

Prediction Model for Underweight among Age Under-five Children in Community Health Center of Banjar

Rusmilawaty^{1,*}, Tri Tunggal¹, Yuniarti¹, Norlaila Sofia¹, Nur Rohmah Prihatanti¹, Efi Kristiana¹, Hapisah¹, Evi Risa Mariana¹, Anwar Mallongi²

¹Polytechnic of Health Ministry of Health Banjarmasin, Indonesia

²Faculty of Public Health, University of Hasanuddin, Indonesia

Received August 2, 2024; Revised September 19, 2024; Accepted October 25, 2024

Cite This Paper in the Following Citation Styles

(a): [1] Rusmilawaty, Tri Tunggal, Yuniarti, Norlaila Sofia, Nur Rohmah Prihatanti, Efi Kristiana, Hapisah, Evi Risa Mariana, Anwar Mallongi, "Prediction Model for Underweight among Age Under-five Children in Community Health Center of Banjar," *Universal Journal of Public Health*, Vol. 12, No. 6, pp. 1174 - 1181, 2024. DOI: 10.13189/ujph.2024.120614.

(b): Rusmilawaty, Tri Tunggal, Yuniarti, Norlaila Sofia, Nur Rohmah Prihatanti, Efi Kristiana, Hapisah, Evi Risa Mariana, Anwar Mallongi (2024). *Prediction Model for Underweight among Age Under-five Children in Community Health Center of Banjar*. *Universal Journal of Public Health*, 12(6), 1174 - 1181. DOI: 10.13189/ujph.2024.120614.

Copyright©2024 by authors, all rights reserved. Authors agree that this article remains permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

Abstract In 2022, the prevalence of underweight children in South Kalimantan was higher than the national average, with Banjar District ranking third at 26.9%. Being underweight leads to impaired brain intelligence, decreased immunity, disrupted child growth and development, and affects human resources. This study aims to create a prediction model for underweight in children under five in Banjar District by identifying dominant influencing factors, including birth weight, birth length, history of infectious diseases, exclusive breastfeeding, immunization completeness, regular visits to integrated health center (IHC) (*posyandu*), number of family members, and family income. This study used an observational design with a case-control approach. The research sample consisted of 202 children under five years old in the work area of Aluh-aluh Community Health Center (CHC) (*puskesmas*) of Banjar District, selected using probability sampling with simple random sampling. The research location was in the work area of Aluh-aluh CHC of Banjar District. Data analysis was performed using logistic regression tests. There was a relationship between birth weight, exclusive breastfeeding, immunization completeness, and regular visits to integrated health posts with underweight status, with Odds Ratio (OR) values of 18.8, 1.97, 3.33, and 3.05 respectively. There is no relationship between birth length, history of infectious

diseases, family income, and number of family members with underweight status. The most influential risk factors for underweight occurrences are birth weight and immunization completeness, with OR values of 20.13 and 2.58 respectively. The probability of underweight due to risk factors can be predicted as follows: 90.1% due to Low Birth Weight (LBW), 82.0% due to incomplete immunization, and 92.9% due to both LBW and incomplete immunization.

Keywords Prediction Model, Underweight, Children Under Five, Birth Weight, Immunization

1. Introduction

The process of growth occurs at a faster pace, with 80% of an individual's development taking place within the initial five years of life, which is commonly referred to as the golden era. This period is characterized by rapid cognitive development. Toddlers require adequate nourishment to facilitate their growth and development during this critical phase [1].

Underweight refers to a state in which an individual's body weight is not suitable for their predicted age. This

commonly happens in toddlers between the ages of two and five, as they start to imitate their family's dietary habits and engage in vigorous physical activity [2].

Children who lack nutritious food face the risk of malnutrition in the form of underweight which may further lead to inadequate brain growth, lower intelligence and poor school performance below average achievement.

Underweight is a problem that should be managed since it can give rise to the lost generation. The quality of the nation in the future will be greatly influenced by the current nutritional status [3].

Minister of Health Regulation No. 2 of 2020 states that Underweight refers to the Body Weight Index by Age (BW/A) of -3 SD to <-2 SD for children aged 0 (zero) to 60 (sixty) months [4].

