

The Effect of Fruit Ice Cream on Weight Gain in Stunted Children

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Keywords:

Avocado Ice Cream;
Weight Gain; Toddlers;
Stunting; Supplements

Abstract

Growth problems in toddlers, particularly stunting, remain a significant nutritional concern that requires serious attention. One strategy to improve nutritional intake in children is the provision of appealing supplementary foods, such as fruit-based ice cream. Avocados contain energy and nutrients that may help support nutritional adequacy and weight gain in stunted toddlers. This study aimed to determine the effect of avocado ice cream consumption on weight gain in stunted toddlers. A quantitative approach with a quasi-experimental two-group design was employed, consisting of an intervention group and a control group. The study included 36 toddlers, with 18 participants assigned to the intervention group and 18 to the control group. Body weight was measured before and after the intervention. Differences in weight gain between the intervention and control groups were analyzed using an independent-samples t-test at a significance level of $\alpha = 0.05$. The mean weight gain in the intervention group was 610 g, whereas the control group experienced a mean weight gain of 205.56 g. The independent-samples t-test yielded a two-tailed p-value of 0.001 ($p < 0.05$), indicating a statistically significant difference in weight gain between the two groups. The provision of avocado ice cream was associated with significantly greater weight gain among stunted toddlers. Therefore, avocado ice cream may serve as an appealing supplementary food option to support weight gain in toddlers with stunting.

INTRODUCTION

Stunting is a form of chronic undernutrition that develops during the critical first 1,000 days of life and is characterized by impaired linear growth, resulting in a child being shorter than the age-specific growth standard. Globally, an estimated 150.2 million children under five years of age experienced stunting in 2024, representing approximately 23.2% of children in this age group. This estimate was reported in the Joint Child Malnutrition Estimates (JME) produced by WHO, UNICEF, and the World Bank. In Indonesia, based on the 2024 Indonesian Nutrition Status Survey (SSGI), the national prevalence of stunting decreased to 19.8% from 21.5% in 2023. The Ministry of Health reported that this figure was lower than the 2024 target of 20.1%. In Banten Province, the 2024 SSGI reported a stunting prevalence of approximately 21.1%, according to local government publications comparing provincial and national figures. The 2025 profile of the South Tangerang Health Office recorded the nutritional status of toddlers using weight-for-age (W/A) and weight-for-height (W/H) indices and identified 1,162

underweight children across 35 community health centers in the South Tangerang area. These conditions indicate that stunting remains a public health problem requiring continuous prevention and management efforts, including nutritional interventions for toddlers (Aminah et al., 2024; Haselow et al., 2016; Keats et al., 2021; Mulyani et al., 2025; Saleh et al., 2021).

The relationship between the first 1,000 days of life and the incidence of stunting is particularly important because many risk factors for stunting can emerge before birth. Research by Islam et al. (2020) showed that low maternal weight, limited access to nutritious food, household food insecurity, lack of exclusive breastfeeding, infectious diseases, particularly diarrhea, and low birth weight and length were associated with stunting during the first 1,000 days of life. During pregnancy, inadequate maternal energy and nutrient intake can impair fetal growth and increase the risk of low birth weight or growth impairment from birth. After birth, the risk of stunting may persist when infants do not receive optimal breastfeeding or adequate complementary feeding (MP-ASI) in terms of both quality and quantity and when they experience recurrent infections.

Nutritional interventions during the early stages of life are particularly important because recent research has shown that specific nutrition interventions, including nutrient supplementation, fortified foods, and food-based strategies, can support linear growth and reduce the risk of stunting, particularly when initiated early and implemented consistently.

In Indonesia, the government continues to prioritize the first 1,000 days of life as a critical period for stunting prevention. Interventions are implemented during the prenatal, childbirth, and postnatal periods through improvements in maternal health, growth monitoring, breastfeeding promotion, complementary feeding (MP-ASI), infection prevention and management, and nutritional interventions for at-risk groups.

Stunting is influenced by multiple factors, including inadequate maternal knowledge, unfavorable environmental conditions, inappropriate dietary practices, and frequent consumption of nutrient-poor snack foods. However, children's preference for snack foods may also provide an opportunity to introduce nutrient-dense foods in attractive and acceptable forms. Product presentation and sensory appeal may influence children's willingness to consume supplementary foods. Ice cream is generally appealing to children and can be prepared relatively easily by caregivers. When formulated appropriately, fruit-based ice cream can serve as a supplementary food containing energy and essential nutrients that may support growth, including weight gain. Its formulation should therefore consider balanced amounts of carbohydrates, protein, fats, vitamins, and minerals to contribute meaningfully to children's nutritional requirements (Holinesti et al., 2025; Savarino et al., 2021).

