Associated Factors of Recurrent Wasting among Children Aged 6-59 Months in Indonesia: A Cross-sectional Study

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Abstract: *Introduction*: Acute malnutrition (wasting) is a major public health problem that contributes significantly to morbidity and mortality among children under five years of age. Although nutrition intervention programmes have proven effective, a key challenge in wasting management is the high rate of recurrence after interventions, which continues to sustain the burden of malnutrition. This study aimed to identify factors associated with recurrent wasting among children aged 6-59 months in Maros Regency.

Methods: A cross-sectional study was conducted in 2025 at Mandai and Turikale Primary Health Centres, involving 250 children with a previous history of wasting selected through purposive sampling. Maternal characteristics were assessed using a structured questionnaire. Data were analysed using the chi-square test and multivariable logistic regression. Due to the cross-sectional design, causal relationships cannot be established.

Results: The prevalence of wasting recurrence was 26.8%. Multivariable logistic regression analysis showed that adequate maternal nutritional status was independently associated with a lower likelihood of wasting recurrence (OR = 0.14; 95% CI: 0.06-0.28; p < 0.001). Similarly, favourable maternal psychosocial conditions, particularly lower levels of anxiety, were significantly associated with reduced odds of recurrence (OR = 0.06; 95% CI: 0.00-0.59; p = 0.016). Appropriate maternal caregiving practices were also associated with decreased likelihood of recurrent wasting (OR = 0.30; 95% CI: 0.09-0.92; p = 0.03). Household income showed a marginal association with wasting recurrence but did not reach statistical significance in the adjusted model.

Conclusion: Maternal nutritional status, psychosocial well-being, and caregiving practices were significantly associated with the recurrence of wasting among children aged 6-59 months. These findings suggest that maternal-related factors are important correlates of wasting recurrence. However, given the cross-sectional design, the results should be interpreted as associations rather than causal relationships. Further longitudinal studies are warranted to better understand potential causal pathways.

Keywords: Wasting recurrence, maternal factors, maternal nutritional status, psychosocial factors, caregiving practices.

INTRODUCTION

Wasting remains a major risk factor contributing to morbidity and mortality among children under five years [1]. It is primarily driven by inadequate dietary intake and recurrent infections, which compromise immune function and increase the likelihood of child mortality [2]. Clinically, wasting is classified as severe when weight-for-height or weight-for-length Z-scores fall below −3 SD, and moderate when scores range from −3 to < −2 SD [3]. Children experiencing wasting are also at 3 times the risk of stunting compared with their peers [4, 5].

Globally, an estimated 6.6% of children, approximately 42.8 million, were affected by wasting in 2024 [2]. In Indonesia, national prevalence reached 8.5% in 2023, declining slightly to 7.4% in 2024 [6], remaining above the WHO target of <5% and the national target of 8% [7, 8]. At the provincial level, South Sulawesi recorded a rise from 8.3% in 2022 to 9.1% in 2023, while Maros Regency reported fluctuating rates, peaking at 13.6% in 2022 and declining to 8.1% in 2023. These trends highlight that nutritional improvements are not yet fully sustained.

Despite existing nutrition intervention programmes, a major challenge is the high rate of wasting recurrence following recovery [1]. Previous studies in Indonesia have largely focused on initial treatment outcomes, with limited long-term follow-up, leaving programme effectiveness and sustainability inadequately monitored [9, 10]. Weak monitoring and evaluation systems contribute significantly to recurring wasting, undermining post-intervention outcomes [11, 12]. Evidence indicates that wasting represents a substantial public health problem, with many children experiencing repeated episodes and recurrence cases requiring a longer duration to achieve nutritional recovery [13]. Notably, a considerable proportion of children who initially recover or attain normal nutritional status fail to sustain this recovery within 12 months following

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programme completion [4]. This pattern underscores the fragility of post-intervention recovery and highlights the persistence of underlying vulnerabilities.

Recurrent wasting is associated with severe adverse health consequences, including a threefold increased risk of stunting and up to a twelvefold higher risk of mortality [5]. Globally, the prevalence of wasting recurrence has been reported to reach 37.5%, with the highest risk occurring within the first three months after programme discharge [13]. Beyond individual health impacts, recurrent episodes of wasting undermine the cost-effectiveness of nutrition programmes and contribute to the sustained burden of acute malnutrition among children [14, 15].

