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Effect Of Moringa Oliefera Supplementation During Pregnancy on Stunting in Children of Pre-School Age

Hasan Basri [1,5]✉, Nur Hikmah [2], Veni Hadju [1,5], Burhanuddin Bahar [1], Andi Zulkifli [3], Syamsiar S. Russeng [4]

[1]Department of Nutrition Science, Faculty of Public Health, Hasanuddin University, Makassar
[2]Master Student of Public Health, Faculty of Public Health, Hasanuddin University, Makassar
[3]Department of Epidemiology, Faculty of Public Health, Hasanuddin University, Makassar
[4]Department of Occupational Health and Safety, Faculty of Public Health, Hasanuddin University, Makassar
[5]Researcher of Indonesian Center of Nutrition Studies (ICONS)

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Abstract

Stunting is a growth failure due to a lack of nutrition that has lasted from pregnancy to 24 months of age. This study aims to examine the effect of moringa supplementation during pregnancy on stunting in preschool children (5-6 years old). This study is a follow-up study of a Randomized Control Trial with Double Blind study that provides moringa supplements in the form of PG (Powder Group), EG (Extract Group), and as well as IFA (Iron Folate Acid) supplements to pregnant women. The subjects were 303 children in six sub-districts in Jeneponto District who were children of mothers who received supplementation of PG, EG, and IFA during pregnancy. Children's height was measured using a microtoice. Data were statistically analyzed using the Logistic Regression test. The results showed a significant difference between the three groups. EG intervention had a significant effect on stunting in preschool-age children (5-6 years old). EG intervention (24.18%) showed the lowest prevalence of stunting among PG (25.47) and IFA (38.68%) interventions. EG prevented stunting by 2.215 times compared to the other intervention groups. The provision of Moringa extract to pregnant women has a better effect on reducing stunting.

Introduction

Stunting is a condition where a person's height is smaller than that of a person of the same age (Kementerian Kesehatan, 2021). Stunting is a linear growth disorder due to malnutrition from nutrient intake and chronic infectious diseases, characterized by a height-for-age z-score (HAZ) of less than two standard deviations. The problem of stunting is not caused by one factor but is caused by multi-factor (Beal *et al.*, 2018). Stunting is a process of stunted child growth occurring due to chronic malnutrition conditions (WHO, 2018). The short-term effect of stunting is impaired child growth, and the long-term is child development. This 1000 Days of Lfe period is the critical period at the beginning of life (Titaley *et al.*, 2019). Some of the direct causes of stunting in children are inadequate nutritional intake, infectious diseases, and poor parenting (Nugroho *et al.*, 2021; Zakaria *et al.*, 2016). Indirect factors affecting stunting include parenting, parents, income, maternal knowledge, and consumption patterns, and direct factors are genetics, intake, and infectious diseases (Sulistyaningsih *et al.*, 2018; Zakaria *et al.*, 2016).

The prevalence of stunting is 22% or 149.2 million children under 5 years globally by 2020. The prevalence of stunted children in Indonesia in 2018 was 30.8%. Then there was a decrease in 2019 the stunting rate was

✉ Correspondence Address:
Department of Nutrition Science, Faculty of Public Health, Hasanuddin University, Makassar
Email: hasanbasri.phunhas@gmail.com

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around 27.7% and reduced to 24.40% in 2021 (Kementerian Kesehatan, 2021), and to 21.6% in 2022 (Kementerian Kesehatan, 2022). The prevalence of stunting in South Sulawesi ranks 10th highest in Indonesia at 27.2%. Similarly, Jeneponto Regency has the highest prevalence of stunting in South Sulawesi at 39.8% (Kementerian Kesehatan, 2022). One of the local foods, rich in nutrients, is Moringa Oleifera, commonly known as Moringa leaves (Ariesthi *et al*., 2021; Fuglie, 2003). Moringa trees are easily grown in Indonesia and very common in the South Sulawesi area (Hastuti *et al*., 2020). This plant usually grows in dry places (Khan *et al*., 2014). A comparative study of fresh Moringa leaves, when compared to other foods, contains 7 times the vitamin C of oranges, 4 times the vitamin A of carrots, 4 times the calcium of milk, 3 times the potassium of bananas, and 2 times the protein of yogurt(Sultana, 2020). Moringa Oleifera leaves are rich in macronutrients and micronutrients such as calcium, potassium, zinc, magnesium, iron, and copper (Gopalakrishnan *et al*., 2016). Moringa content effectively increases hemoglobin (Hb) concentration, which plays the same role as iron-folate supplementation (Nadimin *et al*., 2015). Providing moringa leaf extract can also help repair DNA and prevent underweight at birth, a trigger for stunting (Nadimin *et al*., 2019). Moringa leaves contain several essential amino acids that are very beneficial for tissue growth in the fetus (Ulmy *et al*., 2020). Interventions with moringa supplementation for pregnant women, infants, and toddlers' nutritional status can prevent stunting in children.

