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ANALYSIS OF SANITATION, INTERNAL AND EXTERNAL FACTORS AFFECTING STUNTING KNOWLEDGE AMONG AT-RISK COMMUNITIES IN CENTRAL SULAWESI, INDONESIA

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ABSTRACT

Stunting remains a significant public health challenge in Indonesia, particularly in underdeveloped regions like Central Sulawesi, where limited access to health information and services contributes to poor nutritional outcomes. This study evaluates the effectiveness of interventions in improving knowledge about stunting among four vulnerable groups: families with stunted children, pregnant women, couples of childbearing age (PUS), and female senior high school students in Central Sulawesi. Using a pre-and post-test design, the average knowledge scores on stunting increased from 14.12 to 50.95 among pregnant women, 28.57 to 58.43 among PUS, and 34.82 to 57.67 among female senior high school students. Correlation analysis revealed that sanitation, internal, and external factors were strongly associated with knowledge improvement (correlation values between 0.05% and 0.01%). These findings suggest that tailored, community-based educational approaches can significantly enhance awareness and knowledge of stunting, thereby contributing to long-term prevention efforts in underdeveloped regions.

Kata Kunci:

Faktor sanitasi;
Internal;
Eksternal;
pengetahuan stunting.

ABSTRAK

Stunting masih menjadi tantangan kesehatan masyarakat yang signifikan di Indonesia, khususnya di daerah tertinggal seperti Sulawesi Tengah, di mana keterbatasan akses terhadap informasi dan layanan kesehatan berkontribusi terhadap buruknya status gizi. Penelitian ini mengevaluasi efektivitas intervensi dalam meningkatkan pengetahuan tentang stunting pada empat kelompok rentan: keluarga dengan anak stunting, ibu hamil, pasangan usia subur (PUS), dan siswi sekolah menengah atas di Sulawesi Tengah. Dengan menggunakan desain pre-test dan post-test, skor rata-rata pengetahuan tentang stunting meningkat dari 14,12 menjadi 50,95 pada ibu hamil, dari 28,57 menjadi 58,43 pada PUS, dan dari 34,82 menjadi 57,67 pada siswi SMA. Analisis korelasi menunjukkan bahwa faktor sanitasi, faktor internal, dan faktor eksternal memiliki hubungan yang kuat terhadap peningkatan pengetahuan (nilai korelasi antara 0,05% hingga 0,01%). Temuan ini menunjukkan bahwa pendekatan edukasi berbasis komunitas dapat secara signifikan meningkatkan kesadaran dan pengetahuan tentang stunting, sehingga berkontribusi terhadap upaya pencegahan jangka panjang di wilayah tertinggal.

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INTRODUCTION

Stunting remains a significant public health challenge in Indonesia, particularly in underdeveloped and rural regions such as Central Sulawesi. According to the Indonesian Nutritional Status Survey (SSGI) 2022, the national prevalence of stunting among children under five was 21.6%, with several provinces, including Central Sulawesi, exceeding the national average. Stunting, characterized by impaired linear growth due to chronic malnutrition and recurrent infections, has long-term consequences on cognitive development, educational attainment, and future economic productivity. In Central Sulawesi, factors such as limited access to clean water, inadequate sanitation facilities, and poor hygiene practices contribute to persistent high stunting rates. A study in Kinovaro, Sigi Regency, identified factors contributing to stunting,

including low birth weight, exclusive breastfeeding, immunization history, and infections (Nasrul et al., 2024; Syam & Bungawati, 2024).

