

The Difference Between Giving Iron Syrup and Vitamin C with Leaflet Media Education on Hemoglobin Levels in Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

Asni¹, Risnawati¹, Chandra Sulistyorini², Widya Astutik²

¹Undergraduate Midwifery Study Program, Wiyata Husada Institute of Health Technology and Science, Samarinda, Indonesia

²Wiyata Husada Institute of Health Technology and Science, Samarinda, Indonesia

Email: wdasnii@gmail.com

Abstract. *Stunting remains a health problem in toddlers, often accompanied by low hemoglobin levels due to iron deficiency. This condition can disrupt children's growth and development, requiring effective intervention. This study aims to analyze the differences in the provision of iron syrup and vitamin C with leaflet media education on hemoglobin levels in stunted toddlers aged 2–5 years in Perdana Village, Kembang Janggut District. The study used a quantitative method with a quasi-experimental design through a pretest-posttest control group design approach. The study population was 67 stunted toddlers with a sample of 36 respondents divided into experimental and control groups using a purposive sampling technique. The research instrument used the Easy Touch GCHb hemoglobin test and observation sheets. Data analysis was performed using the Wilcoxon Signed Rank Test and Mann-Whitney test. The results showed that the average hemoglobin level in the experimental group increased from 10.256 g/dL to 11.278 g/dL with a p-value <0.001, while the control group increased from 10.450 g/dL to 10.489 g/dL with a p-value of 0.088. The conclusion of the study showed that providing Fe syrup and vitamin C was more effective than leaflet media education in increasing hemoglobin levels in stunted toddlers aged 2–5 years.*

Keywords: *Anemia, Hemoglobin, Iron Supplementation, Stunting, Vitamin C*

Received: June 12, 2026

Received in Revised: July 10, 2026

Accepted: August 24, 2026

INTRODUCTION

Stunting remains a serious public health problem in toddlers because it impacts physical growth, cognitive development, and the quality of future human resources. The World Health Organization reports that the global prevalence of stunting in toddlers remains at 22%, or approximately 149.2 million children (Kartika et al., 2024). The global burden of childhood stunting continues to represent a major nutritional challenge, particularly in low- and middle-income countries, where inadequate dietary intake, infection, and socioeconomic vulnerability frequently interact (Suryawan et al., 2022). Stunting has also been associated with adverse neurodevelopmental and cognitive trajectories during early childhood (Aghniya, 2022; Mustakim et al., 2022). In Indonesia, the prevalence of stunting according to the Indonesian Nutritional Status Survey decreased from 21.5% in 2023 to 19.8% in 2024, but this figure remains above the long-term national target and requires continued attention.

In East Kalimantan Province, the prevalence of stunting was recorded at 22.9%, while Kutai Kartanegara Regency reached 16.24%, ranking sixth highest in the province. A more concerning condition was found in Kembang Janggut District with a stunting prevalence of 19.6%, and Perdana Village even became the area with the highest number of stunted toddlers in 2026. This phenomenon shows that the stunting problem in the area still requires comprehensive handling through nutritional interventions and optimal health services (Anjani et al., 2024; Mulyani et al., 2025; Herawati & Sunjaya, 2022; Ramlan et al., 2025). Previous evidence from Indonesia demonstrates that stunting is influenced by multiple individual, household, maternal, and environmental factors, with socioeconomic conditions and rural residence contributing to persistent disparities (Widyaningsih et al., 2022; Laksono et al., 2022; Yushananta & Ahyanti, 2022).

In addition to impacting physical growth, stunting is also closely related to low hemoglobin levels and the incidence of anemia in toddlers. Stunted toddlers who experience anemia are at risk of impaired brain development, delayed thinking skills, and decreased immunity, which can affect the child's quality of life in the future (Bhutta et al., 2017; Pettoello-Mantovani et al., 2025; Yakooob & Lo, 2017). Research by Orsango et al. (2021) shows that hemoglobin levels have a significant relationship with the incidence of stunting in toddlers aged 6–59 months. This condition is supported by research by Danianto et al. (2024) which explains that anemia in stunted toddlers is characterized by low hemoglobin levels due to chronic iron deficiency. Recent evidence confirms that iron-deficiency anemia and stunting frequently coexist among children in developing countries, with stunted children showing an elevated risk of iron-deficiency anemia (Oktarina et al., 2024). The global burden of anemia among children under five also remains substantial, with iron deficiency identified as its leading cause in many settings (Liu et al., 2024). Iron deficiency during infancy and childhood can further interfere with neurodevelopment and is particularly important during periods of rapid growth (Arulparithi et al., 2023).

In the work area of the Kembang Janggut Community Health Center, the number of stunting cases increased from 158 toddlers in 2024 to 335 toddlers in April 2026. The results of the preliminary study also showed that the majority of stunted toddlers had below-normal hemoglobin levels accompanied by poor consumption patterns, low vitamin C intake, and inadequate sanitation conditions. These findings indicate that the problem of anemia in stunted toddlers remains a health issue that needs to be addressed more effectively and sustainably (Kailola et al., 2025). Dietary diversity is an important component of adequate nutritional intake among young children and is associated with children's nutritional status in Indonesia (Samosir et al., 2023). Community and household conditions also remain important because maternal education, household socioeconomic characteristics, sanitation, and access to appropriate nutrition services can influence childhood nutritional outcomes (Laksono et al., 2022; Suleman et al., 2021).

The government has implemented stunting prevention efforts through strengthening nutritional services, community empowerment, and specific interventions such as iron supplementation. The Indonesian Ministry of Health, along with UNICEF, has implemented various stunting prevention programs through improving maternal and child health services, providing family support, and strengthening the capacity of health workers and community cadres. One recommended intervention is iron supplementation, as iron plays a crucial role in hemoglobin formation and oxygen transport in the body. However, the effectiveness of iron supplementation can be enhanced when combined with vitamin C, which helps increase iron absorption in the digestive tract, thus optimizing hemoglobin synthesis (Milman, 2020). Evidence from a large systematic review and meta-analysis indicates that oral iron supplementation produces meaningful improvements in hemoglobin concentration and reduces anemia, iron deficiency, and iron-deficiency anemia among children (Andersen et al., 2023). Another systematic review found that iron supplementation can improve hemoglobin outcomes in

children with iron-deficiency anemia, although the effectiveness may vary according to the iron preparation used (Arulparithi et al., 2023).

Research by Sumanti and Risnawati (2025) showed that iron supplementation increased hemoglobin levels in stunted children from an average of 10.329 g/dL to 11.119 g/dL. Furthermore, research by Deng et al. (2024) found that the combination of iron and vitamin C resulted in a higher increase in hemoglobin levels compared to iron supplementation alone. However, most previous studies were conducted on adolescent girls or pregnant women, while research on the combination of Fe syrup and vitamin C in stunted toddlers aged 2–5 years is still limited, especially in rural areas such as Perdana Village, Kembang Janggut District. Evidence concerning vitamin C supplementation alongside iron remains mixed, with a recent meta-analysis reporting a small increase in hemoglobin when vitamin C was added to oral iron, although the clinical magnitude of the effect was considered limited (Deng et al., 2024). Nevertheless, vitamin C remains biologically relevant because it facilitates the absorption of non-heme iron, particularly in populations with limited dietary iron bioavailability (Aulia et al., 2025).

