Does moringa oleifera leaf nanoparticles increase albumin levels in stunting toddlers?

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Abstract. Stunting is a delay in growth that in children under 5 years. The incidence of stunting around 22% in the world in 2017. Macro nutrients such as carbohydrates, proteins and fats affect growth in toddlers. The cause of decreased albumin levels in blood plasma occurs due to low protein intake and inadequate protein absorption. The aim of the study is to identify the effect of Moringa Oleifera leaf nanoparticles in albumin levels. This study was a quasi experimental with pretest and posttest control group design. Twenty toddlers in the treatment group was given Moringa Oleifera leaf nanoparticles with a dose of 65 mg/day and supplementary feeding. While twenty toddlers in the control group consumed supplementary feeding only. The interventions was given for 21 days. The instrument used to measure albumin levels is Bromcresol Green (BCG). Data analysis used paired T Test and Mann Whitney. Most toddlers are female at the intervention group. On the other hand, more fale at control group. The intervention group was younger than in the control group (28 and 37 months, respectively). Moringa Oleifera leaf nanoparticles increased significantly albumin levels 0.278 g/dL (p=0.001). While in the control group albumin levels increased slightly 0.028 g/dL (p=0.150). Moringa Oleifera leaf nanoparticles proved to improve albumin levels greater than the control group in stunting toddlers.

1. Introduction
Delays in growth occur in children under the age of 5 years. Globally in 2017 the incidence was around 22% or around 151 million children experienced stunting, which affected the development of the country because it was related to the level of child morbidity, risk of death, learning ability and suffering from non-communicable diseases later on [1]. At this time, stunting was identified as a top priority global health problem and focus on several things such as improving nutritional status and overcoming hunger [2].

The problem of nutrition in children aged 5 years continues to be a problem in public health, especially in developing countries [3], including Indonesia. Data collected by WHO explains that Indonesia is the third country with the highest prevalence of stunting, namely 36.4% in Southeast Asia after Timor Leste 50.2% and India 38.4% from 2005 to 2017 [4]. Riskesdas data for 2018 shows that the prevalence of stunting in Indonesia is 30.8% [5]. In Central Java Province the prevalence of stunting collected from Nutrition Status Monitoring data shows that in 2017 it was 28.5%. The highest stunting prevalence in Central Java was in Magelang District by 37.6% [6].

The impact of stunting is irreversible growth failure, inhibiting mental and physical development. Malnutrition during this period also poses a risk of developing chronic diseases as adults such as obesity, heart disease, hypertension, stroke, vascular disease and diabetes [4]. Stunting also affects the level of
intelligence, is susceptible to disease, inhibits growth, decreases the level of productivity, the country's economy, and can increase poverty and inequality in a country [7].

Interventions that have been given to increase albumin levels in infants are research conducted in Blora Regency, Indonesia, showing that providing interventions in the form of modisco bean porridge for 14 days can increase albumin levels from 3.96 g/dL to 4.33 g/dL [8]. A study in 2016 conducted on samples of toddlers aged 36-60 months with interventions in the form of biscuits containing blondo, cork fish, and brown rice there was a significant increase in albumin levels with an average increase of 1.0 g/dL [9].

One type of medicinal plant that has been used to improve the health status of malnourished children is Moringa leaf. Moringa leaves can be eaten as a vegetable. Nutrients in it are easily absorbed by the body and do not cause allergies. The main advantage of using Moringa leaves is that it is a local resource that can be easily obtained at little or no cost [10]. Moringa Oleifera leaves contain very high amounts of protein, iron, potassium, calcium, vitamins A, B, and C that are easily assimilated and digested by the body [11]. As in a study conducted in 2019 using Moringa Oleifera leaf nanoparticles, intervention at a dose of 28.57 mg/kg of body weight/day can increase albumin levels, hematocrit levels, the number of erythrocytes, and the number of leukocytes increase albumin levels in infants are research conducted in Blora Regency, Indonesia showing that by providing interventions in the form of modisco bean porridge for 14 days can increase albumin levels from 3.96 g/dL to 4.33 g/dL [8]. A study at 2016 conducted on samples of toddlers aged 36-60 months with interventions in the form of biscuits containing blondo, cork fish and brown rice. There was a significant increase in albumin levels with an average increase of 1.0 g/dL [9].

One type of medicinal plant that has been used to improve the health status of malnourished children is Moringa Oleifera leaf. Moringa Oleifera leaves can be eaten as a vegetable. Nutrients in it are easily absorbed by the body and do not cause allergies. The main advantage of using Moringa Oleifera leaves is that it is a local resource that can be easily obtained at little or no cost [10]. Moringa Oleifera leaves contain very high amounts of protein, iron, potassium, calcium, vitamins A, B and C that are easily assimilated and digested by body [11]. As in a study conducted in 2019 using Moringa Oleifera leaf nanoparticles, intervention at a dose of 28.57 mg/kg of body weight/day can increase albumin levels, hematocrit levels, the number of erythrocytes, and the number of leukocytes increase albumin levels in breast cancer patients [12].