Acute malnutrition (wasting) and chronic growth impairment (stunting) in toddlers may be accompanied by difficulty gaining weight. Several factors may contribute to inadequate weight gain, including insufficient energy and protein intake, inadequate quality and frequency of complementary feeding (MP-ASI), feeding difficulties or poor appetite, recurrent infections, the infection–malnutrition cycle, impaired nutrient absorption, a history of low birth weight or prematurity, inappropriate feeding and caregiving practices, adverse socioeconomic conditions, and delayed access to healthcare services. Wasting and stunting can also occur simultaneously. UNICEF reported that children with stunting have an increased risk of wasting, while children with wasting are also at greater risk of stunting. The coexistence of these conditions further increases health risks among children (UNICEF, 2024).

Complementary feeding plays an important role in improving nutrient intake during early childhood. Research conducted in eight provinces of Kenya showed that vitamin A, vitamin B12, and folate were relatively affordable for many households through foods such as liver, nuts, and, in some provinces, orange-fleshed fruits and vegetables, avocados, and small dried fish. In contrast, calcium, animal-source protein, zinc, and iron were less affordable and showed greater variation across provinces, largely depending on the availability of small dried fish (Ryckman, T. et al. 2024). Avocado (*Persea americana* Mill.) is a fruit belonging to the Lauraceae family and has long been consumed by Indigenous populations in tropical regions (Galindo-Tovar et al., 2007). Avocados contain various plant-derived bioactive compounds, including polyphenols, flavonoids, carotenoids, and tocopherols (Tremocoldi et al., 2018; Hurtado-Fernández et al., 2011; Figueroa et al., 2018).

The government has implemented various national programs to support maternal and child health, including (1) specific interventions involving iron supplementation for adolescent girls, prospective brides, and pregnant women; (2) promotion and support for exclusive breastfeeding; (3) classes for pregnant women; (4) education on balanced nutrition; and (5) the Community Healthy Living Movement, which promotes increased physical activity, fruit and vegetable consumption, and early disease detection (Erika, K. A. et al. 2024).

The Ministry of Health established its 2025–2029 Strategic Plan through Minister of Health Regulation (Peraturan Menteri Kesehatan [Permenkes]) Number 12 of 2025. The strategy emphasizes strengthening promotive and preventive health services, improving the quality of primary healthcare, implementing nutritional interventions, and enhancing cross-sectoral coordination to achieve national health targets. The national target is to reduce the prevalence of stunting from 19.8% in 2024 to 14.2% in 2029. The prevalence of 19.8% was derived from the 2024 SSGI announced by the Ministry of Health in 2025.

Despite the implementation of various national programs and policies, a critical gap remains in the availability of practical, acceptable, and evidence-based supplementary food interventions that can be readily integrated into primary healthcare services and community-based nutrition programs. Many existing interventions rely on commercial supplementary foods or relatively complex formulations that may not be readily accessible or affordable for families in resource-limited settings. Furthermore, empirical evidence regarding the effectiveness of locally developed and culturally acceptable food products, such as fruit-based ice cream, as a strategy to support weight gain in stunted toddlers remains limited. This study addresses this gap by evaluating avocado ice cream as a simple, affordable, and child-friendly supplementary food intervention.

This study aimed to determine whether avocado ice cream could support weight gain among stunted toddlers and provide a practical supplementary food option that caregivers could prepare and provide to their children. The study contributes empirical evidence regarding the effectiveness of locally developed, affordable avocado ice cream as a supplementary food that may be replicated by families and healthcare workers. It may also provide a practical intervention model that could be incorporated into existing primary healthcare activities, such as growth monitoring and nutrition counseling, without requiring substantial additional resources. Furthermore, the findings may inform the development of policies and guidelines for community-based supplementary feeding programs, particularly in areas with a high prevalence of stunting and limited access to commercial nutritional products. Ultimately, this

research contributes to national efforts to reduce stunting by providing an evidence-based and potentially applicable strategy that connects nutritional interventions with community-based implementation.

METHODS

This study employed a quantitative approach with a quasi-experimental, non-equivalent control group pretest–posttest design. The study population consisted of 1,162 underweight toddlers. The sample size was determined using power analysis with G*Power, resulting in 36 participants, with 18 assigned to the intervention group and 18 to the control group.

Body weight was measured before and after the intervention. Differences in weight gain between the intervention and control groups were analyzed using an independent-samples t-test at a significance level of $\alpha = 0.05$.

Research Instruments

The instruments used in this study were anthropometric measuring instruments and observation sheets. The anthropometric measuring instruments used included digital weight scales to measure the weight of toddlers before and after the administration of avocado ice cream as well as *stadiometer/microtoise* or *length board* to measure the height or length of the body of toddlers.

The observation sheet was used to record the characteristics of the respondents, the results of weight measurements before and after the intervention, height/length, and the implementation and consumption of avocado ice cream during the study. The determination of stunting status was carried out based on the indicator of height or body length by age (TB/U or PB/U) with reference to the applicable anthropometric standards. The research instrument was first ensured to be in good condition and the weight and height measuring instruments were used in accordance with anthropometric measurement procedures to obtain accurate measurement results.