The problem of this research lies in the persistently high incidence of low hemoglobin levels in stunted toddlers in Perdana Village despite the implementation of various stunting prevention programs. Low hemoglobin levels in toddlers can worsen the child's growth and development if not promptly addressed through appropriate interventions. On the other hand, health education using leaflets is also an approach used to increase parental knowledge regarding children's nutritional needs, but its effectiveness in increasing hemoglobin levels is not yet known with certainty. Nutritional education has been shown to improve maternal knowledge, self-efficacy, and complementary feeding practices, which are important components of childhood nutritional management (Mardani et al., 2024). Community-based interventions targeting mothers have likewise demonstrated improvements in knowledge, attitudes, and practices related to stunting prevention (Sutinbuk et al., 2024).

Therefore, scientific evidence is needed regarding the difference in effectiveness of providing iron syrup and vitamin C compared to leaflet-mediated education on increasing hemoglobin levels in stunted toddlers aged 2–5 years. This research is important because it can provide a scientific basis for health workers in determining more effective interventions to improve the hemoglobin status of stunted toddlers in areas with a high prevalence. Previous research has demonstrated that leaflet-based education can improve maternal knowledge and attitudes regarding stunting prevention (Achjar et al., 2023; Febriyanti & Setiyadi, 2023). Similar findings have been reported for e-leaflet-based education, which significantly improved mothers' knowledge concerning stunting prevention (Ariani et al., 2024). These findings suggest that educational media can strengthen parental understanding, although improvements in knowledge do not necessarily demonstrate a direct physiological effect on children's hemoglobin levels.

This study aims to analyze the differences in the provision of Fe syrup and vitamin C with leaflet media education on hemoglobin levels in stunted toddlers aged 2–5 years in Perdana Village, Kembang Janggut District. The urgency of this study lies in the high number of cases of stunting accompanied by anemia that are still found in toddlers, so that effective, easy-to-implement, and appropriate interventions are needed for local community conditions. The novelty of this study compared to previous studies is the use of a combination of Fe syrup and vitamin C in stunted toddlers aged 2–5 years with a comparison to leaflet media education in areas with a high prevalence of stunting. This study is expected to contribute to the development of community-based nutritional interventions to increase hemoglobin levels and support the acceleration of stunting reduction in toddlers. Evidence from recent intervention research also indicates that targeted nutritional interventions can improve linear growth among children experiencing pre-stunting and stunting. Interactive nutrition education has also demonstrated potential for improving maternal knowledge and attitudes toward stunting prevention compared with conventional leaflet-based education.

METHODS

This study employed a quantitative method with a quasi-experimental approach through a pretest-posttest control group design. This design was used to determine differences in hemoglobin levels in stunted toddlers aged 2–5 years between the group given the iron syrup and vitamin C intervention and the group given the leaflet education. Hemoglobin levels were measured before the intervention (pretest) and after the intervention (posttest) in both groups so that the changes could be compared objectively. The quantitative approach was chosen because it can explain the causal relationship between variables through statistically analyzed numerical data. The use of a quasi-experimental design is also considered appropriate for public health research with a limited number of respondents and field conditions that do not allow for full randomization. The population in this study was all stunted toddlers aged 2–5 years in Perdana Village, Kembang Janggut District, totaling 67 toddlers based on data from the Kembang Janggut Community Health Center in 2026. The research sample was selected using a purposive sampling technique based on inclusion and exclusion criteria that had been determined by the researcher. The inclusion criteria included toddlers aged 2–5 years who were diagnosed with stunting, were not currently taking iron or vitamin C supplements, did not have chronic diseases, and had obtained parental consent. The sample size was determined using the Federer formula because the study consisted of two treatment groups, resulting in a minimum of 16 respondents per group, then an additional 10% to anticipate dropout to 18 respondents per group for a total of 36 respondents. This technique was used so that the samples obtained were in accordance with the characteristics of the study and were able to optimally represent the population.

The research instruments consisted of an observation sheet, an Easy Touch GCHb (Point of Care Testing) hemoglobin test tool, and a standard operating procedure (SOP) for administering iron syrup and vitamin C, adapted from previous research. Hemoglobin testing was performed using capillary blood samples before and after the 14-day intervention. The data obtained were analyzed using SPSS through univariate and bivariate analyses. Univariate analysis was used to describe the distribution of hemoglobin levels based on minimum, maximum, mean, median, and standard deviation values. Prior to bivariate analysis, a Shapiro-Wilk normality test was performed because the sample size was less than 50 respondents. The test results showed that most of the data were not normally distributed, so a non-parametric test, the Wilcoxon Signed Rank Test, was used to determine differences in Hb levels before and after the intervention in each group, and the Mann-Whitney test to determine differences between treatment groups. The use of this test is appropriate for numerical data that is not normally distributed in two independent or paired groups. The research procedure was carried out through preparation, implementation, and final stages. The preparation stage included obtaining research permits, ethical testing, instrument preparation, and a preliminary study in the Kembang Janggut Community Health Center (Puskesmas) work area. The implementation stage involved identifying respondents according to the research criteria, providing explanations and obtaining informed consent to parents of toddlers, and then conducting an initial Hb test (pretest). The experimental group was given iron syrup and vitamin C once daily for 14 days, while the control group received education using leaflets. Researchers monitored intervention consumption daily to ensure respondent compliance. After the intervention was completed, a final Hb test (posttest) was conducted on both groups, and all data was recorded on an observation sheet. The final stage of the research involved checking data completeness, data processing, statistical analysis, and compiling a systematic and objective research report in accordance with ethical principles of health research.

RESULT AND DISCUSSION

Description of Hemoglobin Levels Before and After Administration of Iron Syrup and Vitamin C in the Experimental Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

To determine the picture of hemoglobin (Hb) levels before and after administration of Fe syrup and vitamin C in the experimental group of stunted toddlers aged 2–5 years in the Kembang Janggut District, a univariate analysis was conducted. This analysis aims to see the minimum, maximum, average (mean), and data distribution (standard deviation) of the respondents' hemoglobin levels before and after being given the intervention in the form of Fe syrup and vitamin C. The results of the analysis are presented in Table 1 below:

Table 1. Description of Hemoglobin Levels Before and After Administration of Iron Syrup and Vitamin C in the Experimental Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

	Minimum	Maximum	Mean	Std. Dev	N
Pretest	9.0	11.0	10,256	0.7188	18
Posttest	9.9	12.2	11,278	0.6236	

Source: Primary Data, (2026)

Based on Table 1, it is known that of the 18 respondents in the experimental group, before the administration of Fe syrup and vitamin C (pretest), the lowest hemoglobin (Hb) level was 9.0 g/dL and the highest was 11.0 g/dL, with an average Hb level of 10.256 g/dL and a standard deviation of 0.7188. After the administration of Fe syrup and vitamin C (posttest), the lowest Hb level was 9.9 g/dL and the highest was 12.2 g/dL, with an average Hb level of 11.278 g/dL and a standard deviation of 0.6236. Overall, the data describe the distribution of hemoglobin (Hb) levels in the 18 respondents in the experimental group before and after the administration of Fe syrup and vitamin C.

