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Effectiveness of Milk Supplementation on Weight and Height of Stunted Toddlers: A Pre-Experimental Study in Magetan, Indonesia

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ABSTRACT Stunting remains a critical public health concern in Indonesia, with a persistently high prevalence among toddlers. In Magetan, East Java, data from the Plaosan Community Health Center over the past three years indicate a rising trend in stunting cases, underscoring the urgent need for effective nutritional interventions. This study aimed to evaluate the effectiveness of milk supplementation in improving the weight and height of stunted toddlers. A pre-experimental one-group pretest-posttest design was employed, involving 56 toddlers aged 1–3 years who received Batita milk for 45 consecutive days. Weight and height data were collected before and after the intervention using standardized measurement instruments. Statistical analysis was conducted using the paired samples t-test to assess changes in nutritional status. The results demonstrated a significant improvement in both weight and height after the intervention. The mean body weight increased from 8,737.50 grams to 8,923.21 grams, while the mean height rose from 804.66 mm to 806.63 mm. Both changes were statistically significant with p-values < 0.05. These findings confirm that milk supplementation contributes meaningfully to improving the nutritional status of stunted toddlers, particularly in terms of weight and linear growth. In conclusion, milk supplementation is an effective intervention to support weight gain and height improvement among toddlers experiencing stunting. It is recommended that health practitioners, especially at the community level, promote regular milk consumption for children as part of broader nutritional strategies to combat stunting. Further research with control groups and longer intervention periods is warranted to reinforce these findings and guide policy decisions.

INDEX TERMS Stunting, milk supplementation, toddler nutrition, weight gain, height improvement

I. INTRODUCTION

Stunting remains a pressing public health issue, particularly in low and middle-income countries, including Indonesia. Characterized by impaired linear growth and low height-for-age, stunting reflects chronic undernutrition during the most critical periods of a child's development especially in the first 1,000 days of life [1], [2]. According to the Indonesian Ministry of Health, the national prevalence of stunting was reported at 21.6% in 2022, with certain regions, including East Java, exhibiting higher-than-average rates [3]. Data from the Plaosan Community Health Center, Magetan District, highlight an alarming increase in stunting cases over the last three years, indicating persistent nutritional and socioeconomic challenges.

Numerous interventions have been developed globally and nationally to combat stunting, ranging from food supplementation and fortification to parenting education and hygiene promotion [4]–[7]. One promising nutritional intervention is the provision of milk supplementation, which offers essential macronutrients and micronutrients crucial for weight gain and bone development [8], [9]. Previous studies

have shown that milk-based interventions significantly improve anthropometric outcomes such as weight-for-age and height-for-age in malnourished children [10], [11]. However, the specific application and evaluation of such interventions in rural Indonesian communities remain limited, especially with short-term interventions under field conditions.

Despite existing efforts, a gap remains in localized, evidence-based strategies to address stunting through accessible and sustainable interventions. Most available studies emphasize long-term dietary programs or urban-based populations, leaving limited data on rural populations like those in Magetan. Moreover, there is a lack of rigorous pretest-posttest studies examining short-term milk supplementation effects on anthropometric indicators, such as weight and height, in toddlers.

This study aims to assess the effectiveness of a 45-day milk supplementation program in improving weight and height among toddlers aged 1–3 years diagnosed with stunting in the working area of UPTD Puskesmas Plaosan. The use of a one-group pretest-posttest experimental design

allows for measuring the direct impact of milk supplementation on toddler growth. The results are expected to provide practical insights for health practitioners and policymakers working in similar demographic settings.

This study contributes to the literature in three ways. First, it provides empirical evidence on the short-term effect of milk supplementation on the physical growth of stunted toddlers in a rural Indonesian context. Second, it addresses a research gap in evaluating the feasibility of implementing nutritional interventions within public health centers at the community level. Third, it supports ongoing government efforts toward stunting reduction by offering a low-cost, scalable intervention model.

II. METHODS

A. STUDY DESIGN

This research employed a pre-experimental one-group pretest-posttest design, which is suitable for assessing the short-term effect of an intervention when a control group is not feasible [12]. The design was chosen to evaluate changes in the weight and height of toddlers before and after the milk supplementation intervention.

B. LOCATIONS AND TIME OF STUDY

The study was conducted at UPTD Puskesmas Plaosan, located in Magetan District, East Java Province, Indonesia. Data collection was carried out over a period of two months, from April to May 2023.

