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Nutritional Intervention Based on Moringa Leaf Flour to Prevent Stunting in First 1000 Days of Life (1000 HPK): Review Articles

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ABSTRACT
Stunting problem in South Sulawesi Province is very seriously and needs more attention. On the other hand, this area has many moringa plants that have not been used optimally. The aims of this review to determine the effect of moringa leaf intervention on stunting factors in the 1000 HPK. The review was carried out through from 17 result reviews of intervention research conducted in Indonesia and neighborhood countries. The results of research are searched online through Google Scholars, Scopus and the Open Knowledge Maps application (PubMed). The intervention of moringa leaf in the form of extract or flour can improve nutritional status, hemoglobin levels, prevent oxidation stress in pregnant women, prevent low birth weight, increase breastmilk (ASI) production and quality, and improve the nutritional status of children under five. Moringa leaf can be used to prevent stunting factors in the 1000 HPK. The effectiveness of moringa intervention will be maximized when added with honey or mixed in children's food.

Keywords: Moringa Oliefera, Stunting

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INTRODUCTION

Nowadays, Indonesia has three nutritional problems in one time called Triple Burden Diseases. Nutritional problems cause lack of macro nutrients such as stunting, wasting and underweight, problems of excess nutrition such as obesity and nutrition-related diseases, and nutritional problems due to micronutrient deficiencies such as nutritional anemia, vitamin A deficiency, iodine deficiency and zinc deficiency. Basic Health Research (Riskesdas) in 2018 reported that the prevalence of malnutrition problems in Indonesia, namely stunting (30.2%), wasting (10.2%) and underweight (17.7%). South Sulawesi Province is one of Provinces with the highest stunting compared to other Provinces, which is in fourth rank. The Prevalence of stunting in this area reached 30.2% in 2018, although it has decreased compared to 2013 (34%) (1). On the other hand, South Sulawesi has the potential for richness of local foodstuffs such as moringa (*moringa oliefera*), but it has not been utilized optimally.

The cause factors of malnutrition in children, especially stunting, are cause by multifactor including breastfeeding, supplementary feeding that is not suitable for needs and infectious diseases (2). The practice of exclusive breastfeeding is determined by the smooth production of breast milk. Breast milk production itself and influenced by production of the hormone's prolactin and oxytocin. In addition, the nutritional status and pregnant women health are also important factors affecting stunting, especially in Indonesia (3). Pregnant women with malnutrition cause by Intrauterine growth restriction (IUGR) and it has high risk to bear a baby with low birth weight (LBW) (4). Iron deficiency anemia that occurs during pregnancy has a relationship with stunting in children under five (5).

In globally, prevention of stunting is focused on the age of the first 1000 days of life (100 HPK), starting from conception at the beginning of pregnancy until child in two years old. This age is a golden period for children's growth so that it requires to fulfillment of balanced nutritional (6). Malnutrition during this period results in growth disturbances, resulting in stunting (7). Nutrition intervention in the framework of stunting prevention programs is directed to ensuring the fulfillment of nutritional needs at that age.

Efforts to deal with stunting in South Sulawesi Province need to be done through the utilization of potential and local wisdom. One of many local potentials available is Moringa plant. *Moringan oliefera* is commonly called a miracle tree because it is easy to grow and easy to cultivate, and its very suitable for climate and natural conditions such as in South Sulawesi (8). *Moringa Oliefera* has leaf that contain various kinds of nutrients so that this plant is known as the Super Nutritional Plant. *Moringa leaf* contain essential nutrients that have a role in growth and development such as protein with various amino acids, fat with various fatty acids, vitamin A, calcium, iron and others (9) (10). Sreelatha (2009) reported that moringa leaf contain antioxidant nutrients such as vitamin A, vitamin E and vitamin C which have a role in improving pregnant women health (11). Besides containing essential nutrients for growth, *Moringa leaf* also contain chemical compounds containing *galactagogueg* which have function to stimulate hormone prolactin to increase production of breast milk (12).