The Indonesian Nutrition Status survey in 2022 revealed that the prevalence of children with underweight increased every year. The underweight percentage was 16.3% in 2019, which increased to 17.0% in 2021 and 17.1% in 2022. The prevalence of underweight in South Kalimantan was 24.3% in 2021, which further decreased to 21.7% in 2022, but still higher than the national percentage. In 2022, the prevalence of underweight in Banjar District was in third place by 26.9% after North Hulu Sungai District (32.5%) and Central Hulu Sungai District (29.2%). Aluh-aluh Sub-district was found as the area with the highest prevalence of underweight in Banjar District by 329 cases (21.5%) [5].

Previous study revealed that underweight was caused by lack of nutritional intake, history of infectious disease, diet, family income, economic status, history of exclusive breastfeeding, history of LBW, education level, number of family members, completeness of immunization, knowledge, environmental factors, parenting style, inadequate health service and sanitation [1], [6], [7], [8], [9].

Underweight in children under five is still a significant health problem in many parts of the world, especially in developing countries. It is one of the factors affecting family consumption patterns, which are often influenced by access to food sources and eating habits. In coastal communities living near rivers, such as the Aluh-aluh community in South Kalimantan, there is a unique phenomenon where although access to high protein sources, such as fish, is relatively easy to obtain, protein intake for children under five is inadequate.

The people of Aluh-aluh are part of the Banjar tribe, whose main livelihood is fishing. Fish obtained from the catch is usually processed into salted fish, which is then sold for family income, but the consumption of fresh fish or fish products by family members, especially children under five, is still lacking. Interviews with several members showed that the consumption of vegetables and fruits is also very rare. This situation puts children under five in these families at risk of nutritional deficiencies, especially protein and essential vitamins that are important for growth.

This suggests a paradox in the consumption patterns of the Aluh-aluh community, where they have abundant access to protein sources from river catches, yet their children are underweight. This phenomenon has not been studied in depth, especially in the context of coastal communities who work as fishermen in Indonesia. Therefore, this study aims to further explore the factors that influence the nutritional status of children under five years old.

A study conducted at Doi-doi CHC, Barru District found that there was a relationship between knowledge, perception, parenting style and income with malnutrition among under-five children [10]. A study conducted in the work area of Ambarawa CHC, Pringsewu District found that food consumption patterns, infectious diseases, parenting style and weight-bearing behavior were the causal factors of underweight [11]. A study conducted at Karang Intan I CHC revealed that there was a relationship between the history of exclusive breastfeeding, parenting style, history of infectious disease, regular visits to IHC, and family economic status with the case of underweight below the red line (BGM) among under-five children [12].

Being underweight has immediate effects such as impairing cognitive function, causing stunted physical growth, and disrupting metabolic processes. In the long term, it leads to a weakened immune system, making individuals more susceptible to illnesses, and diminishing their overall productivity and work capability.

Efforts made by the Banjar District Health Office to manage cases of underweight among under-five children include holding classes for Below the Red Line (BRL), providing additional food (PMT), visiting/assisting cases and carrying out early tracking through 2T and BRL cases screening. It is expected that such cases are immediately managed to prevent underweight. There is also a Therapy Feeding Center (TFC) and the provision of vitamins (Vitamin A, *taburisa*, etc.) [3].

The research is conducted in Banjar District due to the pressing need to address the high prevalence of underweight children, which surpasses the national average. Underweight status significantly impacts the growth and development of children, ultimately shaping the future human resources of the region.

This study creates a prediction model for underweight among under-five children using multivariate analysis through identification of the dominant factors that influence the dependent variable of underweight, which makes this study a novel value. The independent variables studied were birth weight, birth length, history of infectious diseases, history of exclusive breastfeeding, completeness of immunization, visits to IHC, number of family members and family income.

2. Materials and Method

The current study was conducted in 2024 in the work area of Aluh-aluh Community Health Center, Banjar

District. This was an observational study with a case control approach. The research method used an observational research design with a case control approach, and the sample of this study used a ratio of 1: 1. The case sample (all children aged less than 5 years who are underweight) amounted to 101 people, while the case sample (children aged less than 5 years who have good nutritional status) amounted to 2,078 people and was selected using simple random sampling as many as 101 people.

The dependent variable, namely underweight, is the nutritional status of toddlers measured based on body weight per age categorized as not underweight if -2 Standard Deviation (SD) to $+1$ SD and underweight if -3 SD to <-2 SD. Independent variables include a history of infectious diseases that have been suffered by children in the last 6 months such as upper respiratory tract infections and diarrhea. Infant birth weight is categorized as Normal Birth Weight (NBW) if ≥ 2500 grams and LBW if < 2500 grams, infant birth length is categorized as normal if 48-52 cm and less if < 48 cm, exclusive breastfeeding history is breastfeeding alone without additional food or other drinks until the baby is 6 months old, completeness of basic immunizations obtained until the age of 12 months, visits made by mothers to check their children to health facilities in the last 6 months, the number of family members living in one house is categorized as small if < 7 people and large if ≥ 7 people, family income calculated for one month according to the South Kalimantan regional drinking wage of IDR 3. 282.000.

