

ANALYSIS OF RISK FACTORS CONTRIBUTING TO STUNTING AMONG TODDLERS IN A RURAL AREA

¹*Rifai Agung Mulyono; ²Safari Daud; ³Heni Noviarita; ⁴Fitri Yanti; ⁵Rini Setiawati; ⁶Nawasari Indah Putri Sejati
^{1,6}Ministry of Health Polytechnic of Health Tanjung Karang, ^{2,3,4,5}Universitas Islam Raden Intan, Lampung, Indonesia

*Correspondence: rifai_agungmulyono@poltekkes-tjk.ac.id

ABSTRACT: Stunting remains a major public health problem among children under five in rural areas of Indonesia. It is a condition of impaired growth caused by chronic malnutrition and is often associated with environmental and behavioral risk factors. This study aimed to analyze the risk factors of stunting based on exclusive breastfeeding history, history of infectious diseases, maternal personal hygiene, clean water quality, and household sanitation. A case-control study was conducted involving 70 stunted children as the case group and 70 non-stunted children as the control group, selected purposively based on anthropometric measurements. Data were collected through structured interviews using questionnaires and direct observation of household environmental conditions. Bivariate analysis showed that children who were not exclusively breastfed, had a history of infectious diseases (such as diarrhoea and acute respiratory infections), and lived in poor environmental conditions—such as inadequate sanitation, unsafe water, and poor maternal hygiene—had a significantly higher risk of stunting ($p < 0.05$). Multivariate analysis revealed that lack of exclusive breastfeeding and history of infectious diseases were the most dominant risk factors ($OR > 2$). This study highlights the need for integrated efforts to promote exclusive breastfeeding, improve maternal hygiene practices, and enhance household sanitation to reduce the incidence of stunting in rural communities.

Keywords: stunting, exclusive breastfeeding, infectious diseases, personal hygiene, household sanitation

I. INTRODUCTION

Stunting, or stunted growth, is one of the leading indicators of chronic malnutrition in children and is a significant public health problem, especially in rural areas in low- and middle-income countries. Stunting occurs when a child is taller than average for their age, often caused by chronic malnutrition, recurrent diseases, and poor environmental factors. It is estimated that more than 149 million children worldwide were stunted in 2020, with the highest prevalence found in South Asia and Sub-Saharan Asia [1, 11, 22].

Consistent evidence suggests nonexclusive breastfeeding for the first 6 months, low household socio-economic status, premature birth, short birth length, and low maternal height and education are particularly important for child stunting in Indonesia. Children from households with both unimproved latrines and untreated drinking water are also at increased risk [3].

Multi-sectoral collaboration can produce a mutually beneficial positive impact to reduce stunting rates in vulnerable populations [6]. Capacity building and community empowerment programs in rural areas are very effective in reducing stunting cases

and are a good holistic approach to improving the physical and social environment in rural areas [7, 19, 23]. This study aims to analyse the risk factors of stunting in rural areas and provide insights into potential interventions to address the issue.

Stunting remains a major public health concern, particularly in rural communities of low- and middle-income countries, where chronic malnutrition, repeated infections, and poor environmental conditions frequently intersect. Evidence from Indonesia shows that nonexclusive breastfeeding, low socio-economic status, premature birth, short birth length, and low maternal height and education significantly increase the likelihood of stunted growth. Inadequate sanitation and untreated drinking water further amplify this risk. The literature consistently highlights that multi-sectoral collaboration, along with capacity-building and community

empowerment initiatives, offers an effective pathway to reduce stunting prevalence. Strengthening these integrated efforts can help improve both the physical and social environment of rural areas and support long-term child health and development.