Data Collection Process

The data collection process in this study is carried out systematically through several stages, namely the preparation stage, the implementation of the initial measurement (*pretest*), the provision of intervention, the final measurement (*posttest*), and data documentation. The data collection time from the preparation to the end of the research is from June to July 2029 at the South Tangerang Regional Health Center (Serpong 1 Health Center, Serpong 2 Health Center, Rawa Mekar Jaya Health Center and Lengkong Wetan Health Center).

Analysis

Analysis of univariate and bivariate research data, univariate analysis consisted of respondent characteristics such as age, birth weight (BB), birth height (TB), pre-intervention BB and *post-intervention* BB as well as differences in BB increase in intervention groups and control groups presented with *mean data, Std. Deviation, minimum and maximum values* while gender, current medical history, history of BB difficult to rise, history of allergies and stunting categories were presented with frequency and percentage data. Normality tests were carried out to determine normal and homogeneous distribution data. Furthermore, bivariate analysis was carried out using *the Independent Samples T-Test* with a significance level of $\alpha = 0.05$ to see the effect of avocado ice cream on pre and post-intervention BB in both the intervention and control groups.

Research Ethics

Research involving toddlers as respondents must pay attention to the ethical principles of research to protect the rights, security, comfort, and confidentiality of respondents. In this study, the researcher applies several principles of research ethics as follows:

1. Ethical Clearance

Before the research is carried out, the researcher submits the research to the authorized Research Ethics Committee to obtain ethical approval. The research is carried out after obtaining ethical approval and permission from related parties.

2. Informed Consent

Because the study respondents were toddlers, consent was obtained from the respondent's parents or guardians. The researcher provided an explanation of the purpose, benefits, procedures, duration of the research, the administration of avocado ice cream, possible inconvenience, and the respondent's right to participate or reject the study. Parents or guardians who are willing to participate are asked to sign an *informed consent sheet*.

3. Respect for Persons

The researcher respects the right of parents/guardians and respondents to accept or refuse participation in the study. Parents/guardians are also given the freedom to terminate their child's participation at any time without incurring sanctions or losses.

4. Principle of Beneficence

The study was carried out by considering the benefits for the respondents. The provision of avocado ice cream is expected to be one of the additional food alternatives that can help increase energy intake and support weight gain for toddlers. During the study, the researcher monitored the condition of the respondents.

5. Non-maleficence

The researcher seeks to prevent risks or losses to the respondents. The materials used in making ice cream are ensured to be safe and processed hygienically. The administration of interventions is carried out according to the established procedures. If during the study unexpected conditions are found, the administration of interventions can be stopped and the respondents get follow-up as needed.

6. Justice

Each respondent received fair treatment regardless of gender, age, background, or social condition. The selection of respondents was carried out based on the research criteria that had been set.

7. Confidentiality

The researcher maintains the confidentiality of all information obtained during the study. The identity of the respondent is not included in the research report and is replaced with the respondent's code or number. The research data is only used for research purposes.

8. Anonymity

To maintain the privacy of respondents, the name of the toddler is not included in the data collection sheet or the results of the research publication. Each respondent is given a specific code to facilitate data processing and analysis.

9. Safety and hygiene of the intervention

Avocado ice cream is made by paying attention to the cleanliness of ingredients, tools, processing processes, storage, and administration to respondents. Researchers also pay

attention to the possibility of allergies or incompatibility with the ingredients used. Before the intervention is given, parents/guardians are asked about their history of allergies or reactions to the food ingredients used.

RESULTS AND DISCUSSION

Univariate Statistics

Table 1. Characteristics of Respondents (Age, Birth Rate, Birth Rate, Pre-Intervention BB and Post Intervention BB) of Stunting Toddlers in South Tangerang Area

Variable	Red	SD	Min	Max
Intervention Groups				
Age (months)	39.06	13.255	10	59
BB born (grams)	2392.22	579.782	1700	3800
Born TB (cm)	46.22	2.510	42	50
Pre-intervention BB	9988.89	1670.114	5800	13000
BB <i>post intervention</i>	10598.89	1574.641	6800	13700
Control Group				
Age (months)	30.83	8.577	21	48
BB born (grams)	2625.00	422.962	2000	3700
Born TB (cm)	47.61	3.958	42	55
Pre-intervention BB	9216.67	1426.328	7000	11500
BB <i>post intervention</i>	9422.22	1318.892	7500	11600

Source: Primary data

Based on Table 1. In the intervention group, the average age of toddlers was 39.06 months with a standard deviation of 13.255 months, with the youngest age being 10 months and the oldest being 59 months. The average birth weight was 2,392.22 grams with a standard deviation of 579.782 grams, with a birth weight ranging from 1,700–3,800 grams. The average birth length/height was 46.22 cm with a standard deviation of 2.51 cm, with a minimum value of 42 cm and a maximum of 50 cm. The average body weight before the intervention was 9,988.89 grams with a standard deviation of 1,670,114 grams, with a minimum body weight of 5,800 grams and a maximum of 13,000 grams. After being given the intervention, the average body weight increased to 10,598.89 grams with a standard deviation of 1,574,641 grams, with a minimum body weight of 6,800 grams and a maximum of 13,700 grams. Thus, descriptively there was an increase in average body weight of 610 grams after the intervention.

