



The Role of Environmental Factors in Stunting in Rural Areas

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ABSTRACT

Stunting is a serious problem reflecting chronic malnutrition in children, with a high prevalence, especially in rural areas of low- and middle-income countries. This study examines the relationship between environmental factors and stunting incidence, identifying that limited food availability, poor water quality, and inadequate sanitation contribute significantly to stunted growth. Poor infrastructure and limited access to health services exacerbate the situation, affecting children's ability to absorb essential nutrients. In addition, socioeconomic conditions and parental education, especially maternal education, strongly influence children's nutrition and health practices. Findings suggest that children from families with low economic status and low maternal education are at higher risk of stunting. Therefore, interventions aimed at improving access to nutritious food, sanitation, and health education are critical in reducing the prevalence of stunting in vulnerable communities. This study suggests the need for an integrated multisectoral approach to address this issue effectively and recommends further research on other factors, such as the impact of culture and environment in the context of stunting.

Keywords: Stunting, nutrition, sanitation, education, poverty

ABSTRAK

Stunting adalah masalah serius yang mencerminkan malnutrisi kronis pada anak-anak, dengan prevalensi yang tinggi terutama di daerah pedesaan negara berpenghasilan rendah dan menengah. Penelitian ini mengkaji hubungan antara faktor lingkungan dan kejadian stunting, mengidentifikasi bahwa ketersediaan makanan yang terbatas, kualitas air yang buruk, dan sanitasi yang tidak memadai berkontribusi signifikan terhadap pertumbuhan terhambat. Infrastruktur yang buruk dan akses terbatas ke layanan kesehatan memperburuk situasi, mempengaruhi kemampuan anak untuk menyerap nutrisi penting. Selain itu, kondisi sosial ekonomi dan pendidikan orang tua, terutama pendidikan ibu, sangat mempengaruhi praktik gizi dan kesehatan anak. Temuan menunjukkan bahwa anak-anak dari keluarga dengan status ekonomi rendah dan pendidikan ibu yang rendah memiliki risiko stunting yang lebih tinggi. Oleh karena itu, intervensi yang bertujuan untuk meningkatkan akses terhadap makanan bergizi, sanitasi, dan pendidikan kesehatan sangat penting dalam mengurangi prevalensi stunting di komunitas rentan. Penelitian ini menyarankan perlunya pendekatan multisektoral yang terintegrasi untuk menangani masalah ini secara efektif dan merekomendasikan penelitian lebih lanjut tentang faktor lain seperti dampak budaya dan lingkungan dalam konteks stunting.

Kata kunci: Stunting, gizi, sanitasi, pendidikan, kemiskinan

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 (Ainy et al., 2021; Kalinda et al., 2023; Rahut et al., 2024)

Studies have shown that stunting results from complex interactions between various environmental factors. Factors such as limited food availability, poor water quality, lack of access to sanitation facilities, inadequate housing conditions, low parental education, and poor economic status contribute to stunting in children (Jaacks et al., 2019; Kartini et al., 2019). In rural areas, these factors are often exacerbated by limited infrastructure and resources, which make residents more vulnerable to environmental conditions that affect children's health and growth. The existence of access to (Koyraty et al., 2022). Clean water and adequate sanitation indirectly positively impact children's health in rural areas by reducing the risk of diarrheal diseases that can interfere with the absorption of nutrients necessary for children's growth and development. Increased access to sanitation facilities, such as clean toilets, is essential to prevent the spread of pathogens and support children's gastrointestinal health (Lanita et al., 2023; Tetania et al., 2023). In addition, exposure to

environmental pollution, such as pesticides and heavy metals, also has negative effects that can damage children's growth. Exposure to these harmful substances can interfere with body function and metabolism, thus potentially causing malnutrition and developmental disorders (Haq et al., 2021; Takele et al., 2019). It is important to reduce this exposure through stricter regulations regarding the use of chemicals and by encouraging sustainable agricultural practices in rural areas (Shofiyah & Komarayanti, 2020).

By improving sanitation infrastructure and reducing environmental pollution, positive results in reducing stunting rates in the community can be achieved (Shofiyah & Komarayanti, 2020). Poor water quality and inadequate sanitation also play an important role in causing recurrent intestinal infections, which inhibit the absorption of essential nutrients (Irawan & Hastuty, 2022). This situation is exacerbated by high poverty rates and a lack of access to affordable food markets (Diana et al., 2021; Koyratty et al., 2022; Petri et al., 2014).

