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Factors Associated with Coexisting Forms of Malnutrition (Stunting and Wasting) in Under-Five in Southeast Sulawesi

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ABSTRACT
The presence of more than one type of nutritional disorder in a person's body is called Coexisting Forms of Malnutrition (CFM). Children with CFM, such as those experiencing stunting, wasting, and underweight, 12.3 fold risk of death (CI=7.67-19.28) compared to healthy children. Southeast Sulawesi has the tenth highest prevalence of these cases. This study used secondary data based on the Indonesian Nutrition Status Survey (SSGI) 2022 with a cross-sectional design using complex sample analysis. The sample was children under five from Southeast Sulawesi Province, with a final sample size of 8,518 children analyzed. The median age of the sample was 32 months, most of them were male (50.5%), the median birth weight was 3,128.8 grams, and most of their nutritional intake was not diverse (92.1%). Bivariate analysis used chi-square, and multivariate analysis used logistic regression with a full model approach. 3.1% of children had CFM (stunting and wasting). Factors associated with this case based on bivariate analysis (p-value <0.05) were child age, sex, mother's education, mother's occupation, food security, sanitation, socioeconomic status, weight measurement, and vitamin A administration. Factors associated with this case based on multivariate analysis were child age 36-47 months (OR=4.027; 95% CI=1.838-8.825; p-value=0.001), male (OR=1.832; CI=1.324-2.536; p< 0.000), child with Low Birth Weight (LBW) (OR=3.061; CI=1.879-4.986; p<0.000), and poorest socioeconomic status (quintile 1) (OR=3.109; CI=1.641-5.890; p<0.001).

INTRODUCTION

Malnutrition is a global health problem that affects almost every individual regardless of age, sex, race, social status, or geographical boundaries. Malnutrition can be defined as an imbalance in energy and nutrient intake that alters body measurements, composition, and function. The World Health Organization (WHO) classifies malnutrition into three major categories: undernutrition, overnutrition, and Micronutrient-Related Malnutrition (MRM). Stunting, wasting, and underweight are the most common types of undernutrition, whereas obesity is related to overnutrition.[1] According to WHO (2022), it is estimated that 148.1 million children under the age of five are stunted, 45 million are wasted, and 37 million are overweight or obese. Most malnourished children reside in Africa and Asia. In Indonesia, the estimated prevalence of stunting in 2022 was 31%, wasting 10.2%, and overweight 10.6%.[2]

Malnutrition remains a serious public health concern, affecting at least half of children under five in developing countries. Stunting, wasting, underweight, overweight, and obesity are the forms of malnutrition commonly found among children.[3] Children often experience multiple forms of malnutrition simultaneously rather than a standalone form of malnutrition. The presence of more than one type of nutritional disorder in an individual is referred to as Coexisting Forms of Malnutrition (CFM). Children with CFM, such as those who are both stunted and wasted, are at higher risk of mortality compared to children with only one form of malnutrition. CFM arises from the simultaneous presence of multiple anthropometric deficits, micronutrient deficiencies, or a combination thereof in a single individual.[1] A cohort study showed that children who are stunted and underweight but not wasted have a 3.4-fold risk of mortality compared to children with no anthropometric deficits; children who are wasted and underweight but not stunted have a 4.7-fold risk; and children suffering from stunting, wasting, and underweight concurrently have a 12.3-fold risk.[4] A study conducted in Senegal found that wasting, stunting, and their interaction significantly contribute to mortality, where a lower z-score increases the risk of death by 11.1 times compared to children with normal nutritional status.[5]

Several studies have identified CFM issues across various countries.[3,6–9] In Pakistan, the prevalence of CFM decreased from 30.6% (2012–2013) to 21.5% (2017–2018).[3] In India, the prevalence of coexisting stunting and overweight was 0.8%, and stunting with underweight was 5.2% (2015-2016).[6] In Indonesia, the prevalence of stunting and overweight among children aged 2–4.9 years exceeded 5% and showed an upward trend of 0.06% per year,[7] in West Sulawesi, 1.6% of children were simultaneously wasted, underweight, and wasted (2022).[10] In Brazil, the prevalence of stunting and overweight was 2%, while stunting and wasting coexisted in 0.5% of children.[8] In China, the prevalence of stunting and wasting was 0.2% and stunting and overweight was 0.4% (2016).[9]

Studies focusing on concurrent wasting and stunting (WaSt) also show variation: 2.4% in Indonesia (2021),[11] 6.2% in Senegal (early 1980s),[5] 5.8% in Ethiopia (2019),[12] 1.4% in Ghana (2014),[13] 5.2% in India (2019–2020),[14] and 4.9% in Uganda (2015-2018).[15] A study across 84 countries revealed an average WaSt prevalence of 3% (range 0%–8%), with nine countries exceeding 5%.[16] Another study in 51 countries reported an average of 1.4%. The WHO acknowledges that some children may suffer from more than one form of malnutrition, but there are no precise global or regional estimates.[17]

Malnutrition is a complex health issue caused by multiple factors, categorized into immediate, underlying, and basic causes. Immediate factors include inadequate nutrient intake and a history of infectious disease. Underlying factors include household food insecurity, inadequate childcare practices, and unsanitary environments with poor health services. Basic causes include economic and social factors.[18,19]

The relationship between malnutrition and infectious diseases is particularly strong. Children with good nutritional status are more resistant to infections. In contrast, malnourished children are more susceptible to diseases, especially infectious ones.[20] Infectious diseases often reduce appetite and cause vomiting, resulting in inadequate food intake and ultimately negatively impacting child growth.[21]

Underlying factors, such as household food insecurity, have a significant impact on nutritional

status and overall health. Prolonged food unavailability leads to undernutrition among young children even in the absence of disease.[22] Good childcare practices by mothers can substantially contribute to child growth and development, thereby reducing malnutrition rates. Mothers should understand how to care for and protect their children to ensure comfort, stimulate appetite, prevent injuries, and reduce the risk of disease that can hinder growth.[23]

Moreover, poor environmental sanitation, lack of access to clean water, and inadequate hygiene are significant risk factors for diarrhea and have been linked to other adverse health outcomes, including infectious diseases and poor nutritional status.[24] Integrated community health posts, which are called Posyandu in Indonesia, play a crucial role as the frontline providers of basic health services for young children. Posyandu activities monitor child growth and development, and detect early signs of nutritional or health issues. Immunization programs and supplementary feeding programs offered at Posyandu are expected to improve children's nutrient intake.[25]