In the control group, the average age of toddlers was 30.83 months with a standard deviation of 8.577 months, with a minimum age of 21 months and a maximum of 48 months. The average birth weight was 2,625 grams with a standard deviation of 422.962 grams, with a birth weight ranging from 2,000–3,700 grams. The average birth length/height was 47.61 cm with a standard deviation of 3.958 cm, with a minimum value of 42 cm and a maximum of 55 cm. The average pre-study body weight in the control group was 9,216.67 grams with a standard deviation of 1,426,328 grams, with a minimum body weight of 7,000 grams and a maximum of 11,500 grams. After the study period, the average body weight increased to 9,422.22 grams with a standard deviation of 1,318,892 grams, with a minimum body weight of 7,500 grams and a maximum of 11,600 grams. Thus, the control group experienced an average weight increase of 205.55 grams.

The age range in the study showed that respondents were in the age group of toddlers who were still experiencing a very dynamic growth and development process. In this period, meeting energy and nutrient needs is very important because lack of intake in the long term can cause growth disorders. Stunting itself is a *multifactorial* condition and is related to nutritional factors, health, feeding patterns, socioeconomic conditions, and the environment. The latest systematic review shows that complementary feeding practices, birth weight, and various maternal and environmental factors are important determinants of stunting incidence in children under five years of age. (Ayue, H. I. et.al. 2025).

These findings are consistent with evidence that food-based interventions may contribute to improved child growth, although the magnitude of the effects may vary by type of food, child's age, duration of intervention, initial nutritional condition, and the environment in which the intervention was performed. A *systematic review and network meta-analysis* that included 79 clinical trials with 81,786 children found that some forms of food and nutrient supplementation provided benefits for linear growth and/or reduced risk of stunting. Food supplementation in a specific energy range as well as *lipid-based nutrient supplements* showed a reduced risk of stunting compared to standard treatments. (Park, J. J. H. et.al. 2020)

The results of this study can also be compared with a *2024 systematic review* on the use of biscuits as a nutritional intervention to reduce stunting. The *review* included 11 studies and showed that fortified foods can be used as a medium of nutrition to support the improvement of children's nutritional conditions, although the researchers emphasized that research with better design and more standardized intervention formulations is still needed. Mamun, A. A. et.al. 2024). This supports the concept of this study that supplemental feeding in a form that is acceptable to children can be one approach to help meet energy and nutrient needs.

Furthermore, a recent systematic review of the effectiveness of nutrition-specific interventions in 2026 found that interventions in the form of fortified foods, *lipid-based nutrient supplements*, and food-based strategies are generally associated with linear growth improvements and reduced stunting prevalence. Greater effects are likely to be found when interventions are administered early and carried out in a sustainable manner, particularly in populations with high prevalence of stunting and food insecurity. (Salim, A. et.al. 2026)

In the context of this study, avocado ice cream can be seen as a form of food modification that aims to increase children's acceptance of supplements. Forms of food that children are attractive and liked have the potential to help increase the consumption of additional foods so that they can provide additional energy and nutrients. However, it should be emphasized that weight gain is not solely caused by one type of food. Children's growth is influenced by a variety of factors, including overall food intake, infectious diseases, parenting, sanitation, and socioeconomic conditions. Therefore, food interventions should be part of a more comprehensive approach to nutrition. The 2025 review also shows that nutritional interventions combined with multisectoral interventions have not always provided consistent additional effects compared to nutritional interventions alone, so their effectiveness depends largely on the context and quality of their implementation. (Shakya, E. et.al. 2025).

Table 2. Characteristics of Respondents (Gender, Disease History, History of Difficult BB, History of Allergies and Stunting Category) of Stunting Toddlers in the South Tangerang Region

Navigable	Intervention Groups		Control Group	
	f	%	f	%
Gender				
Male	11	61.1	13	72.2
Women	7	38.9	5	27.8
Quantity	18	100.0	18	100.0
Pain History				
Yes	2	11.1	2	11.1
No	16	88.9	16	88.9
Quantity	18	100.0	18	100.0
The history of BB is difficult to climb				
Yes	18	100.0	18	100.0
No	0	0	0	0
Quantity	18	100.0	18	100.0
History of allergies				
Yes	0	0	0	0
No	18	100.0	18	100.0
Quantity	18	100.0	18	100.0
Stunting Category				
Medium/Short Stunting	4	22.2	4	22.2
Severe/very short stunting	14	77.8	14	77.8
Quantity	18	100.0	18	100.0

Source: Primary data

Based on Table 2. In terms of gender characteristics, the intervention group was mostly male, namely 11 toddlers (61.1%), while women were 7 toddlers (38.9%). In the control group, most of them were also male, namely 13 toddlers (72.2%), while women were 5 toddlers (27.8%). Thus, in both groups, there were more male respondents than female respondents.