Multi-sectoral collaboration in improving environmental health can produce a mutually beneficial positive impact to reduce stunting rates in vulnerable populations (Yakin et al., 2023). 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 (Hovhannisyan et al., 2014; Petri et al., 2014; Selviana & Suwarni, 2023). This study aims to review the role of environmental factors in stunting in rural areas and provide insight into possible interventions to address this problem (Diana et al., 2021; Petri et al., 2014).

METHOD

This study uses a systematic literature review method to identify and assess relevant studies on environmental factors contributing to stunting in rural areas. The selected articles are focused on the main search terms i.e. "stunting" OR "stunted growth" OR "growth delay" OR "developmental retardation" OR "growth stagnation" OR "physical growth" in combination with keywords related to environmental factors i.e. "food availability" OR "water quality" OR "poor sanitation" OR "living conditions" OR "parental education" OR "low economic status" OR "limited access to healthcare services" OR "unhealthy eating patterns" OR "environmental stress", OR "maternal nutrition during pregnancy".

The databases used include PubMed, Scopus, and Google Scholar, with a time limit from 2010 to 2024. Only United Kingdom articles are considered for this review. The article selection process involves screening the abstract and the full-text content based on relevance, methodological quality, and contribution to the purpose of the study.

RESULTS AND DISCUSSION

The availability of food and unhealthy diets are environmental conditions related to access to food sources so they are often the cause of lack of nutritional intake in children, which ultimately contributes to the incidence of stunting (Hovhannisyan et al., 2014). Studies show that an unbalanced diet and dependence on an environment that provides staple foods without adequate protein and micronutrient intake increases the risk of stunting events (Nadila, 2022). Socioeconomic factors and parental education greatly affect children's eating practices and health, especially maternal education. Low economic status, makes access to nutritious food and health services difficult, further worsening children's health due to the increase in the prevalence of stunting (Diana et al., 2021; Petri et al., 2014). Other research also shows that children from wealthy families or mothers who have formal education do better to reduce the incidence of stunting. The low level of maternal education has a direct relationship with the increase in the prevalence of stunting, with a prevalence of 47.43%. In

addition, economic status also has a significant effect on the incidence of stunting; children from the richest families have a lower risk of stunting than children from the poorest families (OR = 0.81 for educated mothers and 0.73 for educated fathers) (Sari, 2021).

Some of the proximal factors found and significant are birth weight, age, parasitic infection, and exclusive breastfeeding duration. Children with low birth weight and who do not receive exclusive breastfeeding for the first six months are more at risk of stunting. Including factors such as maternal nutritional status and maternal health status during pregnancy also play a very important role (Dahlansyah et al., 2023; Ekholuenetale et al., 2022)

Socio-demographic factors such as household wealth index, parental education level, and media factors such as access to information through radio, television, and newspapers also contribute to the risk of stunting events. Better access to information through the media was found to help reduce the prevalence of stunting (Kalinda et al., 2023; Mushtaq et al., 2011; Uwiringiyimana et al., 2019).

Limited access to clean water and adequate sanitation facilities greatly contribute to the increased risk of stunting in rural areas. Poor sanitary conditions increase the risk of intestinal infections that reduce the absorption of essential nutrients, directly affecting the child's growth. Therefore, interventions to improve access to clean water and sanitation in rural areas are important in reducing stunting (Gizaw et al., 2022; McKenna et al., 2017).

The family's economic status and the mother's education level are the main determinants of stunting in rural areas. Families with limited economic resources have less access to nutritious food, and mothers who do not have formal education tend to be less aware of proper nutrition practices for their children (Deepthi et al., 2016; Modjadji et al., 2022; Sunardi & Martha, 2021; Uwiringiyimana et al., 2019). Therefore, economic empowerment and education for women can be an effective step to reduce stunting. Community factors such as the active participation of public health workers in child growth and development monitoring activities also play an important role in stunting prevention. Community-based intervention programs such as kitchen gardens, bio-fortification enrichment, and awareness campaigns on the importance of the first 1000 days of life should be strengthened to address the problem of stunting in rural areas (Retroningrum et al., 2024). Maternal education and family economic status significantly affect the risk of stunting in children in rural areas. Mothers who do not have formal education or have low household incomes are more likely to have stunted children (OR = 0.81 for maternal education and OR = 0.73 for father's education). Factors such as father's and mother's occupation were not statistically significant to the incidence of stunting. Children with low birth weight, older age, and children who have experienced parasitic infections in the past six months are more at risk of stunting (OR = 1.94 for birth weight, OR = 1.47 for child age, OR = 1.64 for parasitic infections) (Fitriani et al., 2020).

