Volume 13, Issue 4, 2025: 456-470
p-ISSN 2354-7642 e-ISSN 2503-1856
Accredited by Directorate General of Higher Education, Research and Technology, Republic of Indonesia No. 35/E/KPT/2019

Jurnal Ners dan Kebidanan Indonesia
(Indonesian Journal of Ners and Midwifery)
DOI : http://dx.doi.org/10.21927/jnki.2025.13(4).456-470
Available online at: http:ejournal.almaata.ac.id/index.php/JNKI

Determinants of underweight among children under five years in Sungai Malang Community-Health Center

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ABSTRACT

Background: *The most common nutritional problem in Indonesia is malnutrition. Children under five years are the age group that most often suffers from malnutrition. Underweight is a condition when a child's weight is below the normal range, indicated by a weight for age index of <-2 SD. Data from the health report for children under five years in North Hulu Sungai Regency, the percentage of underweight in Sungai Malang Community-Health Centers was 15.38% and in 2023 increase to 15.87%.*
Objectives: *The aims of this research to determine the determinants of underweight among children under five years in Sungai Malang Community-Health Center, North Hulu Sungai Regency, South Kalimantan Province.*
Methods: *A cross-sectional study was conducted involving 106 respondents selected through simple random sampling. Data were analyzed using univariate, bivariate (Chi-square), and multivariate (binary logistic regression) methods.*
Results: *The prevalence of underweight was 33.96%. Significant determinants included low family income (OR=12.74; p=0.006), medium household size (OR=7.98; p=0.023), history of infectious diseases (OR=13.84; p=0.001), and low meal frequency (OR=47.19; p<0.001). Maternal education, child's age, and sex were not significantly associated.*
Conclusions: *Meal frequency emerged as the strongest determinant of underweight among children under five, followed by low family income, medium household size, and history of infectious diseases. The study recommends prioritizing efforts to improve meal frequency through community-based education, while encouraging health centers to actively promote early detection and prevention of underweight.*

KEYWORD: *children under five; household size; income level; infectious diseases; meal frequency; underweight*

Article Info :
Article submitted on April 28 , 2025
Article revised on August 10, 2025
Article accepted on October 29, 2025
Article Published on December 31, 2025

INTRODUCTION

One of the health parameters assessed in the Sustainable Development Goals (SDGs) in Indonesia is the nutritional status of children under five years. The most common nutritional problem in Indonesia is malnutrition. Children under five years are the age group that most often suffers from malnutrition or among the most nutritionally vulnerable groups. In the developing countries, children aged 1-5 years are the most vulnerable to malnutrition. Children usually suffer from various infections and low nutritional status (1). The prevalence of underweight in children is one of the targets to be achieved in eliminating all forms of malnutrition. The nutritional status of children under five years can be assessed through anthropometric measurements. In children's anthropometric standards, underweight is a condition when a child's weight is below the normal range marked by a weight-to-age index of < -2 standard deviations (1).

The prevalence of underweight increased every year, in 2022 to 17.1% which was previously 17% in 2021, and in 2019 it was 16.3% (1). The prevalence of underweight children under five years in South Kalimantan Province in 2021 was 24.3%, decreasing by 21.7% in 2022. However, this figure is still above the average prevalence of underweight in children under five years nationally (17.1%). The prevalence of underweight in North Hulu Sungai Regency in 2021 was 23.5% and increased in 2022 by 32.5%, and this figure is the highest incidence rate of underweight in South Kalimantan Province, so cross-sectoral cooperation efforts are still needed to reduce the number of underweight children under five years (1).

The percentage of underweight among children under five years based on weight/age by regency in 2023, the highest percentage is found in 3 regencies, namely North Hulu Sungai Regency (23.5%), Banjar Regency (17.9%), and Balangan Regency (17.7%) (2). The Sungai Malang Community-Health Centers is ranked third as the largest contributor to the number of underweight cases, namely 380 children under five years (3). In addition, the percentage of underweight among children under five years in the work area of the Sungai Malang Community-Health Centers has increased in the last 2 years, in 2022 the percentage of underweight is 15.38% and in 2023 it will increase to 15.87% while the target underweight indicator in 2023 in North Hulu Sungai Regency is 13%.