Description of Hemoglobin Levels Before and After Providing Leaflet Media Education to the Control Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

To determine the hemoglobin (Hb) levels before and after the control group of stunted toddlers aged 2–5 years in Perdana Village, Kembang Janggut District, a univariate analysis was conducted. This analysis aimed to determine the minimum, maximum, average (mean), and data distribution (standard deviation) of respondents' hemoglobin levels before and after being given education using leaflets. The results of this analysis are presented in Table 2 below:

Table 2. Description of Hemoglobin Levels Before and After Providing Leaflet Media Education to the Control Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

	Minimum	Maximum	Mean	Std. Dev	N
Pretest	9.3	11.0	10,450	0.5670	18
Posttest	9.4	11.1	10,489	0.5561	

Source: Primary Data, (2026)

Based on Table 2, it is known that in the 18 respondents in the control group before being given leaflet media education (pretest), the lowest hemoglobin (Hb) level was 9.3 g/dL and the highest was 11.0 g/dL, with an average Hb level of 10.450 g/dL and a standard deviation of 0.5670. After being given leaflet media education (posttest), the lowest Hb level was 9.4 g/dL and

the highest was 11.1 g/dL, with an average Hb level of 10.489 g/dL and a standard deviation of 0.5561. Overall, the data illustrates the distribution of hemoglobin (Hb) levels in the control group before and after being given leaflet media education.

Analysis of the Effect of Giving Iron Syrup and Vitamin C on Hemoglobin Levels Before and After in the Experimental Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

Table 3. Analysis of the Effect of Giving Iron Syrup and Vitamin C on Hemoglobin Levels Before and After in the Experimental Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

Ranks					
		N	Mean Rank	Sum of Ranks	P Value
<i>Posttest</i> Experimental Group Pretest Experimental Group	Negative Ranks	0a	.00	.00	<0.001
	Positive Ranks	18b	9.50	171.00	
	Ties	0c			
	Total	18			

Source: Primary Data, (2026)

Based on Table 3, the results of the Wilcoxon Signed Rank Test show that there were no respondents who experienced a decrease in hemoglobin (Hb) levels after administering Fe syrup and vitamin C, which is indicated by a negative ranks value of 0. On the other hand, all respondents (n = 18) experienced an increase in hemoglobin (Hb) levels after administering Fe syrup and vitamin C, which is indicated by a positive ranks value of 18 with a mean rank of 9.50 and a sum of ranks of 171.00. In addition, there were no respondents who had constant hemoglobin (Hb) levels before and after administering Fe syrup and vitamin C, which is indicated by a ties value of 0. Of the total 18 respondents studied. The statistical test results obtained a p-value <0.001, which is smaller than 0.05 ($p < 0.05$). This indicates that there is a statistically significant difference between hemoglobin (Hb) levels before and after administration of Fe syrup and vitamin C in the experimental group.

Analysis of the Effect of Leaflet Media Education on Hemoglobin Levels Before and After in the Control Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

Table 4. Analysis of the Effect of Leaflet Media Education on Hemoglobin Levels Before and After in the Control Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

Ranks					
		N	Mean Rank	Sum of Ranks	P Value
<i>Posttest</i> Control Group - Control Group Pretest	Negative Ranks	3D	5.00	15.00	0.088
	Positive Ranks	8e	6.38	51.00	
	Ties	7f			
	Total	18			

Source: Primary Data, (2026)

Based on Table 4. the results of the Wilcoxon Signed Rank Test in the control group show that there were 3 respondents who experienced a decrease in hemoglobin (Hb) levels after being given leaflet media education, which was indicated by a negative ranks value of 3 with a mean rank of 5.00 and a sum of ranks of 15.00. On the other hand, there were 8 respondents who experienced an increase in hemoglobin (Hb) levels after being given leaflet media education, which was indicated by a positive ranks value of 8 with a mean rank of 6.38 and a sum of ranks of 51.00. In addition, there were 7 respondents who had stable hemoglobin (Hb) levels before and after being given leaflet media education, which was indicated by a ties value of 7. Of the total

18 respondents studied. The statistical test results obtained a p-value of 0.088, which is greater than 0.05 ($p > 0.05$). This indicates that there was no statistically significant difference between hemoglobin (Hb) levels before and after the leaflet media education in the control group.

The Difference Between Providing Iron Syrup and Vitamin C with Leaflet Media Education on Hemoglobin Levels in Stunted Toddlers Aged 2–5 Years

Table 5. Differences in Providing Iron Syrup and Vitamin C with Leaflet Media Education on Hemoglobin Levels in Stunted Toddlers Aged 2–5 Years

Group	Mean rank	P Value
Administration of Iron Syrup and Vitamin C	24.39	<0.001
Providing Educational Media Leaflets	12.61	

Source: Primary Data, (2026)

Based on Table 5, it is known that the group that was given Fe syrup and vitamin C had a mean rank value of 24.39, while the group that was given leaflet media education had a mean rank value of 12.61. The results of the Mann-Whitney test obtained a p-value <0.001 ($p < 0.05$). This shows that there is a significant difference between the group given Fe syrup and vitamin C and the group given leaflet media education on hemoglobin (Hb) levels in stunted toddlers aged 2–5 years in Perdana Village, Kembang Janggut District. The higher mean rank value in the group given Fe syrup and vitamin C indicates that the hemoglobin (Hb) levels in that group are higher than the group given leaflet media education.

Description of Hemoglobin Levels Before and After Administration of Iron Syrup and Vitamin C in the Experimental Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

Based on Table 1, it is known that of the 18 respondents in the experimental group, before the administration of Fe syrup and vitamin C (pretest), the lowest hemoglobin (Hb) level was 9.0 g/dL and the highest was 11.0 g/dL, with an average hemoglobin (Hb) level of 10.256 g/dL and a standard deviation of 0.7188. After the administration of Fe syrup and vitamin C (posttest), the lowest Hb level was 9.9 g/dL and the highest was 12.2 g/dL, with an average Hb level of 11.278 g/dL and a standard deviation of 0.6236. Theoretically Ningsih et al. (2018) explain that normal hemoglobin levels in children aged 1–2 years are around 11–14 g/dL, while in children aged 3–5 years they are around 11–15 g/dL. Hemoglobin (Hb) is a protein found in red blood cells that functions to transport oxygen from the lungs to all body tissues and carry carbon dioxide back to the lungs for excretion. Low hemoglobin levels can indicate anemia, potentially disrupting a child's growth and development (Leung et al., 2021).

In toddlers with stunting, hemoglobin levels require attention because they are an indicator of a child's health and nutritional status. Stunted toddlers have a higher risk of having hemoglobin levels below the normal range than toddlers who do not experience stunting. This condition is related to the fulfillment of micronutrients, especially iron. Iron (Fe) is an essential micromineral that is crucial for the body, particularly in the formation of blood, specifically hemoglobin (Hb) in red blood cells. Furthermore, iron acts as a cofactor for various enzymes, thus influencing numerous physiological functions in the body. Iron deficiency can disrupt hemoglobin formation, resulting in low blood hemoglobin levels. Therefore, adequate iron intake from an early age is crucial for optimal child growth and development (Armitage & Moretti, 2019; Iolascon et al., 2024)

Several previous studies also describe the condition of hemoglobin levels in stunted toddlers. Analysis of Hemoglobin (Hb) Levels in Stunted Toddlers Aged 6–59 Months showed that of the 16 stunted toddlers studied, 9 toddlers (56.3%) had hemoglobin levels less than 11 g/dL, while 7 toddlers (43.7%) had hemoglobin levels ≥ 11 g/dL. The results of the study showed that 9 of the 16 stunted toddlers studied had hemoglobin levels less than 11 g/dL. In addition, research conducted by Eliati et al. (2021) entitled Comparison of Hemoglobin Levels in Stunting and Non-

Stunting Children showed that 33.33% of stunted toddlers had low hemoglobin levels, while all non-stunted toddlers had normal hemoglobin levels. The results of the study showed that low hemoglobin levels were found in 33.33% of stunted toddlers, while all non-stunted toddlers had normal hemoglobin levels.

