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NUTRITIONAL INTERVENTION USING CHICKEN EGGS AND ZINC TO ENHANCE GROWTH IN STUNTED CHILDREN AGED 6–72 MONTHS

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Abstract

The results of the 2023 Indonesian Health Survey showed that the prevalence of stunting and wasting in toddlers was 21.5% and 8.5%. The stunting rate in Central Java Province was 20.7%, while wasting was 7.1%. Toddlers who experience growth retardation as a result of poor nutritional intake or repeated infections have a high risk of death and illness. This study aims to determine the effect of providing chicken eggs and zinc to improve growth of children with stunting. The study used Quase-Experiment one group pre-posttest design with 30 respondent for 90 days of intervention. The results showed that 86.67% of toddlers were stunted and 13.33% were severely stunted. The analysis test showed a significant difference and there was an effect of providing chicken eggs and zinc on increasing toddler weight (p-value 0.00). Likewise, for height, the p-value was 0.00, indicating that there was an effect of providing chicken eggs and zinc on increasing toddler height. Providing chicken eggs and zinc can be considered as an intervention to improve toddler nutritional status.

Keyword: *Egg, Children under 5 years old, Malnutrition, Stunting, Zinc*

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1. Introduction

Child nutritional status is a key indicator of overall growth and development. When this status is compromised, one of the most prevalent manifestations is stunting, defined as a condition in which a child's height is below the standard for their age due to acute or chronic malnutrition. Stunting reflects not only impaired physical growth but also an increased risk of child mortality and serves as a marker of disrupted developmental processes. Consequently, children affected by stunting often fail to reach their full physical and cognitive potential. For this reason, regular monitoring of infant and child growth is essential in child health surveillance. Nevertheless, inadequate growth resulting from insufficient nutritional intake continues to contribute to the high prevalence of undernutrition among children in many developing countries [1].

This persistent burden of undernutrition positions child malnutrition as a major global public health concern. Recent data from the World Health Organization (WHO) indicate that approximately 149.2 million children under five years of age are affected by stunting, while 45.4 million

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experience wasting. Undernutrition accounts for nearly 45% of deaths among children under five, with the majority occurring in low- and middle-income countries. Although global trends suggest a general decline in stunting, this improvement has not been observed in Africa, and more than three-quarters of children with severe wasting are concentrated in Asia [2]. In the Indonesian context, findings from the 2023 Indonesian Health Survey (SKI) reported a stunting prevalence of 21.5% and a wasting prevalence of 8.5%, reflecting an increase compared to the 2022 Indonesian Nutritional Status Survey (7.7%). In Central Java Province, the prevalence of stunting and wasting reached 20.7% and 7.1%, respectively. These findings are particularly concerning, given that Central Java is located on Java Island, a region with relatively better food availability, healthcare access, and health workforce capacity compared to other areas [3].

Beyond prevalence figures, the consequences of impaired growth in early childhood extend far beyond the immediate period. Children who experience growth faltering due to inadequate nutrient intake or recurrent infections face a substantially higher risk of morbidity and mortality. Stunting, as a manifestation of long-term nutritional deficiency, is associated with delayed mental development, reduced intellectual capacity, and poorer academic performance. Over time, these developmental setbacks can translate into reduced economic productivity at the national level [4]. Moreover, the impact of stunting persists into adulthood, encompassing both short- and long-term consequences such as increased susceptibility to infections and non-communicable diseases, greater fat accumulation in specific body regions, insulin resistance, and a heightened risk of diabetes, hypertension, and dyslipidemia. Ultimately, these outcomes contribute to diminished reproductive capacity and lower overall productivity later in life [5].