Moringa leaf are processed in the form of extract, flour or juice, and made into supplements, food or drinks. The development research was studied the effect of moringa leaf intervention in the last 10 years has progressed very rapidly. These studies were initially only conducted on experimental animals, but now many have used clinical trials in humans. These studies were conducted on various groups prone to malnutrition, such as pregnant women, nursing mothers and children under two years of age. The aims of this study to review the results of research on moringa leaf intervention as a recommendation to prevent stunting in the 1000 HPK period.

METHODS

The target focusses of this study studied was group of the first thousand days of life (1000 HPK) including pregnant

women, nursing mothers and children 6-24 months. Types of intervention given include Moringa leaf in the form of extracts or flour with a single dose, plus honey, and added iron folic acid (IFA). Intervention in children was giving Moringa flour leaf which are made in the form of complementary foods with breast milk (MPASI) or mixed in children's food. The intervention output observed from pregnant women was hemoglobin levels, oxidative stress assessed based on levels of 8-hydroxy-2- deoxyguanosine (8-OHDG), and birth weight of baby. Breastfeeding mothers were examined for parameters related to the production and content of breast milk (ASI), including the production of the hormone prolactin, milk volume, and milk fat content. The parameters assessed in the child included growth in body weight and height, and nutritional status. We conducted an online search for related articles via Google Scholars, Scopus and the Open Knowledge Maps application (PubMed).

In this research, searching article by online and using keywords Moringa oliefera, pregnant women, Moringa oliefera ASI, and Moringa oliefera children. Besides that, we used keywords Moringa oliefera accompanied by keywords that were the output of the intervention, namely hemoglobin, DNA damage, birth weight, breast milk, growth and nutritional status. From the results of this search, we recorded data on the type of intervention, dose, and duration of intervention in each group of pregnant women, breastfeeding mothers and children aged 0-24 months. After that we recorded the results achieved on indicators of hemoglobin levels, 8-OHDG, birth weight, production and volume or levels of breast milk fat. Other indicators recorded were the growth and nutritional status of children as seen based on weight gain, body length and Z-score for body length for age (HAZ) and Z-score for body weight for age (WAZ).

The results of search then tabulated in a table matrix containing authors, subject, type, dose and time of intervention, and the results of the intervention. The results of the intervention were seen based on the results of statistical analysis on each variable and grouped based on the research subjects, namely pregnant women, nursing mothers and children aged 0-24 months.

RESULT

Table 1. Intervention of Moringa Oliefera Leaf in 1000 HPK

No	Autors	Subject	Methods intervention	Result
1	Nadimin (2016) (13) Nadimin, *et.al* (2019) (14); Nadimin, *et.al* (2020) (15)	Pregnant women non-anemia	The first group consumed 4 cap MOL capsules, the second group consumed iron-folic acid (IFA) capsules.	Moringa leaf extract can prevent the increase in MDA levels and improve the nutritional status of pregnant women. The anthrometric size of the infants in the moringa group was the same as the IFA group.
2	Muis M, *et.al* (2014)(16)	Pregnant women non-anemia, informal workers	The first group received MOLIFA capsules and the second group received IFA capsules.	There was a decrease in oxidation stress and an increase in the nutritional status of the mother with the intervention of moringa capsules.
3	Nadimin, *et.al* (2015)(17)	Pregnant women non-anemia	The main group consumed 4 cap MOL capsules, the second group consumed IFAs.	Moringa leaf extract capsules have the same ability as IFAs in preventing anemia in pregnant women
4	Khuzaimah *el.al* (2015)(18)	Pregnant women tersemester, passive smoking	The main group was given 1000 mg MOLIFAH capsules/day, the control group was given MOLIFA capsules.	Giving MOLIFAH capsules can prevent the increase in MDA and 8-OHDG levels of pregnant women. Placenta weight was higher in the main group.
5	Nurdin *et al*. (2018) (19)	Pregnant women trisemester, anamiaand nonanemia	Namely the MOLE intervention group, the MOLEP group and the IFA group. The intervention lasted 3 months.	Hemoglobin levels decreased in all groups.
6	Estrella, et.al (2000)(20)	Postpartum mothers, normal	Namely the intervention group MOL 250 mg capsule. and the control group.	The daily volume of the intervention group's milk was significantly higher than the control.
7	Espinosa, CL. (2005)(21)	Postpartum mothers	The intervention group received 2 capsules of MOL every day, the second group as a control.	The use of moringa capsules is safe and increases the volume of breast milk.
8	Sulistiawati, et.al. (2017) (22)	Postpartum mothers normal	Namely the intervention group who consumed 1 capsule of MOL capsules (250 mg/cap) for 28 days, and the control group.	There is an effect of consumption of Moringa capsules on prolactin production and sleep duration of infants.