The contribution of recurrent wasting to stunting further reinforces the urgency of addressing wasting recurrence as a core component of stunting prevention strategies. Children with a history of repeated wasting episodes have a threefold higher likelihood of developing stunting compared with those without such a history [16]. Consequently, persistent wasting recurrence may compromise the effectiveness of national stunting reduction programmes. This issue is particularly relevant in Indonesia, where the prevalence of stunting remains high at 19.8%, exceeding the national target of 14% [6].

Maternal factors play a significant role in precipitating wasting recurrence, particularly during the post-recovery period following Community-Based Management of Acute Malnutrition programmes [1]. Maternal knowledge, caregiving practices, nutritional status, psychosocial well-being, and education are known to influence child nutrition outcomes [17]. Suboptimal maternal practices, limited nutrition knowledge, and poor antenatal care utilisation elevate the risk of wasting recurrence [1, 18].

Wasting recurrence is influenced by multiple interconnected factors at the child, household, and caregiver levels. In early childhood, strong dependence on the immediate environment makes maternal factors especially important in shaping nutritional outcomes. In the Indonesian context, mothers play a central role in child feeding, caregiving, and health-related decision-making. Previous studies have shown that maternal characteristics are consistently associated with child malnutrition and its recurrence.

However, few studies have comprehensively examined maternal factors associated of wasting recurrence [19, 20]. This gap limits understanding of post-discharge risks and may undermine the long-term effectiveness of nutritional interventions [18, 21, 22]. Therefore, this study aimed to examine the association between maternal factors and the recurrence of wasting among children aged 6-59 months in Maros District. The findings are expected to contribute to a better understanding of post-recovery vulnerabilities and to inform the development of more sustainable nutrition interventions.

METHOD

Study Design

An observational analytic study with a cross-sectional design was conducted to examine the association between maternal factors and wasting recurrence among children aged 6-59 months. The study was carried out in the working areas of Mandai Primary Health Center and Turikale Primary Health Center, Maros Regency, South Sulawesi Province, Indonesia. Data collection was conducted from September to November 2025. The selected health centres were purposively chosen because of their relatively high burden of wasting cases in Maros Regency. These facilities serve as key service delivery points for nutrition programmes, thereby providing access to a sufficient number of eligible participants with a documented history of wasting.

Study Population and Sample

The target population comprised all children aged 6-59 months with a history of wasting in Maros Regency. The accessible population included children registered in the electronic Community-Based Nutrition Recording and Reporting System (e-PPGBM) with complete anthropometric records before and after nutritional intervention. Based on e-PPGBM data (March 2025), Mandai and Turikale Primary Health Centres were selected as study sites because they had a high number of wasting cases and complete programme records. The study population consisted of eligible children from these two health centers. A purposive sampling approach was used to select participants who met predefined inclusion and exclusion criteria, particularly the availability of complete nutritional status data and documented participation in nutrition programmes. This approach was chosen to ensure data completeness and relevance to the study objective.

Participants with incomplete data were excluded, including those with missing nutritional records in e-PPGBM, relocation during the study period, or refusal to participate.

The minimum sample size was calculated using the LEMESHOW formula for observational studies, assuming a 95% confidence level and 80% power, yielding a minimum of 115 children. A total of 250 mother-child pairs were included in the analysis.

Variables and Measurements

The dependent variable was wasting recurrence. Wasting recurrence was defined as the presence of wasting (weight-for-height z-score [WHZ] < −2 SD) at the time of assessment among children aged 6-59 months with a documented history of wasting within the past 6-12 months. Based on guidance from the Council of Research & Technical Advice on Acute Malnutrition, recurrence is defined as a new episode of wasting within 6 months after recovery, while ongoing episodes, regression, and reoccurrence represent distinct conditions. In this study, recovery was defined according to WHO criteria (WHZ ≥ −2 SD), but objective confirmation of recovery prior to the current episode was not consistently available. Therefore, children were not required to have documented recovery before being classified as experiencing wasting recurrence.

Due to the cross-sectional design and limited follow-up data, it was not possible to distinguish between recurrence, non-recovery, regression, and reoccurrence. Thus, a composite outcome was used, which may introduce misclassification bias and should be interpreted with caution. This study was part of a larger research project. The present analysis focused specifically on maternal-related factors, given their central role in caregiving, feeding practices, and health-related decision-making.