This study was conducted in compliance with the code of ethics. The ethics code was identified as No.532/KEPK-PKB/2024. Underweight data were collected from a cohort of children under 5 years old, while data on the history of infectious diseases, birth weight, birth length, exclusive breastfeeding history, immunization completeness, family income, visits to the posyandu and the number of family members were collected from the toddler cohort and maternal and child health book.

Multivariate analysis uses the logistic regression test to identify the risk factors that most affect the incidence of underweight, and data analysis uses the chi square statistical test to identify the factors linked to the incidence of underweight. The logistic regression equation is

$$y = \frac{1}{1 + e^{-(\alpha + \beta_1 x_1 + \beta_2 x_2)}}$$

3. Results

Characteristics of Respondents and effect of Risk Variables on Underweight among Under-Five Child

The data collected includes information on Birth Weight, Birth Length, History of Infectious Diseases, Exclusive Breastfeeding, Immunization Completeness, Visits to Integrated Health Center, Number of family members, and

Family Income and the effect of each risk factor on underweight was tested using the chi square test with a confidence level of 95%. This information is presented in Table 1.

Table 1 revealed that the majority of children who were underweight and those who were not underweight had normal birth weight by 84.2% and 99%. Furthermore, based on birth length, the majority of children who were underweight and those who were not underweight had normal birth length by 85.1% and 91.1%. Neither underweight nor non-underweight toddlers had a history of infectious disease, with percentages of 64.4% and 77.2%.

Only 59.4% of the majority of toddlers who were underweight were exclusively breastfed. In contrast, 57.4% of toddlers who were not underweight had experienced exclusive breastfeeding.

The percentage of both underweight and non-underweight toddlers who received complete immunizations was 50.5% and 77.2%. Similarly, the percentage of underweight and non-underweight toddlers who attended IHC visits more than 4 times in 6 months was 79.2% and 92.1%. Additionally, 67.3% of underweight toddlers and 74.3% of non-underweight toddlers had a small number of family members. Approximately 99% of underweight toddlers and 99.5% of non-underweight toddlers were from families with an income that was equal to or higher than the minimum wage.

Thus it provides an explanation of the four variables that are linked to the occurrence of underweight in toddlers. These variables are birth weight, exclusive breastfeeding, vaccination completion, and frequency of Integrated Health Center visits. The risk factors that have the most significant impact on the cases of underweight are birth weight, vaccination completeness, frequency of Integrated Health Center visits, and history of exclusive breastfeeding. These factors have OR values of 18.8, 3.33, 3.05, and 1.97, respectively.

Variables that do not have a statistically significant association with the incidence of underweight in toddlers include birth length ($\rho = 0.227$), history of infectious diseases ($\rho = 0.063$), number of family members ($\rho = 0.353$), and family income ($\rho = 1.000$). Statistically, these factors lack significance. Nevertheless, their correlation can be recognized through the patterns of data distribution in cross-tabulation. Toddlers with a low birth length have a much higher proportion of underweight individuals compared to those who are not underweight. On the other hand, the proportion of toddlers with normal birth length who are not underweight is greater. Therefore, there is a correlation indicating that toddlers with shorter birth lengths are more prone to being underweight. Disregarding the significance value (ρ), the Odd Ratio (OR) for birth length is 1.78 (95% CI 0.7-4.3), indicating that toddlers with short birth length have a roughly 1.78 times higher chance of being underweight compared to those with normal birth length.

The tendency for data distribution in the Birth Length

variable was also found in other variables which did not show a statistically significant relationship. Furthermore, by only considering the OR value for each variable, the risks of underweight among children with a history of infectious disease, large number of family members, and low income were 1.88 times, 1.4 times, and 2 times, respectively compared to the respective comparison variables.

Risk Variables that Showed an Effect on the Incidence of Underweight among Under-five Children in Multivariate Manner

The study employed multivariate logistic regression to assess the risk factors that impact the occurrence of underweight in toddlers. The risk variables included in this

test are those with a significance value ($p \geq 0.25$). Only the variables of Birth Weight, History of Infectious Diseases, History of Exclusive Breastfeeding, Immunization Completeness, and Visits to Integrated Health Center were included in the analysis. The results of multivariate analysis using logistic regression test are shown in Table 2.