9	Yuliastuti S., et.al. (2017) (23)	Postpartum mothers	Namely the intervention group taking MOL capsules 2 x 250 mg daily for 2 weeks, the second group as a control.	Moringa leaf flour can increase the production of breast milk fat and baby weight.
10	Zongo U, e.al (2018)(24)	Children aged 12-59 months	Namely the intervention group consuming MOL powder and the control group consuming the usual diet. 30 g / day MOL powder consumed for 12 weeks.	Consumption of moringa flour can increase the intake of Vitamin A, vitamin A levels and reduce the prevalence of VAD, as well as increase the nutritional status (BB / TB) of children under five. This intervention has not been able to increase the child's height.
11	Boateng L, et.at (2019)(25)	Infants 8-12 months	The first group (control) received MLP ş as a mixture of cereals and legumes (CF-35), the second group received MPL powder as a food topping (MC-5g), and the third group received mixed cereal and legumes without MPL.	Provision of complementary foods enriched with MLP 5 grams per day did not have a significant impact on hemoglobin levels and infant growth indicators compared to the group that received MLP in complementary foods.
12	Zongo U, et.al (2013)(26)	Malnutrition children 6-59 months	The first group received regular porridge and the second group received porridge mixed with 10 grams of Moringa leaf flour. The study lasted for 6 months.	Moringa leaves which are packaged as additional food can help overcome nutritional deficiencies.

MOLIFA = *Moringa Oliefera* + Iron folic acid, MOLIFAH = *Moringa Oliefera* + Iron folic acid + Honey, IFA = Iron folic acid, MOL = *Moringa Oliefera*

Table 1 shows that there are seven studies that reported the results of moringa intervention in pregnant women, four studies on the effect of moringa on breast milk production, and three studies on the effects of moringa on children's nutritional status. All of these studies used comparison groups.

Tabel 2. Intervention Effect of Moringa Leaf on Nutrition Status and Oxidation Stress in Pregnant Women

No	Authors	Variable	Groups	Pretest	Post-test	p-value	Change	p value
1	Muis *et al.* (2014)	MUAC	MOLIFA (n=35) IFA (n=35)	25.19 ± 2.73 26.05 ± 2.83	26.18 ± 2.76 26.50 ± 2.82	0.000 0.000	0.89 ± 0.74 0.45 + 0.49	0.001
2	Nadimin *et al*. (2019)	MUAC	MOL (n=33) IFA (n=35)	25.72 ± 3.30 25.13 ± 3.03	26.42 ± 3.24 26.08 ± 3.27	0.006 0.000	0.70 ± 1.41 0.89 + 1.19	0.418
3	Nadimin, *et al* (2016)	MDA	MOL (n=33) IFA (n=35)	7.82 ± 1.22 7.42 ± 8.92	8.34 ± 1.70 8.96 ± 1.90	0.031 0.000	0.55 ± 1.57 1.54 ± 1.84	0.011
4	Khuzaimah *et al.* (2015)	MDA	MOLIFAH (n=40) MOLIFA (n=40)	26.30 ± 12.21 16.64 ± 13.05	24.45 ± 14.22 15.86 ± 10.97	0.090 0.230	1.84. ± 0.03 0.22 ± 15.30	0.000
		8-OHdG	MOLIFAH (n=40) MOLIFA (n=40)	47.62 ± 54.99 38.56 ± 49.39	41.53 ± 50.05 45.43 ± 13.50	0.020 0.040	6.09 ± 31.89 6.87 ± 29.41	0.000

