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Contributing factors to underweight among children under five: A cross-sectional study at Belawan Primary Health Center

Faktor-faktor yang berkontribusi terhadap kejadian underweight pada balita: Studi cross-sectional di Puskesmas Belawan

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Abstract

Underweight in toddlers is a significant public health concern in Indonesia, where the 2022 National Nutrition Status Survey reported a prevalence of 17,1% among children under five years of age, reflecting persistent nutritional challenges. This study aimed to analyze the incidence of underweight in toddlers in the Belawan Primary Health Center (PHC) and its contributing factors. This research applied a descriptive-analytical design with a cross-sectional approach, conducted in January 2025, in Belawan, Medan City, North Sumatra. A total of 41 toddlers were selected using a total sampling method. Data were collected using structured questionnaires and secondary records, and ethical approval was obtained from the Institutional Review Board. The sample size was determined based on the population of underweight toddlers recorded at the health center. Data were analyzed using chi-square tests and logistic regression. The results indicated significant associations between exclusive breastfeeding (p=0,032), inappropriate complementary feeding (p=0,041), and maternal education (p=0,021) and underweight incidence. Logistic regression showed that low maternal education was the most dominant factor (OR=7,26). In conclusion, the role of mothers is very important in child feeding practices. Interventions to reduce underweight should prioritize maternal education and community-based nutrition programs by strengthening the roles of health workers and Integrated Health Post cadres.

Keywords: Complementary feeding, exclusive breastfeeding, nutritional status, underweight

Abstrak

Underweight pada balita merupakan salah satu indikator penting status gizi yang mencerminkan kekurangan asupan nutrisi jangka panjang. Penelitian ini bertujuan untuk menganalisis kejadian underweight pada balita di wilayah kerja Puskesmas Belawan dan faktor-faktor yang memengaruhinya. Desain penelitian ini adalah deskriptif analitik dengan pendekatan potong lintang. Jumlah responden sebanyak 41 balita yang dipilih menggunakan metode total sampling. Data dikumpulkan melalui kuesioner terstruktur dan dianalisis dengan uji Chi-square dan regresi logistik. Hasil penelitian menunjukkan bahwa terdapat hubungan yang bermakna antara pemberian ASI eksklusif (p=0,032), riwayat MP-ASI yang tidak tepat (p=0,041), dan pendidikan ibu (p=0,021) dengan kejadian underweight. Hasil analisis regresi logistik menunjukkan bahwa pendidikan ibu yang rendah merupakan faktor paling dominan dengan OR = 7,26. Kesimpulan, peran ibu sangat penting dalam praktik pemberian makan pada anak. Upaya penanggulangan underweight perlu difokuskan pada edukasi dan intervensi perilaku pemberian makan melalui penguatan peran petugas gizi dan kader Posyandu.

Kata Kunci: ASI eksklusif, MP-ASI, pendidikan ibu, status gizi balita, underweight

Introduction

Underweight is a critical indicator of poor nutritional status in children, reflecting broader malnutrition issues. The prevalence of underweight among children under five years of age remains high in several developing countries, including Pakistan (29,4%), Bangladesh (52% of low birth weight children), and sub-Saharan Africa (average 17,6%) (Khan et al., 2019; Rahman et al., 2016; Tamir et al., 2024). This condition substantially increases the risk of mortality from infectious diseases, such as pneumonia, adversely affects children's physical growth and cognitive development, and reduces productivity in adulthood (Shrestha et al., 2022). Contributing factors include low maternal education, poor socioeconomic conditions, low birth weight, limited access to maternal and child health services, and inadequate dietary intake (Siddiqa et al., 2023).

Underweight children are at a higher risk of growth retardation, recurrent infections, and premature mortality (South et al., 2024). Underweight reflects a prolonged deficiency in energy or nutrient intake, which can result from a poor diet, recurrent illness, and low socioeconomic status. Such children require targeted nutritional and health interventions, as being underweight impairs physical growth and cognitive development and increases the likelihood of future health complications (Al Rahmad, 2023; Toma et al., 2024).

