, 17(15), 1–12. <https://doi.org/10.1186/s13690-020-00444-9>
- Syahrudin, A. N., Ningsih, N. A., & Menge, F. (2022). Hubungan Kejadian Stunting dengan Perkembangan Anak Usia 6-23 Bulan The Association Between Stunting and Development Among Children Aged 6-23 Months Sekolah Tinggi Ilmu Kesehatan Tamalatea Makassar , Indonesia. *Ilmu Kesehatan*, 15(4), 327–332. <https://doi.org/10.33860/jik.v15i4.733>
- UNICEF. (2021). UNICEF Conceptual Framework on Maternal and Child Nutrition. *Nutrition and Child Development Section, Programme Group 3 United Nations Plaza New York, NY 10017, USA*, 2–3.
- UNICEF Indonesia. (2023). *Wasting (Gizi Kurang dan Gizi Buruk) dan Dampaknya pada Anak*. <https://www.unicef.org/indonesia/id/gizi/artikel/dampak-wasting-pada-anak>
- Venkatesh, J. S., Kulkarni, M., & Kumar, K. S. (2026). *Maternal feeding knowledge and practices as determinants of anthropometric indices in under-five children*. 22(4), 2020–2024. <https://doi.org/10.6026/973206300222020>
- Victora, C. G., Christian, P., Vdaletti, L. P., Gatica-Domínguez, G., Menon, P., & Black, R. E. (2021). Revisiting maternal and child undernutrition in low-income and middle-income countries : variable progress towards an unfinished agenda. *Lancet*, 397(10282), 1388–1399. [https://doi.org/10.1016/S0140-6736\(21\)00394-9](https://doi.org/10.1016/S0140-6736(21)00394-9). Revisiting
- WHO. (2018). *Malnutrition in children*. https://www.who.int/data/nutrition/nlis/info/malnutrition-in-children?utm_source=chatgpt.com
- Widad, S. (2024). Hubungan Tingkat Pengetahuan Ibu dengan Status Gizi Balita Usia 6-59 Bulan di Posyandu Desa Pandean Probolinggo. *Health Research Journal*, 2(1).
- Zhou, Y., & Xu, Y. (2023). *Nutrition and Metabolism in the First 1000 Days of Life*. *Nutrients*, 15, 2554. ; <https://doi.org/10.3390/nu15112554>