MOLIFA = *Moringa Oliefera* + Iron folic acid, MOLIFAH = *Moringa Oliefera* + Iron folic acid + Honey, IFA = Iron folic acid, MOL = *Moringa Oliefera*

Table 2 shows the effect of moringa intervention on the nutritional status and pregnant women health. Study number 1 shows that moringa intervention can increase the MUAC of pregnant women who work in the informal sector. The increase in nutritional status of pregnant women who received moringa intervention was significantly better than those who received IFA intervention. Likewise, the results of study number 2 show that moringa intervention can increase MUAC in non anemic pregnant women. The moringa intervention for three months starting at 5 months of gestation improved the nutritional status of pregnant women which was equivalent to those who consumed IFAs. The results of study number 3 show that moringa intervention in pregnant women cannot reduce MDA levels in pregnant women but can reduce the rate at which MDA levels increase. Pregnant women who were intervened with moringa experienced a slower increase in MDA levels compared to those receiving the IFA intervention. In contrast to the results of study number 4, moringa intervention can reduce MDA levels in pregnant women with smoke passive. The decrease in MDA levels was more significant if moringa intervention was combined with honey. The results of this study also reported that both MOLIFA and MOLIFAH interventions can reduce levels of 8-OHDG in pregnant women with smoke passive.

Table 3. Effect of moringa Leaf Intervention on Hemoglobin Levels of Pregnant Women

No	Authors	Grups	Pretest	Post-test	p-value	Change	p-value
1	Muis *et al.* (2014)	MOLIFA (n=35) IFA (n=35)	11.80 ± 0.94 11.57 + 1.20	11.77 ± 1.29 11.88 + 1.50	0.909 0.337	-0.02 ± 1.32 0.30 + 1.80	0.002
2	Nadimin *et al*. (2015)	MOL (n=33) IFA (n=35)	11.28 ± 0.78 11.28 + 0.86	11.75 ± 1.09 12.27 + 1.53	0.040 0.003	0.47 ± 1.31 0.99 + 1.76	0.168
3	Khuzaimah *et al.* (2015)	MOLIFAH (n=40) MOLIFA (n=40)	11.88 ± 1.23 12.68 + 1.08	13.52 ± 1.28 12.85 + 1.33	0.020 0.760	1.64. ± 1.39 0.17 + 0.74	0.001
4	Nurdin *et al*. (2018)	MOL (n=62) MOLP (n=64) IFA (n=68)	10.14 ± 0.62 09.98 ± 0.55 10.11 + 0.58	09.89 ± 1.45 10.09 ± 1.60 10.52 + 1.42	0.418 0.550 0.021	-0.16 ± 1.54 0.11 ± 1.50 0.41 + 1.43	0.028

MOLIFA = *Moringa Oliefera* + Iron folic acid, MOLIFAH = *Moringa Oliefera* + Iron folic acid + Honey, IFA = Iron folic acid, MOL = *Moringa Oliefera*, MOLP = *Moringa Oliefera* Powder.

There are four moringa intervention studies that have complete data analysis of changes in hemoglobin in pregnant women. Each study uses a different composition of moringa capsules. Table 3 shows that Study 1 used a capsule containing the combined extract of moringa olifera + iron folic acid (MOLIFA). Study 2 used a single dose of moringa oliefera extract (MOL), study 3 combined moringa olifera extract + iron folic acid + honey (MOLIFAH). Study 4 used Moringa Oliefera Powder (MOLP) and MOL. The results of study 2 indicate that MOL administration can increase hemoglobin levels in normal pregnant women, and the increase is not different from the IFA group. Likewise, the results of study 3 show that MOLIFAH administration can increase the hemoglobin level of passive smoking pregnant women, with a better increase than the MOLIFA group. Pregnant women who took MOLIFA (study 1) and MOL (study 4) experienced a decrease in hemoglobin levels after the intervention.