The Sungai Malang area is one of the densely populated subdistricts in North Hulu Sungai Regency, South Kalimantan, characterized by communities whose livelihoods are predominantly in agriculture, fishing, and informal sectors. Limited household income, relatively low educational levels, and restricted access to nutritious food contribute to nutritional problems among children under five. Environmental conditions such as sanitation, clean water availability, and hygiene behavior also vary across the region, influencing the risk of infectious diseases

such as diarrhea and upper respiratory tract infections, which are known direct causes of undernutrition(2).

The problem of malnutrition in children under five years can be influenced by two factors, namely direct and indirect factors. The direct causative factors that affect malnutrition are the food intake of children under five years and infectious diseases such as upper respiratory tract infection and diarrhea. Meanwhile, indirect factors are education level, family income, maternal nutritional knowledge, number of family members, food availability, and environmental sanitation hygiene (4). Many parents don't understand the importance of a healthy diet and balanced nutrition for children's growth and development. Children don't get enough nutrition from the food they eat, or their feeding methods are inappropriate. A family's low economic status can also affect their ability to afford the necessary nutritious food, especially for pregnant women and children, especially in the Malang River Region.

Despite numerous studies on underweight among children under five, there is limited research focusing on the specific determinants in Sungai Malang, particularly identifying the dominant behavioral factors. This study addresses this gap by analyzing socio-economic, health, and feeding behavior factors to determine the most influential contributor to underweight in this local context. This study highlights the specific conditions and context of a particular region, namely Hulu Sungai Utara Regency, South Kalimantan, which are often overlooked in previous studies. By considering local factors, such as culture, government policies, and access to health services, this study provides more relevant and applicable recommendations for intervention.

The aims of the study was to find out the factors related to the incidence of underweight in children under five years at the Sungai Malang Community-Health Centers, North Hulu Sungai Regency, South Kalimantan. This study not only investigates socio-economic and health determinants but also highlights meal frequency as the strongest factor associated with underweight, providing novel insight for targeted nutritional interventions in Sungai Malang.

MATERIALS AND METHODS

This study utilized a cross-sectional design with simple random sampling to investigate the determinants of underweight among children aged 24-59 months in the Sungai Malang Community Health Center area. From a total population of 1,745 children, a sample size of 106 was determined using Slovin's formula with a 10% margin of error and adjusted for potential drop-out. Inclusion criteria required permanent residency and parental consent, while exclusion criteria included children under five years who get illness or absence during data collection, or experience poor nutritional status and obesity. Sampling was conducted using a random number table to ensure equal

selection probability. From the research population, the samples used in the research were children under five years who met the following inclusion criteria including children aged 24-59 months who live in the research area and mothers of children under five years are willing to be respondents in the study. Exclusion criteria from the research sample are as follows including children under five years who are sick during the study, children under five years who do not come during the study, children under five years who do not live permanently in the research area, and children under five years who experience poor nutritional status and obesity.

This study analyzes the relationship between independent variables (mother's education level, income level, infectious diseases, meals frequency, and household size or number of family members) and dependent variables (underweight) where measurements are taken simultaneously. Underweight is one of three malnutrition criteria that reflect growth failure either in the past or in the present (5). Based on the Regulation of the Minister of Health Republic of Indonesia Number 2 of 2020 concerning Children's Anthropometric Standards, an underweight which has a calculation a weight-to-age index as its indicator (6). Based on the weight index according to age, children aged 0-60 months are categorized into four nutritional statuses, namely: severely underweight with threshold <-3 standard deviations (SD), underweight with threshold -3 SD until <-2 SD, normal body weight with threshold -2 SD until +1 SD, and overweight with threshold >+1 SD (6). Underweight indicates a condition of acute malnutrition. Underweight that is not treated early will cause the body to experience a continuous deficiency of energy or protein intake. If this continues for a long time, the body will fall into a more chronic malnutrition such as stunting (7).