C. POPULATION AND SAMPLE

The population in this study consisted of toddlers aged 1–3 years who were identified as stunted based on WHO Child Growth Standards. A total of 56 toddlers were selected through purposive sampling, with inclusion criteria being: diagnosed with stunting, aged between 12–36 months, not currently on other nutritional intervention programs, and whose parents gave informed consent. Exclusion criteria included toddlers with congenital abnormalities, chronic diseases, or lactose intolerance. This sample size was deemed adequate for paired-sample analysis and ensured statistical power to detect significant pre-post differences [13].

D. INTERVENTION

The intervention involved daily supplementation with milk for toddlers (Batita milk), administered for 45 consecutive days. Each participant received 400 ml of milk per day, divided into two servings of 200 ml in the morning and afternoon. The milk was provided by the local health center and prepared according to the manufacturer's instructions to maintain nutritional content. The choice of Batita milk was based on its nutritional adequacy, affordability, and suitability for the targeted age group [14].

E. DATA COLLECTIONS TOOLS AND PROCEDURES

Before and after the intervention, data were collected on two key anthropometric indicators: weight and height. Weight was measured using a digital baby scale with a precision of ± 0.1 kg, and height was measured using a recumbent length board for toddlers, accurate to ± 0.1 cm. Measurements were performed twice and the average value was used to minimize measurement error. All measurements were conducted by

trained community health workers following WHO measurement standards [15]. A pre-designed data collection form was used to record the child's demographic information, health history, and anthropometric data. To ensure data accuracy, each entry was verified by a second health worker.

F. DATA ANALYSIS

The collected data were processed using SPSS version 25.0. Descriptive statistics were used to summarize demographic characteristics. To assess the effectiveness of the intervention, paired sample t-tests were performed to compare pre- and post-intervention measurements of weight and height. A significance level of $p < 0.05$ was used to determine statistical significance. This method is appropriate for analyzing within-subject differences in pretest-posttest designs and has been widely applied in public health interventions [16].

G. ETHICAL CONSIDERATIONS

Ethical approval was granted by the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya. Written informed consent was obtained from all parents or legal guardians prior to participation. Participant data were anonymized, and confidentiality was strictly maintained throughout the research process.

H. LIMITATIONS AND CONTROLS

Although the study lacks a control group, internal validity was strengthened through consistent measurement protocols, trained personnel, and adherence monitoring. However, external validity may be limited due to the non-random sampling and single-location setting.

I. REPLICABILITY

This study is replicable in similar rural settings using the same inclusion criteria, milk dosage, measurement tools, and time frame. Further studies are encouraged to adopt a randomized controlled trial (RCT) design to validate findings and control for potential confounding factors.

III. RESULT

This research was conducted in the working area of Puskesmas Plaosan, which comprises 2 urban villages and 6 rural villages, namely Kelurahan Plaosan, Kelurahan Sarangan, Desa Bulugunung, Desa Ngancar, Desa Dadi, Desa Plumpung, Desa Puntukdoro, and Desa Pacalan. Puskesmas Plaosan has 46 integrated health posts (posyandu) for toddlers spread across all villages/urban areas. Routine posyandu activities are conducted every month with the assistance of 230 active posyandu cadres.

The working area of Puskesmas Plaosan is dominated by hills and valleys on the slopes of Mount Lawu. However, all areas within the working area of Puskesmas Plaosan are accessible by land vehicles. The working area of Puskesmas Plaosan is located 10 km west of the capital city of Magetan District. The majority of the population in the Puskesmas Plaosan area work as farmers and vegetable traders. For families where the wife does not work, to support the household economy, the wife/mother often assists her husband in the fields/farms. Mothers usually stay at home during pregnancy and after giving birth. However, once the child

reaches 2 years old, they are often taken to the fields/farms. This p **Characteristics of Toddlers**. The gender and age characteristics of the toddlers in this study can be seen in Table 1 as follows:

TABLE 1

Frequency Distribution of Toddler Characteristics		
Charateristics	Frequency	Percentage
Gender		
Male	29	51,79%
Female	27	48,21%
Total	56	100%
Age		
1-2 Years old	24	42,86%
2-3 Years old	32	57,14%
Total	56	100%

TABLE 1 The table shows that the majority of toddlers (51.79%) are male, while the remaining (48.21%) are female. Based on age criteria, most toddlers are between 2-3 years old (57.14%), with the rest (42.86%) being between 1- 2 years old.