Sanitation plays a crucial role in child growth and development. Poor sanitation, in particular, has been repeatedly identified as a major determinant of child growth faltering. Children exposed to unsafe drinking water, open defecation, and environments contaminated with fecal pathogens are more likely to suffer from repeated episodes of diarrhea and environmental enteric dysfunction (EED), which impair nutrient absorption and compromise immune function. These conditions are prevalent in many areas of Central Sulawesi, where access to basic sanitation and hygiene services remains limited. Although the Indonesian government has implemented various national programs to reduce stunting—including Community-Based Total Sanitation (*Sanitasi Total Berbasis Masyarakat*/STBM), nutritional supplementation, and parenting education—implementation gaps, particularly in remote and disadvantaged areas, continue to hinder progress. Studies have shown that children from households with unimproved latrines and untreated drinking water are at increased risk of stunting. Furthermore, improper wastewater disposal has been identified as a predisposing factor for childhood stunting (Soe et al., 2023; Cumming & Cairncross, 2016).

Internal factors, particularly parental education and knowledge, are crucial in stunting prevention. Higher maternal and paternal education levels are associated with protective caregiving behaviors, including better nutrition, complete immunizations, and improved sanitation practices. A study in Indonesia found that both maternal and paternal education significantly reduced the odds of child stunting, highlighting the importance of parental education in child health outcomes (Nurbaya et al., 2023; Rd. Halim et al., 2022). A study in West Java found associations between sociodemographic characteristics and the knowledge and motivation of health cadres in stunting prevention. Similarly, external factors, including access to healthcare and community health services, are associated with child stunting (Mediani et al., 2022).

External factors, such as access to healthcare and community health services, are also significantly associated with child stunting. A review of child stunting determinants in Indonesia emphasized that community and societal factors, including access to healthcare, health infrastructure, and qualified health providers, play an important role in child stunting. Additionally, limited access to healthcare services and socioeconomic disparities can exacerbate the risk of stunting in children (Beal et al., 2018).

In the Sigi Regency, community-based interventions like Community-Led Total Sanitation (CLTS) have been implemented to address sanitation issues. However, despite these efforts, the problem of stunting persists (Ningsih et al., 2021). Given this context, it is imperative to analyze the interplay of sanitation, internal, and external factors affecting stunting knowledge among at-risk communities in the Marawola Subdistrict, Sigi Regency. Understanding these factors can inform targeted interventions to reduce stunting prevalence in the region.

METHOD

Type of Research

This study employed an analytical survey research design using a pre-posttest approach. The design was selected to evaluate the relationship between sanitation, internal, and external factors, with the level of knowledge about stunting among at-risk community groups before and after the intervention.

Research Location and Time

The research was conducted in the Marawola District, Sigi Regency, Central Sulawesi Province, Indonesia**.** It took place from May to September 2024 and covered both data collection and intervention phases.

Population and Sample

The study population consists of community groups at risk of stunting, as identified by the Sigi District Health Office (2021). One hundred sixty respondents were selected using purposive sampling based on Posyandu visit schedules and community health outreach activities. The sample consisted of 40 families with stunted children, 40 pregnant women, 40 couples of childbearing age (*Pasangan Usia Subur*/PUS), and 40 female high school students. If selected respondents were not present during Posyandu sessions, home visits were conducted by village health cadres to ensure sample completeness.

Data collection

Data were collected using both primary and secondary sources. Primary data was obtained through structured interviews and questionnaires administered before and after the intervention. Secondary data were extracted from health records at the Marawola Community Health Center and Sigi District Health Office, including stunting prevalence data and demographic profiles. Descriptive statistics were first employed to summarize the characteristics of respondents, including age, education level, and baseline knowledge about stunting. To assess changes in knowledge before and after the intervention, a paired sample t-test was applied for normally distributed data, while the Wilcoxon signed-rank test was used for non-normally distributed variables. The relationship between categorical variables, such as sanitation access and knowledge levels, was examined using the Chi-square test.

RESULT

Table 1 shows that the majority of parents of stunted toddlers in Marawola Sub-district have low educational attainment, with most fathers completing junior high school (55%) and most mothers completing senior high school (65%), while only 2.5% from each group reached higher education. In terms of employment, 72.5% of fathers work in the private sector, whereas 92.5% of mothers are unemployed. Income levels are predominantly low, with 85% of fathers and 97.5% of mothers earning less than Rp 1,000,000 per month, indicating significant economic vulnerability among these families.