RESULTS AND DISCUSSION

RESULTS

The results in this study consisted of univariate, bivariate, and multivariate analysis. The general characteristics of the respondents involved in the study are shown in **Table 1**. **Table 1** shows that 36 children (33.96%) were being underweight. The majority of children were aged 0-42 months (55.66%). The majority of children were male (51.89%). Additionally, the majority of the mothers graduated from primary and secondary school (43.40%) and the family had income less than 3 million Indonesian rupiah per month (64.15%). In terms of household size, most of the households were small with less than or equal four members (58.49%). Less than half of the children did not experienced infectious diseases (59.43%), and children were reported had enough meals per day (57.55%).

Table 1. General characteristics of the respondents

Independent variables (N = 106)	Frequency	Percentage (%)
Underweight		
No	70	66.04
Yes	36	33.96
Children's age		
0 to 42 months	59	55.66
43 to 59 months	47	44.34
Sex		
Female	51	48.11
Male	55	51.89
Mother's education level		
University (Postgraduate, Undergraduate, diploma)	22	20.75
High school (Senior high school)	38	35.85
Primary and secondary school (Elementary and Junior high school)	46	43.4
Income level		
≥ 3 million IDR	38	35.85
< 3 million IDR	68	64.15
Household size		
Small (≤ 4 people)	62	58.49
Medium (5-6 people)	26	24.53
Large (≥ 7 people)	18	16.98
Infectious diseases		
No	63	59.43
Yes	43	40.57
Meals frequency		
Enough (≥3 times a day of main meals and ≥ 2 times a day of snacks)	61	57.55
Less (<3 times a day of main meals and <2 times a day of snacks)	45	42.45

Table 2. Relationship between each predictor and incidence of underweight

Independent variables	No underweight (%)	Underweight (%)	Total	Chi-square (p-*value*)
Children's age				
0 to 42 months	57.63	42.37	59	4.2
43 to 59 months	76.6	23.4	47	
Sex				
Female	62.75	37.25	51	0.47
Male	69.09	30.91	55	

Mother's education level				
University	77.27	22.73	22	6.97
High school	76.32	23.68	38	
Primary and secondary school	52.17	47.83	46	
Income level				
≥ 3 million IDR	81.58	18.42	38	6.38
< 3 million IDR	57.35	42.65	68	
Household size				
Small	67.74	32.26	62	8.85
Medium	46.15	53.85	26	
Large	88.89	11.11	18	
Infectious diseases				
No	84.13	15.87	63	22.66
Yes	39.53	60.47	43	
Meals frequency				
Enough	91.8	8.2	61	42.53
Less	31.11	68.89	45	

The bivariate analysis using Chi-square statistical test in this study can be seen in **Table 2**. **Table 2** shows that the factors including children's age, mother's education level, income level, household size, having infectious diseases, and meals frequency were statistically significant associated with incidence of underweight. However, children's sex was found insignificantly associated with being underweight.

Table 3 shows the binary logistic regression result of correlation of all independent variables and incidence of underweight. Before tested by this multivariate analysis, the multi-collinearity test was checked to ensure the correlation between each independent variable. The results revealed each independent variable is independent each other. Among 106 children under five years olds employed to this study, the factors associated with being underweight were family income, household's size, having infectious diseases, and frequency of meals. In detail, compared to children from family with income IDR3 million or higher per month, children from family with lower than IDR3 million per month were 12.74 times more likely to be underweight after adjusted to all predictors. Additionally, compared to small household's size, children from medium household's size were 7.98 times more likely to be underweight. Compared to children without infectious diseases, children having infectious diseases were 13.84 times more likely to be underweight. Moreover, children with less daily meals were 47.19 times more likely to be underweight compared to their counterparts having enough daily meals. The predictors found insignificantly associated with incidence of underweight were children's

age and sex and mother's educational level which showed a p-value less than 0.05. The model in **Table 3** reflected the 57.48% (based on pseudo R^2) factors associated with being underweight and the rest are other variables not included in this study.