Table 4. Effect of Moringa Leaf Intervention on Birth Weight

No	Authors	Groups	Birth weight (g)	p-value
1	Nadimin *et al*. (2015)	MOL (n=33) IFA (n=35)	3022 ± 530 3022 ± 530	0.366
2	Khuzaimah *et al.* (2015)	MOLIFAH (n=40) MOLIFA (n=40)	3235 ± 385 3025 ± 368	0.020
3	Arundhana *et al*. (2018)	MOL (n=146) MOLP (n=155) IFA (n=152)	3162 ± 528 3240 ± 454 3101 ± 412	0.033

MOLIFA = *Moringa Oliefera* + Iron folic acid, MOLIFAH = *Moringa Oliefera* + Iron folic acid + Honey, IFA = Iron folic acid, MOL = *Moringa Oliefera*, MOLP = *Moringa Oliefera* Powder.

There are three studies examining the effect of moringa intervention on birth weight, in Table 4. Study 2 shows birth weight in the MOLIFAH intervention group is higher than the MOLIFA intervention group. Likewise study 3 reported higher birth weight of the MOLP intervention group than the MOL and IFA intervention groups. Study 1 reported no difference in birth weight between the MOL intervention group and the IFA intervention group.

There are four studies that have studied the effect of moringa interventions on the production of breast milk (ASI). Study 1 and 2 assessed breast milk volume, study 3 assessed prolactin levels and Study 4 assessed breast milk fat levels from the results of moringa intervention. Table 5 shows the results of Study 1 and 2, the volume of breast milk in the moringa intervention group was higher than that in control. Study 3 showed that the prolactin level in the moringa intervention group was higher in the control group. The increase in breast milk fat content was higher in the moringa intervention group than in the control.

Table 5. Effect of Moringa Leaf Intervention on Breast Milk Production

No	Authors	Observations	MOL group	Control group	Sig	Indicators
1	Espinosa CL, *et al*, 2005	Day-3 Day-4 Day-5 Day-6 Day-7 Day-8 Day-9 Day-10	96.35 ± 14.30 111.85 ± 14.30 127.50 ± 10.33 140.30 ± 11.97 185.52 ± 23.40 249.02 ± 46.98 330.40 ± 39.50 395.90 + 36.33	78.56 ± 09.81 89.58 ± 11.67 93.70 ± 22.60 101.5 ± 09.30 166.6 ± 11.66 128.0 ± 13.20 140.30 ± 10.88 150.80 + 16.50	< 0.05 < 0.05 < 0.05 < 0.05 < 0.05 < 0.05 < 0.05 < 0.05	Volume breast milk
2	Estrella CP, *et a*l, 2000	Day-3 Day-4 Day-5	144.10 ± 162.90 190.00 ± 103.50 319.70 + 154.10	387.20 ± 49.10 123.80 ± 84.90 120.20 + 54.70	0.052 0.007 0.000	Volume breast milk
3	Sulistiawati Y. *et al*, 2017	-	231.72 ± 60.45	152.75 ± 66.99	0.002	Prolactin level
4	Yuliastuti S., *et al*, 2018	Before After	1.84 ± 0.23 6.62 + 2.39	1.73 ± 0.29 2.74 + 0.41	0.240	Breast milk fat

MOL = *Moringa oliefera* leaf

Table 6. Effect of Substitution and Fortification of Children's Food with Moringa Leaf Flour on Children's Nutritional Status

No	Authors	Groups	Nutrition status	Sig	Indicators
1	Zongo U, *et al* (2013)	BB (n=52) BMOL (n=58)	5.7 ± 2.72 8.9 + 4.30	0.002	weigh
2	Zongo U, *et al* (2018)	MOL (n=59) Diet (n=60)	-2.33 ± 1.50 -2.15 + 1.61	0.158	HAZ
		MOL (n=59) Diet (n=60)	-2.31 ± 0.84 -2.20 + 0.81	0.792	WHZ
		MOL (n=59) Diet (n=60)	-2.89 ± 0.88 -2.72 + 0.98	0.734	WAZ
3	Boateng L, *et at* (2019)	CF-35g (n=83) MCL-35g (n=80) MS-5g (n=74)	0.91 ± 0.42 0.75 ± 0.51 0.85 + 0.34	0.05	weight
		CF-35g (n=83) MCL-35g (n=80) MS-5g (n=74)	4.71 ± 1.17 4.14 ± 1.29 4.65 + 1.23	0.02	High