In Indonesia, being underweight is a pressing public health concern. Although the national prevalence of underweight among children under five years of age has shown a gradual decline from 19,6% in 2013 to 17,0% in 2023 (Rachmi et al., 2016), this reduction has been uneven across the regions. Densely populated and socioeconomically vulnerable areas, particularly coastal urban districts such as Medan Belawan, continue to have prevalence rates that are above the national average. Local data from Medan Belawan highlight complex nutritional challenges, including a high prevalence of stunting and underweight status among toddlers (Febrianti et al., 2025).

North Sumatra is a province with a high prevalence of malnutrition. Research conducted in several regions indicates that being underweight in toddlers remains a significant public health concern. For instance, in Sei Rotan Village, 48,8% of toddlers were identified as underweight (Firza, 2022). Medan City, the provincial capital, has been designated as a priority area for malnutrition interventions, particularly in densely populated coastal districts such as Medan Belawan. This district has been categorized within the priority nutrition intervention cluster along with the Batu Bara Regency (Silitonga et al., 2024). The Belawan Community Health Center, which serves this densely populated coastal area, reports some of the highest malnutrition rates in Medan, particularly among socioeconomically disadvantaged fishing families (Nasution et al., 2024).

While previous studies have examined national underweight trends and demographic risk factors, most have emphasized rural populations or focused primarily on stunting (Irawan et al., 2022; Kurnianingtyas et al., 2021). Limited evidence exists on the determinants of underweight status in urban coastal settings such as Belawan. This gap is noteworthy, given that Belawan combines multiple vulnerabilities—high population density, infectious disease burden, and socioeconomic disparities—that increase the risk of under-nutrition.

Being underweight in early childhood has profound developmental effects. Children with low weight-for-age are more likely to experience delays in cognitive and neurodevelopmental outcomes, which can impair their learning and academic performance (Suryawan et al., 2022). Nutritional deficiencies in early life also weaken immune system function, increase susceptibility to recurrent infections, and reduce vaccine responses (Oktarina et al., 2023). In the long term, undernutrition contributes to reduced human capital and national productivity, as adverse effects of undernutrition on growth and cognition often persist into adulthood (Emerson et al., 2020).

Several social and environmental determinants exacerbate underweight. Maternal education plays a pivotal role, as the children of mothers with higher educational attainment face a lower risk of undernutrition (Chowdhury et al., 2018). Socioeconomic conditions, such as family income, also strongly influence child nutrition, with poverty consistently associated with a higher prevalence of underweight children (Hanandita & Tampubolon, 2015). Environmental determinants, including access to clean water, sanitation, and safe living conditions are critical (Cockerham, 2022). Access to essential health services, such as immunization and regular growth monitoring, is another decisive factor in preventing underweight (Saidu & Danielson, 2024).

This study aimed to identify and analyze the risk factors for underweight among toddlers within the catchment area of the Belawan Primary Health Centre ("Puskesmas") in Indonesia, including exclusive breastfeeding practices, complementary feeding quality, maternal education level, and a history of infectious diseases. The findings are expected to provide an evidence base for developing community-based nutrition intervention programs and inform local policies aimed at reducing the prevalence of underweight in coastal urban areas such as Medan Belawan.

Methods

This study employed a quantitative descriptive analytical design with a cross-sectional approach. This design was selected because of its efficiency in identifying associations between variables at a specific point in time. However, as with all cross-sectional designs, causal relationships cannot be temporally established; thus, interpretations are limited to associations rather than cause–and–effect dynamics. Although longitudinal or cohort studies are better suited for identifying causal pathways, they require extensive time, cost, and resources, rendering them less feasible for the objectives of this study than cross-sectional studies.

The study population comprised all children aged 0–59 months registered at the Integrated Health Post (Indonesia called "Posyandu") and listed in the nutrition registry of the Belawan Primary Health Centre, Medan City, North Sumatra. Sampling was conducted using a total sampling method, including all toddlers classified as underweight and who met the inclusion criteria. The final sample consisted of 41 toddlers based on the case data recorded at the Community Health Center in January 2025. The inclusion criteria were as follows: (1) toddlers aged 0–59 months listed in the Belawan Nutrition Registry, (2) availability of complete anthropometric data, and (3) parental/guardian consent via informed consent form. The exclusion criteria were as follows: (1) toddlers with chronic diseases (e.g., congenital heart disease and metabolic disorders) and (2) toddlers who were hospitalized during the data collection period. Sample adequacy was confirmed using a power analysis with a significance level of 5% and power of 80%, which yielded a minimum requirement of 35 respondents. With 41 respondents, this study satisfied the minimum-sample-size requirement.