Building on the understanding of the long-term consequences of stunting, several risk factors have been identified as contributing to stunting among children under five years of age. These factors include birth length, birth weight, and exclusive breastfeeding practices. Children born with a body length of less than 48 cm have a sixfold higher risk of developing stunting compared to those born with normal birth length. In cases where children are born with normal birth length but later experience stunting, this condition is often associated with maternal employment status, which may reflect lower household socioeconomic conditions. Low socioeconomic status can negatively affect both the quality and quantity of food consumed within the family. A short birth length also indicates inadequate maternal nutrition during pregnancy, which subsequently impairs fetal growth. Similarly, infants with low birth weight are at an increased risk of stunting, as low birth weight is often accompanied by immature gastrointestinal function. This condition may lead to feeding difficulties, as low birth weight infants tend to be physically weaker, have smaller stomach capacity, and experience challenges during breastfeeding. Moreover, children who do not receive exclusive breastfeeding are reported to have a 14-fold higher risk of developing stunting compared to those who are exclusively breastfed. Breast milk serves as a vital source of nutrients essential for optimal child growth and development [6]. In addition, limited maternal knowledge regarding stunting, inappropriate parenting practices, and short birth intervals between siblings have also been associated with an increased risk of stunting [7].

Given that inadequate nutrition plays a central role in the development of stunting, effective management strategies are required to minimize both the short- and long-term health consequences and to improve children’s overall quality of life. One nutritional approach that has gained attention is the use of eggs as a complementary food, as eggs are rich in

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high-quality protein, essential fatty acids, choline, vitamin A, and vitamin B12. Compared to other animal-based food sources, eggs are relatively affordable and widely accessible. Evidence from a meta-analysis indicates that children who received egg supplementation experienced a greater increase in height, with a mean difference of 0.47 cm compared to those who did not consume eggs. Similarly, weight gain was higher in the egg-supplemented group, with an average increase of 0.07 kg. Notably, the effect on weight gain was more pronounced in children under two years of age than in older children [8].

In addition to their macronutrient content, eggs also provide important micronutrients, particularly zinc, which is predominantly found in the egg yolk. Approximately 100 grams of eggs contain about 1.29 mg of zinc, along with other essential micro- and macronutrients. Adequate zinc intake has been shown to repair cellular damage caused by zinc deficiency, including intracellular DNA damage, and to support bone growth and development. Previous findings demonstrate that the average zinc level among children who consumed one egg per day for 30 days reached 718.8 ± 363.9 µg/dL, whereas children in the control group who did not consume eggs had a substantially lower average zinc level of 143.3 ± 65.6 µg/dL [9].

While eggs provide an important dietary source of zinc, inadequate zinc intake remains a critical concern in child growth and development. Zinc deficiency has been associated with growth impairment, reduced appetite, and compromised immune function. In children, insufficient zinc levels increase the risk of growth faltering as well as susceptibility to diarrheal diseases and lower respiratory tract infections. Evidence indicates that children who received zinc supplementation at a dose of 15 mg for six months experienced greater linear growth compared to those who did not receive zinc supplementation [10]. The growth-promoting effect of zinc appears to be more pronounced in children than in infants. Among children older than two years, zinc supplementation has been shown to significantly improve height and height-for-age scores (HAZ), as well as body weight and weight-for-age scores (WAZ) [11]. Further supporting its role in linear growth, zinc supplementation administered for 12 weeks at a dose of 10 mg/day was found to significantly enhance child growth outcomes. The mean increase in height before and after zinc supplementation reached 3.07 ± 1.04 cm. Notably, children who received 10 mg of zinc demonstrated greater height gains compared to those receiving a lower dose of 5 mg. In addition, zinc supplementation was associated with an average weight gain of 0.99 ± 0.37 kg [12].

Although previous studies have independently examined egg consumption or zinc supplementation among young children, limited research has explored the combined administration of chicken eggs and zinc, particularly among children with stunting. he novelty of the present study lies in integrating chicken egg consumption and zinc supplementation as a simultaneous intervention for stunted children. This combined approach is expected to improve nutritional status, especially linear growth, as zinc plays a crucial role in cellular growth and development, while chicken eggs provide essential macro- and micronutrients required to meet children's nutritional needs. Moreover, chicken eggs represent an affordable and widely available source of high-quality animal protein, making them a practical intervention in community settings. In this study, zinc was administered at a dose of 20 mg/day (10 mL/day), in accordance with evidence-based recommendations issued by the World Health Organization (WHO) and supported by previous research conducted in Makassar, which demonstrated positive growth outcomes among children aged 24–60 months receiving zinc supplementation at the same dosage [13,14]. Accordingly, this study aimed to

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examine the effect of combined chicken egg and zinc supplementation on the growth of children aged 6–72 months with stunting. The research question guiding this study was: "How does the intervention of chicken egg consumption combined with zinc supplementation affect the growth of children aged 6–72 months with stunting?"