II. METHOD

Data collection involved multiple approaches to obtain comprehensive information. Structured interviews were conducted using a validated questionnaire to capture demographic characteristics, feeding practices, health history, and household socio-economic conditions. In addition, direct observations were performed to assess environmental factors within the home, including sanitation facilities, water sources, hygiene practices, and the surrounding physical environment. This combination of interview and observational data allowed for more accurate identification of risk factors contributing to stunting.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS), where descriptive and inferential statistics were applied to explore associations between the assessed variables and stunting outcomes. To support the empirical findings, an extensive literature review was conducted using major academic databases such as PubMed, Scopus, and Google Scholar. The review covered publications from 2010 to 2024, with inclusion criteria limited to studies originating from the United Kingdom to maintain contextual relevance for the analytical framework. The article selection process involved rigorous screening of abstracts followed by full-text evaluation to ensure alignment with the research objectives, methodological rigor, and contribution to the understanding of child growth and nutritional determinants.

Through this systematic approach, the study integrated field data with high-quality scientific evidence, providing a strengthened foundation for analyzing risk factors and formulating relevant recommendations for stunting prevention.

III. RESULTS

Univariate Analysis

The results of the data analysis are presented in table 1:

Table 1. Distribution of Respondent Characteristics in Case and Control Groups

Respondent Characteristics	Stunting Case		Control	
	n	%	n	%
Age				
>35 months	38	54,3	5	7,1
20 – 35 month	32	45,7	65	92,9
Level of education				
Basic education	37	52,9	4	5,7
Higher education	33	47,1	66	94,3
Type of work				
IRT	44	62,9	40	57,1
Self-employed	11	15,7	10	14,3
Farmer	8	11,4	12	17,1
Private officer	7	10,0	8	10,7
Riwayat pemberian ASI Eksklusif				
Tidak ASI Eksklusif	69	98,6	8	11,4
ASI Eksklusif	1	1,4	62	88,6
History of Infectious Diseases				
Have an infection history	54	77,1	23	32,9
Do not have an infection history	16	22,9	47	67,1
Mother's Personal Hygiene				
Not clean	50	71,4	3	4,3
Clean	20	28,6	67	95,7
Water quality				
Do not meet the requirements	54	77,1	24	34,3
Meet the requirements	16	22,9	46	65,7
Home sanitary conditions				
Not clean	50	71,4	5	7,1
Clean	20	28,6	65	92,9

Table 1 shows that among the 70 respondents in the case group, the highest proportion had an age >35 years (54.3%), elementary education level (52.9%), were unemployed (housewives) (62.9%), did not practice exclusive breastfeeding (98.6%), had toddlers with a history of

infectious diseases (77.1%), mothers with poor personal hygiene (71.4%), inadequate clean water quality (71.1%), and unclean home sanitation conditions (71.4%).

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Table 2. Risk analysis of exclusive breastfeeding history, infectious disease history, maternal personal hygiene, clean water quality, and home sanitation conditions on stunting in toddlers in rural areas

Variable	Stunting				Total	OR (LL-UL)
	Case		Control			
	n	%	n	%		
History of Breastfeeding						
Not Exclusive Breastfeeding	69	98,6	8	11,4	77	534.750
Exclusive Breastfeeding	1	1,4	62	88,6	63	(65.029-4397.351)
History of the Infectious Diseases						
Have an infection history	54	77,1	23	32,9	77	6.897
Do not have an infection history	16	22,9	47	67,1	63	(3.263-14.576)
Mother's Personal Hygiene						
Not clean	50	71,4	3	4,3	53	55.833
Clean	20	28,6	67	95,7	87	(15.718-198.331)
Water Quality						
Do not meet the standards	54	77,1	24	34,3	78	6.469
Meet the standards	16	22,9	46	65,7	62	(3.071-13.624)
Home sanitary conditions						
Not clean	50	71,4	5	7,1	55	32.500
Clean	20	28,6	65	92,9	85	(11.407-92.599)

In the control group, the highest proportions were respondents aged 20–35 years (92.9%), with a high education level (94.3%), unemployed (housewives) (57.1%), practiced exclusive breastfeeding (88.6%), had toddlers with no history of infectious diseases (67.1%), mothers with good personal hygiene (95.7%), adequate clean water quality (65.7%), and clean home sanitation conditions (92.9%).