Table 2 shows that it can be observed that two of the five risk factors tested had a significant effect on the incidence of underweight among under-five children with p values ranging from 0.004 to 0.004. 0.007 or $< \alpha(0.05)$, namely birth weight and completeness of immunization.

Birth weight is the most significant risk factor for underweight in toddlers, with an odds ratio of 20.136 and a 95% confidence interval. The subsequent notable risk factor is the completeness of immunization, with an odds ratio of 2.585 with a 95% confidence interval.

Table 1. Characteristics of Respondents and Effect of Risk Variables on Underweight among Under-five Child

No.	Variables	Underweight				p value*)	OR (CI 95%)
		Yes	%	No	%		
1.	Birth Weight						
	- LBW (< 2.500 gram)	16	15.8	1	1	0.000*	18,824
	- NBW (\geq 2.500 gram)	85	84.2	100	99		(2.445-144.891)
2.	Birth Length						
	- Less (<48 cm)	15	14.9	9	8.9	0.277	1.783
	- Normal (48-52 cm)	86	85.1	92	91.1		(0.742-4.286)
3.	History of Infectious Disease						
	- Yes	36	35.6	23	22.8	0.063	1.878
	- No	65	64.4	78	77.2		(1.012-3.485)
4.	Exclusive Breastfeeding						
	- No	60	59.4	43	42.6	0.024*	1.974
	- Yes	41	40.6	58	57.4		(1.128-3.455)
5.	Completeness of Immunization						
	- Incomplete	50	49.5	23	22.8	0.000*	3.325
	- Complete	51	50.5	78	77.2		(1.812-6.101)
6.	Visits to Integrated Health Center						
	- < 4 times	21	20.8	8	7.9	0.016*	3.052
	- \geq 4 times	80	79.2	93	92.1		(1.282-7.265)
7.	Number of Family Members						
	- Large (\geq 7 people)	33	32.7	26	25.7	0.353	1.400
	- Small (< 7 people)	68	67.3	75	74.3		(0.761-2.576)
8.	Family Income						
	- Minimum Wage (< Rp 3.282.000)	1	1	0	0.5	1.000	2.010
	- Minimum Wage (\geq Rp 3.282.000)	100	99	101	99.5		(1.749-2.310)

Source: Secondary Data, 2024

Description:

*) Based on chi square test

*) Meaningful at the 95% confidence level

Table 2. Risk Factors with the Most Significant Effect on the Incidence of Underweight among Under-five Children

No.	Variables	B Coeff	SE (B)	<i>P value</i> *)	<i>Adj OR (CI 95%)</i>
1.	Birth Weight	3.003	1.053	.004*	20.136
2.	Infectious Disease	.578	.346	.095	1.783
3.	Exclusive Breastfeeding	.543	.323	.093	1.721
4.	Completeness of Immunization	.950	.354	.007*	2.585
5.	Visits to Integrated Health Center (IHC)	.573	.496	.248	1.774
	Constant	-4.607	1.160	<.001*	

Source: Secondary Data, 2024

Description:

*) Based on logistic regression test

*) Meaningful at the 95% confidence level

R²(Nagelkerke) = 24,3%

The prediction model for underweight among under-five children by the risk factors was predicted using the Logistic Regression equation as follows:

$$y = \frac{1}{1 + e^{-(1.16 + 1.053.LBW + 0.354.Immunization)}}$$

The model predicts that the probability of underweight in babies caused by risk factors is as follows: 90.1% due to LBW, 82.0% due to incomplete immunization, and 92.9% due to both LBW and incomplete immunization.

4. Discussion

Characteristics of Respondents and Effect of Risk Variables on Underweight among Under-Five Child

The study conducted in the Aluh-aluh CHC area found that four risk factors are strongly linked to underweight in toddlers, namely birth weight, exclusive breastfeeding, immunization completion, and IHC visits.

The immune system of LBW babies is not functioning properly so they are more susceptible to infectious diseases which result in decreased appetite, low nutritional intake during the growth period and ultimately malnutrition and disruption of growth and development.