Basic or structural causes of malnutrition include economic and social factors.[18,19] There is a strong relationship between poverty and malnutrition. Poverty creates unstable and unfavorable conditions that contribute to undernutrition. Families living in poverty often face financial constraints that limit their ability to access safe, sufficient, and nutritious food.[26] Parental socioeconomic conditions, including education and occupation, the number of children, maternal knowledge, and parenting styles, are strongly correlated with children's nutritional status.[27]

Evidence on CFM remains limited because most global, national, and regional surveys focus on the prevalence, trends, and determinants of individual forms of malnutrition, such as stunting, wasting, underweight, overweight/obesity, and micronutrient deficiencies.[1] Although there are studies on concurrent wasting and stunting in Indonesia,[11] no research has investigated stunting and wasting as coexisting forms of malnutrition among children across an entire province.

The prevalence of malnutrition remains high in Indonesia. According to the Basic Health Research/*Riset Kesehatan Dasar (Riskesdas)* 2018, the prevalence of stunting among children under five was 30.8% and wasting was 10.2%.[28] The Indonesian Nutrition Status Survey 2022/ *Survei Status Gizi Indonesia (SSGI 2022)* indicated that the prevalence of stunting was 21.6% and wasting was 7.7%. According to the processed SSGI 2022 data, the highest prevalence of stunting and wasting in Indonesia was recorded in Southeast Sulawesi Province at 4.1%.[29] The 2018 *Riskesdas* data showed that the stunting prevalence in Southeast Sulawesi was 28.7% and the wasting prevalence was 11.9%.[28] SSGI 2022 also ranked Southeast Sulawesi ninth for stunting prevalence (27.7%) and fourteenth for wasting prevalence (8.7%) nationally.[29]

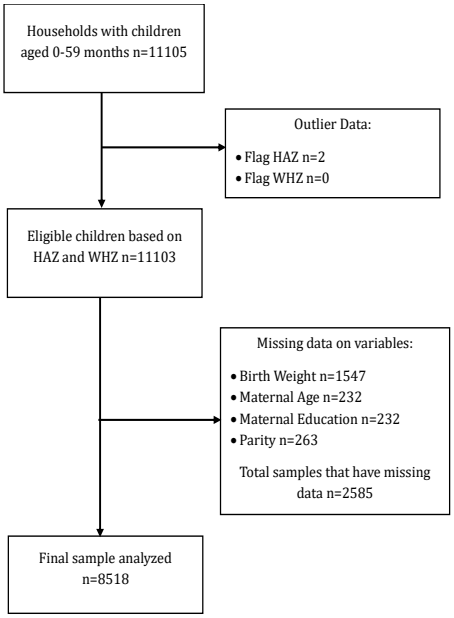
No prior research has examined CFM (stunting and wasting) at the provincial level in Indonesia. Southeast Sulawesi ranks tenth in CFM prevalence (stunting and wasting) nationwide in Indonesia, so it is an appropriate site for such research. Moreover, limited studies have focused on the health and nutritional challenges of the Tolaki, Muna, and other ethnic groups residing in this province. Additionally, secondary data from the 2022 SSGI remains underutilized. Therefore, this study aims to analyze factors associated with coexisting forms of malnutrition (stunting and wasting) among children under five in Southeast Sulawesi Province.

MATERIAL AND METHOD

This study employs an analytical research approach, utilizing a quantitative design with a cross-sectional design using a complex sampling method. The data source was secondary data obtained from the Indonesian Nutrition Status Survey 2022 (SSGI 2022). The study was conducted between September 2024 and June 2025 in Southeast Sulawesi Province. The initial sample size before data cleaning was 11,105 respondents; following data cleaning, the final analyzed sample comprised 8,518 children under five years of age. The data cleaning process is shown in Figure 1.

The calculation of children's z-scores was performed using the WHO Anthro software, which was subsequently utilized to determine nutritional status. Socioeconomic status was computed using Stata software through the Principal Component Analysis (PCA) statistical technique. Research data were initially recorded

in Microsoft Excel before being processed and analyzed using SPSS software.



Source: Secondary Data analysis of The Indonesian Nutrition Status Survey 2022 (SSGI 2022)

Figure 1. The Data Cleaning Process

The children's nutritional status was determined by their z-score values. Based on the WHO Growth Standard, stunting and wasting were defined as LAZ or HAZ <-2SD and WLZ or WHZ <-2 SD. Coexisting Forms of Malnutrition (Stunting and Wasting) was defined as children experienced stunting (LAZ/HAZ <-2 SD) and wasting (WLZ/WHZ) simultaneously.

All Indonesian Nutrition Status Survey (SSGI) data were collected by trained enumerators and using standardized procedures and a validated questionnaire through direct interviews. Body weight was measured using digital or analog scales, and body length was measured on a flat wooden measuring board or microtome if the children were able to stand.[29] The child's age in months at the time of data collection was noted, and the child's sex was divided into female and male. Birth weight and birth length were obtained from the records or memories of the mother/other household members. LBW was defined as birth weight <2500 g. Nutritional intake based on dietary diversity, which is divided into non-divers if <5 food groups and divers if >5 food groups.

Maternal age was measured by the years at the time of data collection. Maternal education was measured from the highest and completed education, defined as low (not attending school, not finishing elementary school, graduating from elementary school), medium (graduating from junior high school), and high (graduating from senior high school, undergraduate, and postgraduate level). Maternal occupation was divided to informal sector (unemployed, student, self-employed, farmer, fisher, laborer, driver, taxibike, servant, or others) and the formal sector (civil servant, soldier, police, or BUMN/BUMD worker). Parity was defined as the number of times a female has been pregnant and carried the pregnancies to a viable gestational age was divided into>2 and ≤2. Maternal marital status was divided into divorced/widowed and married. The number of under-five children in a household is divided into >2 and ≤2.