The media plays an important role in educating the public about proper nutrition practices and the importance of maternal and child health. Wider access to information through radio, television, and print media has been shown to reduce the risk of stunting events by increasing parents' awareness of the importance of nutrition and their children's health (Mbuma et al., 2021).

A mother's education and economic status are important factors in determining the risk of stunting in children. Programs to improve women's education and improve household economic statuses, such as skills training and economic empowerment, will have a positive impact on reducing the prevalence of stunting, the involvement of public health workers in monitoring child growth and development and counselling on the importance of nutrition in the first 1000 days of life is essential to overcome stunting. (Has et al., 2024; Saleh et al., 2021)

Several studies have shown that maternal nutrition during the first 1000 days of a child's life, including pregnancy and breastfeeding, significantly influences the incidence of stunting (Bachnas et al., 2022; Fitriani et al., 2020). Protein and vitamin deficiencies during pregnancy are closely related to low birth weight and the risk of stunting in children. Consumption of supplements such as iron,

folic acid, vitamin A, vitamin C, calcium, and zinc during pregnancy has also been shown to improve birth outcomes (Fitriani et al., 2020). The study found a strong link between maternal education and the risk of stunting in children. Mothers with higher education tend to have better nutritional knowledge and practice more protective parenting practices, such as ensuring their children receive vitamin A capsules, complete immunizations, and access to better sanitation. Family wealth status has a significant influence on the prevalence of stunting. Children from poor households are more at risk of stunting due to limited access to nutritious food and adequate health services. A decrease in the prevalence of stunting was found in families with a higher wealth index, which suggests that improved economic status can reduce the risk of stunting (Kennedy et al., 2006).

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 (Koyratty et al., 2022).

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. 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 (Irianti et al., 2019; Kwami et al., 2019).

The article shows 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) (Dearden et al., 2024; Harris et al., 2017). Lack of access to clean water and adequate sanitation facilities increases the risk of infections, such as diarrhoea, which can affect the absorption of important nutrients in children. Therefore, investment in clean water and sanitation infrastructure is an important intervention to reduce stunting, especially in rural areas with inadequate basic infrastructure (Nguyen et al., 2024).

The Government of Rwanda has implemented various interventions to reduce the prevalence of stunting, including improving sanitation infrastructure, promoting education for women, and introducing community-based initiatives such as kitchen gardens and biofortification (Deimi et al., 2009). However, the prevalence of stunting remains high, especially in rural areas with high levels of food insecurity and limited access to clean water and sanitation (Kalinda et al., 2023; Utumatwishima et al., 2024).

Community-based programs involving families and community leaders can strengthen stunting prevention efforts by raising awareness about proper feeding practices and the importance of clean water and sanitation (Batoool et al., 2023; Irianti et al., 2019; Kwami et al., 2019; Torlesse et al., 2016; Woldesenbet et al., 2023). Access to information through media such as radio, television, and newspapers can play an important role in educating the public about good nutrition practices. Nutrition education delivered through the media can reduce the risk of stunting by increasing parents' knowledge about the importance of maternal and child health (Dini et al., 2022; Primandita et al., 2022; Yuniarti et al., 2024).

The study results showed that the family's economic status, as measured by the wealth index, greatly affected the prevalence of stunting. Children from families with low economic status have a higher risk of stunting. In addition, maternal education is also an important factor in preventing stunting. Children born to mothers with higher levels of education tend to have better nutritional status than mothers with lower education (Muamar et al., 2024).

Children living in rural areas have a higher risk of stunting than children living in urban areas. This gap is related to limited access to health services, including poor basic infrastructure such as clean water and inadequate sanitation in rural areas. Limited access to safe WASH infrastructure is strongly

linked to stunting incidents among young people in rural areas. Children are more prone to diarrhoea, intestinal worm infections, and environmental enteropathy when households have poor WASH facilities, which can lead to nutritional problems due to loss of appetite and poor absorption of nutrients (Chenoweth et al., 2007; Nguyen et al., 2024; Vila-Guilera et al., 2021).

