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The effect of moringa leaf extract in increasing Hb levels of pregnant women during COVID-19 pandemic in Parigi Regency, Central Sulawesi, Indonesia

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***Abstract*---** Background; The COVID-19 pandemic has a major impact on socioeconomic conditions and public health, especially pregnant women. The availability of food and nutrition will be greatly reduced due to limited mobility which will have an impact on the incidence of anemia in pregnant women. Thus, it is important to use moringa leaf extract as a local resource. Aim To find out the effect of Moringa leaf extract in reducing the incidence of anemia (hemoglobin levels) in pregnant women during the COVID-19 pandemic in the work area of Siniu, Community Health Center, Parimo Regency. Method It is a quasi-experimental research with randomized controlled Double-Blind design. The sample included 40 pregnant women divided into two groups: 20 pregnant women in the intervention group and 20 pregnant women in the control group. The intervention group was given moringa leaf extract capsule and Fe capsule every day. The control group was only given Fe capsule. Result The results showed that the characteristics of the respondents in the two groups before intervention were not different P=0.106. After the intervention for 1 month, the HB level of pregnant women in the intervention group increased significantly compared to the control group (p=0.050). Likewise, after the intervention for 2 months, there was a significant difference between the intervention group and the control group (p=0.002). Conclussion Moringa leaf extract has an effect in increasing

Hb levels of pregnant women, both in the interventions for 1 month and 2 months during the COVID-19 pandemic. It is suggested that moringa leaf extract is an alternative supplement to treat anemia in pregnant women during COVID-19 pandemic.

***Keywords*---**Moringa, Hb levels of Pregnant women, COVID-19.

Introduction

The COVID-19 pandemic has a major impact on socioeconomic conditions and public health, especially pregnant women. A pregnant woman is at high risk for anemia and lack of other nutrients due to the demands of the body in the context of the pregnancy process (1). Oxidative stress can increase in malnourished pregnant women, which in turn can damage Deoxyribo Nucleic Acid (DNA)(2). If oxidative stress persists and DNA damage occurs, the unborn baby is threatened with Low Birth Weight (LBW)(3).

In connection with the aforementioned case, moringa leaf extract can be a substitute for iron intake needed by the body to produce blood. Pregnant women who consume moringa leaf extract experience an increase in hemoglobin which is equivalent to women who receive iron and folic acid supplements. Besides having a high iron content, a previous study has shown that moringa leaves contain vitamin A four times higher than carrots and vitamin C seven times higher than oranges(3). By having ingredients that can counteract free radicals, moringa leaves can also reduce oxidative stress. Moringa leaf extract can prevent anemia, DNA damage, and low birth weight. Moringa (*Moringa oleifera Lam*) is a local plant that has been known for centuries as a multipurpose, nutrient-dense and medicinal plant(4). It contains more and various natural compounds than other types of plants. According to research results, moringa leaves contain very high amounts of vitamin A, vitamin B, vitamin C, calcium, potassium, iron and protein which are easily digested by the human body(5). The high content of iron (Fe) in dried moringa leaves or in the form of moringa leaf powder, which is equivalent to 25 times higher than spinach, can be used as an alternative to treat anemia in pregnant women naturally. In this case, the content of moringa compounds has been researched and reported by Ibok Odura W, O Ellis et al., (6) (2008).

There have been many studies on the effect of moringa leaf extract on increasing Hb, but a study on the effect of moringa leaf extract in pregnant women during the COVID-19 pandemic has not been conducted. This study is very important to do so that pregnant women can survive, stay healthy, are not anemic and can have normal delivery during the COVID-19 pandemic.

Method

Research design

It is a quantitative study. This study utilized experimental design with pretest-posttest control group design with laboratory analysis. The study was conducted on pregnant women with a high risk of anemia. Subjects were given moringa leaf

extract for 2 months. After that, the effectiveness of moringa leaf extract in increasing hemoglobin was measured.