There were four infections in the data included in this research: Acute Respiratory Infection (ARI), diarrhea, pneumonia, and pulmonary tuberculosis. A child was defined as having a history of ARI if they were diagnosed with ARI by a health worker or experienced ARI symptoms such as fever, cough <2 weeks, runny nose, and/or sore throat in the last month. A child was defined as having a history of diarrhea if a health worker diagnosed them with diarrhea or they experienced diarrhea symptoms, such as defecating more than three times a day and/or defecating liquid not mixed with blood in the last month. A child was defined as having a history of pneumonia if a health worker diagnosed them with pneumonia or they experienced pneumonia symptoms, such as fever, cough, rapid breathing/difficulty breathing, chest indrawing, or shortness of breath/flared nostril breathing, in the last 12 months. A child was defined as having a history of pulmonary tuberculosis if a health worker diagnosed them with pulmonary tuberculosis or they experienced pulmonary tuberculosis symptoms, such as cough for more than 2 weeks or fever for ≥ 2 weeks or weight loss/no gain without clear cause in the previous 2 months or feeling unwell/malaise for ≥ 2 weeks and no change even though medication has been given by a health worker for >2 weeks, in the last 12 months.

Food security was defined by the Food Consumption Score (FCS) in a household, divided into not good if the FCS score <87,5 and good if the FCS score ≥87,5. The main drinking water source is divided into unimproved and im-

proved, as is sanitation. Residence divided into rural and urban. Socioeconomic Status (SES) was the family wealth index measured using asset ownership. SES is divided into five quintiles: poorest, poorer, middle, richer, and richest. The principal analysis component method was used to measure SES.

Weight monitoring, length/height measurements, child development monitoring, vitamin A supplementation, and complete routine immunizations are health services that toddlers can access through Posyandu. Posyandu is an integrated basic health post in Indonesia that focuses on optimizing the health of mothers and children through various activities. Health insurance ownership is divided into no (a child who doesn't have health insurance) and yes (a child who has health insurance).

Data analysis involved several stages: normalizing weights, creating a plan in the Prepare for Analysis menu, and conducting complex sample analysis. The analysis included univariate, bivariate, and multivariate stages. A total of 25 independent variables were examined in the bivariate analysis using the chi-square test; variables were considered significantly associated if $p < 0.05$. All independent variables were included in the multivariate analysis, adopting a full model approach. Odds ratios (ORs) were derived from Exp(B) values, and the model's explanatory power was assessed using the Nagelkerke R Square.

RESULTS

An overview of respondents' characteristics is presented in Table 1. Among the surveyed children, 3.1% were identified as experiencing Coexisting Forms of Malnutrition (stunting and wasting). The median age of the children was 32 months, with slightly more than half being male (50.5%). The median birth weight was 3,128.8 grams. Nearly all children exhibited poor dietary diversity (92.1%). The mothers' median age was 31 years. Most mothers had a high level of education (63%), were employed in the informal sector (88.2%), had a median parity of two, were predominantly married (98.2%), and had a median of one child under five per household.

Most children did not have a history of acute respiratory infections (85.4%), diarrhea (90.9%), pneumonia (97.8%), or pulmonary tuberculosis (99.2%). The median household food security score was 73. The majority of households had an improved main drinking water source (85.3%) and adequate sanitation facilities (87.1%). Most households resided in rural areas (59%) and the median socioeconomic status was in quintile three.

Regarding health services, the majority of children did not receive standard weight monitoring (59.6%), while 62% underwent standardized length/height measurements. Additionally, 50.3% of child development monitoring was below standard, 59.7% received Vitamin A supplementation according to standards, 61.1% had complete routine immunizations, and 63.5% were uninsured or not covered by the National Health Insurance/*Jaminan Kesehatan Nasional (JKN)*.

In the bivariate analysis, several variables were significantly associated ($p < 0.05$) with CFM: child's age, sex, birth weight, maternal education, household food security, sanitation, socioeconomic status, weight monitoring, and Vitamin A supplementation (Table 2).

The results of the multivariate analysis are presented in Table 3. Child age, male sex, low birth weight, and lower socioeconomic status were the only factors independently associated with coexisting stunting and wasting among children under five in Southeast Sulawesi.

DISCUSSION

This analysis showed that children aged 36–47 months had approximately four times higher odds of experiencing coexisting forms of malnutrition (stunting and wasting) compared with children aged 6–11 months. In the present study, the reference age group was 6–11 months, implying that this group has the lowest risk of WaSt. This finding aligns with a study conducted in Ethiopia, which demonstrated that the risk of concurrent wasting and stunting (WaSt) is higher in children aged ≥12 months than in those aged 6–11 months, with the highest risk observed in the 12–23 months age group (OR = 2.25; 95% CI = 1.85–2.74).[30] Another Ethiopian study further reported that children aged 36–47 months were 1.6 times more likely (AOR = 1.66; 95% CI = 1.03–2.67) to suffer from stunting than those aged 6–11 months. This increased risk is attributed to greater exposure to the external environment, unhygienic play areas, self-feeding with unclean hands, and independent hygiene

practices after defecation, all of which elevate the risk of diarrheal diseases. Diarrhea, as a form of infectious disease, contributes to undernutrition by diminishing appetite, reducing energy intake, causing nutrient loss, and impairing nutrient absorption.[31] Similarly, a study in Pakistan found that children older than 12 months were three times more likely to experience stunting. This may be due to the increasing caloric requirements with age, which must be met through a diverse diet. Families with limited resources may struggle to provide sufficient nutrition, hindering child growth.[32] Another study in Pakistan found that children aged 36–47 months were 3.6 times more likely (95% CI = 2.05–6.25) to be stunted than those under 12 months, emphasizing the need for timely and adequate complementary feeding to meet children's nutritional demands.[33] The 6–11 month age group serves as a protective factor against CFM due to continued breastfeeding and the introduction of complementary feeding. According to WHO, infants and young children require age-appropriate support to ensure adequate intake of complementary foods through responsive feeding practices.[34]