Independent variables included maternal age, education, marital status, nutritional status, knowledge, psychosocial condition, hygiene practices, parenting style, and household income. Maternal nutritional status was assessed using body mass index (BMI) and categorised as underweight (<18.5 kg/m²), normal (18.5-24.9 kg/m²), or overweight/obese (≥25.0 kg/m²). Maternal psychosocial condition was measured using the Depression, Anxiety, and Stress Scale-21 (DASS-21). Scores were classified as normal, mild, moderate, severe, and extremely severe, and further grouped into "no symptoms" (normal) and "presence of symptoms" (mild to extremely severe) for analysis. Parenting style was classified as non-risk (authoritative) or risk (authoritarian or permissive). Household income was categorised based on the regional minimum wage.

Anthropometric measurements of children were conducted by trained community health volunteers (kader kesehatan) using standard procedures at the integrated health posts. The weighing scales and height boards were calibrated by the same personnel prior to data collection. Maternal BMI was calculated using self-reported weight and height.

Data Collection

Primary data were collected through home visits using structured questionnaires administered to mothers or primary caregivers. Secondary data were obtained from e-PPGBM records to assess children's nutritional history. Data collection was conducted by two trained enumerators using standardized procedures.

Statistical Analysis

Data were analyzed using SPSS version 27. Univariate analysis was performed to describe the distribution of variables using frequencies. Bivariate associations between maternal factors and wasting recurrence were examined using the Chi-square test. Variables with p-values <0.05 in bivariate analysis were included in multivariate analysis. Binary logistic regression was conducted to identify maternal factors independently associated with wasting recurrence. Statistical significance was set at $\alpha = 0.05$, and results were presented as odds ratios (ORs) with 95% confidence intervals (CIs). Prior to multivariable logistic regression, multicollinearity among independent variables was assessed using variance inflation factors (VIF), with values < 5 indicating no significant multicollinearity. Model fit was evaluated using the Hosmer-Lemeshow goodness-of-fit test; $p > 0.05$ indicated adequate fit. In addition, the number of events per variable (EPV) was assessed to evaluate model stability.

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee, Faculty of Public Health, Universitas Hasanuddin, Ministry of Education, Culture, Research, and Technology, Indonesia (No. 1739/UN4.14.1/TP.01.02/2025). Ethical clearance was

valid from 12 September 2025 to 12 September 2026. This observational study was not registered in a clinical trial registry, as it is not an interventional study. Written informed consent was obtained from all participants prior to data collection. Participants were informed about the purpose of the study, procedures, potential risks and benefits, and their right to withdraw at any time. Confidentiality of all collected data was strictly maintained.

RESULTS

The characteristics of the respondents in this study are shown in the following table.

Table **1** presents the characteristics of the respondents. A total of 250 mothers of children with a history of wasting were included in the study. Most mothers were aged 20-35 years (65.2%), while 34.8% were younger than 20 or older than 35. The majority had attained secondary or higher education (92.4%), and nearly all were married (99.2%). Regarding household income, 80.8% of families reported a monthly income below IDR 3,657,527.37, while 19.2% had income at or above this threshold.

Table **2** shows the proportion of wasting recurrence among children aged 6-59 months. Of the 250 children with a history of wasting, 26.8% experienced a recurrence during the post-intervention period, while 73.2% remained free from wasting. Based on nutritional status, wasting recurrence occurred in 24.7% of children with concurrent wasting and stunting and in 30.7% of children with wasting without stunting.

Table **3** shows the results of the bivariate analysis. Maternal education, household income, maternal nutritional status, parenting style, and maternal psychosocial conditions were significantly associated with wasting recurrence among children aged 6-59 months. In contrast, maternal age, marital status, maternal knowledge, hygiene practices, and maternal stress were not significantly associated with wasting recurrence.

