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The Correlation between Environmental Sanitation and Stunting Management through Women's Interventions and Food Security in Pre-School Age Children

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Abstract: Stunting is a chronic nutritional deficiency that impedes growth and affects the development of body and brain cells. Addressing stunting requires multisectoral collaboration to reduce and prevent stunting among children under 5 years old, the critical "Golden Age" period. Malang City's stunting rate was 18% in 2022, 16% in 2023, with a 2024 target of 14%. Achieving zero stunting involves a multidisciplinary approach, considering environmental, social, and economic factors within a sustainable development framework. This study examines the roles of the community, stakeholders, and government in stunting management. A quantitative approach using explanatory research was conducted on pre-school children in Karangbesuki Village, with a sample of 112 families at risk of stunting from a population of 584. Data was collected through offline questionnaires, and analysis was performed using SEM-PLS software. The study found that environmental sanitation had no significant direct effect on stunting management but positively influenced women's intervention and food security. Both women's intervention and food security significantly impacted stunting management. Furthermore, women's intervention and food security played a perfect mediating role in the relationship between environmental sanitation and stunting management. Future research should consider expanding the sample size and exploring additional independent variables beyond the current framework.

Keywords: Environmental sanitation; Food security; Pre-school children; Stunting handling; Women's intervention.

Introduction

Indonesia is one of the countries in the world with the highest prevalence of stunting compared to other developing countries. The prevalence of stunting in Indonesia decreased from 24.4% in 2021 to 21.6% in 2022 (Rokom, 2023) and further stated that the target of reducing the prevalence of stunting to 14% by 2024 can be achieved. (Novrizaldi, 2023). This condition is taken seriously, considering that stunting is a serious problem. The result can affect toddlers and or infants with poor cognitive abilities (Haryuni, 2022). Similarly, in the future, stunted children are more likely to have a high risk of disease which leads to decreased productivity. This is because the spread of stunting can have a larger and more crucial impact on economic growth, poverty levels, and the level of inequality in society (Lalu, 2023).

The fact based on the Renyoet et al. (2016), showed that the implications of stunting that the implications of

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stunting for state losses reach 11% of the loss of Growth Domestic Product (GDP), resulting in a 20% decrease in adult income. In addition, the impact of stunting also reduces 10% of lifetime income, resulting in intergenerational poverty (Kemendikbud, 2016). Not only that, data from the Organization for Economic Cooperation and Development-Programme for International Student Assessment (OECD-PISA) in 2018 explained a decrease in learning loss which reached 12 to 13 points compared to 2012 (UNICEF, 2020). This means that 82% of children in Indonesia have limited thinking power and therefore struggle and lose the ability to receive learning materials (Martony, 2023).

The argument about reducing the percentage of stunting was expanded by declaring Indonesia's joining the global Scaling-Up Nutrition (SUN) movement. This initiated the framework of stunting intervention into 2 (two) major parts, namely malnutrition intervention and nutrition-sensitive intervention (Purba et al., 2020). Various programs have been initiated by 13 (thirteen) relevant ministries and institutions. Each program in the ministries and agencies is aimed at improving regional development and empowerment and specifically includes the village fund program. (Iskandar, 2023). This is an effort to encourage all elements to collaborate in realizing the reduction of evidence-based stunting rates and statistics (Patriota et al., 2023).

The percentage reduction in stunting rates was contributed by the synergy of the implementation of the national action plan program in Malang City, East Java. One of the main activities implemented is a stunting audit to identify risk factors for stunting in the target group and understanding the triggers for stunting risk (Pemkot Malang, 2024). Not only that, identification using factor analysis as an effort to prevent, handle cases, and restore case handling and essential preventive measures. In specific interventions, the Ministry of Health organizes strengthening education and debriefing for brides-to-be, pregnant women and breastfeeding mothers, and so on (Harianto, 2022). Moreover, (Informasi Publik, 2023) related to nutrition is aligned with the Indonesian Food and Drug Authority (BPOM), and those related to education are continued by the Ministry of Education and Culture and other institutions with their functions and roles.

The government has also set stunting as a national priority issue with a target of reducing it to 14% by 2024. According to BPS data, Malang City is the second largest city in East Java with a very high Human Development Index (HDI) of 82.71. HDI includes dimensions of health, education, and living standards. In this condition, Malang City still has a stunting rate of 18% in 2022, indicating that stunting cases are still high and need to be addressed specifically by considering the conditions of the Malang City area (Informasi Publik, 2022).