Bivariate Analysis

This study evaluates risk factors contributing to stunting among toddlers in rural areas. Analysis using the Odds Ratio (OR) showed that all variables examined were significantly associated with the occurrence of stunting. The analysis results are presented in Table 2 above.

Table 2 shows that lack of exclusive breastfeeding greatly increases the risk of stunting (OR = 534.75; 95% CI: 65.03–4397.35). A history of infectious diseases also raises the risk significantly (OR = 6.90; 95% CI: 3.26–14.58). Poor maternal hygiene (OR = 55.83; 95% CI: 15.72–198.33), inadequate clean water quality (OR = 6.47; 95% CI: 3.07–13.62), and poor household sanitation (OR = 32.50; 95% CI: 11.41–92.60) were all strongly associated with stunting. The above analytical results are discussed as follows:

IV. DISCUSSION

History of Exclusive Breastfeeding

Breastfeeding is a common method of providing breast milk as food supply for infants and young children [14]. The World Health Organisation recommends exclusive breastfeeding for the first 6 months of an infant's life and continued breastfeeding for 2 years [2]. The results of the study showed that toddlers who did not receive exclusive breastfeeding had a 534.750 times greater risk of experiencing stunting compared to those who received exclusive breastfeeding (OR = 534.750; 95% CI: 65.029–4397.351). The confidence interval, which does not include the value 1, indicates a statistically significant association. These results are consistent with the study conducted by [10]. The results showed that Children without exclusive breastfeeding had 4.57 times greater risk of stunting than those with exclusive breastfeeding (OR = 4.57; 95% CI: 1.57–13.27).

The main findings show that toddlers who do not receive exclusive breastfeeding have a 534,750 times greater risk of experiencing stunting (OR = 534,750; 95% CI: 65,029–4,397,351). A confidence interval value that does not include the number 1 indicates that this association is statistically significant. These results are in line with the study by Izzah et al. (2022), which also found that children without exclusive breastfeeding had a 4.57 times greater risk of stunting (OR = 4.57; 95% CI: 1.57–13.27).

Although the magnitude of the effect differs between the two studies (OR 534.750 vs. 4.57), both consistently show that not providing exclusive breastfeeding is a significant risk factor for stunting. The large difference in OR values is likely due to differences in sample characteristics, research methods, or other contextual factors. These findings reinforce the WHO recommendation to provide exclusive breastfeeding for the first 6 months of life as a preventive measure against

stunting, as well as the importance of continuing breastfeeding until the age of 2 years.

History of Infectious Diseases

Stunting is a chronic nutritional problem caused by a long period of malnutrition. Prolonged malnutrition can reduce the body's resistance, making it more susceptible to disease [15]. The results of the study showed that toddlers with a history of infectious diseases had a 6.897 times higher risk of experiencing stunting compared to those without such a history (OR = 6.897; 95% CI: 3.263–14.576). These findings indicate that infections, particularly recurrent ones such as diarrhoea and respiratory tract infections, affect nutrient absorption, disrupt metabolism, and exacerbate the child's nutritional status. The results of this study are in line with research [8], that the risk factors for stunting are the frequency of respiratory tract infections (OR=39.00), the frequency of diarrhoea (OR=2.37), and the frequency of coronary heart disease (OR=1.00). Repeated infections can cause growth disorders due to increased energy and protein requirements during the healing process [17].

The main findings show that toddlers with a history of infectious diseases have a 6.897 times higher risk of stunting (OR = 6.897; 95% CI: 3.263–14.576). A confidence interval value that does not include the number 1 indicates that this association is statistically significant. These results are consistent with the study by Ibrahim et al., which identified several risk factors for stunting related to infection, namely the frequency of respiratory tract infections (OR = 39.00), the frequency of diarrhoea (OR = 2.37), and the frequency of coronary heart disease (OR = 1.00).

The mechanism of the relationship between infection and stunting can be explained through several pathways: recurrent infections such as diarrhoea and respiratory tract infections, which interfere with nutrient absorption, damage the body's metabolism, and worsen children's nutritional status. In addition, recurrent infections cause growth disorders due to increased energy and protein requirements during the healing process. These findings emphasize the importance of preventing and treating infectious diseases as an integral part of stunting prevention efforts, including maintaining environmental hygiene, good sanitation, complete immunization, and prompt treatment of infectious diseases to prevent long-term effects on children's growth.