Maternal education was significantly associated with wasting recurrence ($p < 0.001$). A higher proportion of recurrence was observed among children of mothers with low educational attainment compared to those whose mothers had secondary or higher education. Similarly, household income was significantly associated with wasting recurrence, with a higher proportion of recurrence among children from households with a monthly income below the regional minimum wage. Maternal nutritional status was also

Table 1: Characteristics of Respondents

Characteristic	Frequency (n)	Percentage (%)
Maternal Age		
< 20 years or >35 years	87	34.8
≥20-35 years	163	65.2
Total	250	100
Maternal Education		
Low	19	7.6
Medium/High	231	92.4
Total	250	100
Marital Status		
Divorced/Widowed/Single	2	0.8
Married	248	99.2
Total	250	100
Household Income		
< IDR 3,657,527.37	202	80.8
≥ IDR 3,657,527.37	48	19.2
Total	250	100

Table 2: Proportion of Wasting Recurrence according to Stunting Status among Children Aged 6-59 Months

Stunting Status	Wasting Recurrence n (%)	No Recurrence n (%)	Total n (%)
Stunted	40 (24.7)	122 (75.3)	162 (100)
Not Stunted	27 (30.7)	61 (69.3)	88 (100)
Total	67 (26.8)	183 (73.2)	250 (100)

Table 3: Association between Maternal Factors and Wasting Recurrence

Variable	Wasting Recurrence n (%)	No Recurrence n (%)	P-Value
Maternal Age			0.269
< 20 years or >35 years	27 (40.3)	60 (32.8)	
≥20-35 years	40 (59.7)	123 (67.2)	
Maternal Education			<0.001
Low	11 (16.9)	8 (4.4)	
Medium/High	56 (83.1)	175 (95.6)	
Marital Status			0.457
Divorced/Widowed/Single	1 (1.5)	1 (0.5)	
Married	66 (98.5)	182 (99.5)	
Maternal Knowledge			0.414
Poor	44 (65.7)	130 (71.0)	
Good	23 (34.3)	53 (29.0)	
Parenting Style			0.001
At risk	11 (16.4)	8 (4.4)	
Not at risk	56 (83.6)	175 (95.6)	
Maternal Hygiene Practices			0.396
Poor	26 (38.8)	82 (44.8)	
Good	41 (61.2)	101 (55.2)	
Maternal Nutritional Status			<0.001
At risk	33 (49.3)	20 (10.9)	
Normal	34 (50.7)	163 (89.1)	
Psychosocial Status (Depression)			0.028
Present	3 (4.5)	1 (0.5)	
Absent	64 (95.5)	182 (99.5)	
Psychosocial Status (Anxiety)			<0.001
Present	6 (9.0)	1 (0.5)	
Absent	61 (91.0)	182 (99.5)	
Psychosocial Status (Stress)			0.098
Present	1 (1.5)	0 (0.0)	
Absent	66 (98.5)	183 (100)	
Household Income			0.003
< IDR 3,657,527.37	46 (68.7)	156 (85.2)	
≥ IDR 3,657,527.37	21 (31.3)	27 (14.8)	

Table 4: Maternal Associated with Wasting Recurrence

Variable	P-Value	AOR (95% CI)	VIF
Maternal Education	0.168	0.455 (0.148-1.394)	1.308
Parenting Style	0.036	0.303 (0.099-0.926)	1.290
Maternal Nutritional Status	<0.001	0.140 (0.069-0.283)	1.144
Psychosocial Status (Depression)	0.769	1.503 (0.099-22.889)	1.885
Psychosocial Status (Anxiety)	0.016	0.062 (0.007-0.593)	1.355
Psychosocial Status (Stress)	1.000	0.001 (0.00-0.001)	1.665
Household Income	0.091	0.518 (0.242-1.111)	1.244

significantly associated with wasting recurrence. Among children who experienced relapse, 33 (49.3%) had mothers with at-risk nutritional status, while 34 (50.7%) had mothers with normal BMI. Parenting style showed a significant association with recurrence (p = 0.001). Children exposed to at-risk parenting styles (non-authoritative: authoritarian or permissive) had a higher proportion of recurrence compared to those exposed to non-risk (authoritative/democratic) parenting styles. Maternal psychosocial conditions showed mixed associations. In the bivariate analysis, maternal depression and anxiety were statistically associated with wasting recurrence (p = 0.028 and p < 0.001, respectively), were significantly associated with wasting recurrence, whereas maternal stress was not (p = 0.098). However, the number of mothers classified as having depression or anxiety was very small. Only 4 mothers were categorized as having depression (3 in the recurrence group and 1 in the non- recurrence group), and 7 mothers were categorized as having anxiety (6 in the recurrence group and 1 in the non-recurrence group). Due to these small subgroup sizes, the anxiety variable was further collapsed into a binary category (presence vs absence of anxiety). The direction of the association remained consistent; however, the estimates were imprecise. These small cell counts indicate an imbalanced distribution and should be interpreted with caution.