Research subjects

The research subjects were pregnant women in their first trimester who had anemia in Kasimbar Sub-district. Sampling was conducted using purposive sampling technique; selecting subjects according to the eligibility criteria. The inclusion criteria of the subject were pregnant women who were willing to be research subjects and domiciled in the area of Siniu Community Health Center, while the exclusion criteria were pregnant women who had other diseases. Additionally, the researchers divided the research subjects into 2 groups: the control group and the intervention group with each group of consisting of 20 people.

O (control group)	pretest →	no treatment →	posttest
X (intervention group)	pretest →	treatment →	posttest

Research location

This study was conducted in the area of Siniu Community Health Center, Parigi Mountong Regency

Research variable

There were two variables:

1. Independent variable: moringa leaf extract
2. Dependent variable: Hemoglobin

Operational Definition of Variables

No	Variables	Operational Definition	Measuring Instrument	Measurement Results	Scale
1	Moringa leaf extract	moringa leaves which are dried and processed into powder form	-	-	-
2	Hemoglobin	Hemoglobin levels in the blood	Lab analysis	g/dL	Ratio

Data analysis method

Comparison of the increase in hemoglobin before and after treatment was measured using repeated Anova. Furthermore, the comparison of hemoglobin between the two groups after treatment was measured using the independent t-test with the help of the SPSS program application.

Research ethics

Before starting the study, the researchers proposed ethical clearance to the Ethics Committee of the Faculty of Medicine, Universitas Tadulako. Importantly, before

starting data collection, the researchers asked the research subject as a respondent by asking for informed consent.