According to the researcher's assumption, the description of hemoglobin levels in this study shows that the condition of hemoglobin levels before treatment is still below the normal range, while after treatment it is within the normal range according to the reference value for children aged 2–5 years. This condition illustrates that hemoglobin levels are one of the indicators that need to be considered in assessing the health condition and nutritional status of stunted toddlers. Therefore, the fulfillment of iron as a nutrient that plays a role in the formation of hemoglobin needs to be given attention so that hemoglobin levels in children aged 2–5 years remain within the normal range so that they can support the health condition and nutritional status of stunted toddlers.

Description of Hemoglobin Levels Before and After Providing Leaflet Media Education to the Control Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

Based on Table 2, it is known that in the 18 control group respondents before being given leaflet media education (pretest), the lowest hemoglobin (Hb) level was 9.3 g/dL and the highest was 11.0 g/dL, with an average Hb level of 10.450 g/dL and a standard deviation of 0.5670. After being given leaflet media education (posttest), the lowest Hb level was 9.4 g/dL and the highest was 11.1 g/dL, with an average Hb level of 10.489 g/dL and a standard deviation of 0.5561.

The characteristics of respondents in the control group showed that 8 toddlers with higher hemoglobin levels consisted of 6 toddlers aged 36–60 months and 2 toddlers aged 24–35 months, with 5 toddlers not receiving exclusive breastfeeding and 3 toddlers receiving exclusive breastfeeding. A total of 7 toddlers with stable hemoglobin levels consisted of 4 toddlers aged 24–35 months and 3 toddlers aged 36–60 months, with 4 toddlers receiving exclusive breastfeeding and 3 toddlers not receiving exclusive breastfeeding. Meanwhile, 3 toddlers with lower hemoglobin levels consisted of 2 toddlers aged 36–60 months and 1 toddler aged 24–35 months, with 2 toddlers not receiving exclusive breastfeeding and 1 toddler receiving exclusive breastfeeding. This picture shows that hemoglobin levels in the control group were not completely the same in each respondent.

Hemoglobin levels in toddlers are related to various factors that support the hemoglobin formation process, both from nutritional intake and the child's health. Malnutrition is one condition often found in toddlers with low hemoglobin levels. Furthermore, impaired nutrient absorption, blood loss, increased iron requirements during growth, and infectious diseases are also associated with hemoglobin formation. Therefore, meeting nutritional needs and maintaining a child's health are crucial to maintaining hemoglobin levels within normal limits.

In addition to nutritional factors and health conditions, hemoglobin levels in toddlers are also related to various other factors, such as the child's age, feeding patterns, parental knowledge of nutrition, education level, parenting styles, and the family's socioeconomic status. These factors reflect various conditions related to hemoglobin levels in toddlers. Meeting optimal nutritional needs and providing a supportive environment for child growth are crucial for maintaining hemoglobin levels in toddlers.

This is supported by research conducted by Sunardi et al. (2021) entitled Determinants of Anemia Incidence in Toddlers in Indonesia. The results showed that of the 1,153 toddlers studied, 687 toddlers (59.6%) had hemoglobin levels ≥ 11 g/dL, while 466 toddlers (40.4%) had hemoglobin levels < 11 g/dL. The study showed that hemoglobin levels in toddlers were related to the child's age, the number of household members, and the family's economic status. The results of the multivariate analysis also showed that the child's age and family economic status were the factors most related to hemoglobin levels in toddlers.

Furthermore, "Overview of Risk Factors for Anemia in Toddlers" shows that toddlers with low hemoglobin levels are more likely to be female (69.5%), have normal birth weight (57.4%), have stunted nutritional status based on the Height/Age index (66.6%), have a history of prematurity (60%), and come from mothers with low educational levels. This study illustrates that hemoglobin levels in toddlers are related to nutritional status, birth history, history of exclusive breastfeeding, and maternal and family characteristics that support the fulfillment of toddlers' nutritional and health needs.

According to the researcher's assumption, the hemoglobin level in the control group showed that the toddlers' hemoglobin levels before and after the leaflet education were still around 10 g/dL. This condition illustrates that hemoglobin levels in toddlers are related to various factors that support hemoglobin formation, such as adequate nutritional intake, health conditions, child age, feeding patterns, parental knowledge about nutrition, education level, parenting patterns, and family socioeconomic conditions. Therefore, fulfilling the nutritional needs and maintaining the health of toddlers needs to be considered so that hemoglobin levels remain within normal limits so that they can support optimal growth and development of toddlers.

The Effect of Giving Iron Syrup and Vitamin C on Hemoglobin Levels Before and After in the Experimental Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

Based on Table 3, the results of the Wilcoxon Signed Rank Test in the experimental group show that all respondents experienced an increase in hemoglobin (Hb) levels after administering Fe syrup and vitamin C. This is indicated by the positive ranks value of 18 respondents with a mean rank of 9.50 and a sum of ranks of 171.00. Meanwhile, the negative ranks value of 0 indicates that there were no respondents who experienced a decrease in hemoglobin levels after the intervention. In addition, the ties value of 0 indicates that there were no respondents with stable hemoglobin levels before and after administering Fe syrup and vitamin C. The results of the statistical test also showed a p-value <0.001 or less than 0.05. Thus, the alternative hypothesis (H_a) is accepted and the null hypothesis (H_0) is rejected, so there is an effect of administering Fe syrup and vitamin C on hemoglobin levels in stunted toddlers aged 2–5 years in Perdana Village, Kembang Janggut District.

The mechanism by which Fe contributes to hemoglobin levels occurs through several interrelated physiological processes. Fe plays a key role in the formation of heme, the structure of hemoglobin that binds oxygen. Adequate Fe availability allows for optimal heme synthesis, enabling the body to produce adequate amounts of hemoglobin. Furthermore, Fe plays a crucial role in erythropoiesis in the bone marrow, as it is necessary for erythrocyte maturation. When Fe requirements are met, red blood cell formation is more effective, supporting hemoglobin levels in the blood.

In this regard, vitamin C plays a role as a companion to iron intake or supplementation because it can help increase Fe absorption in the body. Adequate Fe availability is necessary for the process of hemoglobin synthesis, so increasing Fe absorption is crucial for hemoglobin formation. Mechanically, Fe entering the body is generally in the form of ferric (Fe^{3+}) and needs to be reduced to ferrous (Fe^{2+}) for easier absorption. Next, Fe^{2+} is absorbed in the small intestine, enters the bloodstream, binds to transferrin, and is transported to the bone marrow to be used as a raw material for hemoglobin synthesis. The available Fe then plays a role in the formation of heme and combines with globin to form hemoglobin. Thus, increasing Fe absorption with the help of vitamin C can support the process of hemoglobin formation and thus affect hemoglobin levels in the blood (Skolmowska & Głabska, 2022).

This is in line with research conducted by Sumanti and Risnawati (2025) entitled The Relationship of Iron Supplementation to Hb Levels in Stunting Children with Anemia in the Babulu District. The results of the study showed that iron supplementation affected hemoglobin levels in stunted children with anemia. The average hemoglobin level changed from 10.329 g/dL

before iron supplementation to 11.119 g/dL after iron supplementation. The results of the Wilcoxon Signed Rank Test also showed a p-value = 0.000, indicating a significant effect of iron supplementation on hemoglobin levels. The study explains that sufficient iron availability supports the process of hemoglobin formation so that hemoglobin levels can be in better condition.