Table 3. Binary logistic regression of factors associated with underweight

Independent variables	Adj. OR	Standard errors	z	*p-value*	95% conf. interval	
Children's age						
0 to 42 months						
43 to 59 months	0.56	0.4270751	-0.76	0.449	0.13	2.49
Sex						
Female						
Male	1.42	1.097651	0.45	0.65	0.31	6.46
Education level						
University						
High school	0.66	0.6233843	-0.44	0.662	0.1	4.19
Primary and secondary school	0.87	0.8017118	-0.15	0.882	0.14	5.29
Income level						
≥3 million IDR						
<3 million IDR	12.74	11.80835	2.75	0.006**	2.07	78.34
Household size						
Small						
Medium	7.98	7.310745	2.27	0.023*	1.33	48.04
Large	0.08	0.1055082	-1.86	0.062	0.01	1.14
Infectious diseases						
No infectious						
Yes	13.84	11.3831	3.2	0.001**	2.76	69.37
Meals frequency						
Enough						
Less	47.19	43.59444	4.17	0.000***	7.72	288.53
Cons	0	0.0036403	-3.66	0	0	0.06

*$p_{\text{-value}}$<0.05, **$p_{\text{-value}}$<0.01, ***$p_{\text{-value}}$<0.001, Log likelihood = -28.883155, Pseudo R^2 = 0.5748.

DISCUSSION

The results of the study based on **Table 1** showed that incidence of underweight among children under five years in the working area of Sungai Malang community-health centers based on the findings of this study was 36 out of 106 children (33.96%). It was in line with the results of the Indonesian Basic Health Survey in 2018, where most children under five years (86.2%) in Indonesia are well-nourished but each province experienced malnutrition (8). Underweight is defined as nutritional status based on the weight-for-age index which is a combination of the terms malnutrition and under nutrition with Z-score <-2 standard

deviations (9). Underweight can be caused by two factors: direct factors and indirect factors. Direct factors causing nutritional problems are due to lack of illness (infectious diseases), exclusive breastfeeding, and indirect factors such as maternal knowledge, number of family members, and socio-economic factors (10). Under nutrition that takes place very quickly during growth will lead to abnormal child behavior and poor learning ability and can be carried over into adulthood. Previous research revealed the impact of malnutrition on children has short-term and long-term effects (11). Short-term effects include problems with body metabolism, physical growth, and brain intelligence. Long-term effects include decreased immunity, which leads to illness, and decreased productivity and work capacity.

The results of the analysis showed in **Table 2** that meals frequency were statistically significant associated with incidence of underweight. Various studies have shown that the risk of child mortality among children with poor nutritional status is significantly elevated, particularly in developing countries (12). Existing research underweight among children under five years reported that the caused can be direct and indirect causal factors (13). Most children under five years are malnourished because they do not receive adequate nutritional intake or experience infectious diseases. Nutritional intake is a nutrient that is very important for children's immunity so that they can maintain their immunity (14). Based on **Table 3**, the strongest factor associated with being underweight based on the multivariate analysis results among children under five years in community-health centers of Sungai Malang is frequency of meals. Other factors that also contributed to being underweight are low-income level, medium household's size, and having infectious diseases.