Table 1. Characteristics of Respondents – Families with Stunted Toddlers in Marawola Sub-district

Characteristics	Father (%)	Mother (%)
Education		
Junior High School	55,0	32,5
Senior High School	42,5	65,0
Higher Education	2,5	2,5
Occupation		
Government Employee	10,0	7,5
Private Sector	72,5	0,0
Unemployed	17,5	92,5
Income		
Low (< Rp 1,000,000)	85,0	97,5
Moderate (> Rp 1,000,000 – < Rp 3,250,000)	7,5	0,0
Good (> Rp 3,250,000)	7,5	2,5

Table 2 shows the characteristics of families of pregnant women in Marawola Sub-district shows that most parents have completed at least senior high school, with 65% of fathers and 77.5% of mothers reaching this level, while a smaller portion pursued higher education (7.5% of fathers and 15% of mothers). In terms of employment, 50% of fathers work in the private sector and 10% in government, whereas the majority of mothers (80%) are unemployed, and only 15% are government employees. Regarding income, half of the fathers and 82.5% of mothers reported having a low monthly income of less than Rp 1,000,000, while a smaller percentage of families reported moderate to good income levels, suggesting that economic constraints remain a concern among these households.

Table 2. Characteristics of Respondents – Families of Pregnant Women in Marawola Sub-district

Characteristics	Father (%)	Mother (%)
Education		
Junior High School	27,5	7,5
Senior High School	65,0	77,5
Higher Education	7,5	15,0
Occupation		
Government Employee	10,0	15,0
Private Sector	50,0	5,0
Unemployed	40,0	80,0
Income		
Low (< Rp 1,000,000)	50,0	82,5
Moderate (> Rp 1,000,000 – < Rp 3,250,000)	22,5	5,0
Good (> Rp 3,250,000)	27,5	12,5

The data in Table 3 shows that most husbands (67.5%) and wives (55%) in couples of reproductive age in Marawola Sub-district have completed senior high school, with a notable proportion of wives (35%) having attained higher education, compared to 22.5% of husbands. In terms of employment, 22.5% of husbands and 12.5% of wives work as government employees, while 30% of husbands are employed in the private sector. A large majority of wives (87.5%) and nearly half of the husbands (47.5%) are unemployed. Regarding income, 77.5% of both husbands and wives fall into the low-income category (earning less than Rp 1,000,000 per month), with only 17.5% in the good income bracket, highlighting the economic challenges faced by many of these families.

Table 3. Characteristics of Respondents – Couples of Reproductive Age in Marawola Sub-district

Characteristics	Husband (%)	Wife (%)
Education		
Junior High School	10,0	10,0
Senior High School	67,5	55,0
Higher Education	22,5	35,0
Occupation		
Government Employee	22,5	12,5
Private Sector	30,0	0,0
Unemployed	47,5	87,5
Income		
Low (< Rp 1,000,000)	77,5	77,5
Moderate (> Rp 1,000,000 – < Rp 3,250,000)	5,0	5,0
Good (> Rp 3,250,000)	17,5	17,5

Table 4 shows the characteristics of female adolescent respondents and their spouses in the Marawola Sub-district. The majority of both husbands (67.5%) and wives (50.0%) have completed senior high school, while only 12.5% in each group had attained higher education. Most were not employed, with 90.0% of husbands and 87.5% of wives reported as not working. In terms of income, 90.0% of both groups fell into the low-income category, earning less than IDR 1,000,000 per month, indicating that most respondents came from economically disadvantaged households.