2. Method

This study employed a quantitative research approach, which is an empirical method based on data that can be measured and analyzed numerically. Quantitative research focuses on the systematic collection and analysis of numerical data and typically follows a structured process beginning with theoretical formulation and hypothesis development, followed by research design, subject selection, data collection, data processing, data analysis, and conclusion drawing. One common form of quantitative research is experimental research, which is used to evaluate the effectiveness of a particular intervention or variable [15].

A quasi-experimental design was applied in this study. Quasi-experimental research is characterized by the non-randomized assignment of respondents to intervention and control groups. Specifically, this study used a one-group pretest–posttest design, in which measurements were conducted before and after the intervention. The pretest was performed to assess the baseline condition of participants prior to receiving the intervention, while the posttest was conducted to determine changes following the intervention. However, it is acknowledged that differences observed before and after the intervention may also be influenced by external factors such as age, environment, and prior knowledge [16].

Research Design

O_1	X	O_2

design

Description:
O_1 = measurement before chicken egg and zinc intervention
X = chicken egg and zinc intervention
O_2 = measurement after chicken egg and zinc intervention

The study was conducted in Domiyang Village, Pekalongan, Central Java. A total of 91 children under five years of age were identified in the study area. Sampling was performed using quota sampling, resulting in 30 mother–child pairs with stunted children who were assigned to a single intervention group (chicken egg and zinc supplementation). The study was carried out from June to August 2025.

The instruments used in this study included a calibrated digital weighing scale, a microtoise, and an observation checklist. The study participants consisted of mothers and children aged 6–72 months who were identified as stunted. The inclusion criteria were: (1) children diagnosed with stunting, (2) residency in the study area, (3) children not currently enrolled in a supplementary feeding program (PMT), and (4) children not suffering from diseases other than stunting. The exclusion criteria included: (1) children with egg allergy and (2) withdrawal from the study. In total, 30 mothers and their children under five years of age participated in this study.

All participants received an intervention consisting of one chicken egg per day and zinc syrup at a dose of 10 mL per day (20 mg/day) for a duration of 90 days. The zinc supplement used was Lecozinc®. Chicken eggs and zinc supplements were distributed weekly to mothers and children by community health volunteers and village midwives who served as field research assistants. Mothers were instructed to provide one boiled chicken egg per day and two tablespoons of zinc syrup per day (10 mL, equivalent to 20 mg of zinc). Monitoring of children's body weight and height was conducted weekly, coinciding with the distribution of eggs and zinc supplements.

This study utilized primary data, consisting of anthropometric

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measurements of children, including body weight, height, head circumference, and mid-upper arm circumference. These measurements were collected weekly over the 90-day intervention period. Data analysis was performed using SPSS software. The Shapiro–Wilk test was applied to assess the normality of weight and height data distributions. To determine whether there were significant differences in mean changes in body weight and height before and after the intervention, a paired sample t-test was conducted.

3. Results and Discussion

Table 1. Respondent Characteristics

Characteristics	Frequency	%
Sex		
Male	14	46.67
Female	16	53.33
Nutritional Status		
Stunted	26	86.67
Severely stunted	4	13.33

Table 1 presents the nutritional status of the study participants. All children included in this study were classified as stunted. The majority of participants (86.67%) were categorized as stunted, while the remaining 13.33% were classified as severely stunted.

Prior to hypothesis testing, data analysis was preceded by a normality assessment using the Shapiro–Wilk test to determine the appropriate statistical test for further analysis.