Underweight among children under five years of age remains a concern in low- and middle-income countries because long-term impact for children development. There are several factors might influence the incidence of underweight which need a comprehensive understanding of the various determinants that contribute to this condition. Socio-economic status (SES) is one of the most significant determinants of underweight in children under five. Numerous studies have established a strong correlation between low SES and higher rates of underweight. Supporting the findings of this study, the study in Ethiopia found that children from economically disadvantaged households were 65% more likely to be underweight compared to those from wealthier families (15). This relationship is often attributed to limited access to nutritious food, healthcare, and education, which are more readily available to families with higher income levels (16). This also related to the frequency of meals provided in the family. Poorer households' income tends to limit the frequency and even the portion of the meals. Countries with good economic conditions will have a high value on the health status of each individual (17).

This study found insignificant association between mother's educational level and being underweight of children under five years. In middle-income countries, higher maternal education is significantly associated with elevated weight for age z-score in children (18). Research consistently shows that higher levels of mother education correlate with lower rates of underweight among children. Educated mothers are more likely to understand the importance of nutrition and healthcare, which directly affects their children's dietary practices (19). Moreover, one study in Sangihe, Indonesia noted that mothers with higher education levels were more likely to initiate breastfeeding efficiently and provide appropriate complementary foods, thereby reducing the risk of underweight (16).

Incidence of underweight among children under five years tends to occur among mothers with low education (20)(21)(22). Research by Suraya et al. also showed a relationship between Mother's education and the incidence of underweight in toddlers, with a p-value of 0.049. Mother's education is an external factor contributing to malnutrition in toddlers. Most mothers' education levels are still relatively low, as many mothers only graduated from high school. This low level of maternal education results in a lack of knowledge about achieving balanced nutrition. This condition is a contributing factor to underweight toddlers (23). Research by Shaputri and Dewanto demonstrated a strong link between maternal education and the nutritional status of children under two years of age (24). Increasing maternal education will have an impact on investing in quality human resources, because maternal education will improve the nutritional status of children under five years. This is mainly related to their parenting responsibilities, which include organizing meal plans, buying groceries, cooking, preparing food, and serving food. However, mothers' level of education does not necessarily hinder their ability to prevent child underweight. Even with a low level of education, curious mothers can still obtain information related to maintaining optimal nutritional status for their children. Knowledge on how to meet optimal nutritional conditions can also be obtained from various sources, such as from family, friends, nutritionists, doctors/health workers, government agencies or programs (25).

Dietary practices might also play a role in determining the incidence of underweight among children. Exclusive breastfeeding for the first six months of life is vital for preventing malnutrition, yet many children do not receive this essential nutrition (26). A study in India found that dietary diversity is a protective factor against underweight, indicating that a varied diet can help meet the nutritional needs of growing children (27). Conversely, late initiation of complementary feeding has been associated with increased risk of underweight (16). Health-related factors, particularly the prevalence of infectious diseases, also contribute significantly to underweight among children as supporting

the finding of this study. Illnesses such as diarrhea and respiratory infections can lead to malnutrition by reducing appetite and nutrient absorption (28). Additionally, children who experienced diarrhea had significantly higher odds of being underweight (19). This highlights the importance of ensuring access to healthcare and preventive measures, such as vaccinations and clean water, to mitigate the impact of diseases on child nutrition. Moreover, environmental factors, including sanitation and hygiene practices, are critical in preventing infections that can exacerbate malnutrition (27).

Infectious diseases are symptoms that arise or immunological responses due to the entry and development of disease seeds or parasites (agents) into the human or animal body (host). The microorganisms that enter the body, the body's reaction to micro-organisms, and the general characteristics of the disease are some of the factors that greatly affect infectious diseases. Any damage to a person's body structure and function will cause the disease to show clinical symptoms. Illness can cause loss of appetite, so the child does not want to eat, and can become weight loss, which can lead to malnutrition (29).