Table 4. Characteristics of Female Adolescent Respondents in Marawola Sub-district

Characteristics	Father (%)	Mother (%)
Education		
Junior High School	20,0	37,5
Senior High School	67,5	50,0
Higher Education	12,5	12,5
Occupation		
Government Employee	7,5	12,5
Private Sector	2,5	0,0
Unemployed	90,0	87,5
Income		
Low (< IDR 1,000,000)	90,0	90,0
Moderate (> IDR 1 million – < IDR 3,250,000)	10,0	10,0
High (> IDR 3,250,000)	0,0	0,0

The research results were obtained through a pre-test, followed by a meeting held 1–2 weeks later, facilitated by village *posyandu* cadres and health officers from the Marawola Community Health Center. An interactive discussion was then conducted with the research team, *posyandu* cadres, and health officers, focusing on the causes and triggers of stunting, as well as strategies to address stunting through *posyandu* using a non-formal participatory approach that encouraged open and light-hearted conversations. The activity also included empowerment sessions on home gardening, where participants received chili, tomato, and vegetable seeds. The session concluded with a post-test, during which participants were invited to enjoy the food provided. The following data have been obtained on participants' level of knowledge about stunting before and after the intervention.

Table 5. Distribution of Stunting Knowledge Before and After the Intervention by Type of Respondent

Type of Respondent	Pre-test	Post-test	Improvement
Families with stunted children	31,6	32,0	0,40
Pregnant women	14,12	50,95	36,83
Couples of childbearing age (PUS)	28,57	58,43	29,86
Female high school students	34,82	57,67	22,85

Table 5 presents the distribution of knowledge about stunting before and after the intervention across different types of respondents, including families with stunted toddlers, pregnant women, couples of reproductive age (*Pasangan Usia Subur*/PUS), and female high school students. Overall, the results show that the intervention has successfully increased stunting-related knowledge in all respondent groups, although the extent of the improvement varied. The group of families with stunted toddlers showed a modest increase of 0.40 points. While minimal, this change still reflects a positive impact of the intervention. A more significant improvement has been observed among pregnant women, with a notable increase of 36.83 points. This indicates that the intervention has been highly effective in enhancing their understanding of stunting, likely due to the direct relevance of the topic to their current condition and concern for their children's health.

Couples of reproductive age have also experienced a substantial increase of 29.86 points, suggesting that the intervention successfully strengthened their awareness, particularly as they represent a key group in preventing stunting. Meanwhile, female high school students have shown an increase of 22.85 points. Although this is the lowest among the groups, it still indicates a positive effect and highlights the importance of early education on stunting during adolescence. The data demonstrate that the intervention has effectively improved knowledge about stunting across all respondent categories. The variations in the level of improvement are likely influenced by factors such as age, life experience, and educational background.

These findings underscore the importance of tailoring educational approaches to the specific characteristics and needs of each target group.

Table 6. Correlation Test of Stunting Knowledge Level After the Intervention with Its Influencing Factors Among Respondents in Marawola Subdistrict

Type of Respondent	Sanitation Factor	Internal Factors	External Factors
Families with stunted children	0,05 (Moderate)	0,01 (Very Strong)	0,05 (Moderate)
Pregnant women	0,01 (Very Strong)	0,05 (Moderate)	0,01 (Very Strong)
Couples of childbearing age (PUS)	0,01 (Very Strong)	0,01 (Very Strong)	0,01 (Very Strong)
Female high school students	0,01 (Very Strong)	0,01 (Very Strong)	0,01 (Very Strong)

Table 6 presents the results of the correlation test between the level of knowledge about stunting after the intervention and the influencing factors across various types of respondents in Marawola Subdistrict. In general, there is a varying relationship between stunting knowledge and sanitation, internal, and external factors, depending on the respondent group. In the group of families with stunted children, there is a moderate correlation between stunting knowledge and both sanitation and external factors (each at 0.05), while the correlation with internal factors is very strong (0.01). This suggests that internal aspects—such as knowledge, occupation, income, health-seeking behavior, personal hygiene, and number of family members—play a significant role in shaping their understanding.