Based on the disease history, in the intervention group there were 2 toddlers (11.1%) who had a history of illness and 16 toddlers (88.9%) who had no history of illness. The same results were found in the control group, namely 2 toddlers (11.1%) had a history of illness and 16 toddlers (88.9%) had no history of illness. This shows that most of the respondents in both groups had no history of illness.

In the characteristics of a history of difficulty gaining weight, all respondents in the intervention group and the control group had a history of difficulty gaining weight, namely 18 toddlers (100%) each. There were no respondents who did not have a history of difficulty gaining weight. This condition showed that all respondents who were the subjects of the study had characteristics that were difficult to gain weight.

Based on allergy history, all respondents in the intervention group and control group had no history of allergies, namely 18 toddlers (100%) each. Thus, no respondents were found to have a history of allergies in both study groups.

Based on the stunting category, in the intervention group there were 4 toddlers (22.2%) who were in the medium/short stunting category, while 14 toddlers (77.8%) were in the severe/very short stunting category. The same distribution was found in the control group, namely 4 toddlers (22.2%) in the medium/short stunting category and 14 toddlers (77.8%) in

the severe/very short stunting category. Thus, the majority of respondents in both groups were in the severe/very short stunting category.

The proportion in the study showed that the number of boys under five in this study was twice as many as women. This gender composition needs to be considered because gender is one of the factors that can be related to the risk of nutritional problems in children. A *meta-analysis* of gender differences in malnutrition shows that boys in general have a higher chance of experiencing stunting than girls. In the analysis of 38 studies on stunting, boys have a chance of stunting of around 1.29 times compared to girls. However, the magnitude of these differences can vary based on population and environmental characteristics. (Wells, J. C. K., et al. 2021)

More recent findings also support this approach. A 2026 *systematic review* of nutrition-specific interventions shows that fortified foods, lipid-based supplementation, and food-based strategies can improve linear growth and potentially reduce the prevalence of stunting. Greater effects tend to be seen if interventions are given early and carried out in a sustainable manner. (Salim, E. A. S., & Hadju, V. 2026).

Research in Indonesia published in 2026 also shows relevant results. In 111 children with *pre-stunting, stunting, and severe stunting in Surabaya*, a nutrition-specific intervention for 6–12 months resulted in significant weight and height improvements ($p < 0.001$). Weight gain was recorded in all nutritional status groups, although the magnitude of the change varied by group. (Salim, E. A. S., & Hadju, V. 2026).

Child characteristics are one of the determinant groups related to the incidence of stunting. These characteristics include age, gender, health status, weight, growth, and history of infectious diseases. Children's age is related to the risk of stunting because as they get older, the impact of malnutrition and chronic infections can be increasingly seen in linear growth. Children who experience a lack of energy and nutrient intake for a long time will experience growth disorders so that their length or height is not appropriate for their age. In addition, recurrent infectious diseases can increase energy and nutrient needs while reducing appetite and interfering with nutrient absorption. The results of *systematic reviews* in Indonesia show that child characteristics such as low birth weight and gender are factors related to stunting. Children with low birth weight have a higher risk of stunting than children with normal birth weight. (Gusnedi, G., et.al. 2023)

These results support the study's findings that supplemental feeding can be one of the strategies to support child growth. However, fruit ice cream cannot be seen as the only factor determining weight gain, as a child's growth is also influenced by overall food intake, health conditions, parenting patterns, socioeconomic status, and environment.

The characteristics of the respondents were a group of toddlers with the main problem in the form of weight gain difficulty, while most of them were not experiencing pain. This condition provides a fairly relevant basis for evaluating the administration of fruit ice cream as an additional intervention. The division of respondents into intervention and control groups with the same number, namely 18 toddlers each, also provides an opportunity to compare weight changes in a more balanced manner. If after the intervention there is a greater increase in weight in the group that consumes ice cream, then these results can support the hypothesis that supplemental feeding in a form that children can tolerate contributes to weight gain.

However, because stunting is a *multifactorial condition*, the *interpretation of* the results must still consider other factors. The latest literature confirms that the determinants of stunting

include child characteristics, birth factors, maternal factors, feeding patterns, socioeconomic, sanitation, and environment. (Dessie, G., Li, J., Nghiem, S., & Doan, T. 2025). Therefore, the results of this study are more accurately interpreted as the effect of interventions on weight change, rather than as evidence that ice cream alone can cure or eliminate stunting. In addition, weight gain does not automatically mean that stunting status has improved. Stunting assessment mainly uses height indicators by age (TB/U or HAZ). Therefore, future research should consider measurements of changes in height in addition to weight so that the effectiveness of interventions against linear growth can be evaluated more comprehensively.