In addition, The Effect of Fe Tablets and Vitamin C on Hemoglobin Levels in Adolescent Girls showed that the group receiving a combination of Fe tablets and vitamin C had better hemoglobin levels than the group receiving only Fe tablets. The average difference in hemoglobin levels in the Fe and vitamin C combination group was 2.2 g/dL, while in the group receiving only Fe tablets it was 0.9 g/dL. The study explains that vitamin C helps increase iron absorption, thereby supporting the process of hemoglobin formation.

Although all respondents in the experimental group experienced changes in hemoglobin levels after administering iron syrup and vitamin C, the magnitude of the changes varied among respondents. The study found that some respondents experienced the highest hemoglobin level change of 1.4 g/dL, while others experienced the lowest change of 0.6 g/dL during the 14 days of intervention. These differences in hemoglobin level changes indicate that each toddler's response to iron syrup and vitamin C can vary, even if they receive the same type and duration of intervention.

Differences in hemoglobin levels among respondents may be related to various factors that support the hemoglobin formation process. According to the Indonesian Ministry of Health (2018), hemoglobin levels are related to adequate intake of iron, vitamin C, folic acid, vitamin B12, diet, and the child's health condition. Furthermore, infectious diseases can also be related to iron metabolism and the erythrocyte formation process, so hemoglobin levels can vary from child to child. In stunted toddlers, suboptimal nutritional status can also be related to the body's ability to absorb and utilize iron. Compliance with iron and vitamin C syrup consumption, the frequency of nutritious food intake, and the child's immune system are also factors related to changes in hemoglobin levels after intervention.

Iron absorption in the body is also related to the type of iron consumed, the composition of complementary foods, and the presence of other nutrients in the food. Vitamin C and animal protein are known to help increase the absorption of non-heme iron in the digestive tract, while inhibitors such as tannins in tea, calcium, and fiber can hinder the iron absorption process in the intestine. Furthermore, the timing of consumption of foods or drinks containing inhibitors can also be related to the amount of iron absorbed by the body.

This is supported by research from Nugroho & Wardani (2022) "The Habit of Consuming Tea, Coffee, and Iron Tablets with the Incidence of Anemia in Pregnant Women in Sidoarjo." The results showed a correlation between the habit of consuming tea, coffee, and iron tablets and the incidence of anemia, with a p-value of 0.000. The study explained that the tannin content in tea and coffee can inhibit iron absorption in the body, thus related to the process of hemoglobin formation. Furthermore, adherence to iron tablet consumption and a nutritious diet also play a role in supporting adequate hemoglobin levels.

According to the researcher's assumption, administering iron syrup and vitamin C affects hemoglobin levels in stunted toddlers aged 2–5 years. This is evident from the changes in hemoglobin levels in all respondents after the intervention. This effect is related to the role of iron as a major component in hemoglobin formation and the role of vitamin C which helps increase iron absorption in the body. However, the magnitude of the change in hemoglobin levels in each respondent is not the same, which indicates that hemoglobin levels are also related to various other factors, such as adequate nutritional intake, diet, health conditions, infectious diseases, compliance with intervention consumption, and the body's ability to absorb and utilize iron. Therefore, administering iron syrup and vitamin C supported by adequate nutrition and good health conditions can help support hemoglobin levels in stunted toddlers.

The Effect of Leaflet Media Education on Hemoglobin Levels Before and After in the Control Group of Stunted Toddlers Aged 2–5 Years in Perdana Village, Kembang Janggut District

Based on Table 4, the results of the Wilcoxon Signed Rank Test in the control group show that there were 8 respondents who experienced changes in hemoglobin (Hb) levels after being given leaflet media education, with a mean rank of 6.38 and a sum of ranks of 51.00. In addition, there were 3 respondents who experienced a decrease in hemoglobin levels with a mean rank of 5.00 and a sum of ranks of 15.00, and 7 respondents who had stable hemoglobin levels before and after treatment (ties). The results of the statistical test showed a p-value of 0.088 or greater than 0.05. Thus, the alternative hypothesis (H_a) was rejected and the null hypothesis (H_0) was accepted, so there was no effect of leaflet media education on hemoglobin levels in stunted toddlers aged 2–5 years in Perdana Village, Kembang Janggut District.

The health education mechanism through leaflets on hemoglobin levels occurs through increasing mothers' knowledge and understanding of children's health and nutrition. Health education provides information that can help mothers understand the importance of nutritional intake, particularly iron and vitamin C, which play a role in hemoglobin formation. This increased knowledge can support changes in mothers' behavior in selecting, preparing, and providing food that meets children's nutritional needs. In this regard, leaflets are a health communication medium in the form of sheets containing information, images, or a combination of both to help convey health messages to the public. Leaflets are used to facilitate public understanding of health information because they are presented concisely, simply, and easily read (Dianna et al., 2020). Furthermore, leaflets can be read repeatedly, helping the target audience understand and recall the health information provided. By delivering information that is easy to understand and re-accessible, leaflets can support increased mothers' knowledge about nutritional intake, stunting prevention, and efforts to maintain children's health.

This is supported by research from Safitri et al. (2025) entitled *The Effectiveness of Health Education Through Leaflet Media on the Level of Knowledge of Anemia in Adolescent Girls at SMPN 8 Satap Mantewe, Tanah Bumbu Regency in 2024*. The results of the study showed that health education through leaflet media was effective in increasing adolescent knowledge about anemia with a p-value of 0.000 ($p < 0.05$). The study explained that leaflets have the advantage of conveying information briefly, easily understood, can be read repeatedly, and help improve the target's understanding of the health information provided.

However, the results of the study showed that changes in hemoglobin levels in the control group did not show optimal results. Based on the research data, there were 8 respondents who experienced changes in hemoglobin levels with the highest change being 0.2 g/dL, 3 respondents experienced a decrease in hemoglobin levels of 0.1 g/dL, and 7 respondents had stable hemoglobin levels after being given leaflet media education. These results indicate that leaflet media education did not provide significant changes to hemoglobin levels in the control group. In addition, leaflet media education focused more on increasing mothers' knowledge and understanding so that changes to biological conditions such as hemoglobin levels require more time and consistency in applying the information that has been provided.

Changes in hemoglobin levels in toddlers are not only related to the health information received by mothers but also to their ability to apply that information in their daily lives. According to Prasetyo et al. (2023), knowledge is one of the factors underlying the formation of a person's health behavior. Good knowledge can help mothers make decisions regarding their children's nutritional and health needs. However, changes in health behavior do not occur instantly, requiring a continuous process of understanding, acceptance, and implementation. Therefore, increasing knowledge through educational leaflets may not necessarily lead to immediate changes in biological conditions, such as hemoglobin levels, within a relatively short

period of time. In addition to knowledge, changes in hemoglobin levels in toddlers can also be related to various other factors, such as food consumption patterns, the child's health condition, the mother's occupation, and family income. These factors play a role in meeting a child's nutritional needs and can therefore be related to the child's nutritional status and overall health.

This is supported by research from Khair et al. (2021) "Factors Affecting the Nutritional Status of Preschool Children." The results showed a relationship between maternal knowledge, maternal occupation, and family income with the nutritional status of preschool children, with a p-value <0.05. The study explained that a lack of nutritional knowledge among mothers can hinder the fulfillment of children's nutritional needs, while low family income can limit the family's ability to provide nutritious food. Furthermore, working mothers have less time to pay attention to their children's diet and nutritional needs, which is related to children's nutritional status and health.

