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Association of Environmental Factors with Stunting in Biromaru Health Center, Sigi Regency

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ABSTRACT

Stunting is a major concern in public health. The prevalence of stunting according to 2021 data for each community health center work area in Sigi Regency, the Biromaru Community Health Center is at the highest, namely 377 cases (20.9%). This study aims to analyze the relationship between environmental risk factors and the incidence of stunting in the work area of the Biromaru Health Center, Sigi Regency. This research was conducted using quantitative methods, cross-sectional study design. The population in this study was 308 people, the sample was 174 respondents. Sampling used the cluster random sampling method in 18 villages. Data were analyzed using univariate and bivariate. The results of analysis using the chi square test with a confidence level of 95%, showed that the ρ value for the variables of hand washing habits, availability of clean water sources and Availability of Latrines was less than 0.05. Based on findings from research results regarding the relationship between environmental factors and the incidence of stunting in the work area of the Biromaru Health Center, Sigi Regency, it can be stated that there is a correlation between the habit of washing hands (ρ = 0.000), the availability of clean water sources (ρ = 0.000), and the condition of latrines (ρ = 0.001) with the prevalence of stunting in children under two years of age in the area.

Keywords *: Stunting; Environmental Factors; Sanitation.*

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INTRODUCTION

Stunting is a disorder of growth and development in children due to chronic malnutrition and repeated infections, which is characterized by a length or height below the standard set by the minister who oversees government affairs in the health sector (1). According to the World Health Organization (WHO), the prevalence of stunting ≥20% is still considered a major public health problem (2). Based on WHO data in 2018, the prevalence of stunting among children under five remains the highest in the Southeast Asia Region (SEAR). WHO reported that the prevalence of stunted children under two years in Asia (55%) was higher compared to Africa (39%), with Southeast Asia accounting for 17.5% (3).

In Indonesia, stunting continues to be a significant public health challenge. The country ranks third among Southeast Asian nations with the highest prevalence—following Timor-Leste (50.5%) and India (38.4%)—reaching 36.4% (3). Although the rate has declined over the years, it remains above the WHO threshold of 20%, indicating that the global target to reduce stunting has not yet been achieved.

According to the 2023 Indonesian Health Survey, the national prevalence of stunting was 21.5%, showing only a slight reduction from 21.6% in 2022. This minimal decrease suggests that Indonesia's progress toward the national target of 14% by 2024 remains insufficient (4). Furthermore, data from the 2024 Indonesian Nutritional Status Survey (SSGI) showed that national prevalence decreased to 19.8%. However, substantial disparities persist between provinces: Highland Papua recorded the highest rate (40%), followed by East Nusa Tenggara (37%) and West Sulawesi (35.4%). Central Sulawesi recorded a prevalence of 26.1%, remaining well above the WHO threshold (5).

At the provincial level, the trend in Central Sulawesi reflects a persistent and worrying situation. Based on the 2021 Central Sulawesi Provincial Health Profile, stunting prevalence was reported at 23.5%. However, by 2023, this figure increased to 27.2%, placing the

province among the 11 regions with the highest stunting prevalence in Indonesia, accompanied by high rates of wasting (12.9%) and underweight (24.4%)(6)

At the district level, disparities within Central Sulawesi are evident. In Sigi Regency, data from the 2021 National Nutrition Survey reported a prevalence of 40.7%, the highest compared to neighboring districts such as Parigi Moutong (31.7%) and Palu City (23.9%). Within Sigi, the Biromaru Community Health Center recorded a stunting prevalence of 20.9%, which remained higher than other sub-district health centers such as Dolo (15.2%) and Palolo (15.9%).

Despite numerous national initiatives such as the National Strategy to Accelerate Stunting Reduction and various local nutrition programs, the persistence of high stunting prevalence in certain regions—particularly in Central Sulawesi and Sigi Regency—suggests that program implementation at the community level may face contextual challenges. These challenges may include limited access to health services, inadequate maternal and child nutrition practices, poor sanitation, and low community awareness regarding stunting prevention.