This study revealed that the majority of respondents (91.1%) were children born with normal weight. The results of statistical test showed that LBW children had a 19 times higher risk of being underweight compared to those with normal weight (OR=18.8). A previous study found that there was a significant relationship between nutritional problems and several independent variables studied including economic status, history of exclusive breastfeeding, history of LBW, history of disease, level of education and completeness of immunization [1]. Children born with LBW tend to have slower growth and development. This condition will get worse if they have insufficient nutritional intake, poor parenting style and

often experienced infectious disease, leading to be underweight. This study revealed that babies with LBW had a much higher risk of being underweight compared to babies with normal birth weight. In fact, the risk is 18.8 times greater for LBW babies (OR = 18.8). Similar studies conducted in Tanzania and India also found that the risk of underweight was higher in children born with low birth weight compared to other children born with average or higher than average weight [13]. On the other hand, research in three poor sub-districts of Tambak Sari, Simokerto, and Kenjeran in the Municipality of Surabaya, East Java, Indonesia shows that, there was no meaningful correlation between the birth weight of the children and their nutritional health [14].

The study additionally discovered that a majority of underweight toddlers (59.4%) did not obtain exclusive breastfeeding within the initial 0-6 months. It is a contributing factor that increases the likelihood of malnutrition in toddlers. The statistical analysis revealed an OR of 1.9, indicating that infants who did not obtain exclusive breastfeeding are at a 1.9-fold increased risk of being underweight compared to those who did. This conclusion is corroborated by several studies that suggest that using formula to feed infants raises the likelihood of malnutrition when compared to exclusive breastfeeding. Toddlers who were not exclusively breastfed have a 7-fold higher risk of experiencing malnutrition compared to those who were [15]. Malnutrition was predominantly prevalent (80%) in toddlers who did not receive exclusive breastfeeding [16]. Furthermore, additional research has indicated that toddlers who were not exclusively breastfed (84.2%), did not have parents who practiced democratic parenting (82.4%), or came from low-income households (67.3%) encountered malnutrition [17]. A qualitative study conducted at Puskesmas Bumiayu examined the factors that contribute to malnutrition rates in toddlers. These factors include economic position, education level, maternal understanding, and improper complementary feeding methods [18].

Additionally, the research revealed that a majority of toddlers who were not underweight (77.2%) obtained all required vaccines. The immunization status serves as a measure of healthcare engagement. Immunizations are administered to children as a fundamental measure to decrease the likelihood of a sickness and mortality. Administering comprehensive vaccines is anticipated to enhance nutritional issues and yield enduring beneficial impacts on the nutritional status of toddlers. The study revealed that babies who did not receive complete basic vaccines have 2.58 times increased chance of being underweight compared to those who received complete immunizations. This discovery aligns with previous studies that have established a connection between the extent of immunization and the nutritional health of toddlers [19].

The study also found a correlation between the frequency of IHC visits and the prevalence of underweight. Regular weighing at IHC is a crucial component of growth monitoring, which provides valuable health data on children. Its primary objective is to identify potential diseases or nutritional problems that provide the greatest risk of mortality at an early stage. The statistical analysis revealed that toddlers who have less than four IHC visits are 3.05 times more prone to being underweight than those who had more frequent visits. This conclusion is corroborated by additional research that demonstrated a correlation between the frequency of IHC visits and the nutritional status of toddlers in the Puskesmas Hulu Palik district in 2022 [20].

The study identified four risk factors that showed no correlation with underweight, namely birth length, history of infectious diseases, number of family members, and family income. This contrasts with prior research that suggested a correlation between low birth length and maternal nutritional condition during pregnancy, which in turn impacts newborn growth and development, ultimately resulting in underweight babies [21].

The majority of underweight and non-underweight toddlers in this study did not have a prior medical history of infectious disease. Infectious diseases such as diarrhea and respiratory infections elevate the body's metabolism and interfere with the absorption of nutrients, causing a reduction in appetite, feelings of nausea, vomiting, fever, loss of fluids, and shortages in nutrition. Consequently, this leads to weight loss and stunted growth. This finding contradicts previous research that had established a correlation between the history of viral diseases and the nutritional state of children [22], [23].

The study also revealed that both underweight and non-underweight toddlers predominantly originate from homes with a limited number of members. Household food availability is correlated with the number of family members. Insufficient food availability may result from a negative correlation between the number of family members and family income. Contrary to earlier research findings, this study indicates that having more than two family members increases the probability of having a

malnourished child. This is because having more family members affects how revenue is distributed for meeting the nutritional needs of the family [24], [25].

The majority of children who were either underweight or not underweight had family incomes that were at or above the minimum wage. This finding contradicts studies that have shown a substantial correlation between household income and the nutritional condition of toddlers [26]. The quality and amount of food consumed are determined by one's income level. Increased income enables individuals to allocate more funds towards the purchase of essential nutritional items such as fruits, vegetables, and other food products.