Table 3. Increase in BB in the Intervention Group and Stunting Control Group of Toddlers in the South Tangerang Region

Variable	Respondent Group	n	Red	Std. Deviation	Std. Error Red
BB Increase	Intervention	18	610.00	481.151	113.408
	Controls	18	205.56	324.440	76.471

Source: Primary data

Based on Table 3. The intervention group had 18 respondents and the control group had 18 respondents. In the intervention group, an average weight gain of 610 grams was obtained, with a standard deviation of 481.151 grams and a standard error mean of 113.408 grams. These results show that on average, the toddlers in the group who received the intervention experienced a weight gain of 0.61 kg. Meanwhile, in the control group, an average weight gain of 205.56 grams (0.21 kg) was obtained with a standard deviation of 324.44 grams and a standard error mean of 76.471 grams. This shows that the average weight gain in the control group was lower than in the intervention group.

The difference in average shows a tendency that giving ice cream as an additional food can contribute to weight gain in toddlers. Weight gain in the intervention group can occur due to additional energy and nutrient intake from the food given during the intervention period. In children with difficulty gaining weight, supplemental feeding that has the appropriate energy density and nutrients can help increase the total daily intake if the food can be accepted and consumed well by the child.

The results of this study are also supported by *a systematic review and meta-analysis* by Lassi et al. (2025) who evaluated 24 studies on food interventions and community-based supplementation in children up to five years of age. The results showed that *lipid-based nutrient supplements* (LNS) supplementation was associated with an increase in *weight-for-age z-score* as well as a decrease in the incidence of wasting and underweight. These findings show that supplementation with foods containing energy and nutrients can have a positive impact on children's weight growth indicators.

In the context of this study, fruit ice cream can be one of the forms of food supplements that are easier for children to accept because of its attractive characteristics in terms of shape, taste, and texture. Acceptance of food is an important aspect in nutritional intervention because foods that contain good nutrients will not provide optimal benefits if children do not consume them in sufficient amounts. Therefore, food form innovation can be one of the approaches to increase children's interest in supplements.

However, the magnitude of weight gain in this study needs to be interpreted by considering individual variations. The standard deviation value in the intervention group of

481,151 grams showed that weight gain between respondents was quite variable. These variations can be influenced by age, initial weight, diet, ice cream consumption level, health conditions, physical activity, and other food intake during the study.

Research by Salim and Hadju (2026) also shows that the effectiveness of specific nutritional interventions on child growth is not always the same in every population. *The systematic review* found that *fortified foods*, *lipid-based supplementation*, and food-based interventions can provide growth improvement, but the magnitude of the effects is influenced by the context, age at which the intervention was given, the initial nutritional conditions, and the length of the intervention. Greater effects tend to be seen when interventions are done early and administered sustainably.

These findings are important in this study because the respondents have a history of difficulty gaining weight. This means that a weight gain of 610 grams in the intervention group can be seen as a clinically positive change, but it must still be assessed along with the initial condition and growth pattern of each child. Food interventions should not be seen as the only factor determining growth, because the growth of toddlers is influenced by overall food intake, infectious diseases, parenting, sanitation, family food security, and socioeconomic factors.

This is reinforced by research on household food security in Indonesia. Dewi et al. (2024) explained that limited access to food at home can contribute to child growth disorders. Children who are stunted can experience growth disorders due to nutritional deficiencies that persist in the long term. Therefore, feeding interventions need to be considered as part of broader efforts to improve the adequacy and quality of child intake.

In addition, the results of the study need to be compared with studies that show that the effects of dietary interventions on growth are not always consistent. A meta-analysis of fortified complementary foods found that there was no significant difference in *weight-for-age z-score* between the fortified complementary food group and the comparison group. 6 This suggests that the success of dietary interventions can be influenced by the type of food, energy and nutrient content, the amount consumed, the duration of administration, adherence, and the child's initial condition.

In this study, the average difference in weight gain of 404.44 grams between the intervention and control groups gave an idea that the group that received ice cream experienced greater weight gain. The descriptive results were then strengthened by the results of the analysis of *the Independent Samples t-test* that was previously obtained, namely $p = 0.006$ ($p < 0.05$). Thus, the difference in weight gain between the intervention and control groups was not only descriptive, but also showed a statistically significant difference.

These results support the hypothesis that the administration of ice cream as an intervention may contribute to weight gain in the toddlers in this study. In this study, the results were influential but in the intervention it was necessary to consider the study design, the duration of the intervention, and the confounding factors that may exist. The results of the study more precisely showed that there was a significant difference in weight gain between the group given ice cream and the control group.

