Nutritional Intervention Model (Probiotics and Prebiotics) to Address Stunting Problems in Toddlers

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ARTICLE INFO

Article History

Received: September 25th , 2025

Revised: January 20th , 2026

Accepted: February 2nd , 2026

Keywords: probiotics, prebiotics, stunting

ABSTRACT

Stunting is a chronic nutritional problem that impairs child growth. Its main causes include inadequate dietary intake and recurrent gastrointestinal infections. Probiotic and prebiotic–based interventions are believed to improve gut function and enhance nutrient absorption. This study applied a pre–post test design involving 15 stunted toddlers. The intervention consisted of locally sourced foods containing probiotics and prebiotics, administered for 14 days. Data collection included body weight, height, and Z-scores, measured before and after the intervention. Data were analyzed using the Wilcoxon Signed Rank Test. The mean body weight increased by 0.25 kg (p=0.001), while height increased by 0.64 cm (p=0.001). The weight-for-age Z-score improved by 0.27, and the height-for-age Z-score improved by 0.23. All participants demonstrated positive changes, with no decrease observed. Locally sourced foods containing probiotics and prebiotics were proven effective in improving body weight and height among stunted toddlers. This approach offers a simple, affordable, and practical nutritional strategy for the prevention and management of stunting at the community level.

INTRODUCTION

Stunting continues to be a major public health concern in Indonesia. Data from the Indonesian Nutritional Status Survey (SSGI) indicate that the national prevalence of stunting remains above the threshold recommended by the World Health Organization, which is less than 20% (Soekatri, Sandjaja and Syauqy, 2020). On a global scale, an estimated 13.6 million children younger than five years are affected by severe acute malnutrition (SAM), which represents the most critical category of nutritional deficiency (Kementrian Kesehatan RI, 2021). Nutritional disorders contribute to nearly 60% of mortality among children under five, with approximately two-thirds of these deaths occurring within the first year of life (De Onis *et al.*, 2019). Stunting not only impacts a child's physical growth

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p-ISSN: 2354-9653| e-ISSN: 2597-6524

but also affects cognitive development and future productivity, and increases the risk of non-communicable diseases in adulthood (Beal *et al.*, 2018). One of the main factors causing stunting is an imbalance in nutritional intake, especially during the first 1,000 days of life (Kebede *et al.*, 2022). Inadequate intake of essential proteins, vitamins, and minerals can stunt a child's growth. In addition, environmental factors such as parenting patterns, poor sanitation, and repeated infections also contribute to increasing the risk of stunting (Ahmed *et al.*, 2023).

Nutritional inadequacy during early gastrointestinal development may interfere with intestinal maturation and contribute to the onset of Environmental Enteric Dysfunction (EED) in infants and young children (Kebede *et al.*, 2022). The development of microorganisms in the digestive tract occurs gradually, starting at birth, and is influenced by the environment and food intake from birth through adulthood. The digestive tract contains a variety of pathogenic and non-pathogenic microorganisms that play a role in the development of the immune system. Many studies link disruptions in the formation and maturation of the gut microbiota with malnutrition in children. In a 2021 study by Amalia on Ready-to-Use Therapeutic Food (RUTF) as an effort to improve the weight of toddlers aged 1-3 years, as a method to increase children's weight, results showed significant changes in weight in the treatment group. The average weight of toddlers before and after RUTF administration was 11.080 and 11.985, with a P-value of 0.000, indicating that this method is effective in increasing the weight of children aged 1-3 years (Amalia and Satiti, 2021). This is because disruption of the gut microbiota in early life contributes to deficits in growth and development.

Probiotic and prebiotic based nutritional interventions are an innovative strategy in addressing stunting. Probiotics are defined as live microorganisms that confer health benefits when consumed in adequate amounts, while prebiotics are indigestible dietary fibers that selectively stimulate the growth of beneficial intestinal bacteria (Seran, Lisnahan and Purwantiningsih, 2019). Probiotics contribute to gut health maintenance and are known to reduce the incidence of various gastrointestinal disorders, including childhood diarrhea

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p-ISSN: 2354-9653| e-ISSN: 2597-6524

and antibiotic-associated diarrhea (Arif, Mardhiyah and Mediani, 2023). Probiotics also produce antimicrobial substances such as organic acids (lactic and acetic), bacteriocins, reuterin, H2O2, and digestive enzymes. The effects of probiotics on the non-specific immune system include increased mucin production, natural killer (NK) cell activity, macrophage activation, and phagocytosis. Probiotics also influence specific immunity by increasing the production of cytokines, such as IL-2, IL-6, TNF-α, and sIgA levels.