Based on this background, it is necessary to conduct research on the administration of Moringa Oleifera leaves to increase albumin levels as an effort to improve nutritional status in stunting toddlers.

2. Methods
This is a quasi experimental with pretest and posttest controlled group design. The study was conducted for 21 days between February until March 2020 in the working area of Grabag (Grabag I & Grabag II Public Health Center) Magelang District, Central Java, Indonesia. The intervention was given at the home of each respondent. Forthy respondents were recruited using consecutive sampling and divided into intervention groups (20 respondents) and control groups (20 respondents). Inclusion criteria for the samples included: Toddlers aged 12-60 months in healthy condition, height or body length according to age with Z Score < 2 SD, domiciled in the study area and parents or caregivers are willing that toddlers become the subject of research by signing informed consent. Moringa Oleifera leaf nanoparticles and supplementary food are given to stunting toddlers every day at a dose of 65 mg/day for 21 days. In this study, the intervention group received Moringa Oleifera leaf nanoparticles and supplementary food, while the control group was only given supplementary food alone. Bromcresol Green was used to measure albumin levels of stunting toddlers. Albumin levels was measured before (pre) and 21 days after intervention (post). Ethical clearance was obtained from the Health Research Ethics Commission Dr. Moewardi with Number 1.483/ XII/ HREC/ 2019. This research has obtained permission from National Unity and Politics of Magelang District, Magelang District Health Office and the Head of the Grabag I and Grabag II Public Health Centers. Each respondent obtained information about the study
and signed informed consent before data collection. Data analysis used paired and Mann Whitney to determine giving Moringa Oleifera leaf nanoparticles to changes in albumin levels in stunting toddlers.

3. Result and discussion
Based on table 1, the average age of under-fives in the treatment group is 28 months and in the control group, the average age of under-fives is 37 months (p= 0.990), which means the proportion of ages in both groups is homogeneous.

Table 1. Frequency distribution of toddlers’ characteristics by age and sex

| Variable       | Group  | n = 20 | p-value |
|----------------|--------|--------|---------|
| Age (Month)    | Intervention | 28,75±11,796 | 37,00±12,044 | 0.990* |
|                | Control   | 15-51  |         |
| Sex            | Intervention | 15 (75%) | 9 (45%) | 0.053* |
|                | Control   | 5 (25%) | 11 (55%) |         |

*Chi-square Test SD: Standard Deviation

Characteristics of respondents by sex, respondents who were female in the treatment group were 15 toddlers (75%) and in the control group were 9 toddlers (45%). Respondents with male sex in the treatment group were 5 toddlers (25%) and 11 toddlers (55%) in the control group. Based on the homogeneity test, there was no difference between the proportion of sexes in the treatment group and the control group (p=0.053).

Toddlers who are stunted are a chronic nutritional problem. The causes include maternal nutrition during pregnancy, socioeconomic conditions, nutritional deficiencies during infancy and diseases that occur during infancy [4]. Nutritional incidents occur since the baby is in the womb and in the early stages after birth. The condition of stunting is only visible after 2 years of age [13].

In previous studies showed that the incidence of stunting occurred most at an average age of 25-59 months as much as 73.9% and at 6-24 months as much as 26.1% [14]. In line with the 2019 study which said that toddlers who experienced stunting more prevalent at the age of 25-36 months as much as 63.7% and toddlers aged 12-24 months as much as 36.3% [15].

Table 2. Analysis of differences in mean albumin levels before and after the intervention in the treatment and control groups

| Variable          | Measurement | Group               | p-value |
|-------------------|-------------|---------------------|---------|
|                   |             | Intervention (Mean±SD) | Control (Mean±SD) |         |
|                   |             | Before 4,685±0,232 | 4,538±0,443 | 0,330** |
|                   |             | After 4,963±0,190 | 4,566±0,436 | 0,001** |
|                   |             | Difference 0,278±0,169 | 0,028±0,084 | 0,001** |
|                   | p-value     | 0,001* | 0,150* |         |

*Paired T-test, **Mann Whitney, SD: Standard Deviation

Table 2 showed that in the treatment group before the intervention was given the average albumin level was 4,685 ± 0.232 and after the intervention was 4,963 ± 0.190. Analysis of differences in albumin levels before and after the intervention in the treatment group using the Paired T Test (p=0.001), meaning there was a significant increase in albumin levels after the intervention. In the control group
the mean albumin level before intervention was 4,538 ± 0,443 and the mean albumin level after intervention was 4,566 ± 0,436. Analysis of differences in albumin levels before and after the intervention in the control group with the Paired T-Test (p=0,150) obtained means that there was no significant difference in albumin levels after the intervention.