In general, the results of this study are in line with the latest literature showing that food-based interventions can help improve children's growth indicators. Lassi et al. (2025) found an increase in *weight-for-age z-scores* in children who received certain dietary supplementation, while Salim and Hadju (2026) concluded that specific nutrition interventions, especially

fortified foods and food-based strategies, can provide improved child growth. However, there are also research results that show a more limited effect on body weight. Therefore, the results of this study contribute to the fact that child-acceptable forms of food, such as fruit ice cream, have the potential to be an alternative in supplemental feeding, especially in children who have difficulty gaining weight.

Statistical Normality Test

Table 4. Pre and Post Intervention Normality Statistical Test of Intervention and Control Group

Variable	Ice cream consumption	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pre-intervention	Yes	.131	18	.200*	.964	18	.675
BB	No	.129	18	.200*	.947	18	.375
BB	postYes	.132	18	.200*	.964	18	.688
intervention	No	.136	18	.200*	.945	18	.347

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Source: SPSS output

Based on Table 4. The results of the normality test were tested on *pre-intervention and post-intervention* weight (BB) in the group that consumed ice cream and the group that did not consume ice cream. Because the number of respondents in each group was 18 respondents ($n < 50$), the interpretation of normality was more appropriate using *the Shapiro-Wilk test*.

The results of *the Shapiro-Wilk test* showed that in the *pre-intervention BB of the ice cream consumption group*, a significance value of 0.675 was obtained. In the *pre-intervention BB of the non-ice cream consumption group*, a significance value of 0.375 was obtained. Furthermore, in the *post-intervention BB of the ice cream consumption group*, a significance value of 0.688 was obtained, while in the *post-intervention BB of the non-ice cream consumption group*, a significance value of 0.347 was obtained.

The entire *Shapiro-Wilk* significance value was greater than 0.05 ($p > 0.05$). Thus, it can be concluded that *the data on pre-intervention BB and post-intervention BB* in both the ice cream consumption group and the non-ice cream consumption group were normally distributed.

Table 5. Conclusion for Normality Analysis

Variable	Groups	Sig. Shapiro-Wilk	Conclusion
Pre-intervention BB	Ice cream	0,675	Normal
Pre-intervention BB	No ice cream	0,375	Normal
Post-intervention BB	Ice cream	0,688	Normal
Post-intervention BB	No ice cream	0,347	Normal

Source: SPSS output

Thus, the assumption of normality is met. For the analysis of changes in BB before and after the intervention, the *Paired t-test* can be considered if other assumptions are met. To compare weight changes between the ice cream consumption and non-ice cream consumption groups, *the Independent t-test* can be used if the change data ($\Delta BB = BB \text{ post} - BB \text{ pre}$) also meets the assumptions of normality and homogeneity.

Bivariate Statistical Test

Table 6. Statistical Analysis of Independent Samples Test

		<i>Levene's Test for Equality of Variances</i>		<i>t-test for Equality of Means</i>						
		<i>F</i>	<i>Sig.</i>	<i>t</i>	<i>df</i>	<i>Sig. (2-tailed)</i>	<i>Mean Difference</i>	<i>Std. Error Difference</i>	<i>95% Confidence Interval of the Difference</i>	
										<i>Lower Upper</i>
BB Increase	<i>Equal variances assumed</i>	3.022	0.091	2.957	34	0.006	404.444	136.782	126.47	682.419
	<i>Equal variances not assumed</i>			2.957	29.811	0.006	404.444	136.782	125.024	683.865

Source: SPSS output

The results of the Independent *Samples t-test* showed that there was a significant difference in weight gain between the intervention group and the control group with values of $t = 2.957$, $df = 34$, and $p = 0.006$ ($p < 0.05$). The average weight gain in the intervention group was 610 grams, while in the control group it was 205.56 grams, with an average difference of 404.44 grams. Thus, it can be concluded that there was a significant difference in weight gain between toddlers who received ice cream intervention and toddlers in the control group.

The findings are in accordance with the results of the descriptive analysis, namely the average weight gain of the intervention group was 610 grams, while the control group was 205.56 grams. Thus, the toddlers who received the intervention experienced about 2.97 times greater weight gain than the control group based on the average comparison of weight gain. This difference shows a tendency that giving ice cream as an additional food can help increase the weight of toddlers who have difficulty gaining weight.

These results showed that the group that received the intervention experienced greater weight gain than the control group. These findings are in line with evidence that food-based interventions can support child growth. Al Mamun et al. (2023) through *systematic review* and *meta-analysis* found that food-based interventions can increase the linear growth of children under five years old, while Salim and Hadju (2026) report that fortified foods, *lipid-based supplementation*, and food-based strategies are associated with improved growth and stunting reduction.