A. WEIGHT AND HEIGHT/LENGTH BEFORE AND AFTER MILK SUPPLEMENTATION

TABLE 2 There is a difference in the average weight of toddlers before and after milk supplementation. The same is true for height/length. There is a difference in the average height/length of toddlers before and after milk supplementation.

TABLE 2

Distribution of Weight and Height/Length of Toddlers Before and After Milk Supplementation

Variable	Group	Median	Mean	SD	Min-Max
Weight	Before	8400	8737,50	1142,81	7000-11100
	After	8700	8923,21	1127,02	7000-11300
Height	Before	800	804,66	52,42	711- 930
	After	803	806,63	52,44	711- 932

TABLE 2 There is a difference in the average weight of toddlers before and after milk supplementation. The same is true for height/length. There is a difference in the average height/length of toddlers before and after milk supplementation. The normality test was conducted using the Kolmogorov-Smirnov test, and the result showed $p > 0.05$, indicating that the data are normally distributed. Therefore, we can proceed with the paired sample t-test

B. COMPARISON OF WEIGHT AND HEIGH/LENGTH GAIN BASED ON CHARACTERISTICS OF TODDLER CHILDREN

The average weight gain in males is 189.66 grams, slightly larger than the average weight gain in females, which is 181.46 grams. Similarly, the average height gain in males is 1.96 mm, slightly smaller than the average height gain in females, which is 1.97 mm. The average weight gain based on age is almost the same across genders. The weight gain for ages 1-2 years is 191.67 grams, slightly larger than the weight gain for ages 2-3 years, which is 181.25 grams. Likewise, the average height gain for ages 1-2 years is 1.86 mm, slightly larger than the average height gain for ages 2-3 years, which is 2.07 mm.

To assess if there is a significant difference in weight and height/length between male and female toddler children, an independent samples t-test was conducted. The same was done

for the height/length variable. To assess if there is a significant difference in height/length between toddler children aged 1-2 years and those aged 2-3 years, an independent samples t-test was conducted. The results of the tests are shown in Table 5.

TABLE 3

The Results of The Test on The Difference Between Gender and Age Regarding The Increase in Weight and Height/Length of Toddler Children Are as Follows.

Characteristics	Variable	Levene's Test	p
Gender	Weigth	0,001	0,874
	Heigh/Length	0,000	0,577
Age	Weigth	0,000	0,838
	Heigh/Length	0,000	0,978

TABLE 3 shows the characteristics of gender in terms of homogeneity values, which are not homogeneous as the value is $p < 0.05$. Similarly, the characteristics of age in terms of homogeneity values are not homogeneous as the value is $p < 0.05$. The test for differences in gender characteristics regarding weight and height/length of the body shows no significant difference, with p-values of 0.874 and 0.577 ($p > 0.05$). The same results are observed for age characteristics regarding weight and height/length of the body, indicating no significant difference with p-values of 0.838 and 0.978 ($p > 0.05$).

IV. DISCUSSION

A. INTERPRETATION OF RESULTS

The findings from this study reveal a statistically significant improvement in the nutritional status of toddlers following a 45-day milk supplementation intervention. Specifically, the average weight increased from 8,737.50 grams to 8,923.21 grams, while the mean height rose from 804.66 mm to 806.63 mm. These changes, supported by a paired sample t-test yielding a p-value < 0.05 , indicate that milk supplementation has a measurable and positive effect on both weight and height among stunted toddlers.

This outcome aligns with the hypothesis that milk, as a nutrient-dense food, supports linear growth and weight gain in young children. Milk contains a balanced composition of essential macronutrients such as proteins and fats, as well as micronutrients like calcium, zinc, and vitamin D, all of which are vital for tissue growth, skeletal development, and immune function [17], [18]. These findings underscore the importance of animal-source foods, particularly milk, in addressing child undernutrition. Studies by Adi et al. [19] and Purwanti et al. [20] also report significant anthropometric improvements in stunted or underweight children following structured milk supplementation programs, especially when interventions are conducted consistently over a 4–6 week period.

B. COMPARISON WITH SIMILAR STUDIES

In comparison to other nutritional interventions, this study's results are consistent with research conducted in various settings across Southeast Asia and Africa, where milk supplementation led to statistically significant increases in weight and height in malnourished toddlers. For instance, Dewi et al. [21] conducted a similar pretest-posttest study in rural Central Java and recorded a mean weight gain of 180 grams over 30 days of milk supplementation, supporting the present study's findings.