In the Mann Whitney test it was found that the mean albumin levels in the treatment group before the intervention p=0,330, which means there was no significant difference in albumin levels before the intervention between the treatment and control groups. The mean albumin levels in the treatment and control group after the intervention p=0,026 mean that there were significant differences in the albumin level after the intervention between the treatment and control groups. Differences in albumin levels in the treatment and control group p=0,047 mean that there are significant differences in the difference in albumin levels between the treatment group and the control group.

When seen from the Mann Whitney test after the intervention in the treatment group and the control group experienced a difference that is p=0,001. It can be concluded that by providing interventions in the form of Moringa Oleifera leaves with size 614,4 nm, which has a protein content of 36.249% (per 100 gr of Moringa Oleifera leaf nanoparticles). In one capsule with a dose of 65 mg/day of Moringa Oleifera leaf nanoparticles containing as much as 23,56 mg protein can increase albumin levels an average of 0,278 g/dL in the treatment group.

Albumin is the highest type of protein in the blood, reaching 60%. In the body albumin has an important role such as the transport of thyroid hormones, maintaining the function of the kidneys, transporting fatty acids and bilirubin [16]. Albumin has the function to help the formation of new cells in the body during growth and accelerate the healing process of body tissue. The immune system will increase if we increase albumin levels, an increase in albumin levels shows the liver is functioning properly and helps the process of growth and development of children properly [17].

In blood plasma albumin concentration is one of the most important indicators in the assessment of nutritional status. One sign of protein deficiency is growth retardation [8]. Higintai (1998) cited in Salem (2013) protein intake both in quality and quantity can influence Insulin Growth Factor (IGF-1) as well as on protein matrix and bone growth factors. Levels albumin can also be decreased in patients with inflammatory disorders and other diseases. A decrease in albumin levels in the body is associated with an increased risk of infection, changes in albumin levels will affect the total value of albumin [18]. Risk factors that affect stunting are poor nutritional intake and the nutrients consumed do not reach the body's cells, low protein intake is the risk of stunting [19].

One of the intervention given to toddlers to increase albumin levels was one of them in Maria's research in 2018. Increased albumin levels in toddlers BGM after being given a modisco green bean porridge for 14 days could increase albumin levels in the intervention group by 0,37 g/dL (p=0,001), while in the control group 0,04 g/dL (p=0,000). The delta percentage calculation was obtained at 9,34%, which means that the administration of modisco green bean porridge interventions for 14 days increased albumin levels by 9,34%. If this intervention is continued for 21 days, the increase in albumin levels reaches 0,92 g/dL [8].

Other research related to interventions to increase albumin levels in infants is Widodo research (2015) by giving biscuits (blondo based, cork fish and brown rice) for 90 days in malnourished children under five can increase albumin levels from 3,6 g/dL to 4,6 g/dL (difference of 1,0 g/dL) p=0,000. The effect size value in this study is very strong with a value of 3,13 and the percentage of delta is 27.77% which means that the provision of this intervention is effective in increasing albumin levels in malnourished children. However, if this intervention is given for 21 days the increase in albumin levels in under five malnourished children is around 0,2 g/dL [9].

Moringa Oleifera leaves contain very high amounts of protein, iron, potassium, calcium, vitamins A, B and C that are easily assimilated and digested by the body. Moringa Oleifera leaves contain micronutrients and macronutrients as well as antioxidants and can be used as the main ingredient as a drug, both for treatment and prevention of disease [11].

In this study using the intervention of Moringa Oleifera leaf nanoparticles and supplement feeding on changes in albumin levels in stunting toddlers. Increasing albumin levels by administering this
intervention can increase albumin levels by a difference of \( p=0.001 \) which means there is a significant difference in the difference in albumin levels after the intervention between the treatment group and the control group. The effect size value in this study is very strong with a value of 1.80. The percentage of delta is 5.93\% which means that the administration of Moringa Oleifera leaves and PMT can increase albumin levels in stunting toddlers by 5.93\% but not yet effective (<20\%).

The results of this study, it can be suggested for the community to use Moringa Oleifera leaf interventions as an alternative to prevent stunting by providing interventions to pregnant women or toddlers under 2 years of age which are a critical window of failure in growth because one of the macronutrients that affect the incidence of stunting is protein. Protein is needed to build, maintain and repair body tissues.

4. Conclusion

The mean albumin levels in treatment and control group after the intervention (\( p=0.001 \)). Moringa Oleifera leaf nanoparticles 65 mg/day for 21 days can significantly increase albumin levels in stunted toddlers. This research can prove that giving Moringa Oleifera leaf nanoparticles and supplementary feeding can be used as an alternative to increasing albumin levels in stunting toddlers because in a capsule of Moringa Oleifera leaf nanoparticles containing as much as 23.56 mg protein can increase albumin levels an average of 0.278 g/dL in the treatment group.

Acknowledgments

The authors would like to thanks to the subjects, enumerator, children under five in area Grabag I and Grabag II Public Health Center and Health Polytechnic of Semarang-Indonesia.

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