Table 2. Normality Test Results

	Mean	Std	P-value
Body Weight			
Pretest	10.07	1.88±0.34	0.788
Posttest	10.68	2.18±0.39	0.378
Body Height			
Pretest	82.51	10.12±1.84	0.398
Posttest	85.64	9.72±1.77	0.348

As shown in Table 2, both body weight and height variables, measured at pretest and posttest, demonstrated a normal distribution. This was indicated by significance values greater than 0.05 for all variables. Based on these results, the data met the assumptions for parametric analysis, and therefore, a paired sample t-test was applied.

Table 3. Paired Sample t-test Results

Variable	Mean Difference	Std	Sig
Body Weight (Pre–Post)	-0.60	0.66±0.12	0.00
Height (Pre–Post)	-3.13	1.31±0.24	0.00

Table 3 presents the results of the paired sample t-test for changes in body weight and height following the intervention. The analysis showed a statistically significant difference in body weight before and after the administration of chicken eggs and zinc supplementation (p = 0.000), indicating a significant effect of the intervention on weight gain among children.

The findings of this study indicate that 26 children under five were classified as stunted, while 4 were categorized as severely stunted. Although the national prevalence of stunting in Indonesia has shown a downward trend in recent years, the burden remains substantial. Insufficient daily dietary intake is widely recognized as a major risk factor for stunting; previous studies have reported that 69.1% of stunted children experience inadequate or insufficient food intake. In addition, the absence of exclusive breastfeeding has been consistently associated with stunting, with 70.1% of stunted children reported not to have received exclusive breastfeeding. Breast milk plays a critical role during the first six months of life by supporting immune function and reducing the incidence of diarrhea and other gastrointestinal disorders. These effects are largely attributable to the unique composition of breast milk, including lactoferrin, immunoglobulins, and other bioactive components that are not found in cow's milk. Environmental conditions, such as hygiene practices and access to clean water, also contribute to the risk of stunting. In this context, improved

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sanitation, including access to proper waste disposal facilities and the capacity to maintain household cleanliness, is closely linked to child growth outcomes. Moreover, hand hygiene plays an essential role in reducing pathogen transmission and preventing recurrent infections that may impair linear growth [17].

In addition to nutritional and environmental factors, parental characteristics further shape the risk of stunting among children under five years of age. Maternal height below 145 cm and/or paternal height below 161.9 cm have been associated with an increased likelihood of stunting at birth, reflecting the intergenerational transmission of genetic and biological factors. Parental mental health, particularly chronic stress, may adversely affect caregiving practices, leading to suboptimal parenting behaviors and increased psychosocial distress in children, which can ultimately compromise growth. Furthermore, stress during pregnancy has been shown to influence maternal nutritional absorption, immune function, and fetal development. Taken together, the etiology of stunting is multifactorial, arising from the interaction of internal and external determinants. These include genetic factors, dietary intake, access to health services, household and environmental conditions, parental mental health, caregiving practices, as well as socioeconomic status, parental education, and parental physical characteristics [18].

Within this multifactorial context, the present study highlights the potential contribution of targeted nutritional interventions. Accordingly, the provision of chicken eggs and zinc supplementation was found to have a significant effect on height improvement among stunted children. Children who received zinc supplementation at a dose of 10 ml per day for three months demonstrated a statistically significant increase in height ($p = 0.00$). This finding is consistent with evidence from studies conducted in Iran, which reported that oral zinc supplementation over a six-month period significantly improved growth indicators and reduced the risk of stunting. In addition, systematic reviews have consistently documented significant gains in linear growth among children receiving zinc supplementation. Overall, reviews encompassing studies from both developing and developed countries report a positive effect of zinc on child growth, with a pooled effect size of 0.350. Specifically, zinc supplementation at a dose of 10 mg per day for 24 weeks has been associated with an average height increase of 0.37 (±0.25) cm among children under five years of age in developing countries (19–21).