Mother's Personal Hygiene

Improved conditions of sanitation and hygiene practices are associated with reduced prevalence of stunting in rural India. Policies and programming aiming to address child stunting should encompass WASH interventions, thus shifting the emphasis from nutrition-specific to nutrition-sensitive programming [21]. The results of the study showed that mothers with poor personal hygiene habits had a 55.833 times greater risk of having stunted children compared to mothers who practised good hygiene (OR = 55.833; 95% CI: 15.718–198.331). These results are in line with research conducted by Pradana et al. [20], where personal hygiene is a risk factor for stunting (OR=3.867; 95% CI=0.732–20.423). Mother's personal hygiene, including hand washing habits and maintaining environmental cleanliness, is very important to prevent infections in children [16].

There is a highly significant relationship between maternal personal hygiene and stunting in toddlers. Toddlers whose mothers have poor personal hygiene are at a much higher risk of stunting than toddlers whose mothers have good personal hygiene.

The main finding shows that toddlers with mothers who have poor personal hygiene have a 24.167 times higher risk of experiencing stunting (OR = 24.167; 95% CI: 10.804–54.067). The very wide confidence interval value that does not include the number 1 indicates that this association is statistically significant. These results are in line with the study by Pradiana *et al.* [20] who found that personal hygiene is a risk factor for stunting (OR = 3.467; 95% CI: 0.732–20.423). Despite the large difference in OR values, both studies consistently show that poor personal hygiene increases the risk of stunting. The broader context shows that improvements in sanitation conditions and hygiene practices are associated with a decrease in the prevalence of stunting in rural and urban areas. WASH (Water, Sanitation, and Hygiene) programs that integrate nutrition-sensitive and nutrition-specific approaches have been proven effective in addressing stunting.

Maternal personal hygiene, including handwashing habits and maintaining a clean environment, is crucial for preventing infections in children. Poor hygiene practices can increase exposure to pathogens that cause infections in children. Personal hygiene for mothers, including hand washing habits and maintaining a clean environment, is very important for preventing infections in children. Poor hygiene practices can increase exposure to pathogens that cause recurrent infectious diseases, which ultimately interfere with children's nutrient absorption and growth.

These findings emphasize the importance of maternal personal hygiene education and intervention as key strategies in preventing stunting, particularly in the context of comprehensive WASH programs.

Clean Water Quality

The study found that environmental factors such as the availability of clean water, adequate sanitation facilities, the height of the place, and the status of residence (rural vs. urban) significantly affected the prevalence of stunting in children in rural areas. The results of the study showed that clean water quality that did not meet the requirements increased the risk of stunting up to 6.469 times compared to water quality that met the requirements (OR=6.469; 95% CI: 3.071–13.624). Poor access to clean water and sanitation has been shown to significantly increase the risk of stunting, with Odds Ratios (OR) of 1.46 and 0.80 respectively [9, 13]. That limited access to clean water and adequate sanitation facilities are environmental factors that greatly affect the prevalence of stunting in rural areas. Children living in areas with limited access to clean water have a higher risk of stunting (OR = 1.46), while improved sanitation facilities have a significant impact (OR = 0.80) [4, 5].

Poor-quality clean water increases the risk of stunting by 6.469 times compared to good-quality water (OR = 6.469; 95% CI: 3.071–13.624). A confidence interval value that does not include the number 1 indicates strong statistical significance. These results are supported by several previous

studies showing that poor access to clean water and sanitation significantly increases the risk of stunting. Children living in areas with limited access to clean water have a higher risk of stunting (OR = 1.46), while improvements in sanitation facilities have a significant impact with an OR = 0.80, indicating a protective effect.