HAZ = High for Age Z-score, WHZ = Weight for High Z-score, WAZ = Weight for Age Z-score,

There are three studies examining the effect of moringa interventions on children's nutritional status and growth. Study 1 compared the changes in body weight of children who intervened in the porridge mixed with moringa flour and the porridge without moringa flour. The results of study 1 showed that there was a significant increase in body weight in children who consumed porridge moringa flour. Study 3 compared the results of the intervention of mixed cereals, nuts and moringa flour (CF-35g), moringa powder as a food topping (MS-5g) and mixed cereal-nuts without moringa on weight and height of children. The results of study 3 showed that the CF-35g diet had a higher effect on changes in children's height, compared to the MS-5g group and the MCL-35 group. The results of study 2 showed that there was no difference in the nutritional status of children who consumed moringa porridge with foods without moringa, for the W/A, H/A and W/H indices.

DISCUSSION

The Effect of Moringa Intervention on Pregnant Women

The intervention of moringa extract or flour can improve the nutritional status or size of MORA's pregnant women. *Moringa leaf* contain potential nutrients for tissue formation and body fat, such as protein and fat. Moringa leaf are a source of vitamins and minerals which are essential to aid digestion, absorption and metabolism in the body. Each cup of *Moringa oleifera* contains 19% RDA of vitamin B6, 12% of the RDA of vitamin C, 11% of the RDA of Riboflafin (B2), 11% of the RDA of Iron and 2 grams of protein (8). The average Moringa oleifera leaves contain 2.26% fat and 23.29% protein (9). Protein contains a number of amino acids that function to improve muscle quality, including in the upper arms, as well as improve health problems such as fetal growth restriction problems (27).

The Fulfill nutritional needs of pregnant women not only has impact on improving the mother's nutritional status but also will increase fetal growth and development. Nutritional elements and chemical compounds derived from *Moringa olifera* leaf are very important for fetal growth and maternal nutritional status and contain antioxidants to maintain the health of the mother and fetus. *Moringa oliefera* leaf are a strong source of antioxidants, such as Vitamin A, vitamin C and vitamin E (11). Antioxidants in pregnant women are needed to prevent placental blood vessel constriction that occurs due to increased oxidative reactions during pregnancy, especially in the last trimester (28). Consumption of *Moringa oliefera* leaf supplements helps prevent oxidative stress which is characterized by decreased levels of MDA and 8-OHDG (13). The intervention of Moringa oliefera leaves can facilitate the transportation of oxygen and nutrients from mother to fetus, thereby increasing fetal growth which is reflected in the nutritional status of the mother and birth weight (14) (15). *Moringa oliefera* leaf contain a complete number of essential amino acids that can promote fetal growth. Amino acids as protein derivatives are nutrients that have a very essential role in tissue formation and fetal growth, so that they will affect changes in body weight and nutritional status of the mother during pregnancy (27).

Moringa leaf intervention Oliefera can help to fulfill the nutritional needs of mothers during pregnancy. *Moringa Oliefera* leaf contain 11% Iron RDA needed for hemoglobin formation. Besides that, *Moringa Oliefera* leaf are potential vitamin C sources that 12% RDA. Vitamin C is very important to help increase iron absorption in the body (8) (11). This situation is very important in efforts to prevent anemia that often occur during pregnancy. Pregnant women who experience anemia have a risk to born premature babies, so that they will have an impact on birth weight, especially anemia that occurred from the beginning of the first trisemester (29). *Moringa Oliefara* leaf-based supplementation can help prevent anemia from pregnant women at the same time to improve the health of the fetus so that it can suppress the birth of premature. Iron deficiency that occurs during pregnancy influences the weight of the placenta and birth weight. This is evidence that maternal malnutrition deficiency causes placental formation and fetal growth (30).