According to the researcher's assumption, leaflet media education has not had a significant effect on hemoglobin levels in stunted toddlers aged 2–5 years in Perdana Village, Kembang Janggut District. This can be seen from the results of statistical tests which show no significant effect after providing leaflet media education. Leaflet media education plays a role in increasing mothers' knowledge and understanding of the importance of fulfilling nutrition, healthy eating patterns, and preventing stunting. However, changes in hemoglobin levels in toddlers require a more complex process because they are related to the adequacy of nutritional intake, food consumption patterns, children's health conditions, and consistent implementation of eating patterns. Therefore, changes in hemoglobin levels in toddlers cannot be achieved only through providing education in a relatively short time, but also require the support of various factors related to fulfilling nutrition and children's health.

The Difference Between Providing Iron Syrup and Vitamin C with Leaflet Media Education on Hemoglobin Levels in Stunted Toddlers Aged 2–5 Years

Based on Table 5, it is known that the group given Fe syrup and vitamin C has a mean rank value of 24.39, while the group given leaflet media education has a mean rank value of 12.61. The results of the Mann-Whitney test show a p-value <0.001 or less than 0.05. Thus, the alternative hypothesis (H_a) is accepted and the null hypothesis (H_0) is rejected, so there is a significant difference in the effect between the provision of Fe syrup and vitamin C with leaflet media education on hemoglobin levels in stunted toddlers aged 2–5 years in Perdana Village, Kembang Janggut District.

Administering iron syrup and vitamin C through educational leaflets has a different effect on hemoglobin levels. Iron syrup and vitamin C work directly by providing the nutrients the body needs for hemoglobin formation. Iron is a key component of hemoglobin and is essential for red blood cell formation. Furthermore, vitamin C helps increase iron absorption, optimizing its utilization in hemoglobin formation. This process fulfills the iron requirement for hemoglobin formation, thus supporting hemoglobin levels in the blood.

Meanwhile, leaflet-based education does not directly affect hemoglobin formation, but rather improves mothers' knowledge and understanding of children's nutritional needs and health. Information conveyed through leaflets is expected to encourage mothers to adopt better feeding patterns tailored to their children's nutritional needs. Furthermore, leaflets offer the advantage of being concise, easy-to-understand, and reusable, helping to enhance the target audience's understanding of the health messages. However, changes in hemoglobin levels through education take longer because they depend on the application of the information in daily life and the consistency of children's nutritional intake.

According to a study conducted by Thamrin and Sharief (2020) entitled "Comparison of Iron and Vitamin C Tablets with Iron and Vitamin A Tablets on Increasing Hemoglobin Levels in Midwifery Female Students," the results of the study showed that there was a difference in hemoglobin levels after the intervention with a p value = 0.000. The study explains that vitamin

C helps increase iron absorption so that its utilization in the hemoglobin formation process becomes more optimal.

In addition, according to research conducted by Ramadhani & Kuswandi (2025) entitled "Nutrition Education Through Leaflet Media to Increase Knowledge of Mothers of Toddlers in Depok City, West Java in 2023", the results of the study showed that providing nutrition education through leaflet media had an effect on the knowledge of mothers of toddlers with a p -value = 0.001 ($p < 0.05$). The study explained that leaflet media is effective for use as an educational tool because the information conveyed can be read repeatedly, is easy to understand, and helps increase mothers' understanding of nutrition and child health.

Although both groups showed changes in hemoglobin levels after the intervention, the results obtained in each group were different. The group given iron syrup and vitamin C had a mean rank value of 24.39, while the leaflet media education group had a mean rank value of 12.61. In the iron syrup and vitamin C group, all respondents experienced changes in hemoglobin levels, while in the leaflet media education group, there were still respondents who experienced a decrease in hemoglobin levels or hemoglobin levels that remained the same. This condition shows that the two interventions provide different results on hemoglobin levels in stunted toddlers.

The difference in results between the two groups may be related to the type of intervention provided. Nutrition education is one form of intervention in preventing and addressing nutritional and health problems. Education aims to increase knowledge and encourage better behavior changes in meeting nutritional needs. Through this increased knowledge, it is hoped that nutritional intake will improve, which in turn can influence children's nutritional status and health. However, the impact of education on health requires a continuous process and implementation in daily life. Therefore, changes in hemoglobin levels through leaflet-based education require a longer timeframe. In contrast, administering iron syrup and vitamin C is a direct intervention that provides the body with essential nutrients, so its effects on hemoglobin levels can be seen more quickly.

According to research conducted by Munir and Audyna (2022) entitled "The Effect of Education about Stunting on the Knowledge and Attitudes of Mothers with Stunting Children," the results of the study indicate that providing education influences the knowledge, attitudes, and behavior of mothers in caring for stunted children. The study explains that education can improve mothers' understanding of nutrition and child health, thereby encouraging better behavioral changes in meeting children's needs. These behavioral changes are expected to support improvements in children's nutritional and health status, but require continuous implementation in daily life to provide an optimal impact on children's health conditions.

Based on the description, the researcher assumes that the provision of iron syrup and vitamin C has a better effect than leaflet media education on hemoglobin levels in stunted toddlers aged 2–5 years in Perdana Village, Kembang Janggut District. This is seen from the mean rank value of the iron syrup and vitamin C group which is higher than the leaflet media education group. The provision of iron syrup and vitamin C can provide the nutrients the body needs directly to support hemoglobin formation, while leaflet media education plays a greater role in increasing mothers' knowledge and understanding regarding fulfilling children's nutrition. In addition, the condition of hemoglobin levels in toddlers can also be related to various other factors, such as nutritional intake, diet, health conditions, iron absorption capacity, and family socio-economic conditions.

CONCLUSION

The results of the study showed that the administration of Fe syrup and vitamin C significantly increased hemoglobin levels in stunted toddlers aged 2–5 years in Perdana Village, Kembang Janggut District. The average hemoglobin level in the experimental group increased from 10.256 g/dL to 11.278 g/dL with a p -value < 0.001 . Meanwhile, the control group given

leaflet media education only experienced a small increase from 10.450 g/dL to 10.489 g/dL and did not show a statistically significant difference with a p-value of 0.088. The results of the Mann-Whitney test also showed a significant difference between the two groups with a p-value <0.001. These findings indicate that the administration of Fe syrup and vitamin C is more effective than leaflet media education in increasing hemoglobin levels in stunted toddlers.

SUGGESTION

This study is limited by its relatively small sample size, short intervention period of 14 days, and the failure to control for other factors that may influence hemoglobin levels, such as diet, history of infection, and family socioeconomic conditions. Therefore, further research is recommended using a larger sample size, a longer intervention duration, and considering other factors related to the nutritional status and health of toddlers. The practical implications of this study indicate that administering iron syrup and vitamin C can be an effective nutritional intervention in increasing hemoglobin levels in stunted toddlers. Furthermore, ongoing health education is needed to support changes in parental behavior in meeting children's nutritional needs.