Limited access to clean water and inadequate sanitation create an environment conducive to the spread of infectious diseases, especially diarrhoea and gastrointestinal infections. These conditions interfere with children's nutrient absorption and metabolism, which ultimately affects their growth and development. These findings emphasize the importance of infrastructure-based environmental interventions as a stunting prevention strategy, especially in rural areas. Providing access to adequate clean water and sanitation facilities should be a priority in stunting prevention programs, in line with an integrated WASH approach that includes specific and sensitive nutritional interventions.

Home Sanitation Conditions

The strategy to reduce stunting is currently prioritized on improving socio-economic levels, fulfilling food intake, and sanitation conditions [18]. The results of the study showed that unclean home sanitation conditions increased the risk of stunting by up to 32,500 times compared to homes with clean sanitation (OR=32,500; 95% CI: 11,407–92,599). Poor water quality and sanitation, poor water quality and inadequate access to sanitation facilities increase the risk of intestinal infections that can hinder nutrient absorption. Recurrent infections due to poor sanitation conditions contribute significantly to stunted growth in children in rural areas [12].

LIMITATION OF THE STUDY

This study employed a case-control design, which has several limitations. First, there is a potential for selection bias, as the cases and controls may not fully represent the target population. Second, data collected through retrospective interviews are susceptible to recall bias, particularly regarding information on risk factors such as exclusive breastfeeding history and child health. Third, although case-control studies can identify associations between risk factors and stunting, they do not allow for definitive conclusions about causality. Furthermore, the limited geographic scope of the study, which was conducted only in a few rural villages, restricts the generalizability of the findings to the broader rural population.

Selection Bias: There is potential bias in the selection of cases and controls that may not fully represent the target population. This can affect the external validity of the study and limit the ability to generalize the findings to a broader population.

Recall Bias: Data collected through retrospective interviews is susceptible to memory bias, especially regarding risk factor information such as history of exclusive breastfeeding and child health. Respondents may not accurately recall past events or practices, which can affect data accuracy.

Limitations of Causality: Although the case-control design can identify associations between risk factors and stunting, it does not allow for definitive conclusions about cause-and-effect relationships. The associations found do not necessarily indicate that these risk factors directly cause stunting.

Limitations of Generalizability: The limited geographic scope of the study, which was conducted in only a few rural villages, limits the generalizability of the findings to the broader rural population. Local conditions, characteristics, and contexts may differ in other areas.

V. CONCLUSIONS AND SUGGESTIONS

This study demonstrates that several key factors significantly contribute to the incidence of stunting in children, particularly in rural areas. Lack of exclusive breastfeeding, history of infectious diseases, poor maternal personal hygiene, inadequate clean water quality, and unsanitary home conditions were all found to have a strong and statistically significant association with stunting. Among these, the absence of exclusive breastfeeding and poor hygiene practices showed the highest risk levels. These findings emphasize the multifactorial nature of stunting, involving both nutritional and environmental determinants. The consistent results with previous studies reinforce the need for integrated and context-specific interventions to reduce stunting prevalence. For future research are encouraged to explore stunting using a longitudinal or cohort study design to better understand the causal relationships between risk factors and stunting outcomes over time. Additionally, future research should include a larger and more diverse sample across urban and rural settings to improve the generalizability of the findings. It is also recommended to incorporate qualitative approaches to gain deeper insights into maternal behavior, cultural practices, and barriers to implementing proper hygiene, nutrition, and sanitation. Furthermore, investigating the role of paternal involvement and broader socio-economic determinants may provide a more holistic understanding of the factors contributing to child stunting.

This study shows that several key factors significantly contribute to the incidence of stunting in children, especially in rural areas. Factors that have a strong and statistically significant association with stunting include: Not receiving exclusive breastfeeding, showing the highest risk (OR = 534.750), Poor personal hygiene of mothers, very high risk (OR = 24.167), history of infectious diseases, increasing the risk by 6.897 times, inadequate clean water quality – increasing the risk by 6.469 times, inadequate household sanitation conditions. Among these factors, not receiving exclusive breastfeeding and poor hygiene practices show the highest risk levels. These findings emphasize that stunting is multifactorial, involving interrelated nutritional and environmental determinants.