Table **4** presents the results of the multivariate logistic regression analysis examining maternal factors independently associated with wasting recurrence among children aged 6-59 months. Variables with p-values ≤0.25 in the bivariate analysis were included in the adjusted model. The final model included maternal nutritional status, maternal anxiety, parenting style, maternal education, household income, and maternal depression.

After adjustment, maternal nutritional status remained the factor most strongly associated with wasting recurrence. Children of mothers with normal body mass index (BMI 18.5-24.9 kg/m²) had significantly lower odds of recurrence compared with those of mothers with at-risk BMI (underweight or overweight/obese) (adjusted odds ratio [AOR] = 0.14; 95% confidence interval [CI]: 0.06-0.28; p < 0.001). Maternal anxiety was also associated with wasting recurrence in the adjusted model (AOR = 0.06; 95% CI: 0.007-0.593; p = 0.016). However, this estimate should be interpreted with caution due to the small number of exposed cases and the resulting wide confidence interval. In contrast, maternal depression was not significantly associated with wasting recurrence (AOR = 1.50; 95% CI: 0.099-22.889; p = 0.769). Parenting style remained significantly associated with recurrence after adjustment. Children exposed to non-risk (authoritative) parenting styles had lower odds of recurrence compared with those exposed to risk parenting styles (authoritarian or permissive) (AOR = 0.30; 95% CI: 0.09-0.92; p = 0.036). Maternal education and household income were not independently associated with wasting recurrence after adjustment. Maternal education showed a non-significant protective direction (AOR = 0.45; 95% CI: 0.14-1.39; p = 0.166), while household income was also not significant (AOR = 0.51; 95% CI: 0.24-1.11; p = 0.091).

No evidence of multicollinearity was observed, with all variance inflation factor (VIF) values below 5 (range: 1.14-1.89). The Hosmer-Lemeshow goodness-of-fit test indicated adequate model fit (χ^2 = 4.294, p = 0.231). The number of events per variable (EPV) was approximately 6, indicating a relatively limited ratio and a potential risk of overfitting. Therefore, the regression estimates should be interpreted with caution.

DISCUSSIONS

Incidence of Wasting Recurrence

This study observed a wasting recurrence rate of 26.8% among children aged 6-59 months during the 12-month post-intervention period. This rate can be considered relatively high, as the World Health Organization classifies public health concern as serious at 10-14% and critical at ≥15% [23]. Notably, this figure exceeds the global target of reducing wasting prevalence to 5%, suggesting ongoing challenges in maintaining nutritional recovery [2]. Overall, approximately one in four children experienced recurrent episodes. Indicating a substantial potential public health burden.

These findings are consistent with previous studies. Kangas *et al.* (2023) reported a wasting recurrence rate of 26%, while global estimates suggest recurrence rates of up to 37% [14, 24]. Moreover, systematic reviews conducted in low- and middle-income countries and in the United States have reported similar prevalence rates of approximately 27% [12, 25]. The consistency of these findings indicates that wasting recurrence is a persistent phenomenon across diverse contexts, although observed variations are influenced by differences in study design, programme follow-up duration, population characteristics, and cultural and economic factors. Broadly, contextual differences such as household food security, morbidity patterns, and dietary and caregiving practices are likely to contribute to variations in recurrence rates across settings [26].

The findings also suggest a relationship between wasting recurrence and stunting. The proportion of recurrence was higher among stunted children (31.8%) than among non-stunted children (22.8%). This pattern may reflect the broader cycle of malnutrition, in which wasting and stunting are often interrelated and may affect the sustainability of nutritional recovery.

Biological vulnerability may further explain these patterns, as anthropometric recovery does not necessarily coincide with full physiological restoration. Immune competence, metabolic regulation, and gut integrity may remain compromised after discharge, thereby increasing susceptibility to recurrent nutritional challenges [1, 27]. These vulnerabilities may be further influenced by household- and environmental factors, including food insecurity, limited access to health services, and weak growth monitoring systems, which may be associated with a higher likelihood of recurrence [11, 28].