Table 1. Characteristics of Under-Five Children in Southeast Sulawesi

Variables	n = 8,518	%
Dependent Variable:		
Coexisting Forms of Malnutrition (Stunting and Wasting)		
Yes	264	3.1
No	8,254	96.9
Child Factor:		
Age (Months) Median = 32.00; Min-max = 6 - 59		
Sex		
Male	4,302	50.5
Female	4,216	49.5
Birth Weight (Gram) Median = 3,128.8; Min-max = 1,600 – 5,000		
Nutritional Intake (Dietary Diversity)		
Yes	674	7.9
No	7,844	92.1
Maternal Factor:		
Maternal Age (Years) Median = 31; Min-max = 16 - 54		
Maternal Education		
Low	1,504	17.7
Middle	1,644	19.3
High	5,370	63
Maternal Occupation		
Informal Sector	7,509	88.2
Formal Sector	1,009	11.8
Parity (Number) Median = 2; Min-max = 0 - 14		
Maternal Marital Status		
Divorced/Widowed	151	1.8
Marry	8,367	98.2
Under Five in A Household (Number) Median = 1; Min-max = 1 - 4		
History of Infectious Disease:		
Acute Respiratory Infections (ARI)		
Yes	1,245	14.6
No	7,273	85.4
Diarrhea		
Yes	774	9.1
No	7,744	90.9
Pneumonia		
Yes	187	2.2
No	8,331	97.8
Pulmonary Tuberculosis		
Yes	70	0.8
No	8,448	99.2

Variables	n = 8,518	%
Household Factors:		
Food Security (Score) Median = 73; Min-max = 0 - 112		
Main Drinking Water Source		
Unimproved	1,254	14.7
Improved	7,264	85.3
Sanitation		
Unimproved	1,097	12.9
Improved	7,421	87.1
Residence		
Rural	5,024	59
Urban	3,494	41
Socioeconomic Status (Quintile) Median = 3; Min-max = 1 - 5		
Health Services Factor:		
Weight Monitoring		
Not According to Standards	5,079	59.6
According to Standards	3,439	40.4
Length/Height Measurements		
Not According to Standards	3,236	38
According to Standards	5,282	62
Child Development Monitoring		
Not According to Standards	4,286	50.3
According to Standards	4,232	49.7
Vitamin A Supplementation		
Not According to Standards	3,435	40.3
According to Standards	5,083	59.7
Complete Routine Immunizations		
Incomplete	3,312	38.9
Complete	5,206	61.1
Health Insurance Ownership		
Yes	3,106	36.5
No	5,412	63.5

Source: Secondary Data Analysis of the Indonesian Nutrition Status Survey 2022 (SSGI 2022)

Table 2. Bivariate Analysis of Factors Associated with Coexisting Stunting and Wasting among Children Under Five in Southeast Sulawesi

Variable	CFM		Total n (%)	p-value
	Yes n (%)	No n (%)		
Child Age (Months)				
6 – 11	11 (1.2)	907 (98.8)	918 (100)	0.008*
12 – 23	66 (3.5)	1,800 (96.5)	1,866 (100)	
24 – 35	54 (2.7)	1,990 (97.3)	2,044 (100)	
36 – 47	82 (4.2)	1,884 (95.8)	1,966 (100)	
48 – 59	50 (2.9)	1,673 (97.1)	1,723 (100)	
Child Sex				
Male	167 (3.9)	4,136 (96.1)	4,303 (100)	0.001*
Female	97 (2.3)	4,118 (97.7)	4,215 (100)	
Birth Weight				
Yes	35 (7.5)	434 (92.5)	469 (100)	<0.001*
Normal	229 (2.8)	7,820 (97.9)	8,049 (100)	
Nutritional Intake (Dietary Diversity)				
No	250 (3.2)	7,595 (96.8)	7,845 (100)	0.234
Yes	14 (2.1)	659 (8.0)	673 (100)	
Maternal Age (Years)				
<20	2 (1.7)	144 (98.3)	146 (100)	0.537
20 – 35	181 (3)	5,815 (97.0)	5,996 (100)	
>35	81 (3.4)	2,295 (96.6)	2,376 (100)	
Maternal Education				
Low	74 (4.9)	1,430 (95.1)	1,504 (100)	0.001*

Variable	CFM		Total n (%)	p-value
	Yes n (%)	No n (%)		
Middle	46 (2.8)	1,598 (97.2)	1,644 (100)	
High	144 (2.7)	5,226 (97.3)	5,370 (100)	
Maternal Occupation				
Informal Sector	248 (3.3)	7,261 (96.7)	7,509 (100)	0.013*
Formal Sector	16 (1.6)	994 (98.4)	1,010 (100)	
Parity				
High	70 (3.6)	1,890 (96.4)	1,960 (100)	0.241
Low	194 (3)	6,364 (97.0)	6,558 (100)	
Maternal Marital Status				
Divorced/Widowed	3 (1.9)	148 (98.1)	151 (100)	0.477
Marry	261 (3.1)	8,106 (96.9)	8,367 (100)	
Number of Under-Fives in A Household				
>2	8 (4.2)	190 (95.8)	198 (100)	0.388
≤2	256 (3.1)	8,064 (96.9)	8,320 (100)	
ARI History				
Yes	33 (2.6)	1,212 (97.4)	1,245 (100)	0.365
No	231 (3)	7,042 (97.0)	7,273 (100)	
Diarrhea				
Yes	35 (4.5)	740 (95.5)	775 (100)	0.082
No	229 (3)	7,514 (97.0)	7,743 (100)	
Pneumonia History				
Yes	9 (4.6)	178 (95.4)	187 (100)	0.287
No	255 (3.1)	8,076 (96.9)	8,331 (100)	
Pulmonary Tuberculosis				
Yes	5 (6.7)	65 (93.3)	70 (100)	0.298
No	259 (3.1)	8,189 (96.9)	8,448 (100)	
Food Security				
Not Good	212 (3.5)	5,871 (96.5)	6,083 (100)	0.011*
Good	52 (2.1)	2,383 (97.9)	2,435 (100)	
Main Drinking Water Source				
Unimproved	45 (3.6)	1,209 (96.4)	1,254 (100)	0.408
Improved	219 (3)	7,045 (97.0)	7,264 (100)	
Sanitation				
Unimproved	48 (4.4)	1,048 (95.6)	1,096 (100)	0.027*
Improved	216 (2.9)	7,206 (97.1)	7,422 (100)	
Residence				
Rural	173 (3.5)	4,851 (96.5)	5,024 (100)	0.085
Urban	90 (2.6)	3,403 (97.4)	3,493 (100)	
Socioeconomic Status				
Poorest (Quintile 1)	82 (5.3)	1,454 (94.7)	1,536 (100)	<0.001*
Poorer (Quintile 2)	43 (3)	1,374 (97.0)	1,417 (100)	
Middle (Quintile 3)	54 (3.3)	1,601 (96.7)	1,655 (100)	
Richer (Quintile 4)	54 (3.1)	1,727 (96.9)	1,781 (100)	
Richest (Quintile 5)	31 (1.4)	2,098 (98.6)	2,129 (100)	
Weight Monitoring				
Not According to Standards	137 (2.7)	4,942 (97.3)	5,079 (100)	0.026*
According to Standards	127 (3.7)	3,313 (96.3)	3,440 (100)	
Length/Height Measurements				
Not According to Standards	87 (2.7)	3,149 (97.3)	3,236 (100)	0.138
According to Standards	177 (3.4)	5,105 (96.6)	5,282 (100)	
Child Development Monitoring				
Not According to Standards	119 (2.8)	4,167 (97.2)	4,286 (100)	0.172
According to Standards	145 (3.4)	4,088 (96.6)	4,233 (100)	
Vitamin A Supplementation				
Not According to Standards	88 (2.6)	3,347 (97.4)	3,435 (100)	0.036*
According to Standards	176 (3.5)	4,907 (96.5)	5,083 (100)	