SUGGESTIONS

Based on the research findings demonstrating that stunting is a multifactorial problem involving nutritional, health, hygiene, and environmental factors, the following comprehensive recommendations can be implemented by various stakeholders:

1. Recommendations for Government and Policymakers

Development of Integrated Programs: The government needs to develop and strengthen integrated stunting prevention programs that combine nutrition-specific and nutrition-

sensitive interventions. These programs must include promotion of exclusive breastfeeding, improvement of sanitation and access to clean water, as well as maternal and child health education. The WASH (Water, Sanitation, and Hygiene) approach integrated with nutrition programs should be a top priority, especially in rural areas that show higher stunting prevalence.

Adequate Budget Allocation: Given the significant risks posed by poor clean water quality (OR = 6.469) and poor personal hygiene (OR = 24.167), the government needs to allocate substantial budgets for the development of clean water and sanitation infrastructure in rural areas. This investment must include the construction of clean water facilities that meet health standards, adequate sanitation facilities, and proper waste management systems.

Strengthening Regulations and Standards: The government needs to establish and enforce strict regulations regarding clean water quality standards, environmental sanitation, and hygiene in health facilities and communities. Regular monitoring and evaluation of the implementation of these standards is crucial to ensure program effectiveness.

Program Decentralization with Local Approaches: Develop stunting prevention programs tailored to the local context of each area, considering geographical, socio-cultural, and economic characteristics. Top-down programs need to be balanced with bottom-up approaches that involve active community participation.

Strong Surveillance and Monitoring Systems: Build a comprehensive and real-time stunting surveillance system to monitor stunting prevalence, identify priority areas, and evaluate intervention effectiveness. This data must be accessible to various stakeholders to support evidence-based decision-making.

2. Recommendations for the Health Sector

Strengthening Exclusive Breastfeeding Programs: Given the extremely high risk of stunting in children who do not receive exclusive breastfeeding (OR = 534.750), the health sector must prioritize programs for promotion, education, and support of exclusive breastfeeding. This includes intensive training for health workers (midwives, nurses, doctors) on lactation management and breastfeeding counseling, establishment of lactation clinics in every primary health center and hospital, comprehensive prenatal and postnatal education programs about the importance of exclusive breastfeeding, support from trained peer counselors at the community level, implementation of the ten steps to successful breastfeeding in all health facilities, and massive mass media campaigns about the benefits of exclusive breastfeeding.

Prevention and Management of Infectious Diseases Programs: Considering that a history of infectious diseases increases the risk of stunting by 6.897 times, the health sector needs to strengthen complete immunization programs to prevent infectious diseases, improve early detection and rapid treatment of recurrent infectious diseases such as diarrhea and acute respiratory infections, provide easy and affordable access to basic health services, develop education programs for parents about danger signs of diseases and when to seek

medical help, and implement infection control programs at the community level through health cadres.

Comprehensive Maternal and Child Health Services: Integrate maternal and child health services with stunting prevention programs, including quality antenatal care (ANC) with a focus on maternal nutrition, routine and systematic monitoring of child growth through integrated health posts (posyandu), provision of supplementary feeding for pregnant women and toddlers from poor families, individual nutritional counseling for mothers with children at risk of stunting, and micronutrient supplementation (vitamin A, iron, zinc) as needed.

Capacity Building for Health Workers: Conduct continuous training for health workers on identification and management of stunting, nutrition and proper parenting counseling, hygiene and sanitation education, holistic approaches in stunting management, and effective communication with communities.

3. Recommendations for WASH Programs (Water, Sanitation, and Hygiene)

Clean Water Infrastructure Development: Given that water quality that does not meet requirements increases the risk of stunting by 6.469 times, the top priority is building clean water supply systems that meet health standards in every village, installing boreholes or piping systems in areas that do not yet have access to clean water, simple household-level water treatment through filtration or chlorination, regular water quality maintenance and monitoring programs, and community education about the importance of using clean water for daily needs.