From a public health perspective, the high recurrence rate suggests that anthropometric recovery alone may be insufficient as an indicator of long-term nutritional resilience. Sustained prevention of wasting may benefit from a continuum-of-care approach that extends beyond treatment completion. This includes structured post-intervention monitoring, strengthened household food security, and integration of promotive and preventive nutrition strategies. Such measures may support efforts to reduce recurrent wasting and to support progress towards the national target of reducing wasting prevalence to 8% by 2025.

Factors Associated with Wasting Recurrence

Maternal Nutritional Status

Maternal nutritional status was the strongest factor associated with wasting recurrence and remained significant after adjustment for other variables. Children of mothers with normal BMI were less likely to experience recurrence, suggesting that post-recovery nutritional outcomes may be influenced not only by therapeutic interventions but also by maternal nutritional status. In the Maros District, seasonal fluctuations in agricultural and fishery production exacerbate children's reliance on maternal nutrient reserves.

Maternal nutritional status may influence breastmilk quality and feeding patterns, as well as household dietary practices [29, 30]. These factors are important for maintaining adequate child nutrition. Previous studies have reported similar associations between maternal undernutrition and adverse child outcomes, including wasting and growth faltering [31, 32]. From a life-course perspective, maternal nutrition may also influence fetal development and immune function, thereby affecting the maintenance of optimal nutritional status later in life [33]. These findings are consistent with global evidence linking maternal undernutrition to preterm birth, increased risk of acute malnutrition, and stunted growth [34, 35].

Empirical studies consistently report that maternal nutritional status is an important correlate of child nutrition. Children born to mothers with a BMI <18.5 kg/m² have a higher risk of wasting compared with those born to mothers with a normal BMI [34, 36]. Similar associations have been documented by Akombi *et al.* (2017), Chowdhury *et al.* (2016), and Emdadul *et al.* (2018), underscoring the pivotal role of maternal nutrition in shaping child nutritional outcomes. Maternal nutritional status reflects both biological capacity and

the caregiving environment, and may influence the sustainability of post-recovery nutritional status. These findings highlight the potential importance of strengthening nutrition interventions targeting women across the life course. Integrating maternal nutrition into adolescent health, preconception care, and primary health programmes may help reduce the risk of recurrence into wasting.

Maternal Psychosocial Condition

Maternal psychosocial status, assessed using the DASS-21, was associated with wasting recurrence, with maternal anxiety showing a statistically significant association in the adjusted model. However, this finding should be interpreted with caution. The number of mothers classified as having anxiety was very small, which may have resulted in sparse data bias, wide confidence intervals, and unstable estimates. Therefore, this finding should be considered exploratory rather than conclusive. Previous studies suggest that maternal anxiety may influence caregiving practices, including feeding behaviour and responsiveness to child needs. However, the extent to which these mechanisms explain the present findings remains uncertain, given the limitations of the data. In contrast, maternal depression was not significantly associated with wasting recurrence, which may be partly due to the small sample size in the depression subgroup. A sensitivity analysis was conducted by recategorizing anxiety into a binary variable (presence vs absence). The direction of the association remained similar, although estimates remained imprecise due to the small number of exposed cases.

Maternal anxiety may affect caregiving capacity, including feeding practices and responsiveness to child needs, which are important for maintaining adequate nutritional status [37]. Elevated cortisol associated with chronic anxiety further compromises cognitive control, widening the gap between knowledge and caregiving practice [38]. Mechanistically, anxiety affects responsive feeding: caregivers may misinterpret hunger and satiety cues, maintain irregular feeding schedules, and experience oxytocin-mediated inhibition of lactation, undermining breastfeeding adequacy [39, 40]. This impaired responsiveness can hinder maintenance of adequate energy intake following recovery from wasting.

Previous studies suggest that maternal anxiety may be associated with less optimal caregiving behaviours, which could influence child nutritional outcomes. It provides a conceptual framework linking chronic maternal anxiety to disorganised caregiving and heightened child malnutrition risk, whereby mothers understand their child's basic needs but struggle to translate this knowledge into consistent, responsive care [41]. Evidence from low- and middle-income countries consistently associates maternal anxiety with suboptimal feeding practices and poorer child growth outcomes [24, 42-44]. Maternal psychosocial factors, including partner support and stress-coping strategies, can mitigate anxiety, highlighting the importance of timely identification and comprehensive prenatal mental health interventions to improve long-term outcomes for mother and child [44].