Variable	CFM		Total n (%)	p-value
	Yes n (%)	No n (%)		
Complete Routine Immunizations				
Incomplete	110 (3.3)	3,202 (96.7)	3,312 (100)	0.415
Complete	154 (3)	5,053 (97.0)	5,207 (100)	
Health Insurance Ownership				
No	173 (3.2)	5,239 (96.8)	5,412 (100)	0.580
Yes	91 (2.9)	3,015 (97.1)	3,106 (100)	

Source: Secondary Data Analysis of the Indonesian Nutrition Status Survey 2022 (SSGI 2022)
*p-value < 0.05

Table 3. Multivariate Analysis of Factors Associated with Coexisting Stunting and Wasting among Children Under Five in Southeast Sulawesi

Variables	CFM, *Pseudo R Square* = 0.076			
	Standard Error	OR	CI 95%	p-value
Child Age (Months)				
12 – 23	0.397	3.502	1.606 – 7.637	0.002*
24 – 35	0.412	2.322	1.034 – 5.214	0.041*
36 – 47	0.400	4.027	1.838 – 8.825	0.001*
48 – 59	0.406	2.746	1.238 – 6.094	0.013*
6 – 11	ref			
Child Sex				
Male	0.166	1.832	1.324 – 2.536	0.000*
Female	ref			
Birth Weight				
LBW	0.249	3.061	1.879 – 4.986	0.000*
Normal	ref			
Nutritional Intake (Dietary Diversity)				
No	0.379	1.439	0.684 – 3.028	0.337
Yes	ref			
Maternal Age (Years)				
<20	0.775	0.422	0.092 – 1.929	0.265
20 – 35	0.194	0.868	0.593 – 1.270	0.465
>35	ref			
Maternal Education				
Low	0.197	1.281	0.870 – 1.886	0.210
Middle	0.216	0.778	0.510 – 1.189	0.247
High	ref			
Maternal Occupation				
Informal Sector	0.313	1.523	0.824 – 2.813	0.179
Formal Sector	ref			
Parity				
High	0.196	1.074	0.732 – 1.578	0.714
Low	ref			
Maternal Marital Status				
Divorced/Widowed	0.704	0.598	0.150 – 2.377	0.464
Marry	ref			
Number of Under-Fives in A Household				
>2	0.368	1.400	0.680 – 2.882	0.360
≤2	ref			
ARI History				
Yes	0.218	0.758	0.494 – 1.162	0.203
No	ref			
Diarrhea				
Yes	0.259	1.599	0.962 – 2.660	0.070
No	ref			
Pneumonia History				
Yes	0.505	1.200	0.446 – 3.230	0.718
No	ref			

Variables	CFM, *Pseudo R Square* = 0.076			
	Standard Error	OR	CI 95%	p-value
Pulmonary Tuberculosis History				
Yes	0.943	2.259	0.355 – 14.386	0.388
No	ref			
Food Security				
Not Good	0.207	1.256	0.836 – 1.886	0.272
Good	ref			
Main Drinking Water Source				
Unimproved	0.218	1.169	0.762 – 1.794	0.474
Improved	ref			
Sanitation				
Unimproved	0.222	1.098	0.711 – 1.696	0.673
Improved	ref			
Residence				
Rural	0.183	0.980	0.684 – 1.405	0.914
Urban	ref			
Socioeconomic Status				
Poorest (Quintile 1)	0.325	3.109	1.641 – 5.890	0.001*
Poorer (Quintile 2)	0.322	1.795	0.954 – 3.378	0.070
Middle (Quintile 3)	0.279	2.119	1.225 – 3.666	0.007*
Richer (Quintile 4)	0.302	2.104	1.163 – 3.804	0.014*
Richest (Quintile 5)	ref			
Weight Monitoring				
Not According to Standards	0.182	0.927	0.648 – 1.324	0.676
According to Standards	ref			
Length/Height Measurements				
Not According to Standards	0.215	0.903	0.592 – 1.378	0.637
According to Standards	ref			
Child Development Monitoring				
Not According to Standards	0.175	0.839	0.595 – 1.184	0.318
According to Standards	ref			
Vitamin A Supplementation				
Not According to Standards	0.188	0.764	0.529 – 1.103	0.151
According to Standards	ref			
Complete Routine Immunizations				
Incomplete	0.170	1.278	0.915 – 1.783	0.150
Complete	ref			
Health Insurance Ownership				
No	0.172	0.871	0.621 – 1.221	0.421
Yes	ref			

Source: Secondary data analysis of the Indonesian Nutrition Status Survey 2022 (SSGI 2022)
*p-value < 0.05

The study also found that male children have a 1.8 times higher risk of experiencing CFM than females (OR = 1.832; 95% CI = 1.324–2.536; p = 0.000). This finding is consistent with a multi-country analysis across 84 nations, which showed that WaSt is more prevalent among boys and in conflict-prone regions.[16] Higher prevalence of CFM among boys has also been reported in India (5.82%),[14] and Uganda (6.34%) compared to girls.[15] An Indonesian study using 2021 SSGI data showed that boys were 2.15 times (95% CI = 1.72–2.68) more likely to suffer from WaSt than girls,[11] consistent with Ethiopian findings (OR = 2.3; 95% CI = 1.27–4.39).[12] Conversely, in India, female sex was found to be protective against WaSt, reducing the risk by 29% (95% CI = 0.68–0.74).[14] Biologically, male fetuses rely more heavily on maternal nutrition than female fetuses, increasing the likelihood of undernutrition if the mother is malnourished during pregnancy. Female fetuses tend to be smaller with greater fat reserves, providing greater resilience to undernutrition. Generally, males exhibit higher morbidity and mortality throughout life and are more susceptible to infectious diseases such as measles, pertussis, and tuberculosis. Females tend to have stronger immune responses and higher antibody production, contributing to better resilience.[35]