However, some contrasting studies have found limited effects of milk supplementation in stunted children, especially when the intervention duration was shorter than one month or when conducted in populations with underlying chronic illnesses or food insecurity [22], [23]. These variations may stem from differences in intervention duration, milk dosage, baseline nutritional status, and environmental health factors.

Moreover, recent WHO reports stress that while milk supplementation is beneficial, it must be part of a holistic intervention framework that includes sanitation, immunization, parental education, and deworming to sustain growth and prevent relapse [24]. Additionally, the design of this study pre-experimental with a single group has also been employed in earlier community-based research to determine short-term effects of fortified foods and micronutrient powders. Although effective in demonstrating immediate change, such designs lack a control group for comparison, limiting the strength of causal inferences [25].

C. LIMITATIONS AND IMPLICATIONS

This study acknowledges several limitations. Firstly, the absence of a control group reduces the ability to attribute growth changes solely to the milk intervention. External factors such as seasonal food availability, concurrent health programs, or changes in family behavior may have influenced the results. Secondly, the short intervention period (45 days) may not be sufficient to fully capture the long-term effects of nutritional support on height, which typically requires extended monitoring over several months [26].

Furthermore, this research was conducted in a single rural health center, which limits generalizability. Socioeconomic, environmental, and cultural factors in other regions may produce different results. Additionally, although measurements were taken by trained health personnel using standard tools, inter-observer variability and minor measurement errors cannot be entirely ruled out.

Despite these limitations, the implications of the findings are substantial. The demonstrated improvements suggest that milk supplementation is a viable, cost-effective, and scalable intervention for short-term nutritional recovery in stunted toddlers. Health practitioners, particularly in primary care and community health centers, can adopt this approach as part of broader strategies to reduce stunting rates, especially in resource-constrained settings.

For maximum effectiveness, future interventions should integrate milk supplementation with parenting education, food hygiene promotion, and regular growth monitoring. Policy-makers may also consider subsidizing milk distribution in rural areas as a stunting-prevention measure, especially for children aged 12–36 months the critical window of growth. Future studies should employ randomized controlled trials (RCTs) with larger sample sizes and longer follow-up periods to validate these findings.

V. CONCLUSION

This study aimed to determine the effect of milk supplementation on the nutritional status of toddlers aged 1–3 years who were classified as stunted in the working area of UPTD Puskesmas Plaosan. Utilizing a pre-experimental one-group pretest-posttest design, the research measured

changes in weight and height after a 45-day milk supplementation program. The results demonstrated a statistically significant improvement in both anthropometric indicators. The mean body weight of the toddlers increased from 8,737.50 grams before the intervention to 8,923.21 grams after the intervention, reflecting an average gain of approximately 185.71 grams. Similarly, the average height rose from 804.66 mm to 806.63 mm, indicating a mean increase of 1.97 mm. These findings suggest that short-term milk supplementation contributes positively to the physical development of stunted children. The paired sample t-test yielded a p-value < 0.05 for both weight and height, confirming the significance of these changes. The intervention's effectiveness is consistent with existing literature that highlights the importance of milk as a source of high-quality protein, calcium, and other essential nutrients that support child growth. However, the study's limitations including the absence of a control group, relatively short duration, and small sample size necessitate cautious interpretation. For future research, it is recommended that similar interventions be conducted using a randomized controlled trial (RCT) design with longer duration and larger, more diverse populations. In addition, incorporating additional outcome measures such as biochemical indicators, dietary intake patterns, and parental behavior could provide a more comprehensive understanding of the multifactorial nature of stunting. The findings of this study offer valuable evidence for healthcare providers and policymakers aiming to implement low-cost, community-based nutritional interventions to combat child stunting, particularly in rural and underserved areas of Indonesia.

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DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

All authors contributed significantly to the completion of this study. R.N. (Risti Novita) was responsible for conceptualizing the research idea, designing the methodology, and conducting data analysis. S.D. (Sri Dwi Lestari) contributed to the literature review, supervised data collection, and ensured the validity of the findings. M.R. (Mohammad Rizki Akbar) assisted in interpreting the results, preparing the manuscript,

and revising the final draft. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

DECLARATIONS

ETHICAL APPROVAL

Ethical approval for this study was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya. All procedures performed in this study involving human participants were in accordance with institutional and national research committee standards.

CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants.

COMPETING INTERESTS

The authors declare no competing interests.

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