Maternal mental health may be associated with caregiving quality, including emotional bonding, breastfeeding, and daily care practices. Maladaptive feeding behaviours, such as neglecting hunger cues or force-feeding, may increase the long-term risk of inadequate energy intake, contributing to post-recovery wasting recurrence [41, 45]. One possible pathway linking maternal mental health to child nutritional outcomes may be through caregiving quality and feeding practices.

These findings suggest the potential importance of integrating maternal mental health into nutrition programmes aimed at preventing the recurrence of wasting. Routine psychosocial screening, using validated, simple instruments such as DASS-21, should be implemented across the preconception, antenatal, and postnatal periods through primary care services and community health posts, with basic counselling and family support for mild cases and referral for moderate-to-severe disorders. Psychosocial support interventions, including counselling, family-based support, and referral to mental health services when necessary, are crucial for ensuring the sustainability of child nutritional recovery. This approach positions mothers not as the source of the problem but as key agents whose capacity to provide adaptive caregiving and feeding practices must be supported.

Maternal Parenting Practices

Maternal caregiving practices were significantly associated with wasting recurrence, with children exposed to low-risk parenting practices showing lower odds of recurrence. These findings suggest that caregiving behaviours may be important for maintaining post-recovery nutritional status. High-risk caregiving, as assessed through the Parenting Style Questionnaire (PSQ), typically combined coercive and permissive feeding behaviours, reflecting suboptimal responsive

feeding. Among children who recurrenced, mothers classified as high-risk often exercised excessive control over food quantity and compliance, while simultaneously neglecting meal timing, context, and dietary quality. This combination of over-control and permissiveness illustrates a lack of balanced responsive feeding, in which caregivers struggle to adequately meet children's nutritional and behavioural needs.

Authoritarian practices, characterised by strict rules, high discipline, and limited emotional engagement, may be associated with pressured eating and suboptimal nutritional outcomes [46). Conversely, permissive approaches, providing unrestricted food choices, may be linked to selective eating and inadequate nutrient intake [47]. Both styles are considered non-responsive, whereas authoritative (democratic) parenting, which balances responsiveness and demands, promotes optimal child nutrition [48]. Democratic parenting has been associated with more responsive feeding practices by creating safe and positive mealtime environments, recognising hunger and satiety cues, and providing emotional support, particularly crucial for post-recovery children who may experience appetite fluctuations or anorexia following illness. In contrast, non-responsive practices, including coercion, over-control, or neglect, may be associated with feeding difficulties and suboptimal eating behaviours, which may be associated with lower energy intake and a higher likelihood of recurrence [49, 50]. Post-recovery biological vulnerabilities may further highlight the importance of consistent caregiving [1].

These findings align with the Nurturing Care Framework, which highlights that sustainable nutritional gains depend on caregivers' capacity to maintain responsive feeding and care beyond programme support [51]. Empirical studies consistently report that responsive caregiving correlates with improved child nutritional status. Malwani *et al.* (2025) and Adriana *et al.* (2019) observed that the majority of children under democratic parenting (90.1%) remained well-nourished, whereas permissive parenting was linked to higher rates of undernutrition [52, 53]. Restrictive feeding practices were associated with lower weight gain, while coercive practices were associated with lower weight and poorer growth outcomes [46, 54]. Permissive and neglectful parenting were also linked to energy imbalance, driven by unregulated snack consumption and inadequate protein intake [47, 55].

In the context of nutrition interventions, supplementary feeding and therapeutic programmes generally meet children's energy and nutrient requirements temporarily. However, once intervention support ceases, sustained nutritional recovery may depend on household caregiving practices. Reliance on external supplementation without the internalisation of adaptive, responsive feeding strategies may be associated with reduced nutrient intake and a higher likelihood of recurrence into wasting.

Overall, maternal caregiving practices may play an important role in maintaining post-intervention nutritional recovery. Interventions should extend beyond anthropometric restoration to explicitly integrate parenting support and responsive feeding education as key strategies to prevent recurrence of wasting. Post-discharge follow-up, including responsive feeding counselling, home visits by community health workers, and case-based mother-child classes, may help support the continuity of child nutrition gains.