Recent literature suggests that environmental sanitation is just one of the factors contributing to stunting reduction (Mursid, 2022), there are even other elements that are also important in reducing the prevalence of stunting such as poor performance on child learning memory tests, growth delays (Fuada, 2011), women's lack of engagement in pre- and post-marital knowledge and patterns of nutritional intake and access to food that meets all of their nutritional needs (Fauziah, 2023). Knowing the limitations of human resources and lack of literacy and access to implementing important aspects of preventing stunting (Iskandar, 2023) women must actively contribute and play a role in reducing the growth rate of stunting (UNICEF, 2020). The strategic combination also highlights women's ability to manage needs about the influence of their involvement with handling stunting (Kemendikbud, 2016). According to (Al Faruq, 2023) there is broad agreement that women's direct intervention has an essential role in the nutritional fulfillment of prospective mothers, which has implications for the nutritional fulfillment of pregnant women, giving birth and providing linear growth in infancy and early childhood (Mursid, 2022). However, few samples describe programs and/or activities related to literacy and information on nutritional knowledge for adolescent girls (Efevbera et al., 2017). However, (Patriota et al., 2023) strategies to strengthen women's empowerment such as the implementation of many programs, education, and social protection as an effort to increase women's access to literacy (Amalia et al., 2023), health and care after and before pregnancy and breastfeeding, strengthening women's knowledge and skills, and ability to feed and care for children.

The issue of stunting in Malang City is a pressing public health concern, particularly in light of the inconsistent findings from previous research regarding the relationship between environmental sanitation and stunting management. This study aims to address these inconsistencies by incorporating women's interventions and food security as mediating variables, thereby contributing both theoretically and managerially to the discourse on stunting prevention.

Research has consistently shown that environmental sanitation plays a critical role in the prevalence of stunting among children. For instance, Shofifah et al. (2022) found a significant correlation between inadequate environmental sanitation and stunting, indicating that children living in poorly sanitized environments are at a higher risk of stunting

due to increased exposure to infectious diseases. Similarly, a systematic review by Beal et al. (2018) highlighted various determinants of child stunting in Indonesia, emphasizing the importance of environmental factors, including sanitation and hygiene practices. Furthermore, studies have demonstrated that improvements in sanitation are associated with better child growth outcomes, reinforcing the need for effective sanitation interventions in stunting management (Torlesse et al., 2016).

The role of women's interventions in stunting prevention is also well-documented. Empowering women through education and decision-making regarding nutrition can significantly impact child health outcomes. Margatot & Huriah (2021) noted that women's empowerment is crucial in preventing stunting, as it enables mothers to make informed choices about nutrition and healthcare for their children. Additionally, the findings of Titaley et al. (2019) suggest that maternal education and empowerment are vital factors in reducing stunting rates, as educated mothers are more likely to adopt health-promoting behaviors. This aligns with the broader literature indicating that maternal factors, including education and socioeconomic status, are closely linked to child nutritional outcomes (Arini et al., 2022).

Food security is another critical variable that mediates the relationship between environmental sanitation and stunting. Yani et al. (2023) categorized household characteristics affecting stunting into individual, family, and environmental factors, highlighting that food insecurity can exacerbate the risk of stunting, particularly in households with poor sanitation. The interplay between food security and environmental sanitation is further supported by the findings of Purwita (2022), who identified low economic status and food insecurity as significant determinants of stunting. This underscores the necessity of addressing food security alongside sanitation improvements to effectively combat stunting.

Method

The present study employs a quantitative approach characterized by descriptive analysis and chi-square analysis to explore the relationships among environmental sanitation, stunting, women's interventions, and food security. The independent variable in this research is environmental sanitation, while stunting serves as the dependent variable. Women's interventions and food security are treated as mediating variables. The sampling technique utilized is probability sampling, focusing on food-insecure areas identified in the 2022 Food Security and Vulnerability Atlas (FSVA) of Malang City, specifically in Karangbesuki Village (Najib, 2023).

Quantitative research methods are particularly effective in establishing relationships between variables and assessing the impact of interventions. The use of a Likert scale for data measurement, ranging from 1 (strongly disagree) to 5 (strongly agree), allows for nuanced responses regarding perceptions of environmental sanitation and food security. This method is supported by previous studies that have successfully utilized similar scales to gauge the impact of food security on stunting. For instance, Najib's research confirmed a significant relationship between food security and stunting, indicating that children from food-insecure families are at a substantially higher risk of stunting (Najib, 2023). This aligns with findings from Abedi et al. (2021), who reported that households experiencing moderate to severe food insecurity were significantly more likely to have stunted children.