Prebiotics can also prevent the overexpression of several genes related to adiposity and inflammation. The synergistic use of probiotics together with prebiotics, commonly referred to as synbiotics, is considered capable of promoting a healthier intestinal microbial balance, enhancing the efficiency of nutrient uptake, and supporting immune function in children (Sungkawa *et al.*, 2024). Probiotics and prebiotics are actually found in many foods in our environment, such as bananas, yogurt, and other fruits and vegetables. Gourd, other fruits, and vegetables.

Several studies have shown that administering probiotics and prebiotics can increase the height and weight of children with stunting. Research on probiotics and prebiotics suggests that adding a 2 ml probiotic dose per liter of drinking water tends to provide better performance in terms of daily weight gain and final weight. Another study by Septiani and Sari (2023), the findings indicated that intake of prebiotics and synbiotics led to notable modifications in gut microbial composition, characterized by an increase in beneficial bacteria such as *Prevotella 9*, *Lactobacillus plantarum*, and *Bifidobacterium*, along with a reduction in *Enterobacteriaceae* populations. Current evidence suggests that probiotic supplementation is generally safe; however, careful consideration is advised when administered to children with compromised immune systems. In parallel, prebiotics which promote the growth and activity of beneficial intestinal microorganisms are increasingly recognized for their role in supporting digestive health. Lailiyah and Sandera (2024), conducted nutrition education on probiotic containing foods, such as pumpkin, as an alternative to addressing stunting. However, related studies are still limited, especially in the context of

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implementation in Indonesia. Therefore, this study aims to develop a probiotic- and prebiotic-based nutritional intervention model as a strategy to address stunting in toddlers. A preliminary study on the incidence of stunting at the ILP Anggrek Putih Integrated Health Service Post (Posyandu) in Tawangsari Village, Pujon, found that 15 toddlers aged 12-24 months had a Z-score lower than -2 SD, indicating short stature for their age, or stunting. This prompted researchers to innovate by utilizing food processing methods containing probiotics and prebiotics to address this issue.

RESEARCH METHODS

The research method used was a quasi-experimental one-group pre-post test design. The purpose of this design was to evaluate the effectiveness of probiotic and prebiotic based nutritional interventions in reducing the prevalence of stunting in toddlers. The research procedure consisted of an initial assessment (pre-test) to measure baseline nutritional status, followed by the administration of probiotic and prebiotic-based nutritional interventions for a period of eight weeks, and a final assessment (post-test) to evaluate changes in anthropometric indicators. This study was conducted at TMPT D, Kabupaten Malang, with sample collection carried out from July to September 2025. The population in this study consisted of toddlers aged 1–2 years with a height-for-age (H/A) indicator of < −2 SD. Inclusion criteria for this study were toddlers with stunting status, no chronic diseases that could affect growth, and caregivers willing to serve as respondents. Exclusion criteria included toddlers with allergies to probiotics and prebiotics, as well as toddlers undergoing other nutritional interventions. Sampling was conducted using purposive sampling. Data were collected using primary and secondary variables. A total of 15 toddlers were included in the study. The primary variable was nutritional status, measured by height, weight, and H/A Z-score index. Secondary variables included food consumption patterns, history of infectious diseases, and environmental hygiene. The collected data were examined through descriptive statistical methods and further tested using the Wilcoxon signed-rank analysis.

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The research flow is explained as follows eligible stunted toddlers were identified and enrolled based on predefined criteria. Baseline anthropometric measurements were obtained prior to the intervention. Participants then received probiotic- and prebiotic-based nutritional interventions for a specified period. Following the intervention, post-intervention anthropometric assessments were conducted, and the collected data were statistically analyzed to evaluate the effectiveness of the intervention.

Ethical Clearance Certificate with No. 06/PHB/KEPK/322/08.25 was obtained from The Health Research Ethics Committee STIKes Patria Husada Blitar.