Factors Not Significantly Associated with Wasting Recurrence

Maternal education, household income, and maternal depression were not independently associated with wasting recurrence in the multivariable model. Although maternal education showed a protective direction of effect (AOR = 0.45; 95% CI: 0.14-1.39), the association was not statistically significant after adjustment for more proximal maternal and caregiving factors, including maternal nutritional status, anxiety, and parenting style. This finding may be partly explained by the relative homogeneity of maternal educational attainment in the study population, where most mothers had at least secondary education. This limited variability may have reduced the ability to detect an independent association. Similarly, household income was not significantly associated with wasting recurrence after adjustment, suggesting that economic resources alone may not be sufficient to reduce the likelihood of recurrence when maternal caregiving practices and psychosocial conditions are suboptimal. Maternal depression was also not significantly associated with wasting recurrence, as indicated by a wide confidence interval crossing unity. This may reflect limited statistical power or low variability in depressive symptoms within the sample. Overall, these findings suggest that distal socioeconomic factors, such as education and income, may be indirectly associated with wasting recurrence through more proximal maternal and caregiving pathways. This highlights the potential importance of addressing behavioural and psychosocial factors in post-recovery nutrition interventions.

LIMITATIONS

This study has several limitations that should be acknowledged. First, the cross-sectional design limits the ability to establish temporal relationships; the observed findings should therefore be interpreted as associations rather than causal relationships. Second, the purposive sampling used from two primary health centres may introduce selection bias and limit the representativeness of the sample. As a result, the findings may not be generalisable to all children with a history of wasting in other settings. Third, although the study focused on maternal factors, residual confounding from unmeasured variables, particularly child-level characteristics such as age, sex, birth weight, morbidity, and feeding practices, cannot be excluded. These factors may have influenced the observed associations. Fourth, the number of participants in certain psychosocial subgroups, particularly maternal anxiety and depression, was relatively small. This may result in sparse data bias, wide confidence intervals, and limited precision of the estimates. These findings should therefore be interpreted with caution. Fifth, the relatively low number of events per variable (EPV), along with incomplete model convergence, suggests a potential risk of overfitting and may affect the stability of the regression estimates. Finally, data were collected through interviews and observation at a single time point, which may introduce information bias and may not fully capture routine caregiving practices, particularly for dynamic variables such as psychosocial condition and caregiving behaviour. Despite these limitations, this study provides important insights into maternal-related factors associated with wasting recurrence and highlights the need for future longitudinal studies to better understand these relationships.

CONCLUSION

This study found that wasting recurrence among children aged 6-59 months in Maros District was associated with several maternal-related factors. Maternal nutritional status showed the strongest association, while responsive caregiving practices were also associated with lower odds of recurrence. Maternal anxiety was statistically associated with wasting recurrence; however, this finding should be interpreted with caution due to the small number of exposed cases and limited precision of the estimates. In contrast, maternal education and household income were not independently associated with wasting recurrence after adjustment, suggesting that their influence may operate indirectly through more proximal maternal and caregiving factors. These findings highlight the potential importance of extending recurrence prevention strategies beyond child-focused interventions towards a more integrated, mother-centred approach. Strengthening maternal nutrition, supporting responsive caregiving practices, and incorporating basic psychosocial support into post-recovery services may help sustain nutritional recovery. However, given the cross-sectional design, the findings should be interpreted as associations rather than causal relationships. In addition, caution is warranted in generalising these results beyond similar programmatic settings.

AUTHOR'S CONTRIBUTION STATEMENT

Migusvira Dwi Septiani: Conceptualisation of the study, research design, data collection, data analysis, interpretation of findings, drafting of the manuscript, and final approval of the version to be published. Anna Khuzaimah: Methodological supervision, critical review of the study design, guidance on data interpretation, and critical revision of the manuscript for important intellectual content. Citrakesumasari: Academic supervision, validation of analytical methods, contribution to the interpretation of results, and substantive revision of the manuscript. Hasan Basri: Critical evaluation of the manuscript, expert input on the discussion and conclusions, and scholarly review of the final draft. Nurzakiah Hasan: Critical appraisal of the manuscript, contribution to the refinement of arguments, and review of the final version for academic consistency.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest related to this study.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the authors used ChatGPT to refine language, improve clarity, and enhance the overall structure and readability of the manuscript. Following the use of this tool, the authors carefully reviewed and edited the content as necessary and take full responsibility for the publication's content. All scientific content, data analysis, interpretation of results, and conclusions remain entirely the responsibility of the authors.

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