To better understand the observed effect of zinc supplementation on linear growth, it is important to consider the biological role of zinc in child development. Zinc is the second most abundant micronutrient in the human body after iron and plays a critical role in cellular metabolism and physiological function. Zinc deficiency in infants may lead to growth failure, including stunting, skin lesions, impaired immune function, and disrupted brain development. Zinc deficiency among infants and young children is more commonly observed in developing countries than in developed settings [22]. Insufficient zinc levels can result in reduced plasma concentrations of insulin-like growth factor-1 (IGF-1) and growth hormone, both of which are essential regulators of linear growth through their role in bone metabolism. Consequently, zinc deficiency is closely associated with impaired growth, increased susceptibility to infections, and decreased immunocompetence [19].

At the cellular and physiological levels, zinc is involved in multiple biochemical processes, including cell growth, cell division, and cellular metabolism. It also contributes to intestinal electrolyte absorption, neurotransmission, immune responses, enzymatic stabilization and catalysis, protein structure modulation, and reproductive function. Through these mechanisms, zinc supports DNA and RNA synthesis, protein metabolism, and

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overall growth and development. Evidence suggests that increases in height and weight are not consistently observed within the first six months of zinc supplementation; rather, the effects on linear growth and body weight tend to become more apparent after approximately 12 months of continuous intake. Moreover, zinc supplementation appears to exert a stronger effect when administered as a single micronutrient rather than in combination with other minerals or vitamins [10,11].

However, despite its established biological role, empirical findings on zinc supplementation and linear growth remain inconsistent. A study conducted in Jakarta reported no significant differences in height and head circumference between children receiving zinc supplementation and those receiving placebo (p = 0.909 and p = 0.847, respectively), while a significant improvement was observed only in body weight (p = 0.023) (23). Although zinc supplementation administered after birth was associated with increased height, this effect was not reflected in the height-for-age (HAZ) indicator. These findings suggest that zinc supplementation may have a more pronounced effect on indicators related to wasting or weight gain than on linear growth. Differences in study outcomes may be influenced by variation in intervention duration, unmonitored dietary intake, socioeconomic conditions, the form of zinc administered, and study setting [11].

One factor that may help explain these inconsistencies is the age of the child at the time of supplementation. A study administering zinc at a dose of 20 mg per day for one month demonstrated significant differences in weight, height, and mid-upper arm circumference between intervention and control groups (p < 0.05). However, these effects were observed only among children aged 24 to <36 months. No significant differences were found among children aged >36 to <48 months, while significant improvements in weight and height were again observed among children aged >48 to <60 months [24]. Overall, zinc supplementation appears to have a greater effect on linear growth and height-for-age among children older than two years compared to infants. This may be explained by the continued intake of zinc through breast milk during infancy, as zinc is a naturally occurring micronutrient in human milk. Accordingly, the effects of zinc supplementation on height and weight are more consistently observed among children aged 1–5 years and 5–13 years, but not among infants aged 6–12 months [11].

Consistent with the findings on zinc supplementation, the provision of chicken eggs in the present study also demonstrated a statistically significant effect on linear growth among stunted children. A significant increase in mean height was observed following the egg intervention (p = 0.00), indicating that eggs may serve as an effective dietary strategy to support catch-up growth in this population. These findings align with evidence from a systematic review of seven studies, which reported that children receiving egg supplementation experienced a mean height gain that was 0.47 cm greater than that of control groups. Notably, age-stratified analyses revealed that the growth-promoting effect of egg supplementation was more pronounced among children younger than two years, with an average height increase of 0.43 cm, whereas no significant effect was observed among children older than two years. In addition to linear growth, egg supplementation was associated with greater weight gain in the intervention group, with a mean difference of 0.07 kg compared to controls, and a more substantial increase observed among children under two years of age [8].