REFERENCES

- Achjar, K. A. H., Marni, N. K., Lestari, A. S., & Ribek, I. N. (2023). Health education with leaflet media on the level of knowledge of mother's about toddler rearing partners in stunting prevention. *Journal of Education Research and Evaluation*, 7(2), 197–203. <https://doi.org/10.23887/jere.v7i2.61560>
- Aghniya, R. (2022). Dampak stunting terhadap perkembangan kognitif dan motorik anak stunting: Systematic literature review. *Scientia Journal*, 11(2), 178–189.
- Andersen, C. T., Marsden, D. M., Duggan, C. P., Liu, E., Mozaffarian, D., & Fawzi, W. W. (2023). Oral iron supplementation and anaemia in children according to schedule, duration, dose and cosupplementation: A systematic review and meta-analysis of 129 randomised trials. *BMJ Global Health*, 8(2), e010745. <https://doi.org/10.1136/bmigh-2022-010745>
- Anjani, S., Rohmawati, N., Oktafiani, L. D. A., & Handayani, O. R. (2024). Hubungan antara tingkat pendidikan, pengetahuan ibu, dan pendapatan keluarga dengan pola makan balita stunting. *ARTERI: Jurnal Ilmu Kesehatan*, 6(1), 8–16.
- Ariani, D., Septiani, H., & Srinayanti, Y. (2024). The effects of using e-leaflet and lecture methods on maternal knowledge regarding stunting prevention in toddlers. *Genius Journal*, 5(1), 6–11. <https://doi.org/10.56359/gj.v5i1.329>
- Armitage, A. E., & Moretti, D. (2019). The importance of iron status for young children in low-and middle-income countries: a narrative review. *Pharmaceuticals*, 12(2), 59. <https://doi.org/10.3390/ph12020059>
- Arulparithi, C. S., Arunbabu, T., & Manjani, S. (2023). Iron preparations in the management of iron deficiency anemia in infants and children: A systematic review and meta-analysis. *Indian Pediatrics*, 60(9), 752–758.
- Aulia, B., Notarianti, R., Larasati, A. Q., & Sitorus, N. L. (2025). Optimizing iron absorption in children through vitamin C supplementation and fortification: A review. *Journal of Indonesian Specialized Nutrition*, 3(3). <https://doi.org/10.63953/jisn.v3i3.55>
- Bhutta, Z. A., Guerrant, R. L., & Nelson III, C. A. (2017). Neurodevelopment, nutrition, and inflammation: the evolving global child health landscape. *Pediatrics*, 139(Supplement_1), S12–S22. <https://doi.org/10.1542/peds.2016-2828D>
- Danianto, A., Cholidah, R., Amalia, E., & Purnaning, D. (2024). The relationship between stunting and anemia in toddlers in Malaka Coastal Area, North Lombok. *Jurnal Biologi Tropis*,

24(4), 1097–1103. <https://doi.org/10.29303/jbt.v24i4.7990>

- Deng, J., Ramelli, L., Li, P. Y., Eshaghpour, A., Li, A., Schuenemann, G., & Crowther, M. A. (2024). Efficacy of vitamin C with Fe supplementation in patients with iron deficiency anemia: a systematic review and meta-analysis. *Blood Vessels, Thrombosis & Hemostasis*, 1(4), 100023. <https://doi.org/10.1016/j.bvth.2024.100023>
- Dianna, Septianingsih, N., & Pangestu, J. F. (2020). Perbedaan pengetahuan ibu balita sebelum dan sesudah diberikan penyuluhan tentang stunting melalui media video dan leaflet di wilayah kerja Puskesmas Saigon Kecamatan Pontianak Timur. *Jurnal Kebidanan Khatulistiwa*, 6(1), 7.
- Eliati, Handayani, S., Nidia, W. H., Rohani, Susanti, D., & Rahliadi, R. (2021). Faktor-faktor yang berhubungan dengan kejadian stunting pada balita usia 3–5 tahun di Kecamatan Badar Kabupaten Aceh Tenggara. *Nasuwakes: Jurnal Ilmiah Kesehatan*, 14(2), 123–135.
- Febriyanti, C. E. K., & Setiyadi, N. A. (2023). Differences in the effectiveness of audiovisual media and leaflets on the knowledge and attitudes of mothers of toddlers in Bogorejo Village about stunting. *Gaster*, 21(2), 267–278. <https://doi.org/10.30787/gaster.v21i2.1192>
- Herawati, D. M. D., & Sunjaya, D. K. (2022). Implementation outcomes of national convergence action policy to accelerate stunting prevention and reduction at the local level in Indonesia: A qualitative study. *International Journal of Environmental Research and Public Health*, 19(20), 13591. <https://doi.org/10.3390/ijerph192013591>
- Iolascon, A., Andolfo, I., Russo, R., Sanchez, M., Busti, F., Swinkels, D., ... & from EHA-SWG Red Cell and Iron. (2024). Recommendations for diagnosis, treatment, and prevention of iron deficiency and iron deficiency anemia. *Hemasphere*, 8(7), e108. <https://doi.org/10.1002/hem3.108>
- Kailola, N. E., Seimahuira, T. N., Soumena, R. Z., & Siahaya, P. G. (2025). Anemia Screening and Health Education on Stunting Reduction Efforts. *Unram Journal of Community Service*, 6(4), 1100–1106. <https://doi.org/10.29303/ujcs.v6i4.1196>
- Kartika, D., Zoelkarnain, I., Illiandri, O., Adhani, R., & Musafaah, M. (2024). Analysis of Factors Associated with the Incidence of Stunting in Toddlers: Factor Analysis of Family Support, Health Worker Support, Insurance Participation, and Income. *Journal La Medihealthico*, 5(5), 1112–1117. <https://doi.org/10.37899/journallamedihealthico.v5i5.1742>
- Khair, A., Rahayu, S. F., & Muhsinin, M. (2021). Faktor Yang Mempengaruhi Status Gizi Anak Prasekolah. *DINAMIKA KESEHATAN: JURNAL KEBIDANAN DAN KEPERAWATAN*, 12(1), 210–220. <https://doi.org/10.33859/dksm.v12i1.632>
- Laksono, A. D., Wulandari, R. D., Amaliah, N., & Wisnuwardani, R. W. (2022). Stunting among children under two years in Indonesia: Does maternal education matter? *PLoS ONE*, 17(7), e0271509. <https://doi.org/10.1371/journal.pone.0271509>
- Leung, A. K., Lam, J. M., Wong, A. H., Hon, K. L., & Li, X. (2024). Iron deficiency anemia: an updated review. *Current pediatric reviews*, 20(3), 339–356. <https://doi.org/10.2174/1573396320666230727102042>
- Liu, Y., Ren, W., Wang, S., Xiang, M., Zhang, S., & Zhang, F. (2024). Global burden of anemia and cause among children under five years 1990–2019: Findings from the Global Burden of Disease Study 2019. *Frontiers in Nutrition*, 11, 1474664. <https://doi.org/10.3389/fnut.2024.1474664>
- Mardani, R. A. D., Wu, W. R., Hajri, Z., Thoyibah, Z., Yolanda, H., & Huang, H. C. (2024). Effect of a nutritional education program on children's undernutrition in Indonesia: A randomized controlled trial. *Journal of Pediatric Health Care*, 38(4), 552–563. <https://doi.org/10.1016/j.pedhc.2024.02.006>