The results of previous research on children aged 2-5 years showed a decrease in stunting cases in the EG group. Although previous interventions have proven the effect of moringa supplementation in children under five years of age, it is still necessary to see further the consistency of the efficacy of moringa leaf extract supplementation on children's nutritional status. Therefore, this study aims to examine the effect of moringa supplementation during pregnancy on stunting in preschool children (5-6 years old).

Methods

This study is a longitudinal follow-up study of an experimental study with a randomized clinical trial (RCT)-double-blind method since the second trimester of pregnancy. This study was conducted in Jeneponto Regency using 3 forms of intervention, namely moringa extract supplementation (EG), moringa flour (PG), and iron/folic acid tablets (IFA). The samples in this study were pre-school-age children (5-6 years old) with details of 106 PG samples, 106 IFA samples, and 91 EG samples. Data collection in the field was carried out by enumerators who had attended and passed the training. The qualifications of enumerators were those with a minimum education of S1 Nutrition Science or other health majors. Data on household and child characteristics were collected through interviews using a questionnaire. Height measurements used a microtoice twice as a measurement calibration. Stunting was defined based on WHO standards (HAZ <-2 SD). The determination of z-score values used the WHO Anthro Plus application.

Data were analyzed using the SPSS software application. Then, the data was processed by univariate, bivariate, and multivariate analysis. Univariate analysis aims to describe the characteristics of each variable. Then, bivariate analysis was conducted to determine the relationship between 2 variables with the Chi-Square Test. Multivariate analysis to determine the effect of other variables on stunting. The statistical test performed was logistic regression, where the variables included in the model had a p-value <0.25. The value of statistical significance of the relationship when the p-value <0.05.

Results and Discussion

Table 1 shows the characteristics of child age, birth weight, exclusive breastfeeding status, father's education, mother's occupation, and family income where there are 90 stunting cases. Table 1 also shows that the p-value of characteristic risk factors (child's age, child's birth weight, child's exclusive breastfeeding status, father's education, mother's occupation, and family income) in the analysis of the difference between characteristic risk factors and stunting has a p-value> 0.05. It indicates

Table 1. Analysis of Differences between Risk Factors and Stunting in Pre-School 5-6 years old in Jeneponto District

Characteristics	HAZ (HAZ)				N	%	p
	Stunting		Normal				
	n	%	N	%			
Age of Child							
60 - 70 months	78	31.7	168	68.3	246	100	0.113
71 - 81 months	12	21.1	45	78.1	57	100	
Birth weight							
Normal	86	29.7	204	70.3	290	100	0.931
LBW	4	30.8	9	69.2	13	100	
Exclusive breastfeeding							
Exclusive	42	32.1	89	67.9	131	100	0.433
Not Exclusive	48	27.9	124	72.1	172	100	
Father's Education							
Not in School	6	40.0	9	60.0	15	100	
Not graduated primary school	9	42.9	12	57.1	21	100	
Elementary school graduate	33	29.2	80	70.8	113	100	
Not graduated junior high school	3	75.0	1	25.0	4	100	0.203
Junior high school graduate	14	26.9	38	73.1	52	100	
High school graduate	17	22.4	59	77.6	76	100	
Not graduated high school	0	0.00	2	100	2	100	
Bachelor's Degree	6	35.3	11	64.7	17	100	
Mother's Occupation							
Work	9	29.00	22	71	31	100	0.931
Housewife	81	29.8	191	70.2	272	100	
Family Income							
Low (<2.4 million)	75	31.6	162	69.4	237	100	0.161
High (≥2.4 million)	15	22.7	51	77.3	66	100	

Source : Primary Data, 2023

no influence between the intervention group (child's age, child's birth weight, child's exclusive breastfeeding status, father's education, mother's occupation, and family income) and stunting.