Evidence from intervention studies conducted in Ecuador further supports the role of eggs in improving child growth outcomes. Children who received egg-based interventions showed significant improvements in height-for-age (HAZ) scores, with an increase of 0.63 at the end of the intervention period, accompanied by a 47% reduction in stunting

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prevalence. Similarly, weight-for-age (WAZ) scores increased by 0.61, and the prevalence of underweight declined by 74% among children receiving eggs. These improvements were statistically significant and consistently greater than those observed in control groups [25]. Studies examining the provision of whole eggs have reported superior effects on both HAZ and WAZ compared to partial egg consumption, with height gains reaching 24.6 ± 8.5%, exceeding World Health Organization (WHO) recommendations for expected growth velocity across age groups [26]. Together, these findings suggest that eggs may contribute meaningfully to linear growth, particularly during critical periods of early childhood.

The observed effects of egg supplementation on growth are biologically plausible, given the nutrient density and composition of eggs. Following three months of egg consumption, children demonstrated significant increases in energy intake, macronutrients, and key micronutrients, including protein, fat, vitamin A, and vitamin B6, with consistently higher intakes in the intervention group compared to controls. Improvements in biochemical markers such as serum ferritin, zinc, and albumin further indicate enhanced nutritional status among children receiving eggs. Eggs are a high-quality source of complete protein, providing all essential amino acids, along with lipids, vitamins, and carotenoids that support growth and tissue development [27]. These nutritional characteristics position eggs as a particularly efficient food source for addressing multiple nutrient gaps commonly observed among stunted children.

Importantly, the benefits of egg supplementation extend beyond anthropometric outcomes to encompass broader aspects of child development. Children who consumed eggs have been shown to achieve higher scores in gross motor, fine motor, and problem-solving domains. Improved nutritional status, as reflected by gains in height and weight, is closely associated with developmental outcomes, including communication skills, cognitive functioning, motor development, and personal–social abilities [28]. Eggs provide several nutrients critical for neurodevelopment, including docosahexaenoic acid (DHA), vitamin B12, and choline, all of which play essential roles in brain development and immune function. Choline, in particular, is highly concentrated in eggs and has been implicated in neural development and cognitive performance. Emerging evidence also suggests that egg consumption may influence epigenetic mechanisms involved in physical and cognitive development during early life [29]. Given their high nutrient density, wide availability, and relative affordability, eggs represent a feasible and contextually appropriate intervention in many low- and middle-income settings.

Despite these promising findings, evidence regarding the impact of egg supplementation on linear growth remains heterogeneous. Studies conducted in Malawi and India reported no significant effects of daily egg consumption over six months on HAZ, stunting prevalence, or other anthropometric indicators, including weight-for-age and mid-upper arm circumference. In these studies, significant effects were limited to head circumference or were absent altogether. Importantly, contextual factors appear to play a critical role in shaping these outcomes. In the Malawi study, improvements in HAZ were more strongly associated with maternal education than with egg consumption, and the study setting was characterized by high fish availability and widespread fish consumption. As fish represents a high-quality source of animal protein, its routine consumption may have reduced the relative contribution of eggs to overall dietary adequacy. These findings underscore that the effectiveness of egg-based interventions is contingent upon baseline dietary patterns, food availability, caregiving practices, and broader socioeconomic conditions [30, 31].

4. Conclusion

The provision of one chicken egg per day and zinc supplementation at a dose of 10 ml per day for 90 days (12 weeks) had a significant effect on growth improvement among children aged 6–72 months with stunting. The mean body weight before the intervention was 10.07 kg and increased to 10.68 kg after the intervention. The mean height increased from 82.51 cm before the intervention to 85.64 cm after the intervention. Eggs are a source of complete protein; on average, one egg contains approximately 75 calories, 7 g of protein, 5 g of fat, 1.6 g of saturated fat, as well as vitamins and carotenoids. Zinc plays an important role in biochemical and physiological processes in the body, including cell growth, cell division and metabolism, intestinal electrolyte absorption, neurotransmission, immune response, enzyme stabilization or catalysis, protein function modulation, and reproduction. Eggs are an animal-source protein that is relatively easy to obtain and more affordable compared to other animal protein sources. Therefore, the combined provision of chicken eggs and zinc may be applied as an intervention to support child growth.

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