The Effect of Moringa Intervention in Postpartum Mothers on Breast Milk Production

The results of studies that support the role of *Moringa leaf* intervention in breast milk production are still very limited. However, the available information shows that the volume of breast milk in postpartum mothers is higher in the group receiving moringa oliefera leaf intervention. Breast milk products in the intervention group experienced a significant increase compared to the control group (20) (21). There is very limited evidence to explain the role of *Moringa oliefera* leaf consumption on breast milk production.

There are two hormones that play a role in regulating breast milk production, namely the hormone prolactin and oxytocin. Prolactin is required to maintain breast milk production and oxytocin is released in response to stimuli arising from the baby's suction in the area around the breast alveoli so that it triggers the release of milk (31). An important factor that encourages the optimization of milk production is frequent and effective emptying of the breasts. This means that the more frequent emptying of the breasts, the more stimulating the hormones prolactin and oxytocin to produce breast milk (32). *Moringa oliefera* leaf have a *galactogogic* ability to increase breast milk production by providing an effect on prolactin (33) (34). Consumption of *Moringa oliefera* capsules every day (2 x 250 mg) for 2 weeks has been shown to increase prolactin levels in postpartum mothers. Postpartum mothers who took *Moringa oliefera* capsules had higher prolactin levels than the control group. *Moringa oliefera* leaves contain phytosterol compounds (polyponols and sterols) that play a role in increasing prolactin levels (22). Prolactin is needed to increase and smoothen out of milk production. *Moringa oliefera* intervention for toddlers is given in the form of flour or powder mixed or sprinkled in children's food. Moringa flour or powder can be made as a complement to breast milk (MPASI) or made as an additional food in the form of snacks such as biscuits or other local foods. Moringa flour can be used as a substitute for basic ingredients or as a food fortification for children. The addition of Moringa flour or powder can enrich the nutritional value of children's food, both energy, protein, vitamin A, vitamin C, vitamin B1, vitamin B2, iron and a number of other micronutrients.

The Effect of Moringa Intervention on Nutritional Status

Several studies have reported the effect of moringa flour intervention on changes in nutritional status and growth of children. These studies were conducted using control recipients of a meal without moringa flour. The duration of the intervention varied, namely 12 weeks, 4 months and 6 months. Moringa flour is used as a mixture of solid solids and moringa porridge. Giving moringa porridge for 12 weeks can increase the intake of vitamin A, vitamin A levels and nutritional status (W/H) of children under five. However, the results of this study have not shown an increase in the child's body length or height (24). The Boateng et al (2019) study showed that the moringa porridge intervention did not provide better evidence for changes in weight and height in children, compared to a mixture of cereal and legumes. However, the addition of moringa flour in a toddler's diet can enrich the nutrients of mixed foods made from cereals and nuts. Feeding cereals and nuts supplemented with moringa flour had a better effect on weight gain and height in children (25).

Moringa flour intervention shows more effective results when used in the recovery of children under five who are malnourished (wasting). Children who received Moringa supplements gained weight according to the recommendation of 10-20 grams / day. The weight gain of this group was significantly higher than that of the control group. Interestingly, children who received Moringa supplements had shorter recovery periods or treatment days than those who did not receive Moringa supplements (36 $\pm$ 16.5 vs 57 $\pm$ 19.2 days) (26). This can be attributed to the composition of nutrients contained in moringa, such as amino acids and iron which are essential for the recovery of tissue cells and increasing endurance.

CONCLUSION

Intervention of moringa leaf in the form of extract or flour in pregnant women can increase nutritional status, hemoglobin levels, prevent oxidation stress during pregnancy and prevent low birth weight. Moringa supplementation for postpartum mothers. increase milk production and quality. The use of moringa flour as a food mixture can improve the nutritional status of children under five. Moringa leaf can be used to prevent stunting factors in the 1000 HPK. The effectiveness of moringa intervention will be maximized if it is added with honey, or mixed foods for children.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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