Based on Table 2, the frequency distribution of HAZ nutritional status is 90 samples (29.7%) were stunted, and 213 samples (7 0.3%) were normal/not stunted. The frequency distribution of IMT/U nutritional status is 32 samples (10.6%) were wasted, and 271 samples (89.4%) were normal/not wasted. The frequency distribution of BB/U nutritional status is 93 samples (30.7%) were underweight, and 210 samples (69.3%) were normal nutrition. Table 2 also shows that the p-value in the frequency distribution of wasting nutritional status has a p-value> 0.05, so it can be concluded that there is no difference between the intervention groups when pregnant women with wasting variables. However, in the frequency distribution of stunting and underweight, the p-value <0.05, so it can be concluded that there is a difference between the intervention groups when the mother is pregnant with the variables of stunting and underweight.

Table 3 shows that children who received

Table 2. Analysis of Nutritional Status-based Groups in Pre-school Children 5-6 years old in Jeneponto District

Nutrition Status	PG		IFA		EG		Total		p
	n	%	n	%	N	%	n	%	
HAZ (HAZ)									
Stunting	27	8.9	41	13.5	22	7.3	90	29.7	0.042
Normal	79	26.1	65	21.5	69	22.8	213	70.3	
WHZ (IMT/U)									
Wasting	13	4.3	6	2.0	13	4.3	32	10.6	0.113
Normal	93	30.7	100	33.0	78	25.7	271	89.4	
WAZ (BW/U)									
Underweight	40	13.2	23	7.6	30	9.9	93	30.7	0.035
Normal	66	21.8	83	27.4	61	20.1	210	69.3	

Source : Primary Data, 2023

Table 3. Multivariate Analysis of the Effect of Interventions on Stunting in Pre-school Children 5-6 years old in Jeneponto Regency

Variables	p	OR	95% C.I	
			Lower Limit	Upper Limit
Intervention				
PG	0.074	1.744	0.947	3.214
EG	0.015	2.215	1.167	4.202
IFA	0.036	Ref	ref	ref
Child Age (60-70 months)	0.092	0.535	0.258	1.107
LBW	0.796	1.178	0.341	4.073
Breastfeeding (Not Exclusive)	0.572	1.162	0.690	1.954
Father's Education (Low)	0.232	0.728	0.432	1.226
Mother's Occupation (Working)	0.816	0.903	0.384	2.126
Family Income (Low)	0.431	1.319	0.662	2.628

Source : Primary Data, 2023

EG intervention during pregnancy had an effect on the incidence of stunting ($p<0.01$). The provision of EG prevented stunting by 2.215 times compared to other intervention groups. The rest of the variables showed no effect on the incidence of stunting in preschool children aged 5-6 years in Jeneponto Regency.

Results of the study on children aged 5-6 years showed that the EG intervention had a significant effect on stunting. EG intervention (24.18%) showed the lowest prevalence of stunting among PG (25.47%) and IFA (38.68%) interventions. EG prevented stunting by 2.215 times compared to the other intervention groups. In Jeneponto District, a study was conducted on the effects of PG, IFA, and EG interventions on stunting from birth to 5 years of age, followed by one on the same intervention groups of 5-6 years. The study on children aged 0-6 months showed a significant increase in weight in the PG and IFA groups but not in the body length of children given colostrum. In the PG intervention, the number of stunted children at 0 months of age was 2.7% while the IFA intervention was higher at 3.3%. In the age range of 2-5 months, stunting was highest in the PG intervention, which increased every month. EG and IFA interventions at 2-5 months showed better results than the PG intervention (Ulmy et al., 2020).