Underweight is not linked to four specific factors, which could be influenced by other indirect causes such as insufficient food, inadequate caregiving, lack of sanitation, absence of clean water and basic healthcare services, and infrequent IHC visits. The primary factors contribute to malnutrition encompass economic, political, and social upheavals, such as natural calamities, which directly affect the availability of food, the behaviors of family caregivers, and the provision of healthcare services. These factors eventually have an impact on the nutritional status of toddlers [9]. Previous studies have emphasized the impact of knowledge, education, and money on the nutritional condition of toddlers [7]. An analysis of 15 publications suggests that the factors influencing malnutrition in toddlers encompass economic factors, education, environmental factors, diarrhea, maternal awareness, caregiving behaviors, toddler eating patterns, and adequacy of energy and protein intake [7].

Risk Variables that Showed an Effect on the Incidence of Underweight among Under-five Children in Multivariate Manner

The logistic regression analysis reveals that Birth Weight has the most significant influence on the cases of underweight, followed by the completeness of immunization. The risk factor that has the greatest impact on underweight is LBW with an OR value of 20.136 (95% confidence interval). This indicates that the probability of underweight in children with LBW is 20.13 times higher in comparison to children with NBW. Additionally, the risk factor that influences underweight in children is the completeness of immunization, with an OR value of 2.585 and a 95% Confidence Interval (CI). This indicates that the probability of underweight in children who have not received all their immunizations is 2.58 times higher than in children who have received all their immunizations.

A previous study revealed that there was a relationship between birth weight and completeness of immunization with underweight among under-five children [1], [16], [27], [28]. Furthermore, a literature study conducted in India showed that babies born with low birth weight were at risk of being underweight (OR=1.76; 95% CI: 1.70–1.82) in

their childhood compared with those born without low birth weight [28]. A study conducted in South Asia similarly showed low birth weight had a significant impact on malnutrition among under-five children [29]. Another study conducted in Karangrejo found that one of the factors that influenced the cases of underweight among children was a history of complete immunization ($p=0.011$, $OR=4.63$) [30].

The underweight prediction model for children indicates that the likelihood of being underweight as a result of LBW is 90.1%, as a result of incomplete immunization is 82.0%, and as a result of combined LBW and incomplete immunization is 92.9%.

This study suggests that there is a 92.9% probability of underweight in children who are born with a low birth weight (≤ 2500 grams) and have not received complete immunization. Other studies have also found a strong and statistically significant correlation between nutritional issues in children and many factors, such as economic position, exclusive breastfeeding, low birth weight, illness history, education level, and complete immunization. In 2022, a study conducted in the Work Area of Rangkaian health center discovered associations between birth weight, birth length, gender, age, and weight growth status with stunting, underweight, and wasting [1].

A limitation of this study is that the data collection included variables like family income and LBW in the regression model may have produced biased results due to the distribution of these variables among the groups.

5. Conclusions

There is a significant correlation between birth weight, exclusive breastfeeding, vaccination completion, and visits to IHC with underweight. The OR values for these factors are 18.8, 1.97, 3.33, and 3.05, respectively. There was no correlation observed between birth length, history of infectious diseases, family income, and the number of family members with underweight. The primary risk factors that have a significant impact on underweight are birth weight and vaccination completeness, with OR values of 20.136 and 2.585, respectively. The likelihood of becoming underweight as a result of risk factors can be forecasted as follows: 90.1% due to LBW, 82.0% due to incomplete immunization, and 92.9% due to LBW and incomplete immunization.

Abbreviations

IHC: Integrated Health Center; CHC: Community Health Center; LBW: Low Birth Weight; NBW: Normal Birth Weight; BRL: Bellow The Red Line; TFC: Therapy Feeding Center; SD: Standard Deviation.

Ethics Approval and Consent to Participate

The Research Ethics Commission of the Ministry of Health of Banjarmasin, South Kalimantan Province has approved this research with the number: No.532/KEPK-PKB/2024.

Acknowledgments

The researchers would like to express great appreciation to all individuals and organizations who have provided assistance in conducting this research, especially the Director of the Polytechnic of Health Ministry of Health Banjarmasin and all healthcare staff of Aluh-aluh Community Health Center, Banjar District.