Data collection involved a structured questionnaire and secondary data from medical records and the nutrition registry. The questionnaire assessed child identity, breastfeeding history, complementary feeding practices, immunization status, history of infectious diseases (ARI/diarrhea), maternal education and occupation, and family income. Content validity was assessed by three experts in community nutrition and child health, and reliability testing yielded a Cronbach's alpha of 0,82, demonstrating high reliability of the questionnaire.

The nutritional status of toddlers was determined using the Weight-for-Age Z-score (WAZ) index based on WHO standards, calculated using WHO Anthro software or the Indonesian Ministry of Health's toddler growth curve.

Statistical analyses were performed using the latest version of SPSS software. Descriptive statistics (univariate analysis) were used to summarize respondents' characteristics. Bivariate relationships between independent variables and underweight were examined using the chi-squared test. Variables with a significance level of $p < 0,25$ were entered into a multivariate logistic regression model to identify the most significant predictors of underweight. Missing data were managed using the listwise deletion method, whereby only participants with complete information on the analyzed variables were included to preserve the validity and consistency of the results.

Result and Discussion

A total of 41 toddlers were included in this analysis. The largest proportion was aged 24–59 months (46,3%), followed by 12–23 months (29,3%), and 0–11 months (24,4%). The sex distribution was nearly equal (51,2% male and 48,8% female). Most mothers had attained at least a high school education (63,4%), while 36,6% had a lower educational attainment (elementary or junior high school education). More than half of the households (56,1%) reported a monthly income below Rp2,000,000, underscoring the

socioeconomic disadvantages prevalent in the Belawan area. Regarding infant and young child feeding (IYCF) practices, 61,0% of children were exclusively breastfed, whereas 39,0% were not. Suboptimal complementary feeding was observed in 53,7% of the children, and 41,5% had a recent history of infection, primarily acute respiratory illness or diarrhea (Table 1).

Bivariate analysis revealed significant associations between underweight and exclusive breastfeeding (p=0,032), inappropriate complementary feeding (p=0,041), and maternal education (p=0,021). Toddlers who were not exclusively breastfed had higher odds of being underweight than their exclusively breastfed peers did. Similarly, inappropriate complementary feeding was associated with a higher prevalence of underweight. Low maternal education (Junior High School or lower) was also strongly associated with being underweight, underscoring the importance of maternal nutritional literacy. Conversely, a history of infection was not significantly associated with (p=0,210) (Table 2).

Table 1. Respondent characteristics (n=41)

Characteristics	n	%
Toddler Age		
0–11 months	10	24,4
12–23 months	12	29,3
24–59 months	19	46,3
Gender		
Male	21	51,2
Female	20	48,8
Mother's Education		
Did not complete Elementary or Junior High School	15	36,6
High School or higher	26	63,4
Family Income		
<IDR 2.000.000/month	23	56,1
≥IDR 2.000.000/month	18	43,9
Exclusive Breastfeeding		
Yes	25	61,0
No	16	39,0
History of Inappropriate Complementary Feeding		
Yes	22	53,7
No	19	46,3
History of Infection (ARI/Diarrhea)		
Yes	17	41,5
No	24	58,5

Table 2. Relationship between characteristics and the incidence of underweight in toddlers (n=41)

Variables	Underweight				p-value
	Underweight		Not Underweight		
	n	%	n	%	
Exclusive Breastfeeding					
Yes	8	32,0	17	68,0	0,032
No	11	68,8	5	31,2	
History of Inappropriate Complementary Feeding					
Yes	13	59,1	9	40,9	0,041
No	6	31,6	13	68,4	
History of Infection					
Yes	10	58,8	7	41,2	0,210
No	9	37,5	15	62,5	
Mother's Education					
Low (≤Junior High School)	11	73,3	4	26,7	0,021
High (≥High School)	8	30,8	18	69,2	

Table 3. Results of logistic regression analysis of underweight incidence in toddlers