RESULTS AND DISCUSSION

The results of this study are presented to provide an overview of the respondents characteristics as well as the effects of the intervention on child growth. The data are displayed in tables and analyzed statistically to demonstrate differences before and after the treatment. These findings are expected to address the research objectives and serve as the foundation for further discussion.

Table 1. Characteristics of Stunted Toddlers Included in the Study at TMPT D, Malang Regency

Variable	N	%
Mother's Occupation		
Housewife	7	46.67
Farmer	3	20.00
Entrepreneur	2	13.33
Private employee	3	20.00
Total	15	100
Mother's Education		
Bachelor's degree	2	13.33
Senior High School	10	66.67
Junior High School	3	20.00
Elementary School	0	0.00
Total	15	100
Parity		
3 children	5	33.33
2 children	6	40.00
1 child	4	26.67
Total	15	100
Child's Sex		
Male	7	46.67
Female	8	53.33
Total	15	100
History of Gastrointestinal Infection (diarrhea)		
Ever	13	86.70
Never	2	13.30
Total	15	100

Based on Table 1, the majority of mothers were housewives, and most had attained senior high school education. Six respondents reported having two children, indicating that parity of two was the most common. Furthermore, the primary caregivers of the toddlers were predominantly their biological mothers. In terms of sex distribution, female toddlers were

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slightly more represented, with a total of eight children.

Table 2. Changes in Body Weight and Height of Stunted Toddlers Before and After Probiotic and Prebiotic-Based Nutritional Intervention at TMPT D, Malang Regency

Variable	Before	After	Difference	Percentage (%)
Body Weight (Kg)	8.29	8.54	0.25	2.97
Height (Cm)	74.73	75.37	0.64	0.86
Z-score (Weight-for-Age)	-2.12	-1.86	0.27	12.53
Z-score (Height-for-Age)	-2.14	-1.91	0.23	10.78

As presented in Table 2, there was a notable improvement in the nutritional status of the children following the intervention. The mean body weight increased by 0.25 kg, corresponding to a 2.97% rise, while the mean height increased by 0.64 cm (0.86%). These positive changes were further reflected in the Z-scores, with the weight-for-age Z-score improving by 0.27 (12.53%) and the height-for-age Z-score by 0.23 (10.78%). These findings indicate that the intervention contributed meaningfully to both weight and height gains, suggesting improved growth outcomes among the participants.

Table 3. Results of the Wilcoxon Signed Rank Test on Body Weight Changes in Stunted Toddlers Before and After the Nutritional Intervention at TMPT D, Malang Regency

Variable (Post–Pre)	Z	Asymp. Sig. (2-tailed)
Body Weight	-3.441[b]	0.001

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks

Analysis using the Wilcoxon Signed Rank Test produced a Z statistic of −3.441 with a two-tailed significance value of 0.001. As this value was below the predetermined alpha level of 0.05, the null hypothesis was not supported. These findings confirm the presence of a statistically meaningful difference in body weight measurements between the pre-intervention and post-intervention assessments.

Table 4. Output Ranks of the Wilcoxon Signed Rank Test for Body Weight Changes in Stunted Toddlers Before and After the Nutritional Intervention at TMPT D, Malang Regency

Comparison (Post–Pre)	N	Mean Rank	Sum of Ranks
Negative Ranks	0[a]	0.00	0.00
Positive Ranks	15[b]	8.00	120.00
Ties	0[c]	–	–
Total	15		

a. Post-test < Pre-test
b. Post-test > Pre-test
c. Post-test = Pre-test

As shown in Table 4, all 15 respondents demonstrated positive ranks, indicating an increase in body weight after the intervention. No respondents experienced negative ranks (a decrease in body weight), and no ties were observed. These results further confirm that the intervention had a consistent positive effect on body weight among all participants.

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Table 5. Results of the Wilcoxon Signed Rank Test for Height Changes in Stunted Toddlers Before and After the Nutritional Intervention at TMPT D, Malang Regency

Variable (Post–Pre)	Z	Asymp. Sig. (2-tailed)
Height	-3.420[b]	0.001

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks

Based on the Wilcoxon Signed Rank Test, the Z value was -3.420, with an Asymp. Sig. (2-tailed) of 0.001. Since the p-value was less than 0.05, the null hypothesis (H_0) was rejected. This indicates a statistically significant difference in height before and after the intervention.