REFERENCES

- [1] Kusumawati SK., Nutrition for Brain Intelligence, ALPRIN, 2020, pp. 1-43.
- [2] Banjar Regency Health Office, Banjar Regency Health Office Profile, 2021, pp. 23–30.
- [3] Ministry of Health 2020. Minister of Health Regulation Number 2 of 2020 concerning Children's Anthropometric Standards. 2020. Available from: <https://www.regulasip.id/book/17158/read>.
- [4] Ministry of Health of the Republic of Indonesia, Results of the 2022 Indonesian Nutritional Status Survey (SSGI), Ministry of Health of the Republic of Indonesia, 2022, pp. 1–150.
- [5] Wijaya I, Hamdani N, Sari H, "Relationship between Lifestyle and Diet and the Incidence of Dyspepsia Syndrome at Bhayangkara Hospital, Makassar City," *Promotif Preventif Journal*, vol. 3, no. 1, pp. 58–68, 2020. DOI: <https://doi.org/10.47650/jpp.v3i1.149>.
- [6] Agustina SA, Rahmadhena MP, "Analysis of Determinants of Toddler Nutritional Problems," *Health Journal*, vol. 11, no. 1, pp. 8-14, 2020. DOI: <https://doi.org/10.35730/jk.v11i1.685>.
- [7] Sari AP, Haryanti D, "Relationship of Knowledge, Education, and Income Level to Nutritional Status of Toddlers at Posyandu Sumber Jaya Village," *Indonesian Health Promotion Publication Media*, vol. 6, no. 6, pp. 1164–1171, 2023. DOI: <https://doi.org/10.56338/mppki.v6i6.3319>
- [8] Abimayu AT, Rahmawati ND. "Analysis of Risk Factors for Stunted, Underweight, and Wasted Incidents in Toddlers in the Working Area of Rangkaian Jaya Health Center, Depok City, West Java in 2022," *Journal of Population Biostatistics and Health Informatics*, vol. 3, no. 2, pp. 88-101, 2023. DOI: <https://doi.org/10.51181/bikfoke.s.v3i2.6820>.
- [9] Ratna SK, Susilowati E, "Scoping Review: Factors Causing Malnutrition in Toddlers," *Scientific Nutrition Journal*, vol.