Research flow

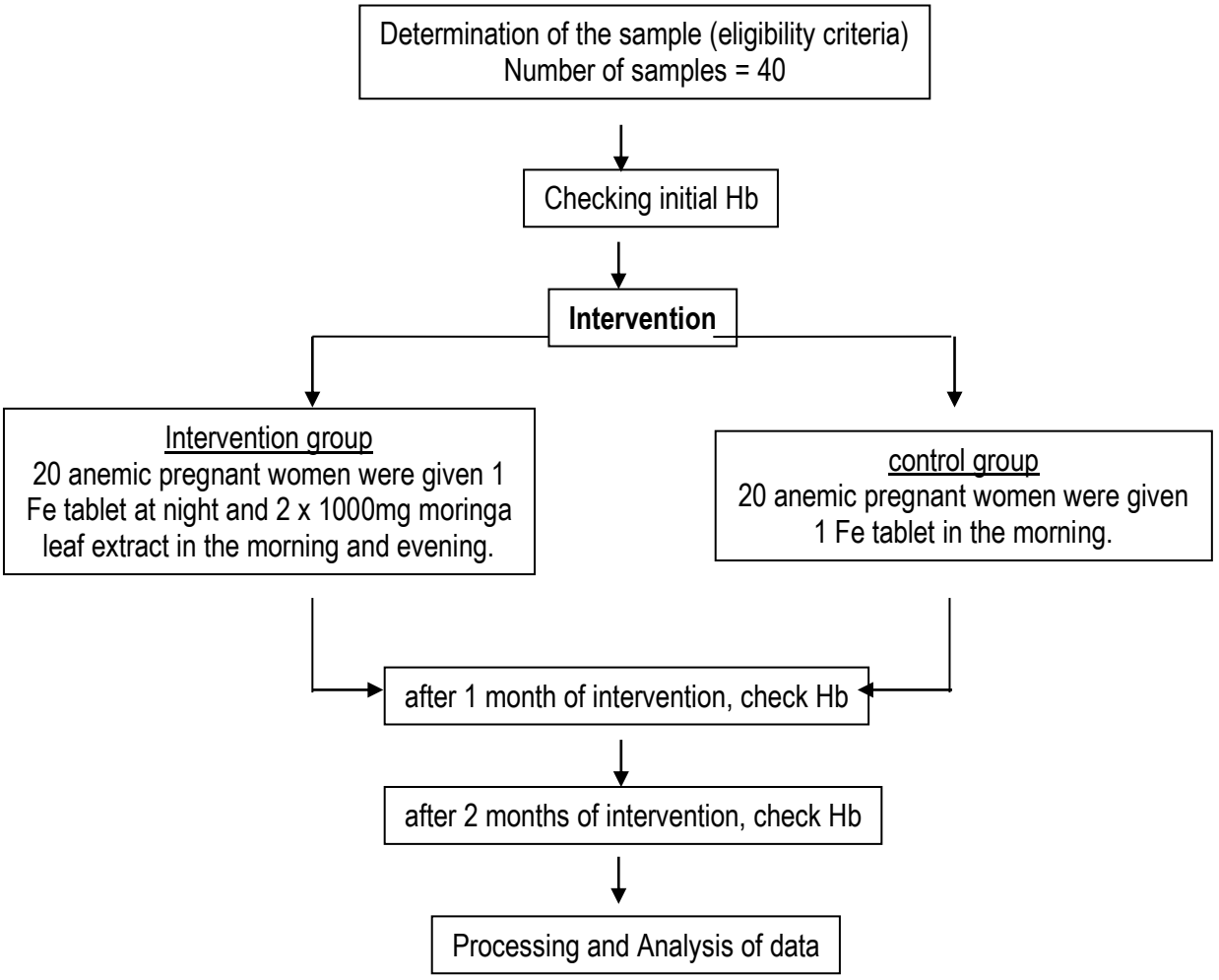

Figure 1. Research Flow

Results and Discussion
Results
Characteristics of Respondents (Pregnant Women)

The study was conducted in February - May 2020 on pregnant women in the work area of Siniu Community Health Center, Parigi Moutong Regency, Central Sulawesi. The subjects selected were pregnant women in the second trimester who had anemia. Subjects in the intervention group consumed 1 Fe tablet at night with the addition of 1000mg of Moringa powder 2 times a day. Meanwhile, subjects in the control group consumed only 1 Fe tablet at night. Table 1 shows the characteristics of the research subject.

Table 1
Characteristics of Research Subjects

Characteristics	N	Percentage
Age		
Non high-risk category	28	70
High-risk category	12	30
Gravida		
Primi	22	55
Multi	18	45
Education		
Elementary School	11	27.5
Junior High School	12	30
Senior High School	16	40
Bachelor's Degree/Diploma 4	1	2.5
Mother's Occupation		
Unemployed	38	95
Employed	2	5
Husband's Occupation		
Private employee	5	12.5
Farmer	30	75
Fisherman	5	12.5

In table 1, it can be seen that there were 30% of pregnant women with high risk (< 20 years and > 35 years) according to age, while those who were at risk were 70%. Moreover, there were 55% mothers with the first pregnancy (primigravida) and 45% mothers with the second or more pregnancy (multigravida). Table 1 also shows that most of the subjects (40%) were high school graduates, followed by 30% junior high school graduates, 27.5% elementary school graduates, and 2.5% bachelor's degree/diploma 4 graduates. Additionally, there were more unemployed/non-working mothers (95%) than employed/working mothers (5%). In addition, most of the husbands of research subjects were farmers (75%), and the rest were fishermen and private employees with a percentage of 12.5% each.

Intervention Results of Moringa Leaf Extract

Table 2
Comparison of hemoglobin (mg/dL) between the intervention group and the control group at pretest in the first month and the second month after treatment

Assessment Indicators	Intervention Group	Control Group
Pre-test	8.33 ± 1.09	8.51 ± 0.83
Month 1	9.42 ± 1.32	9.12 ± 0.92
Month 2	10.27 ± 1.14	9.28 ± 1.32
Repeated Anova	0.000	0.014

In Table 2, it can be seen that in general the subjects in both groups were anemic during the two months of the study. Before treatment, the hemoglobin value in

the control group was slightly higher (8.51 ± 0.83) than the intervention group (8.33 ± 1.09). After one month of treatment, the hemoglobin in both groups increased. A higher increase in hemoglobin was seen in the intervention group which was 9.42 ± 1.32, while in the control group it was 9.12 ± 0.92. In the second month of the study, the increase was also seen in both groups, with a higher increase in the intervention group (10.27 ± 1.14) than in the control group (9.28 ± 1.32). The increase in hemoglobin at pretest, first month, and second month can be seen clearly in Figure 1.