Table 6. Output Ranks of the Wilcoxon Signed Rank Test for Height Changes in Stunted Toddlers Before and After the Nutritional Intervention at TMPT D, Malang Regency

Comparison (Post–Pre)	N	Mean Rank	Sum of Ranks
Negative Ranks	0[a]	0.00	0.00
Positive Ranks	15[b]	8.00	120.00
Ties	0[c]	–	–
Total	15		

a. Post-test < Pre-test
b. Post-test > Pre-test
c. Post-test = Pre-test

As shown in Table 6, all 15 respondents demonstrated positive ranks, reflecting an increase in height after the intervention. No negative ranks (decrease in height) or ties were found. This consistent pattern across all participants confirms the effectiveness of the intervention in improving height outcomes.

The results of the Wilcoxon Signed Rank Test data analysis showed a significant effect on the increase in both body weight and height of respondents. The direction of change that occurred in all respondents was positive. The Rank Output Table of the Wilcoxon Signed Rank Test for body weight, namely there are 15 positive ranks values between the H-Score of body weight before treatment and the H-Score of body weight after treatment while the results of the Wilcoxon Signed Ranks Test Z value of (-3.420) for body height. While the Asymp. Sig. (2-tailed) value is 0.001, the p-value <0.05, so H0 is rejected. This means that there is a significant difference between body height before treatment and after treatment.

The toddler group is a group that is vulnerable to suffering from malnutrition to severe malnutrition. In the framework of the causes of stunting according to the UNICEF Conceptual Framework, direct factors that influence children's nutritional status include inadequate nutrient intake and infectious diseases (Samiyem *et al.*, 2025). These factors are then influenced by indirect causes such as household food security, parenting patterns, health services, and sanitation environments.

The type of work of parents or caregivers is more accurately categorized as a structural factor or indirect basic determinant. This means that the work itself

does not cause stunting, but rather the accompanying impacts—such as income, time available for caregiving, or access to nutritious food can influence the risk of stunting (Markowiak and Ślizewska, 2017). The activities of working mothers can also be a factor in malnutrition in children. Mothers engaged in employment outside the household often face time constraints that limit their ability to provide consistent childcare, particularly in activities such as feeding practices and routine monitoring of their children's growth and developmental progress. The limited time mothers have to care for or accompany their children can result in a lack of attention to their children's consumption patterns during infancy. In this study, all working mothers, whether housewives, farmers, self-employed, or private sector employees, are at risk of having toddlers experience stunting (Sudarmo *et al.*, 2022).

Educational attainment plays a crucial role in shaping an individual's capacity to access, interpret, and utilize information. Individuals with more advanced educational backgrounds tend to process and understand information more effectively than those with limited formal education. For mothers, this capacity becomes an important resource in daily childcare practices, including feeding and health-related decision making. Higher educational exposure enables mothers to respond more openly to new knowledge and recommendations from external sources. In turn, the level of knowledge acquired influences attitudes and behaviors related to food choices, which ultimately contributes to the nutritional status of the child. (Iannotti *et al.*, 2017). However, in this case, all respondents, whether with a high or low level of knowledge, can potentially experience stunting in their toddlers.

Biologically, repeated pregnancies and childbirths with short birth intervals can lead to maternal nutrient depletion syndrome. This condition reduces the availability of essential nutrients during pregnancy and breastfeeding, thus impacting fetal growth and the quality of breast milk. In addition, mothers with high parity often face limited time and energy to provide intensive care for each child, especially during the golden period of the First 1,000 Days of Life (HPK) (Waliyo, Agusanty and Hariyadi, 2020). From a social and economic perspective, having a large number of children can increase the household's economic burden and reduce the proportion of resources (nutritious food, health costs, attention) allocated to each child. This situation can reduce the quality of diet, the regularity of growth and development monitoring, and access to preventive and curative health services. The table above shows the diversity of maternal parity, most of whom have two children.