- 10, no. 3, pp. 1-9, 2023. DOI: <https://doi.org/10.46233/jgi.v10i3.1109>
- [10] Septikasari M, "Children's Nutritional Status and Influencing Factors," UNY Press, Vol. 1, 2018, pp.1–80.
- [11] Rochmano FP, Sugiati S. "The Relationship between Exclusive Breastfeeding, Mother's Parenting Patterns and Family Income to the Incidence of Malnutrition in Toddlers in Bekasi," *J Ilmu Gizi dan Diet.*, vol. 2, no. 4, pp. 287–292, 2023. DOI:<https://doi.org/10.25182/jigd.2023.2.4.287-292>
- [12] Islamiyah S, Inayah Z, "Relationship of Noise Intensity with Work Stress in Production Workers of Block Ice Factory in Lamongan," *Journal of Medical and Health Sciences*, vol. 10, no. 3, pp. 1672–1680, 2023. <http://ejurnalalahayati.ac.id/index.php/kesehatan>.
- [13] Pratiwi WR, Hasriani S. "Factors Related to Malnutrition Status in Toddlers at the Doi-Doi Health Center, Barru Regency," *Jurnal Sakti Bidadari (Midwife Service Unit for the Country)*, vol. 6, no. 2, pp. 62–70, 2023. DOI: <https://doi.org/10.31102/bidadari.2023.6.2.62-70>
- [14] Umijati S, Andajani S, "The Model of Mothers' Caregiving Risk Factors on Keeping Nutritional Status of Children Aged 0-6 Months," *Universal Journal of Public Health*, vol. 11, no. 1, pp. 146-154, 2023. DOI: <https://doi.org/10.13189/ujph.2023.110116>
- [15] Rusmilawaty R, Tunggal T, Daiyah I. "Determinants of the incidence of body weight below the red line (BGM) in toddlers," *J Bidan Cerdas*, vol. 2, no. 2, pp. 81–89, 2020. DOI: <https://doi.org/10.33860/jbc.v2i2.64>.
- [16] Moshi CC, Sebastian PJ, Mushumbusi DG, Azizi KA, Meghji WP, Kitunda ME, et al, "Determinants of underweight among children aged 0–23 months in Tanzania," *Food Sci Nutr*, vol. 10, no. 4, pp. 1167–1174, 2022. DOI: <https://doi.org/10.1002/fsn3.2748>.
- [17] Jana A, Dey D, Ghosh R., "Contribution of low birth weight to childhood undernutrition in India: evidence from the national family health survey 2019–2021," *BMC Public Health [Internet]*, vol. 23, no. 1, pp.1 –14, 2023. DOI: <https://doi.org/10.1186/s12889-023-16160-2>.
- [18] Oematan A, Dion Y, Lette AR, "Analysis of Factors Related to Nutritional Status in Toddlers at the Buraen Health Center, Sonraen Health Center Working Area, Kupang Regency," *CHMK Health Journal*, vol. 3, no. 1, 2019.
- [19] Suminar E, Wibowo A.R., "The Correlation Between Infection Diseases History and Nutritional Status in Toddler," *Fundamental and Management Nursing Journal*, vol. 4, no. 1, pp. 18–22, 2021. DOI: <https://doi.org/10.20473/fmnpj.v4i1.21587>.
- [20] Li W, Yuan J, Wang L, Qiao Y, Liu E, Wang S, et al., "The association between breastfeeding and childhood obesity/underweight: a population-based birth cohort study with repeated measured data," *Int Breastfeed J*, vol. 17, no. 1, pp. 1–9, 2022. DOI: <https://doi.org/10.1186/s13006-022-00522-4>.
- [21] Annisa N, "Risk Factors for Malnutrition Problems in Toddlers in Indonesia," *Journal of Public Health and Social Sciences*, vol. 1, no. 2, pp. 17–25, 2023. DOI: <https://doi.org/10.59024/jikas.v1i2.285>
- [22] Kartiningrum ED, "Risk Factors for Malnutrition in Toddlers in Gayaman Village, Mojoanyar District, Mojokerto," *Majapahit Hosp (Journal of Health Science, Majapahit Health Polytechnic, Mojokerto)*, vol. 7, no. 2, pp. 67–80, 2019. DOI: <https://doi.org/10.55316/hm.v7i2.112>.
- [23] Sadiyah, Rosida L, "The Characteristics of Undernutrition in Toddlers," in *Proceedings of the International Conference on Health and Medical Sciences (AHMS 2020)*, 2021, pp. 212–215. DOI: <https://doi.org/10.2991/ahsr.k.210127.047>.
- [24] Pebrianti M.D, Wiguna PA, Nurbaiti L, "The Relationship between Completeness of Basic Immunization and Nutritional Status of Infants Aged 1-5 Years at the Labuhan Sumbawa Health Center," *Lomb Med J*, vol. 1, no. 1, pp. 1–7, 2022. DOI: <https://doi.org/10.29303/lmj.v1i1.512>
- [25] Ministry of Health of the Republic of Indonesia. Indonesian Health Profile 2020. Available from: <https://www.kemkes.go.id/id/category-download/profil-kesehatan>
- [26] Soleha M, Zelharsandy VT. "The Influence of Parity in the Family on the Nutritional Status of Toddlers: Literature Review," *Lentera Perawat*, vol. 4, no. 1, pp. 71-85, 2023. <https://doi.org/10.52235/lp.v4i1.210>.
- [27] Issadikin DT, "Relationship between Number of Children in Family and Nutritional Status of Toddlers in Pandansari Village, Senduro District, Lumajang Regency," *Community Health Nursing Journal*, vol. 1, no. 1, pp. 1–16, 2023. DOI: <https://doi.org/10.47134/cmhn.v1i1.2>.
- [28] Kasumayanti E., Zurrahmi, "Relationship between Family Income and Toddler Nutritional Status in Tambang Village, Tambang Health Center Working Area, Kampar Regency in 2019," *J Ners.*, vol. 4, no. 1, pp. 7–12, 2020. DOI: <https://doi.org/10.31004/jn.v4i1.682>.
- [29] Chowdhury MRK, Rahman MS, Billah B, Rashid M, Almroth M, Kader M, "Prevalence and Factors Associated with Severe Undernutrition among Under-5 Children in Bangladesh, Pakistan, and Nepal: A Comparative Study Using Multilevel Analysis," *Sci. Rep.*, vol. 13, no. 1, pp. 1–12, 2023. DOI: <https://doi.org/10.1038/s41598-023-36048-w>.
- [30] Fatkuriyah L, Sukowati U, "Factors Contributing To Undernutrition Among Children Under Five Years Old," *Pedimaternals Nurs J*, vol. 9, no. 2, pp. 45-53, 2023. <https://doi.org/10.20473/pmnj.v9i2.41743>.