Consumption of diverse foods in pregnant women significantly reduces the prevalence of stunting. Food diversification, including five or more food groups, is closely related to weight gain to height and weight on children's age scores, reducing the number of children who experience wasting (Rosmalina & Luciasari, 2017). Nutrition education provided during antenatal care significantly reduces stunting in children under 24 months. This education includes awareness of the first 1000 days of life and properly preparing complementary foods (Hossain & Khan, 2018).

Children living in areas with an altitude of more than 2000 meters have a higher risk of stunting than those living in lowlands (Nurjazuli et al., 2023; Retroningrum et al., 2024). In addition, children living in rural areas are more likely to be stunted than those living in urban areas. The distribution of stunting prevalence varies by region. In Rwanda, the prevalence of stunting is higher in the Western and Northern Provinces, which have large agricultural areas but also high population density and limited access to adequate health services. On the other hand, Kigali City has a lower prevalence of stunting than other areas (Baraka et al., 2022). Social factors such as parental employment, education level, and access to health services and education also affect the risk of stunting. Children from families with limited access to health services and education tend to have a higher risk of stunting. Research also shows that the high workload for parents, especially mothers in rural areas, negatively impacts the nutritional status of their children (Victora et al., 1986).

Access to better sanitation facilities and clean water needs to be improved to reduce stunting rates. In Rwanda, access to clean water is expected to increase from 87.4% to 100% and access to sanitation from 86.2% to 100% by 2024, which is expected to help significantly reduce stunting rates (Dearden et al., 2024). Adequate health and sanitation facilities have been proven to reduce the prevalence of stunting significantly. Research shows that access to clean water and proper sanitation facilities is strongly correlated with decreased stunting rates. Access to clean water and better toilets has significantly reduced stunting in Rwanda. Studies show that environmental factors such as the height of the dwelling significantly affect the prevalence of stunting (Seramo et al., 2022).

Multisectoral interventions involving various sectors such as health, education, and sanitation are needed to address the stunting problem effectively. The Rwandan government has implemented various interventions such as increased access to health facilities, promotion of nutrition education, and sanitation programs to reduce the prevalence of stunting (Kroupina et al., 2015; Ndagijimana et al., 2022; Suryawan et al., 2022). Public awareness of good nutrition and correct health practices is very important in stunting prevention efforts. Education through public campaigns and public health programs has effectively increased public knowledge and behaviour related to child nutrition and health. Stunting has a significant long-term impact on economic and social development (Hoque et al., 2024). Stunted children tend to have lower cognitive abilities, decreased productivity, and higher health risks in adulthood. Therefore, overcoming stunting is important from a health perspective and sustainable economic development (Kroupina et al., 2015; Suryawan et al., 2022).

LIMITATION OF THE STUDY

Research on the role of environmental factors in stunting in rural areas faces several limitations. First, reliance on published literature can lead to publication bias, as studies with significant findings are more likely to be published. Second, the geographic focus on rural areas may not fully represent urban dynamics, potentially ignoring major differences in environmental factors that affect stunting. Third, while systematic reviews provide comprehensive insights, they are limited by the quality and consistency of the included studies, which can affect the robustness of the conclusions. Fourth, the

temporal scope, which includes studies from 2010 to 2024, may not consider recent environmental interventions or policy changes. Finally, variations in data reporting and methodologies across studies can affect the comparison of findings, making it difficult to draw generalized conclusions for all rural settings. Future research should address these limitations by combining diverse settings and more rigorous methodologies.

CONCLUSIONS AND SUGGESTIONS

Stunting is a complex problem influenced by multiple factors, including access to nutritious food, socioeconomic conditions, parental education, sanitation, and availability of clean water. Research shows that family economic status and maternal education level play a significant role in increasing the risk of stunting in children, especially in rural areas. Despite efforts by governments and civil society organizations to address this issue, stunting remains a significant challenge, especially in under-resourced communities. Interventions that focus on improving access to health services, nutrition education, sanitation and clean water infrastructure are essential to reducing the prevalence of stunting.

For further research, it is recommended to explore other factors that may contribute to stunting, such as cultural influences, specific dietary patterns in rural areas, and environmental impacts such as pollution and climate change. A multisectoral approach that integrates aspects of health, education, nutrition, and the environment needs to be implemented. In addition, longitudinal studies can provide deeper insights into child development and the long-term impact of interventions. Identifying new innovations in community-based interventions and evaluating the role of the media in increasing awareness of health and nutrition will also be very useful in addressing the prevalence of stunting among children, especially in vulnerable rural areas.

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