Studies have also shown that boys are often introduced to complementary foods earlier than girls,[11,35] possibly due to perceptions of increased hunger or the belief that breastmilk alone is insufficient. An Indonesian study revealed that boys were introduced to complementary feeding at 18.91 weeks, while girls began at 19.74 weeks.[36] An ethnographic study in Guatemala found that mothers perceived boys as hungrier and less satisfied with exclusive breastfeeding than girls.[37] Early introduction of complementary feeding can increase infection risks.[35]

Additionally, gender roles and societal norms influence nutrition and disease exposure. In some sub-Saharan African communities, girls are highly valued for their agricultural contributions and as social security for parents, especially among lower socioeconomic groups.[35,38,39] Girls often spend more time near home, receiving more parental care and better food access, whereas boys may spend more time outdoors, increasing energy expenditure and exposure to environmental risks, including microbial or Soil-Transmitted Helminth (STH) infections that impede growth.[16,37,39]

Low Birth Weight (LBW) was another significant factor: children with LBW had a threefold higher risk (OR = 3.061; 95% CI = 1.879–4.986; p = 0.000) of experiencing CFM compared to those with normal birth weight. This finding aligns with Indonesian SSGI 2021 data, which showed that LBW children were 3.11 times (95% CI = 2.33–4.15) more likely to suffer from CFM.[11] Similarly, an Indian study found that children born small had a 1.81-fold risk (95% CI = 1.66–1.97) of concurrent WaSt.[16] This indicates that undernutrition can originate prenatally and persist postnatally, with intrauterine growth restriction (IUGR) and prematurity contributing to LBW and short birth length.[11] Poor early growth is associated with suboptimal cognitive development and impaired organ growth, increasing the risk of chronic diseases later in life.[40] Stunting is part of an intergenerational cycle; stunted mothers often give birth to stunted offspring, perpetuating malnutrition across generations.[11]

Children from the lowest socioeconomic quintile (quintile 1) were 1.6 times more likely (OR = 3.109; 95% CI = 1.641–5.890; p = 0.001) to experience CFM compared to those from the highest quintile. A study in Pakistan found that children from the poorest households had the highest risk of stunting (OR = 2.174; 95% CI = 1.234–3.376), wasting (OR = 2.243; 95% CI = 1.261–3.287), and underweight (OR = 1.258; 95% CI = 0.831–2.473).[41] Similarly, a study in West Sulawesi, Indonesia, showed that children from the lowest quintile were most at risk of growth failure based on the Composite Index of Anthropometric Failure (CIAF) (OR = 2.08; 95% CI = 1.08–3.99).[10] This may be due to limited access to healthcare, poor diet quality, food insecurity, and inadequate sanitation.[10,41] Surprisingly, another Indonesian study using SSGI 2021 data found that children from middle-income households were most at risk for WaSt (OR = 2.54; 95% CI = 1.75–3.7), followed by those in the poorest quintile (OR = 2.22; 95% CI = 1.5–3.23).[11] These findings suggest that while the poorest households bear the highest burden of CFM, children from middle-income households are also vulnerable.[42]

This study has limitations. It relied on secondary data from the 2022 SSGI, which contained missing values, reducing the sample size. Some variables were excluded due to excessive missing data (over 50%). The model explained only 7.6% of the variation in CFM cases among children under five. The dataset did not include information on individual food portions, restricting dietary intake analysis to food diversity rather than nutrient adequacy measures such as total energy, protein, carbohydrates, fats, and other micronutrients. Moreover, this study focused mainly on child factors and other related variables but did not sufficiently explore maternal health conditions during pregnancy. Potential confounding variables were also not identified during data processing.

CONCLUSION AND RECOMMENDATION

The prevalence of Coexisting Forms of Malnutrition (stunting and wasting) among children under five was 3.1%. Children aged 36–47 months, male children, those with a history of Low Birth Weight (LBW), and those from households in the lowest socioeconomic quintile (quintile 1) were significantly associated with a higher risk of CFM in Southeast Sulawesi Province, based on the Indonesian Nutrition Status Survey (SSGI) 2022 data.

It is recommended that the Southeast Sulawesi Provincial Health Office implement both nutrition-specific and nutrition-sensitive

interventions to improve child nutritional status and prevent all forms of malnutrition. Additionally, advocacy efforts should target local government to promote economic improvements for communities. Mothers are encouraged to provide their children with adequate nutrition and ensure they receive appropriate nutritional support, particularly if planning to have additional children. The Indonesian Ministry of Health, as the institution responsible for the SSGI 2022, should strive to minimize missing data to ensure more valid secondary data for analysis. Future re-searchers are advised to explore maternal health factors during pregnancy when investigating CFM.

AUTHOR CONTRIBUTIONS

Conceptualization, methodology, analysis, and original draft preparation were conducted by ANH; conceptualization, supervision, critical review, and editing were carried out by S; supervision, critical review, and editing were performed by AK. All authors have read and approved the final manuscript. ANH = Aisyah Nurul Hidayah; S = Suyatno; AK = Apoina Kartini.

CONFLICTS OF INTEREST

The authors state emphatically that they have no competing interests.