There is a reciprocal relationship between the incidence of infectious diseases and malnutrition. Children who are mal-nourished will experience a decrease in appetite which can lead to a decrease in endurance, making them vulnerable to infectious diseases and vice versa children under five years who often suffer from infectious diseases can cause malnutrition. Supporting the result of this study, 155 out of 279 respondents had a history of infectious disease which led the high incidence of underweight (30). Infectious diseases are diseases caused by the entry of micro-organisms into the body that cause abnormal reactions to the body. Infectious diseases can cause a decline in appetite/difficulty swallow-ing and digesting food, resulting in a decre-ase in food consumption in body, which can lead to malnutrition. Infections can cause nutrients to be used to repair damaged tissues or cells, which makes infectious diseases a direct contributing factor.

A child suffering from an infectious disease can experience an average of 8 cm of reduced growth and a drop in IQ points by the age of 7 to 9 years. This shows that infectious diseases can stunt a child's growth. Unlike previous studies that emphasized maternal education as the primary determinant of child underweight, our findings indicate that meal frequency has the greatest impact on nutritional status among children under five in Sungai Malang. This novel finding offers a new perspective on behavioral interventions for improving child nutrition.

The number of family members is the number of individuals who live and stay in one house. The number of family members is related to the availability of food in the household. If the number of family members is inversely proportional to the amount of family income, it can lead to a lack of food

availability in the household (31). Multiple factors influence linear growth during early childhood, many of which contribute to the burden of stunting (32). The fulfillment of food needs will be easier in families with fewer members, so that food for their children, every day given varied and nutrient-rich food by paying attention to the composition of 4 healthy 5 perfect, which in effect children can have a good nutritional status (33). Families that have many members will find it difficult to fulfil children's daily nutritional needs for good physical growth. As a result, when the number of family members increases, the amount of money spent by the household increases especially for food and health care, which will eventually lead to delayed growth. In line with (33) that obtained the results of research from 48 respondents who obtained a large family with a nutritional status of under five years of 16 (33.3%) respondents.

The number of family members is defined as the number or number of people who usually live in one household and whose food management is managed in the same kitchen. National Family Planning Coordination Board Republic of Indonesia categorizes families with less than four members as small families. Meanwhile, families with more than 4 members are categorized as large families (34). The number of family members affects the level of food consumption, which is then related to nutritional status. If the number of family members is large but not accompanied by a high income, food distribution will be uneven. The more family members, the more food needs that must be met. Meanwhile, if the number of family members is relatively small, the needs that must be met are also reduced so that the family can allocate more income to buy more nutritious food ingredients (34). A large number of family members will affect food insecurity in the family.

The age of the child is another significant factor associated with underweight, even though in this study was found insignificant association. Previous study indicates that older children within the under-five age group are at a higher risk of being underweight, possibly due to increased nutritional needs as they grow and the challenges of transitioning to solid foods (35). Additionally, the number of children under five years in a household can exacerbate the risk of under nutrition, as resources may be stretched thinner in larger families (28). A study in Ethiopia found that households with more children under five years had a higher prevalence of underweight, emphasizing the need for targeted interventions that consider family dynamics and resource allocation (28).

CONCLUSION AND RECOMMENDATION

The results showed that there was a relationship between the family income level (a p-value of 0.006 <0.05), history of infectious diseases (a p-value of 0.001 <0.05), frequency of meals (a p-value of 0.000 <0.05), and number of family members (a p-value of 0.023 <0.05). The strongest factor associated with being underweight based on the multivariate analysis results is frequency

of meals. Other factors that also contributed to being underweight are having low-income level, medium household's size, and having infectious diseases. The identification of meal frequency as the dominant determinant of underweight in this local context represents a novel contribution, providing actionable evidence for effective nutritional interventions targeting children under five. Based on these findings, it is recommended that intervention programs prioritize improving meal frequency among children under five, supported by community-based education and outreach. Community-health centers are encouraged to actively disseminate information through counselling and training for families and health cadres, focusing on early detection and prevention of underweight. Future research should explore additional variables such as parenting practices, maternal knowledge, and dietary diversity to deepen understanding and enhance intervention strategies.

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