Previous studies in Indonesia have predominantly examined stunting from nutritional or biomedical perspectives, emphasizing dietary intake, infection, and socioeconomic determinants. However, the environmental dimension—such as access to clean water, sanitation facilities, and household hygiene—has often been overlooked, even though these factors play a critical role in child growth and nutritional outcomes. Poor environmental health conditions, including open defecation practices, limited latrine availability, and unsafe drinking water, can contribute to recurrent infections and impaired nutrient absorption, which are key pathways leading to stunting.

Therefore, this study aims to analyze the relationship between environmental factors—specifically handwashing practices, availability of clean water, and latrine conditions—and the incidence of stunting among children under five in the working area of

the Biromaru Community Health Center, Sigi Regency, Central Sulawesi. The findings are expected to offer valuable insights for strengthening environmental health interventions and guiding community-based strategies to accelerate stunting reduction at the local level.

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METHODS

This study employed a quantitative epidemiological observational analysis using a cross-sectional design. The cross-sectional design was selected because it is appropriate for assessing the association between environmental factors and stunting at a single point in time. This design minimizes recall bias related to past events and is efficient for data collection, making it suitable for community-based public health research. The aim of this research was to examine the relationship between environmental factors and the incidence of stunting. The study was conducted in the working area of the Biromaru Community Health Center, Sigi Regency, from August to September 2022. The study population consisted of 308 stunted children residing in the Biromaru Community Health Center area.

The study population consisted of 308 children under two years of age residing in the Biromaru Health Center catchment area, Sigi Regency. The final sample of 174 respondents was determined using Slovin's formula with a 5% margin of error to ensure adequate representativeness. A cluster random sampling technique was applied, with the 18 villages within the health center's jurisdiction serving as clusters. The number of samples from each village was allocated proportionally to the number of children under two years old: Soulove (17), Sidondo I (7), Sidondo II (7), Sidondo III (1), Sidondo IV (4), Bulupountujaya (3), Maranatha (3), Kalukubula (24), Oloboju (1), Sidera (4), Bora (6), Watunonju (6), Ngatabaru (3), Pombewe (7), Loru (20), Jonooge (17), Lolu (23), and Mpanau (21). Respondents were randomly selected within each cluster. Inclusion criteria comprised children aged 6–24 months who had resided for at least six months in the Biromaru area and whose caregivers consented to participate, while exclusion criteria included children with congenital

disabilities or chronic illnesses, and caregivers who were unwilling or unable to complete the interview.

Data were collected through a structured questionnaire assessing household environmental conditions and hygiene practices. The independent variables included handwashing habits, access to clean water, and latrine conditions, while the dependent variable was stunting status, determined from height-for-age using the WHO Anthro (2006) reference, with Z-scores < –2 SD classified as stunted. Data were analyzed using univariate and bivariate techniques. The Chi-square test was applied to examine associations between categorical variables.

RESULTS

Respondent Characteristics

Table 1
Distribution of Respondent Characteristics at Biromaru Community Health Center, Sigi Regency

Characteristics Respondent	n	%
Age (Month)		
7-12	74	42,5
13-18	49	28,2
19-24	51	29,3
Type Sex		
Female	89	51.1
Male	85	48,9
Nutritional Status		
Stunted	66	37,9
Not Stunted	108	62,1

Source : Primary Data, 2022

Table 1 shows the distribution of respondents by age group of children under two years in the working area of the Biromaru Community Health Center, Sigi Regency. Of the 174 respondents, the largest age group was 7–12 months with 74 children (42.5%), while the smallest age group was 13–18 months (28.2%). Based on sex, more than half of the respondents in the Biromaru Community Health Center area were female (51.1%). Regarding the nutritional status of children, most of the 174 respondents were not stunted, with 108 children under two years (62.1%).

Table 2
Analysis of Environmental Risk Factors Related to Stunting at Biromaru Community Health Center, Sigi Regency

Characteristics	n	%
Handwashing Habits		
Poor	59	33,9
Good	115	66,1
Availability of Clean Water Sources		
Poor	55	31,6
Good	119	68,4
Availability of Latrines		
Poor	62	35,6
Good	112	64,4

Source : Primary Data, 2022

Based on Table 2, the distribution of respondents according to handwashing habits among children under two years in the working area of the Biromaru Community Health Center, Sigi Regency, shows that of 174 children, the majority had good handwashing habits, with 115 children (66.1%). Regarding the availability of clean water sources, most of the 174 respondents reported adequate availability, with 119 respondents (68.4%). However,

in terms of latrine conditions, the majority of respondents were categorized as poor, with 112 out of 174 respondents (64.4%).