REFERENCES

1. Khaliq A, Wraith D, Nambiar S, Miller Y. A Review of the Prevalence, Trends, and Determinants of Coexisting Forms of Malnutrition in Neonates, Infants, and Children. *BMC Public Health.* 2022;22(1):1–23. https://doi.org/10.1186/s12889-022-13098-9
2. World Health Organization. Levels and Trends in Child Malnutrition. 2023. http://www.who.int/en/
3. Khaliq A, Wraith D, Miller Y, Nambiar-Mann S. Prevalence, Trends, and Socioeconomic Determinants of Coexisting Forms of Malnutrition Amongst Children Under Five Years of Age in Pakistan. *Nutrients*. 2021;13(12):1–21. https://doi.org/10.3390/nu13124566
4. Mcdonald CM, Olofin I, Flaxman S, Fawzi WW, Spiegelman D, Caulfield LE. The Effect of Multiple Anthropometric Deficits on Child Mortality: Meta-analysis of Individual Data in 10 Prospective Studies from Developing Countries. *The American Journal of Clinical Nutrition.* 2013;97(4):896–901. https://doi.org/10.3945/ajcn.112.047639
5. Garenne M, Myatt M, Khara T, Dolan C, Briend A. Concurrent Wasting and Stunting Among Under-five Children in Niakhar, Senegal. *Maternal & Child Nutrition.* 2019;15(2):1–8. https://doi.org/10.1111/mcn.12736
6. Varghese JS, Stein AD. Malnutrition Among Women and Children in India: Limited Evidence of Clustering of Underweight, Anemia, Overweight, and Stunting Within Individuals and Households at Both State and District Levels. *The American Journal of Clinical Nutrition.* 2019;109(4):1207–1215. https://doi.org/10.1093/ajcn/nqy374
7. Rachmi CN, Agho KE, Li M, Baur LA. Stunting Coexisting with Overweight In 2·0-4·9-Year-old Indonesian Children: Prevalence, Trends and Associated Risk Factors from Repeated Cross-Sectional Surveys. *Public Health Nutrition.* 2016;19(15):2698–2707. https://doi.org/10.1017/s1368980016000926
8. Ferreira HDS. Anthropometric Assessment of Children's Nutritional Status: A New Approach Based on an Adaptation of Waterlow's Classification. *BMC Pediatrics*. 2020;20(1):1–11. https://doi.org/10.1186/s12887-020-1940-6
9. Zhang YQ, Li H, Wu HH, Zong XN. Stunting, Wasting, Overweight and Their Coexistence Among Children Under 7 Years in the Context of the Social Rapidly Developing: Findings from a Population-Based Survey in Nine Cities of China in 2016. *PLoS One.* 2021;16:1–15. http://dx.doi.org/10.1371/journal.pone.0245455
10. Latifah HI, Suyatno S, Asna AF. Factors of Child Growth Failure Based on the Composite Index of Anthropometric Failure in West Sulawesi Province. *Amerta Nutrition.* 2024;8(1SP):1–8. https://doi.org/10.20473/amnt.v8i1SP.2024.1-8

11. Jokhu LA, Syauqy A. Determinants of Concurrent Wasting and Stunting Among Children 6 to 23 mo in Indonesia. *Nutrition*. 2024;122(2024):1–7. https://doi.org/10.1016/j.nut.2024.112390
12. Roba AA, Assefa N, Dessie Y, Tolera A, Teji K, Elena H, et al. Prevalence and Determinants of Concurrent Wasting and Stunting and Other Indicators of Malnutrition Among Children 6–59 Months Old in Kersa, Ethiopia. *Maternal & Child Nutrition.* 2021; 17(3):1–12. https://doi.org/10.1111/mcn.13172
13. Saaka M, Galaa SZ. Relationships Between Wasting and Stunting and Their Concurrent Occurrence in Ghanaian Preschool Children. *Journal of Nutrition and Metabolism*. 2016; 2016:11. http://dx.doi.org/10.1155/2016/4654920
14. Khura B, Mohanty P, Gandhi AP, Patnaik L, Mewara A, Pradhan KB, et al. Mapping Concurrent Wasting and Stunting Among Children Under Five in India: A Multilevel Analysis. *International Journal of Public Health.* 2023;68:1–11. https://doi.org/10.3389/ijph.2023.1605654
15. Obeng-Amoako GAO, Myatt M, Conkle J, Kaijuka B, Richmond M, Andrew A, et al. Concurrently Wasted and Stunted Children 6-59 Months in Karamoja, Uganda: Prevalence and Case Detection. *Maternal & Child Nutrition.* 2020;16(4):1–11. https://doi.org/10.1111/mcn.13000
16. Khara T, Mwangome M, Ngari M, Dolan C. Children Concurrently Wasted and Stunted: A Meta-analysis of Prevalence Data of Children 6 – 59 Months from 84 Countries. *Maternal & Child Nutrition.* 2018;14(2):1–7. https://doi.org/10.1111/mcn.12516
17. Myatt M, Khara T, Schoenbuchner S, Pietzsch S, Dolan C, Lelijveld N. Children Who Are Both Wasted and Stunted Are Also Underweight and Have a High Risk of Death: a Descriptive Epidemiology of Multiple Anthropometric Deficits Using Data From 51 Countries. *Archives of Public Health*. 2018;76(28):1–11. https://doi.org/10.1186/s13690-018-0277-1
18. UNICEF. Strategy for Impoved Nutrition of Children and Women in Developing Countries. New York; 1990; 1–36. https://digitallibrary.un.org/record/227230?v=pdf
19. UNICEF, EU. Multi-sectoral Approaches to Nutrition: Nutrition-specific and Nutrition Sensitive Interventions to Accelerate Progress. https://cnrs.org.bd/reports/communication_materials/Brief_Nutrition_Overview.pdf
20. Putri MS, Kapantow N, Kawengian S. Hubungan Antara Riwayat Penyakit Infeksi dengan Status Gizi pada Anak Batita di Desa Mopusi Kecamatan Lolayan Kabupaten Bolaang Mongondow. *Jurnal e-Biomedik*. 2015;3(2):1–5. https://ejournal.unsrat.ac.id/v3/index.php/ebiomedik/article/view/8461
21. Desyanti C, Nindya TS. Hubungan Riwayat Penyakit Diare dan Praktik Higiene dengan Kejadian Stunting pada Balita Usia 24-59 Bulan di Wilayah Kerja Puskesmas Simolawang, Surabaya. *Amerta Nutrition*. 2017;1(3):243. https://doi.org/10.20473/amnt.v1i3.2017.243-251
22. Rahmah R, Arifin S, Hayatie L. Hubungan Ketersediaan Pangan dan Penghasilan Keluarga dengan Kejadian Gizi Kurang dan Gizi Buruk pada Balita di Wilayah Kerja Puskesmas Beruntung Raya. *Jurnal Homeostasis.* 2020;3(3):401–416. https://ppjp.ulm.ac.id/journals/index.php/hms/article/view/2790
23. Munawaroh S. Pola Asuh Mempengaruhi Status Gizi Balita Relationship of Parenting Pattern and Toddlers' Nutritional Status. *Jurnal Keperawatan*. 2015;6(1):44–50. https://ejournal.umm.ac.id/index.php/keperawatan/article/view/2851
24. Wolf J, Hunter PR, Freeman MC, Cumming O, Clasen T, Bartram J, et al. Impact of Drinking Water, Sanitation and Handwashing with Soap on Childhood Diarrhoeal Disease: Updated Meta-Analysis and Meta-Regression. *Tropical Medicine and*