Improvement of Sanitation Facilities: Build and improve adequate sanitation facilities through healthy latrine construction programs in every household (stop open defecation program), provision of handwashing facilities with soap at critical locations (schools, health posts, public facilities), good waste management systems at household and community levels, and community-led total sanitation (CLTS) programs involving active citizen participation.

Personal Hygiene Education: Considering that poor maternal personal hygiene increases the risk of stunting by 24.167 times, intensive education programs are greatly needed. This includes handwashing with soap campaigns at critical moments such as before preparing food, before eating, after defecation, after cleaning a child who has defecated, and before breastfeeding. It also encompasses hygiene practice training for mothers at health posts and religious gatherings, demonstrations of proper handwashing techniques and home environment cleaning, education on hygienic food processing and storage, and home visit programs by health cadres for direct monitoring and education.

Behavior Change Approaches: Develop effective behavior change strategies through Community-led Total Sanitation (CLTS) to trigger collective awareness, nudging and positive deviance approaches to identify and replicate best practices, use of local media (community radio, mosque loudspeakers) for information dissemination, and formation of behavior change groups at the neighborhood level.

4. Recommendations for Communities and Families

Optimal Parenting Practices: Families, especially mothers, need to provide exclusive breastfeeding for the first 6 months and continue breastfeeding until age 2 years accompanied by nutritious complementary foods, implement good personal hygiene practices especially handwashing habits with soap at critical times, ensure children receive balanced nutritious food with appropriate frequency and portions according to age, bring children for routine health checks and immunizations, and immediately bring children to health facilities when experiencing infectious diseases.

Improvement of Home Conditions: Families need to improve home environmental conditions by using clean water for daily needs especially for cooking and drinking, having and using healthy latrines, maintaining cleanliness of the home and yard environment, managing waste properly, and ensuring adequate home ventilation and lighting.

Participation in Community Programs: Communities are encouraged to actively attend health posts for child growth monitoring, join breastfeeding support groups or mothers' groups, participate in community service activities for environmental sanitation improvement, and remind and support each other in implementing good health practices.

5. Recommendations for the Education Sector

Integration of Health Education in Curriculum: Incorporate materials on nutrition, hygiene, sanitation, and stunting prevention into the education curriculum from primary to secondary levels. This will build early awareness about the importance of health and nutrition.

Healthy School Programs: Develop healthy school programs that include provision of handwashing facilities and clean toilets, nutritious school lunch programs, periodic student growth monitoring, and reproductive health education for adolescents in preparation for becoming healthy parents.

Parent Education: Organize parenting education programs through schools, inviting parents to discuss topics such as parenting patterns, child nutrition, and disease prevention.

6. Recommendations for Further Research

Longitudinal Studies: Conduct long-term prospective cohort research to understand the causal relationships between various risk factors and stunting incidence. This study should follow children from the mother's pregnancy period until age 5 years to identify critical periods and the most influential factors at each stage of development.

Multi-Site Research: Develop research with broader geographical coverage, involving various urban and rural areas with diverse characteristics. This will increase the generalizability of findings and enable comparative analysis across regions.

Mixed-Methods Approach: Integrate quantitative and qualitative methods to gain a deeper understanding of socio-cultural factors affecting feeding practices and child care, barriers and challenges in implementing hygiene and sanitation practices, community perceptions about stunting and its prevention efforts, and decision-making dynamics within families regarding child health.

Intervention Research: Conduct randomized controlled trials to evaluate the effectiveness of various stunting prevention intervention models, including integrated nutrition and

WASH program models, the effectiveness of various behavior change strategies, the cost-effectiveness of various intervention approaches, and the role of digital technology in monitoring and education.

Studies on Social Determinants: Explore the role of broader socio-economic factors, such as paternal involvement in childcare and its impact on stunting, the role of maternal education and employment status on childcare practices, the influence of poverty, access to health services, and social support, and the impact of social protection programs on stunting prevalence.

Community-Based Research: Develop participatory action research involving communities in identifying problems, designing solutions, and evaluating interventions. This approach will produce solutions more suited to local contexts and increase community ownership.

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