Moreover, the chi-square analysis is a robust statistical method for examining the association between categorical variables, making it suitable for this study's design. This method has been effectively employed in various studies to analyze the relationship between food security and nutritional outcomes. For example, Wijaya (2023) highlighted that household food security is a core determinant of stunting prevalence, emphasizing the importance of food availability and access. Similarly, Yanti et al. (2023) conducted a systematic review that demonstrated a direct relationship between household food security and stunting incidence, reinforcing the relevance of this analytical approach.

The incorporation of women's interventions as a mediating variable is particularly noteworthy, as it acknowledges the critical role women play in household nutrition and child health. Research has shown that women's empowerment and education can significantly influence food security and nutritional practices within households, thereby impacting stunting rates. Chandrasekhar et al. (2017) also noted that dietary diversity, which is often influenced by women's decision-making power, is crucial for preventing stunting among children. This highlights the interconnectedness of these variables and the necessity of considering them in stunting research.

The data analysis used in this research is SEM-PLS which is assisted by SmartPLS 3.3.3 software. Indicators to measure stunting handling variables are the availability of nutritious food, food quality, and safety, access to food. Research indicators for environmental sanitation variables adopted from Yurizal (2023) are

waste management, sewerage, and personal sanitation. Variable indicators in women's intervention research were adopted from the research (Badriyah & Syafiq, 2017; Yurizal, 2023). The research indicators of food security were adopted from the research (Putra et al., 2023) namely feeding practices, provision of psychosocial stimulus, and access to health.

Result and Discussion

Analysis of the outer model refers to the results of validity and reliability reflected in the outer loading value in Table 1. Validity is tested with the results of the factor load value of the research questionnaire items. These items are considered valid if the outer loading value exceeds 0.60 (Rahayu, 2019). However, if some items have a value below 0.6 then the items that have weights below the threshold should be removed to enable model analysis at the next stage (Chin, 1998). Overall, table 1 shows questionnaire items that have met the threshold of 0.6, so these items can be considered valid. The validity results are reinforced by the AVE (Average Variable Extracted) test where the research indicators are considered valid if the AVE value exceeds 0.50 (Hair Jr et al., 2019). Table 1 explains that all research variables, which include environmental sanitation, women's intervention, food security, and handling stunting, have AVE values above 0.50, so these variables meet the AVE test requirements.

Table 1. Validity and Reliability

Average Item	Outer Loading	Cronbach's Alpha	Composite Reliability	AVE
AV_Z1.1	0.800			
AV_Z1.2	0.904	0.82	0.89	0.73
AV_Z1.3	0.865			
AV_Z2.1	0.868			
AV_Z2.2	0.882	0.82	0.89	0.74
AV_Z2.3	0.835			
AV_X.1	0.743			
AV_X.2	0.839	0.68	0.82	0.60
AV_X.3	0.754			
AV_Y.1	0.840			
AV_Y.2	0.800	0.74	0.85	0.66
AV_Y.3	0.795			

Source: *(Research Data, 2024)*

Reliability testing is carried out using the composite reliability value as explained Hair Jr et al. (2019) which explains that calculating the composite reliability value assumes that each item must be assessed in the context of the proficiency of the specific item indicator. According to established standards, the assessment is considered reliable if the composite reliability value is greater than 0.70 and the Cronbach alpha value exceeds 0.60 (Hair Jr et al., 2019). In Table 2, it can be seen that the composite reliability value for each latent variable exceeds 0.70 and the Cronbach alpha value is also above 0.60. This shows that all indicators used to measure environmental sanitation variables, women's intervention, food security, and stunting can be considered reliable.

The next testing step is to look at the coefficient of determination. The R2 value for the women's intervention variable is 0.229, which indicates that 22.9% of women's intervention is influenced by environmental sanitation and the remaining 0.771 is influenced by other factors not discussed in this study. Meanwhile, the R2 value of the food security variable is 0.268, which means that food security affects environmental sanitation by only 26.8% while the remaining 73.2% is influenced by variables outside of this study. Meanwhile, the R2 value for the stunting handling variable is 0.588, which means that 58.8% of items in handling stunting can be influenced by food security while the remaining 41.2% are variables not explained in this study.