The direct causes of stunting in children are inadequate nutritional intake

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and infectious diseases. Infectious diseases have a strong interaction with nutritional status, with malnutrition increasing the risk of infection, and vice versa. One approach to support improvements in toddlers' body weight and height is through the provision of nutritionally dense foods that supply adequate energy and protein, along with essential micronutrients, including vitamins such as B-complex, C, and A, as well as key minerals like calcium, iron, iodine, phosphorus, and zinc. (Lin *et al.*, 2018). The composition of children's digestive tract microbes affects growth and development. From the data above in Table 1, it was found that the majority of children, namely 86.7%, have experienced a history of gastrointestinal infections (diarrhea). Consuming prebiotic foods (rich in the digestive tract) can stimulate the growth of normal bacterial flora in the intestines and improve health so that the nutrients contained in food can be absorbed optimally. When a child's digestive tract is healthy, it indirectly reduces the risk of nutritional problems, especially stunting (Haliman and Alfinnia, 2021). Probiotics are microorganisms that benefit health by improving the microbial balance in the large intestine, which can prevent digestive tract diseases by protecting and improving their host and inhibiting the growth of pathogenic and other harmful bacteria. Probiotics are found abundantly in local foods such as green vegetables, cassava tape, and tempe.

Probiotics and prebiotics play an important role in maintaining digestive health through complementary mechanisms. They work by inhibiting the growth of pathogenic bacteria, producing natural antimicrobial compounds, strengthening the intestinal barrier, and aiding digestion and absorption of essential nutrients. Meanwhile, prebiotics are food components, generally in the form of soluble fiber, that cannot be digested by the body but serve as a food source for the beneficial bacteria in the large intestine (Lin *et al.*, 2018). By providing nutrients for probiotics, prebiotics help increase the number and activity of these beneficial bacteria, thus maintaining a healthy gut microbiota. The synergy between the two, known as synbiotics, contributes to preventing gastrointestinal infections, reducing inflammation, and optimizing nutrient absorption. In children, especially those at risk of stunting, this balance is crucial for supporting growth and immunity (Helmyati *et al.*, 2021).

This two-week study aimed to increase the weight and height of stunted toddlers. Food was selected from local ingredients readily available in everyday life, such as tempeh, fermented cassava, yogurt, whole wheat bread, bananas, green vegetables, and nuts. The intervention involved providing therapeutic foods made from these ingredients, which were then

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processed into ready-to-eat meals. The meals provided consisted of two snacks and one main course. The focus was on improving gut function, which requires probiotics and prebiotics. It is hoped that improving gut health will improve nutrient absorption, allowing the body to utilize the food intake to support optimal growth and development of toddlers.

Changes in weight and height in the study showed significant improvements, as evidenced by the increase in the toddler's Z-score after being given therapeutic feeding. Probiotics function to increase the number of good bacteria in the intestine, suppress the population of pathogenic bacteria, and strengthen the integrity of the intestinal wall (S. Septiani and Sari, 2023). Under these conditions, feeding can help restore intestinal inflammation and villi conditions that often occur in children with a history of gastrointestinal infections. Meanwhile, prebiotics act as a substrate or food for probiotics, thus supporting the growth and activity of good bacteria. The synergy between the two will improve the balance of the intestinal microbiota, improve digestion, and maximize the absorption of macro and micronutrients (Chehab, Cross and Forman, 2021).

Improving the digestive tract is crucial for children experiencing stunting, as one of the main causes of stunted growth and development is Enteric Environmental Dysfunction (EED), a condition in which children experience intestinal damage due to exposure to chronic infections and poor sanitation. With probiotic- and prebiotic-based interventions, it is hoped that EED can be minimized so that children's bodies can utilize nutritional intake to build new body tissue, increase muscle mass, and support bone growth (Kamil *et al.*, 2021).

Although the intervention period is relatively short, increased nutrient absorption can result in positive changes in body weight and height, especially when accompanied by adequate nutritional intake that meets the child's energy needs. These results indicate that an approach to improving gut health is a promising strategy in efforts to overcome stunting, especially when combined with improved diet, sanitation, and ongoing health monitoring.

CONCLUSIONS

The results of this study indicate that the use of locally available foods enriched with probiotic and prebiotic components was associated with increases in body weight and linear growth among stunted toddlers. Growth improvements were consistently observed across all participants, as reflected by increases in weight-for-age and height-for-age Z-score indicators. These findings indicate improvements in anthropometric outcomes following

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the nutritional intervention in the study population.

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