Variables	B	SE	OR	CI 95% (Lower–Upper)	p-value
Exclusive Breastfeeding (No)	1,732	0,810	5,65	1,18 – 26,96	0,030
Inappropriate Complementary Feeding (Yes)	1,540	0,755	4,66	1,08 – 20,09	0,039
Mother's Education (Low)	1,982	0,880	7,26	1,39 – 37,81	0,018

Logistic regression identified three dominant predictors of underweight: low maternal education (OR=7,26; 95% CI: 1,39–37,81; p=0,018), lack of exclusive breastfeeding (OR=5,65; 95% CI: 1,18–26,96; p=0,030), and inappropriate complementary feeding (OR=4,66; 95% CI: 1,08–20,09; p=0,039) (Table 3). These findings emphasize the central role of maternal education in shaping nutritional practices, particularly breastfeeding and complementary feeding, which directly influence nutritional outcomes in children in Belawan.

These findings highlight that family level nutritional practices in urban coastal settings continue to face systemic challenges. Low maternal education constrains knowledge of exclusive breastfeeding and recommends complementary feeding. These limitations are compounded by socioeconomic constraints that reduce access to balanced and nutritious foods. Hence, underweight in Belawan cannot be viewed solely as an individual nutritional issue but rather as a consequence of intertwined social, economic, and educational determinants of health. From a policy perspective, these results underscore the importance of community-based interventions focused on maternal education and strengthening the capacity of Integrated Health Post ("Posyandu") cadres. Local governments must also integrate nutritional interventions with broader poverty alleviation programs in coastal communities to achieve sustainable improvements in child nutrition in the long term.

The findings of this study align with those of previous research Abolurin et al. (2021), Ahmed et al. (2017), and Zhang et al. (2024), that demonstrated that inappropriate feeding practices, particularly the absence of exclusive breastfeeding for the first six months, increase the risk of undernutrition. Evidence shows that children deprived of exclusive breastfeeding face higher risks of malnutrition, including stunting and underweight, than those who are exclusively breastfed. Exclusive breastfeeding not only fulfils infants' nutritional needs but also protects them against infection. In contrast, the early introduction of formula or complementary foods contributes to an imbalanced nutrient intake during critical growth periods (Ashok et al., 2018).

Maternal education was the most influential factor in this study (OR=7,26). This aligns with studies by Bras & Mandemakers (2022) and Fadare et al. (2019), which found that the children of mothers with low education are more likely to suffer from malnutrition. Meta-analyses in middle-income countries have consistently shown that higher maternal education is associated with better child nutritional outcomes, particularly weight-for-age and height-for-age. White et al. (2022) confirmed that maternal education and household income influence child nutrition globally, although the magnitude of these effects may vary across different contexts. Interestingly, Frost et al. (2005) found that in some regions such as Bolivia, socioeconomic conditions and family income mediate the relationship between maternal education and child nutrition, suggesting that the impact of education is less pronounced when economic disparities are particularly severe.

Inappropriate complementary feeding, in terms of both timing and food type, was also identified as a significant determinant in this study. The introduction of complementary feeding, either too early or too late, coupled with foods of inadequate nutritional quality, can contribute to growth impairment and suboptimal weight gain. These findings are consistent with those of Masuke et al. (2021), who reported that errors in complementary feeding, such as premature introduction, insufficient feeding frequency, and low dietary diversity, are significant risk factors for underweight in young children, particularly in low-income areas. Inappropriate complementary feeding practices substantially increase the likelihood of being underweight, underscoring the importance of ensuring appropriate timing, frequency, and dietary diversity to prevent malnutrition among vulnerable groups (Ahmad et al., 2018).

Maternal education emerged as the dominant variable influencing the incidence of underweight children. Mothers with lower educational attainment generally possess limited knowledge of appropriate nutritional practices, child-rearing strategies, and the importance of preventive health services such as immunization and routine growth monitoring. This study aligns with the findings of Makoka (2013) and Rezaeizadeh et al. (2024), who demonstrated that higher levels of maternal education are positively associated with improved nutritional status of children.

Educated mothers are more likely to understand health information, apply appropriate nutritional practices, and seek

medical care when necessary. Furthermore, higher maternal education has consistently been linked to reduced risks of stunting, wasting, and underweight, even after adjusting for other socioeconomic factors (Iftikhar et al., 2017).