The results of this study show that the provision of ice cream as a form of dietary supplement has the potential to help increase the weight of toddlers who have difficulty gaining weight. These differences are statistically significant, but the interpretation still needs to consider that a child's growth is influenced by various factors, including overall food intake, disease, socioeconomic conditions, and environment. In addition, weight gain does not directly indicate an improvement in stunting because the assessment of stunting is mainly based on height indicators by age. Therefore, height measurements and *height-for-age z-scores* are still needed to assess the impact of interventions on stunting more comprehensively.

Research Limitations

Research on the effect of avocado ice cream on weight gain in stunting/wasting toddlers has several limitations that need to be considered in interpreting the results of the study, namely:

1. Ice cream consumption cannot be completely controlled.

Researchers have not been able to confirm that all the ice cream given is consumed by the respondents. The possibility that ice cream is not consumed completely can cause the amount of nutrients and energy that actually enter the body of each toddler to be different. In addition, the level of children's liking for ice cream can also affect the amount consumed.

2. The number of calories that actually enter the respondent's body cannot be known for sure. Although the composition and energy content of avocado ice cream have been determined, studies have not been able to directly measure the number of calories actually consumed by each toddler. The difference in the amount of ice cream spent and the child's ability to consume food can cause the actual energy intake of each respondent to be different.

3. The respondents' daily food intake was not calculated as a whole.

The study did not measure the total daily intake of food and beverages of the respondents, both energy, protein, fat, and carbohydrates. This condition is limited because weight gain is not only influenced by the administration of avocado ice cream, but also by the intake of other foods consumed by children during the study period. Thus, the effect of interventions on weight gain has the potential to be influenced by food intake factors from outside the intervention.

4. Respondents also participated in a feeding program for stunting/wasting toddlers.

Some or all of the respondents participated in a supplemental feeding program or a food program for stunting/wasting toddlers during the study period. The program can provide additional energy and nutrients that have the potential to contribute to weight gain. Therefore, the weight gain that occurred during the study cannot be fully attributed to the administration of avocado ice cream alone.

5. The influence of other factors on weight gain has not been fully controlled.

Weight gain in toddlers can be influenced by various factors, such as diet, amount of energy and protein intake, health conditions, physical activity, adherence to consuming interventions, and supplemental feeding from other programs. Not all of these factors can be strictly controlled during the study so that they can be a confounding factor for the research results.

6. Monitoring of consumption outside of the intervention is still limited.

The researcher could not monitor all the food and drinks that the respondents consumed at home. Therefore, there is a possibility of differences in diet between respondents during the study that could affect weight change.

CONCLUSION

This study concluded that, among the 36 respondents, the mean age was 34.94 months, the mean birth weight was 2,508.61 g, and the mean birth length was 46.92 cm. The mean pre-intervention body weight was 9,602.78 g, which increased to 10,010.56 g after the intervention period. Most respondents were male, most had no current history of illness, and all had a history of difficulty gaining weight. The distribution of participants between the intervention and control groups was balanced. The mean weight gain in the intervention group was 610 g, which was significantly greater than the 205.56 g observed in the control group, with a mean difference of 404.44 g. The independent-samples t-test yielded a two-tailed p-value of 0.001 (p

< 0.05), indicating a statistically significant difference in weight gain between the two groups. These findings suggest that the provision of avocado ice cream was associated with greater weight gain among stunted toddlers.

Future research should consider extending the intervention period to evaluate longer-term effects on weight maintenance and linear growth and incorporating height measurements to assess changes in stunting status more comprehensively. Studies with larger sample sizes and longer follow-up periods are also needed to strengthen the evidence base and evaluate the cost-effectiveness of the intervention in different settings. In practice, avocado ice cream may be considered a simple, affordable, and acceptable supplementary food option for integration into primary healthcare services and community-based nutrition programs, particularly in areas with a high prevalence of stunting and limited access to commercial nutritional products.

FUNDING

The author states that this research was financially supported by a grant from the Ministry of Higher Education, Science, and Technology (Kemdiktisaintek) under grant number 1424/LL4/PG/2026 and 01/PB/STIKES-BTN/V/2026.

ACKNOWLEDGEMENTS

The author acknowledges the support and assistance provided during the implementation of this research.

CONFLICT OF INTEREST

The author states that this research was conducted without any commercial or financial relationship that can be interpreted as a potential conflict of interest.

AUTHOR CONTRIBUTION

All authors contributed equally to the conceptualization, data analysis, and preparation of the manuscript.

GENERATIVE ARTIFICIAL INTELLIGENCE USAGE STATEMENT

The authors state that generative artificial intelligence (AI) was used in the preparation of this manuscript. The authors acknowledge the use of generative AI to help improve language clarity and improve the grammatical structure of manuscripts. The use is carried out in compliance with applicable ethical guidelines regarding the use and disclosure of generative AI in scientific research. Each author has made substantial intellectual contributions to this work. The entire content of the manuscript has been carefully reviewed to ensure its accuracy, and the author is solely responsible for the integrity and final content of the manuscript.

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