Table 3
Analysis of the Relationship Between Environmental Factors and Stunting Incidence at Biromaru Community Health Center, Sigi Regency

Environmental Factors	Stunted				P Value (OR)
	Yes		No		
	n	%	n	%	
Handwashing Habits					
Poor	35	20,1	24	13,8	0,000
Good	31	17,8	84	48,3	(3,9)
Availability of Clean Water Sources					
Poor	34	19,5	21	12,1	0,000
Good	32	18,4	87	50,0	(4.4)
Availability of Latrines					
Poor	34	19,5	28	16,1	0,001
Good	32	18,4	80	46,0	(3,0)

Source : Primary Data, 2022

As shown in Table 3, the prevalence of stunting was markedly higher among children from households with poor handwashing habits. Specifically, 20.1% of respondents with poor handwashing practices had stunted children, compared with 17.8% among those with good handwashing habits. This finding indicates that poorer handwashing behavior was associated with a higher proportion of stunting. Children from families with poor handwashing habits were found to be 3.9 times more likely to experience stunting than those with good hygiene practices (OR = 3.9).

In addition to hygiene behavior, access to clean water and latrine conditions were also significantly associated with stunting ($p < 0.05$). Among respondents with adequate access to clean water, 18.4% of children were stunted, whereas 19.5% were stunted among those with poor access. The analysis showed that children from households with inadequate water sources were 4.4 times more likely to be stunted (OR = 4.4), indicating that limited access to clean water is a risk factor for stunting.

Similarly, the condition of household latrines was significantly associated with stunting. Children from households with poor latrine conditions had a 19.5% prevalence of stunting, compared with 18.4% among those with adequate sanitation facilities. Children living in households with poor latrines were 3.0 times more likely to experience stunting (OR = 3.0). As the OR values exceed 1, inadequate sanitation facilities can be identified as environmental risk factors contributing to stunting.

DISCUSSION

The Relationship Between Handwashing Practices and Stunting Incidence

This study found a significant association between handwashing practices and stunting incidence. Children from households with poor handwashing behavior more likely to experience stunting than those with good hygiene habits. This result is consistent with previous studies showing that significantly, WASH intervention wield greater efficacy in bolstering childhood nutrition among children under 2 years of age when compared with interventions targeting older children. This observation is notably grounded in the recognition that the initial 2 years of life constitute a pivotal developmental window. During this phase, exposure to sanitation-related diarrheal and intestinal parasitic infections can inflict lasting, irreversible damage to a child's health (7). The relationship can be explained through biological mechanisms—poor handwashing facilitates fecal–oral transmission of pathogens, leading to diarrheal and intestinal infections that impair nutrient absorption and slow linear growth.In Biromaru, some households still lack access to proper handwashing facilities, and many parents report washing hands only with water, especially after children play or before feeding. These practices reflect limited hygiene awareness and contribute to the persistence of infectious diseases among toddlers. The Indonesian Ministry of Health identifies five critical times for handwashing with soap—before eating, before breastfeeding, before feeding children, after defecation, and after handling animal waste.

However, field observations revealed that these practices are not consistently followed in rural Biromaru villages, where water availability and parental supervision are limited. This highlights the importance of culturally adapted hygiene education programs targeting caregivers to improve child health outcomes.

Handwashing with soap remains a simple yet highly effective preventive measure. Just as in previous studies, the more frequently you wash your hands, the lower the risk of infectious diseases (8). Recurrent infections are a key etiological pathway leading to growth faltering and chronic undernutrition. Therefore, promoting regular handwashing within households represents an essential public health intervention to reduce stunting prevalence in the Biromaru area.