For pregnant women, a very strong correlation has been found between knowledge and both sanitation and external factors (each at 0.01), while the correlation with internal factors is moderate (0.05). This indicates that environmental and sanitation conditions greatly influence their knowledge following the intervention. Among couples of childbearing age (*Pasangan Usia Subur*/PUS), all three factors—sanitation, internal, and external- strongly correlate with knowledge level (each at 0.01), reflecting that the intervention effectively enhanced their knowledge through a combination of influencing aspects. Similarly, in the group of female high school students, all three factors also show a very strong correlation (0.01), indicating that this group is highly responsive to various forms of intervention, whether originating from personal, environmental, or sanitation-related influences. Overall, these results demonstrate that internal, external, and sanitation factors play important roles in influencing the increase in stunting knowledge after the intervention, with varying levels of strength depending on the characteristics of each respondent group. This study is limited by the short intervention timeframe, which may affect the generalizability and sustainability of the outcomes. Additionally, external distractions and varying literacy levels, especially among mothers, may have influenced the accuracy of responses.

DISCUSSION

This study shows that among respondents from families with stunted children, the data showed that the average stunting knowledge score during the pre-test was 31.77. After implementing the intervention, the average post-test score has increased from 1 point to 32.0. This 1-point increase in knowledge may be attributed to the fact that during the activity, particularly during the child measurement session, 100% of those who completed the instrument were mothers. These mothers were occupied with caring for fussy and crying stunted children. Additionally, 97.5% had a low to moderate education level (elementary and junior high school), which further hindered their ability to concentrate and absorb the intervention materials. Their ability to understand the instrument questions and engage in interactive discussions was significantly affected. The mothers also had heavy workloads at home. Furthermore, 92.5% of the mothers who cared for stunted children daily did not have stable jobs but were burdened with housework, working in the fields or gardens, or working as domestic helpers to help support the family financially. These conditions have consumed much of their time and attention, resulting in a very minimal increase in stunting knowledge, only 1 point.

Lower maternal education levels could limit the ability to absorb health education. A WHO review states that mothers with lower education are more likely to have stunted children, as limited education reduces knowledge uptake and subsequently child care practices (World Health Organization, 2018). Meta-analyses also confirm that educational programs significantly improve mothers' knowledge, but improved

child nutrition outcomes aren't always guaranteed, especially when baseline education is low (Waghode et al., 2025).

Among pregnant women respondents, the data showed that the average stunting knowledge score was 14.12. After the intervention, a post-test was conducted, and the average score on stunting knowledge increased to 50.95. Based on these figures, it has been found that stunting knowledge among pregnant women has improved by more than four times, with an increase of 36.72 points from the initial 14.12. During the delivery of the material and the completion of the instrument, the pregnant women filled it out themselves, although in the field it was observed that many were still unable to spend much time at the *posyandu*. The increase in knowledge may be attributed to the fact that pregnant women have participated in the interactive discussion sessions in a calm setting, sitting comfortably without distractions at the research/posyandu location. This creates favorable conditions for understanding the material and research instruments. Many participants even asked questions when something was unclear. This situation was also supported by a relatively good average education level 77,5% had a moderate level of education (junior high school graduates), and 15,5% had higher education. These educational backgrounds significantly supported their ability to comprehend both the materials and the post-test. A study published in *Nutrients* (2023) has evaluated the effectiveness of targeted nutrition education among short-statured pregnant women to prevent gestational stunting. The intervention group has shown significant improvements in knowledge, attitudes, and behaviors regarding maternal nutrition and antenatal care, much more than the control group, which received only a module (Muhamad et al., 2023).

Among respondents who were couples of childbearing age (*Pasangan Usia Subur*/PUS), the data showed that the initial average score of stunting knowledge was 28.57. After the intervention, the average post-test score increased to 58.43. This indicates that stunting knowledge among PUS more than doubled. This improvement may be attributed to the generally good educational background of the respondents. Only 10% of the husbands and wives had a low level of education. In contrast, the majority of husbands had a moderate (67.5%) or high (22.5%) level of education, while most wives had a moderate (55%) or high (35%) education level. This relatively good educational attainment (secondary and higher education) was further supported by the fact that 52.5% of the husbands were employed, and 12.5% were supported by working wives. Couples of childbearing age (PUS) experienced a remarkable doubling of their stunting knowledge, from a pre-test average of 28,57 to a post-test average of 58,43 following the intervention. This aligns with global evidence highlighting the impact of educational interventions on parental knowledge. A study in rural settings has demonstrated that peer education effectively increases parents' understanding of child nutrition and stunting prevention (Rizona et al., 2024).