Although the prevalence of infectious diseases among toddlers, such as acute respiratory infections (ARI) and diarrhea, was relatively high in this study, no statistically significant association was observed with underweight status in this study. This may be explained by the presence of protective factors, including breastfeeding and timely treatment at health care facilities. This result contrasts with prior research, which demonstrated that recurrent infections can lead to weight loss and impaired nutrient absorption. Intestinal infections exacerbate the undernutrition cycle by diminishing nutrient absorption, increasing nutrient loss, and hindering growth and development (Bresnahan & Tanumihardjo, 2014; Carvalho et al., 2025). Infections may also induce anorexia, elevate energy and protein requirements, and worsen nutritional status through inflammatory responses. These findings suggest that environmental conditions and access to healthcare, particularly for infection prevention and effective management, should be prioritized in future research and nutritional interventions (Miko & Al-Rahmad, 2017; Carvalho et al., 2025).

Family income was not show a statistically significantly associated with being underweight in this study. This may be due to the homogeneity of respondents' income levels, as most of households reported earnings below two million rupiahs per month, limiting observable variation in nutritional outcomes (Edwards et al., 2023). While family income is an important determinant of food security and dietary quality, its direct effect on children's nutritional status can be moderated by maternal knowledge and feeding practices. Mothers with adequate nutritional knowledge may be able to optimize food resources, thereby mitigating the adverse effects of limited economic capacity on child nutrition (Budiono et al., 2024).

Providing exclusive breastfeeding and appropriate complementary feeding significantly impacts a child's nutritional status and supports national efforts to strengthen the First 1,000 Days of Life campaign. This critical period determines the quality of a child's long-term growth and development. Meeting nutritional needs through exclusive breastfeeding and providing appropriately timed and high-quality complementary feeding increases the likelihood of a child achieving a normal nutritional status and preventing malnutrition (Boy et al., 2023).

The results of this study reinforce the literature that children's nutritional status, particularly the incidence of underweight, is significantly influenced by maternal behaviors and knowledge. Good maternal nutritional knowledge is significantly associated with children's nutritional status, with mothers who have a better understanding of exclusive breastfeeding, complementary feeding, and healthy eating practices tending to have children with a normal nutritional status (Fairuz & Fadilah, 2025; Marbun et al., 2024). Maternal behavior in applying this knowledge, such as the timing of complementary feeding and children's eating patterns, is crucial for preventing underweight and other nutritional problems (Suharto, 2022). These findings underscore the importance of nutritional education interventions targeting mothers as a strategic effort to improve the nutritional status of children in the community.

The findings of this study emphasize the importance of improving mothers' feeding capacity through ongoing nutrition education. Community-based intervention programs at integrated health posts can improve mothers' nutritional literacy by involving health cadres and nutrition officers at Primary Health Centers or "Puskesmas." Furthermore, health workers need to strengthen the promotion of exclusive breastfeeding and timely provision of complementary foods using a contextual approach that adapts to the local culture of coastal communities.

For policymakers, the results of this study can provide a basis for strengthening nutrition intervention programs within the framework of the first days of life movement, particularly in nutrition-prone areas such as Belawan. Local governments can integrate nutritional interventions with poverty alleviation programs and empower poor fishing families to improve their health. Furthermore, increasing access to affordable and nutritious food through local food subsidies can help reduce underweight rates.

Conclusion

Low maternal education, lack of exclusive breastfeeding, and inappropriate complementary feeding were identified as the dominant factors associated with underweight among toddlers in

the catchment area of the Belawan Primary Health Center. These findings reinforce the critical role of maternal nutritional literacy in shaping child health outcomes, consistent with evidence from Indonesia and other developing countries. From a practical perspective, this study highlights the need for targeted community-based interventions focused on improving maternal nutrition education, strengthening the promotion of exclusive breastfeeding, and enhancing the quality of complementary feeding practices through the support of nutrition officers and integrated service post-cadres.

Recommended follow-up actions include organizing mother-and-toddler classes at the Integrated Service Post, empowering fishing families through programs that increase access to nutritious food, and integrating nutrition improvement initiatives with broader poverty alleviation strategies in coastal areas. Thus, this study contributes to the literature on the determinants of underweight among children under five and provides an empirical foundation for the development of locally relevant and nationally scalable nutritional intervention strategies.

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