The Relationship Between Access to Clean Water Sources and Stunting Incidence

A significant relationship was also found between access to clean water sources and stunting incidence, indicating that limited access to safe water represents an important environmental risk factor (9)(10). Families relying on unprotected wells, rivers, or rainwater storage were more likely to have stunted children than those with piped or treated water sources. Contaminated water contributes to diarrheal diseases, which in turn interfere with nutrient absorption during critical growth periods. This aligns with previous findings in other regions, though the magnitude of association observed in Biromaru appears stronger, likely due to the region's limited water infrastructure and proximity of livestock pens to water sources.

Field observations revealed that in several Biromaru villages, livestock pens are situated near water sources used for domestic purposes. This environmental arrangement facilitates contamination from animal feces containing Escherichia coli, increasing the risk of waterborne diseases. These findings suggest that stunting in the Biromaru Health Center area may partly result from the interplay between agricultural practices and inadequate

water management. In contrast to some urban settings where municipal water supply reduces contamination, rural communities in Biromaru remain vulnerable due to reliance on shallow wells and surface water.

Comparative studies across Indonesia and other developing countries have reported similar trends, though regional differences may reflect variations in local geography, rainfall patterns, and infrastructure investment (11). Ensuring reliable access to clean water should therefore be prioritized in stunting reduction programs. Government and NGO initiatives that expand clean water infrastructure and promote safe storage and usage practices are crucial to breaking the cycle of infection and malnutrition.

The Relationship Between Latrine Conditions and Stunting Incidence

This study also identified a significant association between household latrine conditions and stunting. Poor sanitation conditions can contribute to infectious disease transmission, which in turn reduces nutrient absorption and impairs child growth. These findings support previous research indicating that children living near unimproved latrines or in households practicing unsafe fecal disposal are more likely to be stunted (12)(13). In Biromaru, several villages still practice open defecation due to inadequate sanitation facilities and water shortages. This behavior increases environmental contamination and exposure to fecal pathogens, perpetuating the risk of diarrheal disease and stunting among young children.

Moreover, poor latrine conditions may contaminate groundwater used for bathing, washing, or cooking, exacerbating the problem. Similar mechanisms have been reported in studies by Hendraswari et al. (2019) and Abidin et al. (2021), although they did not find a statistically significant relationship. The discrepancy may be explained by differences in sample characteristics, local sanitation coverage, and household income levels (14)(15).

These contextual variations emphasize that sanitation improvement must be tailored to local environmental and socioeconomic conditions.

Efforts to prevent stunting must therefore include the construction of improved latrines, regular maintenance, and behavioral interventions encouraging consistent use. Collaborative initiatives between local government, NGOs, and community leaders in Sigi Regency could enhance sanitation coverage and hygiene awareness, creating a healthier environment for child growth.

Taken together, the three environmental factors—handwashing behavior, access to clean water, and latrine conditions—form an interrelated system influencing stunting incidence in Biromaru. Poor hygiene practices increase exposure to pathogens, inadequate water access limits hygiene and sanitation, and poor sanitation perpetuates environmental contamination. These factors create a reinforcing cycle of infection and undernutrition that impedes growth.

This integrated understanding highlights that isolated interventions are unlikely to succeed. Comprehensive stunting prevention should combine behavioral change (handwashing), infrastructure improvement (water and sanitation), and community-based education tailored to local cultural and environmental contexts. Strengthening environmental health infrastructure and promoting hygiene awareness in Biromaru will not only reduce stunting prevalence but also improve the overall well-being and resilience of the community.

CONCLUSIONS AND RECOMMENDATIONS

This study found that handwashing practices, access to clean water, and latrine conditions were significantly associated with stunting among children under two years of age in the Biromaru Health Center area, Sigi Regency. These findings highlight that poor hygiene behavior and inadequate sanitation increase the risk of recurrent infections,

disrupt nutrient absorption, and ultimately impede child growth. Therefore, household environmental factors serve as key determinants of nutritional status. However, the cross-sectional design limits causal inference, and the geographic focus on Biromaru may restrict the generalizability of the results.

Strengthening community education on hygiene, improving clean water and sanitation infrastructure, and conducting longitudinal studies to examine causal mechanisms are strongly recommended. Integrated interventions combining behavioral change and environmental improvement are essential to effectively reduce stunting and promote optimal child health and development.

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