Among senior high school female student respondents, the average stunting knowledge score was 34.82 before the intervention. After the intervention, the post-test showed that the average knowledge score increased to 57.67. Stunting knowledge among these female students doubled in the post-test. This improvement may be attributed to internal factors such as educational background, where 80.0% had parents with good education, 67.5% of fathers had a secondary education, and 12.5% had higher education, while 63.5% of mothers had either secondary or higher education levels.

The correlation test results showed strong to very strong relationships between sanitation, internal, and external factors and stunting knowledge across all respondent groups. For pregnant women, sanitation and external factors had very strong correlations (0.01%), while internal factors showed a strong correlation (0.05%). Among couples of childbearing age (PUS), all three factors (sanitation, internal, and external) demonstrated very strong correlations (0.01%). Similarly, for high school female students, all variables also showed very strong correlations (0.01%). These findings indicate that improvements in sanitation, internal (e.g., education), and external (e.g., support systems) factors significantly influence stunting knowledge.

Improved water, sanitation, and hygiene (WASH) practices consistently show strong correlations with reduced stunting and greater nutritional awareness. A UNICEF/WHO-supported study in Ethiopia found that poor sanitation leads to environmental enteric dysfunction—a key driver of stunting—often transmitted via fecal contamination. The study indicates that promoting handwashing and access to toilets can significantly improve child growth outcomes (Kwami et al., 2019). Similarly, research in Myanmar reported that children with unsafely managed sanitation were nearly 2.9 times more likely to be stunted than those with proper facilities (AOR = 2.88, $p < 0.01$) (Soe et al., 2023). These findings support the study results, where sanitation factors have demonstrated strong to very strong correlations (e.g., 0.05% to 0.01%) with stunting knowledge across all respondent groups.

Internal factors, particularly parental education and maternal knowledge, also show very strong associations with stunting knowledge and prevention. A study in Central Tapanuli, Indonesia, found that maternal education, knowledge, and environmental sanitation significantly correlated with lower stunting incidence ($p < 0.05$) (Tarigan, 2021). Likewise, a systematic review on hygiene and maternal health in Indonesia concluded that personal hygiene behaviors—especially handwashing with soap—are among the strongest predictors of stunting prevention (Serly Santiyah et al., 2024).

External factors such as household income, access to health services, and community support also contribute. For example, an study in the stunting locus in Indonesia has found that maternal knowledge, parenting behavior, income level, and environmental sanitation were statistically significant determinants of stunting (AORs ranging from 2.4 to 5.3) (Atamou et al., 2023). These academic insights affirm the findings: internal and external variables each exhibit strong to very strong correlations with stunting knowledge across diverse respondent groups.

CONCLUSION

After the educational interventions, the study reveals a significant increase in stunting knowledge across all respondent groups. Pregnant women's average knowledge score rise from 14,12 to 50,95; PUS from 28,57 to 58,43; and female SLTA students from 34,82 to 57,67. Improvements are strongly associated with internal factors (e.g., parental education), external factors (e.g., employment, social support), and environmental factors (e.g., sanitation), with correlation values between 0,05% and 0,01%. These findings underscore the effectiveness of targeted nutrition education interventions in enhancing community understanding of stunting and its determinants. Future research should assess the long-term impact on stunting prevalence, explore behavioral changes through qualitative approaches, and examine cost-effective models that integrate education with environmental improvements. Moreover, future policies should prioritize community-based education integrated with WASH programs, especially targeting low-literacy groups, to strengthen stunting prevention through accessible, sustained, and context-specific interventions.

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