- Milman, N. T. (2020). A review of nutrients and compounds, which promote or inhibit intestinal iron absorption: making a platform for dietary measures that can reduce iron uptake in patients with genetic haemochromatosis. *Journal of Nutrition and Metabolism*, 2020(1), 7373498. <https://doi.org/10.1155/2020/7373498>
- Mulyani, A. T., Khairinisa, M. A., Khatib, A., & Chaerunisaa, A. Y. (2025). Understanding stunting: impact, causes, and strategy to accelerate stunting reduction—a narrative review. *Nutrients*, 17(9), 1493. <https://doi.org/10.3390/nu17091493>
- Munir, Z., & Audyna, L. (2022). Pengaruh edukasi tentang stunting terhadap pengetahuan dan sikap ibu yang mempunyai anak stunting. *Jurnal Keperawatan Profesional*, 10(2), 29-54. <https://doi.org/10.33650/jkp.v10i2.4221>
- Mustakim, M. R. D., Irwanto, I., Irawan, R., Irmawati, M., & Setyoboedi, B. (2022). Impact of stunting on development of children between 1–3 years of age. *Ethiopian Journal of Health Sciences*, 32(3), 569–578. <https://doi.org/10.4314/ejhs.v32i3.13>
- Ningsih, D. D. R., Panunggal, B., Pramono, A., & Fitranti, D. Y. (2018). *Hubungan Asupan Protein dan Kebiasaan Makan Pagi terhadap Kadar Hemoglobin pada Anak Usia 9–12 tahun di Tambaklorok Semarang Utara* (Doctoral dissertation, Diponegoro University).
- Nugroho, R. F., & Wardani, E. M. (2022). Habit of consumption of tea, coffee and Fe tablets with the incidence of anemia in pregnant women in Sidoarjo. *Pancasakti Journal of Public Health Science and Research (PJPHSR)*, 2(1), 51-56.
- Oktarina, C., Dilantika, C., Sitorus, N. L., & Basrowi, R. W. (2024). Relationship between iron deficiency anemia and stunting in pediatric populations in developing countries: A systematic review and meta-analysis. *Children*, 11(10), 1268. <https://doi.org/10.3390/children11101268>
- Orsango, A. Z., Loha, E., Lindtjørn, B., & Engebretsen, I. M. S. (2021). Co-morbid anaemia and stunting among children 2–5 years old in southern Ethiopia: a community-based cross-sectional study. *BMJ Paediatrics Open*, 5(1), e001039. <https://doi.org/10.1136/bmipo-2021-001039>
- Pettoello-Mantovani, M., Bali, D., Sevetoglu, E., Pastore, M., Vural, M., & Giardino, I. (2025). The first thousand days: nourishing the developing brain for a lifetime of mental well-being. Narrative review. *Global Pediatrics*, 100270.
- Prasetyo, Y. B., Permatasari, P., & Susanti, H. D. (2023). The effect of mothers' nutritional education and knowledge on children's nutritional status: a systematic review. *International Journal of Child Care and Education Policy*, 17(1), 11. <https://doi.org/10.1186/s40723-023-00114-7>
- Ramadhani, L. N., & Kuswandi, F. D. (2025). Edukasi gizi melalui media Leaflet terhadap peningkatan pengetahuan ibu balita di Kota Depok, Jawa Barat tahun 2023. *Jurnal Pengabdian Gizi dan Kesehatan Masyarakat*, 2(2), 155-161. <https://doi.org/10.53823/jpgkm.v2i2.105>
- Ramlan, P., Sukri, P., Abdullah, M. T., Ibrahim, M. A., Ahmad, J., & Adri, K. (2025). A Systematic Review of Maternal and Child Health Policies in Addressing Stunting: Trends and Challenges. *Journal of Public Health and Pharmacy*, 5(1), 119-130. <https://doi.org/10.56338/jphp.v5i1.6001>
- Safitri, L., Suhrawardi, S., Kristiana, E., & Isnaniah, I. (2025). Efektivitas pendidikan kesehatan melalui media leaflet terhadap tingkat pengetahuan anemia remaja putri di SMPN 8 Satap Mantewe Kabupaten Tanah Bumbu tahun 2024. *Jurnal Penelitian Multidisiplin Bangsa*, 1(8), 1432-1437. <https://doi.org/10.59837/jpnmb.v1i8.297>
- Samosir, O. B., Radjiman, D. S., & Aninditya, F. (2023). Food consumption diversity and nutritional status among children aged 6–23 months in Indonesia: The analysis of the results of the

2018 Basic Health Research. *PLoS ONE*, 18(3), e0281426.
<https://doi.org/10.1371/journal.pone.0281426>

- Skolmowska, D., & Głabaska, D. (2022). Effectiveness of dietary intervention with iron and vitamin C administered separately in improving iron status in young women. *International journal of environmental research and public health*, 19(19), 11877. <https://doi.org/10.3390/ijerph191911877>
- Suleman, Y., Tasnim, T., & Wahab, H. (2021). Analysis of the influence of health education to improve mother's knowledge in preventing stunting in Masolaka Raya Sub-District, Bombana District. *Indonesian Journal of Health Sciences Research and Development*, 3(1), 129–135. <https://doi.org/10.36566/ijhsrd/vol3.iss1/65>
- Sumanti, S., & Risnawati, R. (2025). Hubungan Pemberian FE Terhadap Kadar HB Pada Anak Stunting Dengan Anemia Di Wilayah Kecamatan Babulu. *Innovative: Journal Of Social Science Research*, 5(2), 4136-4149. <https://doi.org/10.31004/innovative.v5i2.18683>
- Sunardi, D., Bardosono, S., Basrowi, R. W., Wasito, E., & Vandenplas, Y. (2021). Dietary determinants of anemia in children aged 6–36 months: A cross-sectional study in Indonesia. *Nutrients*, 13(7), 2397. <https://doi.org/10.3390/nu13072397>
- Suryawan, A., Jalaludin, M. Y., Poh, B. K., Sanusi, R., Tan, V. M. H., Geurts, J. M., & Muhandi, L. (2022). Malnutrition in early life and its neurodevelopmental and cognitive consequences: A scoping review. *Nutrition Research Reviews*, 35(1), 136–149. <https://doi.org/10.1017/S0954422421000159>
- Sutinbuk, D., Nugraheni, S. A., Rahfiludin, M. Z., & Setyaningsih, Y. (2024). Effectiveness of ERKADUTA model to increase stunting prevention behaviors among mothers with toddlers in Indonesia: A quasi-experiment. *Narra J*, 4(1), e688. <https://doi.org/10.52225/narra.v4i1.688>
- Thamrin, H., & Sharief, S. A. (2020). Perbandingan Pemberian Tablet Fe dan Vitamin C dengan Tablet Fe dan Vitamin A terhadap Peningkatan Kadar Hemoglobin pada Mahasiswa Kebidanan. *Jurnal Penelitian Kesehatan "SUARA FORIKES"(Journal of Health Research "Forikes Voice")*, 11(1), 1-5. <http://dx.doi.org/10.33846/sf11101>
- Widyaningsih, V., Mulyaningsih, T., Rahmawati, F. N., & Adhitya, D. (2022). Determinants of socioeconomic and rural-urban disparities in stunting: Evidence from Indonesia. *Rural and Remote Health*, 22(1), 7082. <https://doi.org/10.22605/RRH7082>
- Yakoob, M. Y., & Lo, C. W. (2017). Nutrition (micronutrients) in child growth and development: a systematic review on current evidence, recommendations and opportunities for further research. *Journal of developmental & behavioral pediatrics*, 38(8), 665-679.
- Yushananta, P., & Ahyanti, M. (2022). Risk factors of stunting in children aged 6–59 months: A case-control study in horticulture area. *Open Access Macedonian Journal of Medical Sciences*, 10(E), 1–5.