Table 2. Determination Coefficient Results (R2), Predictive Relevance (Q2)

Variable	Coefficient of determination (R2)
Women's Intervention	0.229
Food Security	0.268
Stunting Management	0.588
$Q_2 = 1 - \{(1 - R1_2)\ (1 - R2_2)\ (1 - R3_2)\}$	
$Q_2 = 1 - \{(1 - 0.229)\ (1 - 0.268)\ (1 - 0.588)\} = 0.668$	

Source*: (Research Data, 2024)*

The results of the calculation of Q-square relevance (Q2) are used to evaluate the validity of observations in the research model and its parameters (table 3). The success of the research model is considered good or relevant if the Q-square predictive relevance (Q2) value is more than 0 (Q2> 0), and vice versa the Q-square predictive relevance (Q2) value is less than 0 (Q2 < 0) then the model and research parameters are considered less relevant (Hair Jr et al., 2019). Based on the calculation, the Q-square predictive relevance (Q2) value is 0.668, or equivalent to 66.8%. This figure indicates that this research model shows a positive Q-square predictive relevance (Q2) value, indicating relevant or good research. Furthermore, to assess the suitability of the research model as a whole, the Goodnees of Fit Model (GoF) calculation was carried out. The Goodnees of Fit Model (GoF) value ranges from 0 to 1, with the following measurement criteria; 0.36 (strong or large GoF); 0.25 (medium GoF); and 0.10 (small or weak GoF (Ghozali, 2018). The results of the Goodnees of Fit Model (GoF)

calculation show a value of 0.498. This figure indicates that the overall research model shows a strong and feasible fit because the Goodnees of Fit Model (GoF) is more than 0.36.

The test results explain that the p-value of the effect of environmental sanitation on handling stunting is 0.797, the test results explain that the effect of environmental sanitation on handling stunting has a p-value> 0.05, so it can be said that environmental sanitation has no significant effect on handling stunting, and automatically H1 is rejected. The results of the H1 test explain that the p-value of 0.000 <0.05 (see table 3). In the era of transformation of stunting reduction strategies from various dimensions, it is important to continue to update comprehensive data collection so that handling and prevention assistance is right on Hipotesistarget (Al Faruq, 2023; Efevbera et al., 2017), especially home environmental conditions which are the most optimal source of targets from both individuals and groups in supporting fundamental aspects of the human living environment. However, empirical evidence that illustrates the living environment cannot have a direct impact on handling stunting, things that are related must be intervened through treatment (Supanji, 2022).

These results explain that environmental sanitation has a significant effect on women's intervention, so H2 is accepted. The p-value of environmental sanitation on handling stunting is 0.000 <0.05, so it can be said that environmental sanitation has a significant effect on food security, and H3 is accepted. The test results explain that women's intervention in handling stunting shows a p-value <0.05 which indicates that women's intervention has a significant impact on handling stunting, so H4 is accepted. Mindset interventions are related to the ability to explore literacy about reproductive health early on, have an awareness of family planning, and the ability to make decisions to maintain safety (Reeves, 2020).

Meanwhile, behavioral interventions are related to the application of PHBS and avoiding 4T pregnancies (too young, too old, too close, too many), while policy product interventions support and strengthen pregnant women on the nutrition consumed and awareness of the importance of antenatal care for pregnant women (Salsabila, 2023). This statement illustrates that the spearhead in reducing stunting rates includes the participation of women (Tarigan, 2022).

Meanwhile, the test results for H5 show that the p-value is 0.000 <0.05 which implies that food security has a significant impact on stunting management, so hypothesis H5 can be accepted. The mediation test conducted in this study shows that the significant value (p-value) of the effect of environmental sanitation on handling stunting through women's intervention is 0.006 <0.05 so H6 is accepted. Likewise, the results of mediation of environmental sanitation on handling stunting through food security show several 0.000 which means that the p-value <0.05 so that H7 in this study is accepted.

Table 3. Hypothesis testing

Hypothesis	Path Coefficient	SE	P-Value	Interpretation
H1	-0.020	0.078	0.797	Not Significant
H2	0.478	0.079	0.000	Significant
H3	0.518	0.072	0.000	Significant
H4	0.321	0.102	0.002	Significant
H5	0.517	0.092	0.000	Significant
H6	0.154	0.055	0.006	Significant
H7	0.267	0.066	0.000	Significant

Source: *(Research Data, 2024)*

Conclusion

The study found that environmental sanitation had no significant direct effect on stunting management but positively influenced women's intervention and food security. Both women's intervention and food security significantly impacted stunting management. Furthermore, women's intervention and food security played a perfect mediating role in the relationship between environmental sanitation and stunting management. Future research should consider expanding the sample size and exploring additional independent variables beyond the current framework.

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Author Contributions

Conceptualization, R.O., H.K and N.B.; methodology, R.O.; validation, H.K and N.B.; formal analysis, R.O.; investigation, R.O.; resources, R.O.; data curation, H.K., and N.B.; writing—original draft preparation, R.O; visualization, H.K and N.B. All authors have read and agreed to the published version of the manuscript.

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Conflicts of interest
The authors declare no conflict of interest.

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