International Health. 2018;23(5):508–525. https://doi.org/10.1111/tmi.13051

25. Suriastini W, Alfah D, Sikoki B, Hermoko R, Listiono, Rifai IU, et al. Dampak Pandemi Covid-19 Terhadap Layanan Kesehatan Balita. *Jurnal Keluarga Berencana*. 2021; 6(1):1–10. https://doi.org/10.37306/kkb.v6i1.56
26. Siddiqui F, Salam RA, Lassi ZS, Das JK. The Intertwined Relationship Between Malnutrition and Poverty. *Front Public Health.* 2020;8:1–5. https://doi.org/10.3389/fpubh.2020.00453
27. Putri RF, Sulastri D, Lestari Y. Faktor-Faktor yang Berhubungan dengan Status Gizi Anak Balita di Wilayah Kerja Puskesmas Nanggalo Padang. *Jurnal Kesehatan Andalas*. 2015;4(1):254–261. http://dx.doi.org/10.25077/jka.v4i1.231
28. Kemenkes RI. Laporan Nasional Riskesdas 2018. Jakarta: Kementerian Kesehatan RI; 2019. https://repository.badankebijakan.kemkes.go.id/3514/1/Laporan Riskesdas 2018 Nasional.pdf
29. Badan Kebijakan Pembangunan Kesehatan. Buku Saku Hasil Survei Status Gizi Indonesia (SSGI) 2022. Jakarta; Kementerian Kesehatan RI; 2022. https://kesmas.kemkes.go.id/assets/uploads/contents/attachments/09fb5b8ccfdf088080f2521ff0b4374f.pdf
30. Odei Obeng-Amoako GA, Karamagi CAS, Nangendo J, Okiring J, Kiirya Y, Aryeetey R, et al. Factors Associated with Concurrent Wasting and Stunting Among Children 6–59 Months in Karamoja, Uganda. *Maternal & Child Nutrition.* 2020;17(1):e13074. https://doi.org/10.1111/mcn.13074
31. Wasihun AG, Dejene TA, Teferi M, Marugán J, Negash L, Yemane D, et al. Risk Factors for Diarrhoea and Malnutrition Among Children Under the Age Of 5 Years n the Tigray Region of Northern Ethiopia. *PLoS One*. 2018;13(11):e0207743. https://doi.org/10.1371/journal.pone.0207743
32. Siddiqa M, Shah GH, Mayo-Gamble TL, Zubair A. Determinants of Child Stunting, Wasting, and Underweight: Evidence from 2017 to 2018 Pakistan Demographic and Health Survey. *Journal of Nutrition and Metabolism*. 2023;2023(1):2845133. https://doi.org/10.1155/2023/2845133
33. Khan S, Zaheer S, Safdar NF. Determinants of Stunting, Underweight and Wasting Among Children < 5 Years of Age: Evidence from 2012-2013 Pakistan Demographic and Health Survey. *BMC Public Health.* 2019;19:358. https://doi.org/10.1186/s12889-019-6688-2
34. WHO. Complementary Feeding. Geneva: World Health Organization; 2022. https://www.who.int/health-topics/complementary-feeding#tab=tab_1
35. Thurstans S, Opondo C, Seal A, Wells JC, Khara T, Dolan C, et al. Understanding Sex Differences in Childhood Undernutrition: A Narrative Review. *Nutrients*. 2022:14(5); 948. https://doi.org/10.3390/nu14050948
36. Mulyaningsih T, Mohanty I, Widyaningsih V, Gebremedhin TA, Miranti R, Wiyono VH. Beyond Personal Factors: Multilevel Determinants of Childhood Stunting in Indonesia. *PLoS One*. 2021;16(11):1–19. http://dx.doi.org/10.1371/journal.pone.0260265
37. Tumilowicz A, Habicht JP, Pelto G, Pelletier DL. Gender Perceptions Predict Sex Differences in Growth Patterns of Indigenous Guatemalan Infants and Young Children. *American Journal of Clinical Nutrition.* 2015;102(5):1249–1258. https://doi.org/10.3945/ajcn.114.100776
38. García Cruz LM, González Azpeitia G, Reyes Súarez D, Santana Rodríguez A, Loro Ferrer JF, Serra-Majem L. Factors Associated with Stunting Among Children Aged 0 To 59 Months from the Central Region of Mozambique. *Nutrients*. 2017;9(5);491. https://doi.org/10.3390/nu9050491
39. Akombi BJ, Agho KE, Hall JJ, Wali N, Renzaho AMN, Merom D. Stunting, Wasting and Underweight in Sub-Saharan Africa: A Systematic Review. *International Journal of Environmental Research and Public Health.* 2017:14(8);863. https://doi.org/10.3390/ijerph14080863

40. Aryastami NK, Shankar A, Kusumawardani N, Besral B, Jahari AB, Achadi E. Low Birth Weight Was the Most Dominant Predictor Associated with Stunting Among Children Aged 12-23 Months in Indonesia. *BMC Nutrition.* 217;3(16). https://doi.org/10.1186/s40795-017-0130-x

41. Ahmad D, Afzal M, Imtiaz A. Effect of Socioeconomic Factors on Malnutrition Among Children in Pakistan. *Future Business Journal.* 2020:6(30). https://doi.org/10.1186/s43093-020-00032-x

42. Titaley CR, Ariawan I, Hapsari D, Muasyaroh A, Dibley MJ. Determinants of the Stunting of Children Under Two Years Old in Indonesia: A Multilevel Analysis of the 2013 Indonesia Basic Health Survey. *Nutrients*. 2019;11(5):1106. https://doi.org/10.3390/nu11051106