Then, the study at 6-12 months showed increased body weight and length in both the PG and IFA intervention groups. In this age range, the incidence of stunting fluctuated highly in all intervention groups, but there was little consistency in the IFA group. So, the age of 12 months shows the highest prevalence of stunting in the extract, which is 30.9%, then 28.2% in the PG intervention, and as much as 23.4% in the IFA group. So, we concluded that in the age range of 6-12 months, the IFA intervention showed better results (Sumiaty et al., 2020). Similarly, results of the study at the age of 12-17 months showed nutritional status that was not much different from the prevalence of stunting at the previous age, but at the age of 18-24 months showed different results, where the EG intervention group had fewer stunting incidents than the other intervention groups. In the EG intervention group, the prevalence of stunting reached 41.7%, which is lower than the PG intervention, which reached 48.7%, and the IFA intervention, which reached 42%. It can be concluded that at 24 months of age, the EG intervention is much better than PG and offsets the effect of the control group, or in this case, IFA (Sarih et al., 2020).

Results of the study in children aged 2-3 years showed that the prevalence of stunting in children was highest in the PG intervention (51.8%), then lower interventions in EG (39.3%) and IFA (37.8%), respectively. The PG intervention increased the prevalence of stunting in children with a risk of 1.787 times compared to the IFA intervention. The EG intervention can prevent stunting in 2-3-year-olds (Basri et al., 2022; Basri et al., 2021). The study in children aged 3-4 years showed that the EG intervention significantly reduced stunting in children aged 36-42 months. The EG intervention (25.2%) showed the lowest prevalence of stunting among other interventions, such as PG (41.5%) and IFA (33.3%). Administration of Moringa oleifera extract during pregnancy can prevent stunting in children aged 34-42 months (Basriet al., 2021). The research on children aged 4-5 years showed that the prevalence of stunting in the three groups was significantly different, and the lowest group was in the EG intervention (21.4%). Thus, this study indicates a decrease in stunting cases in EG group children from 0 months of age to 6 years of age. Moringa leaf extract showed better results in preventing stunting. Likewise, in the PG group, there was a decrease in stunting cases, although not significant, as presented in Figure 1 (Basri et al., 2022).

The macronutrient and micronutrient content of the moringa extract has a crucial function in improving pregnancy outcomes and preventing stunting in children (Lin et al., 2018). In a previous study, there was a difference in the effect given between moringa extract and moringa flour in preventing the prevalence of stunting. Moringa leaf extract showed a more positive efficacy in preventing stunting because moringa flour is obtained in powder form from drying (heating) so that the active chemicals in moringa are lost, while moringa extract is obtained from extracted moringa leaves that take all the active chemicals from moringa (Baldisserotto et al., 2018). In making moringa flour into 500 mg capsules, only a few moringa leaves are needed, while in making moringa extract into capsules, many moringa leaves are required to be made into 500 mg moringa extract, so that there is more moringa nutritional content in the extract (Basri et al., 2021). The active chemicals (phytochemicals) in moringa extract were found to be very much like flavonoids, alkaloids, steroids, carotenoids, and other chemicals where these various active chemicals contained many benefits in improving the nutritional status of mothers and children (Baldisserotto et al., 2018; Gull et al., 2016).

Laboratory examination results per each moringa extract capsule showed that the flavonoid/alkaloid content was 301.237 ppm. Some previous studies have shown that the flavonoid content of moringa extract using water extraction is around 11-15 grams/100 grams but will be greater if moringa extract uses ethanol/methanol extraction (Lin et al., 2018). The function of flavonoids is as an anti-cancer, anti-oxidant that can ward off free radicals and prevent and improve malnutrition in children (Falowo et al., 2018; Kasolo et al., 2010). Previous studies showed that giving moringa extract during pregnancy can reduce the prevalence of stunting because moringa

extract can improve pregnancy outcomes better , and it cannot be separated from the prevention of stunting in children (Basri et al., 2021). A study on the efficacy of Moringa Oliefera in malnourished children showed that stunting in children who received it at the beginning of the study was -2.6±1.8 and increased to -2.1± 2.0 at the end of the study. In addition, the group of children given moringa showed significant changes in nutritional status in the WAZ and HAZ z values. This study suggests that moringa can improve the nutritional status of children. Giving moringa leaf extract to pregnant women has a better effect on reducing the prevalence of stunting in children aged 4-5 years.

Conclusion

There is an effect of providing PG, IFA, and EG interventions on stunting in children from the age of 2 years to 6 years, where the provision of EG intervention is better than other interventions. The study in children aged 5-6 years showed that children who received EG intervention during pregnancy affected stunting ($p<0.01$). The provision of EG prevents stunting by 2.215 times compared to other intervention groups.

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