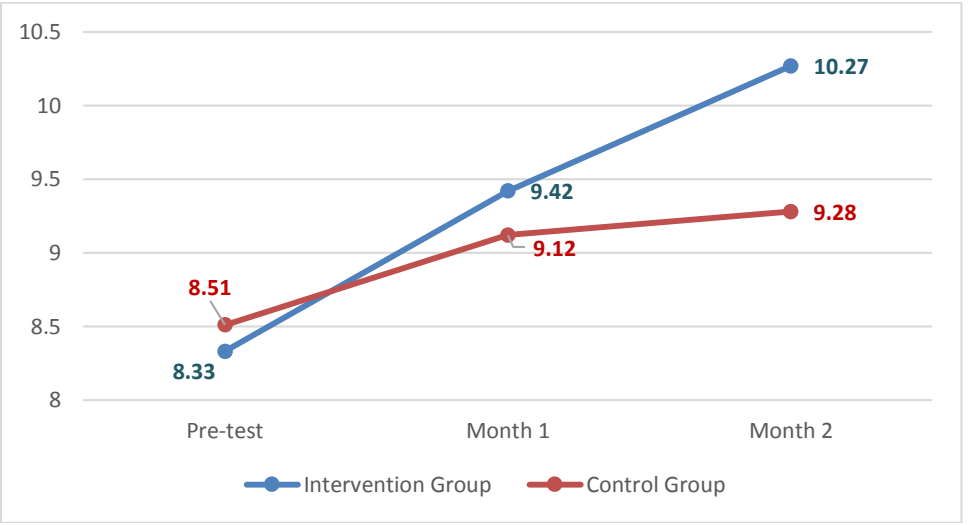

Figure 1. Hemoglobin values at pretest, first month, and second month in the intervention group and the control group

Furthermore, a repeated Anova was conducted to determine the comparison of the mean of hemoglobin before the intervention (pretest), one month and two months after the intervention in each group. As seen in Table 2, the repeated Anova in the intervention group obtained p = 0.000 ($p<0.05$) and in the control group obtained p = 0.014 ($p<0.05$). It indicates that there were differences in hemoglobin values starting from the pretest, the first month and the second month of the study in each intervention group and the control group.

Table 3
Comparison of the Increase in Hemoglobin in the intervention Group and the Control Group

Assessment Indicators	Intervention Group	Control Group	Mean difference	t-test
(Month 1 – pretest)	1.09 ± 0.99	0.61 ± 0.83	0.48	0.106
(Month 2 – month 1)	0.85 ± 0.85	0.17 ± 1.27	0.69	0.050
(Month 2 – pretest)	1.95 ± 0.95	0.78 ± 1.19	1.17	0.002

Table 3 shows the mean difference between the increase in hemoglobin per month and per two months in the two groups. In general, the mean difference in the

intervention group was higher than that of the control group on all assessment indicators. In the first month of the study, the hemoglobin in the intervention group increased by 1.09 ± 0.99, swhile in the control group it increased by 0.61 ± 0.83. In the following month, the second month, the intervention group experienced an increase of 0.85 ± 0.85, while the control group only experienced an increase of 0.17 ± 1.27. In total, the value of the increase in hemoglobin during the two months of the study was 1.95 ± 0.95 in the intervention group and 0.78 ± 1.19 in the control group. The mean difference in the increase in hemoglobin can be seen in Figure 2.

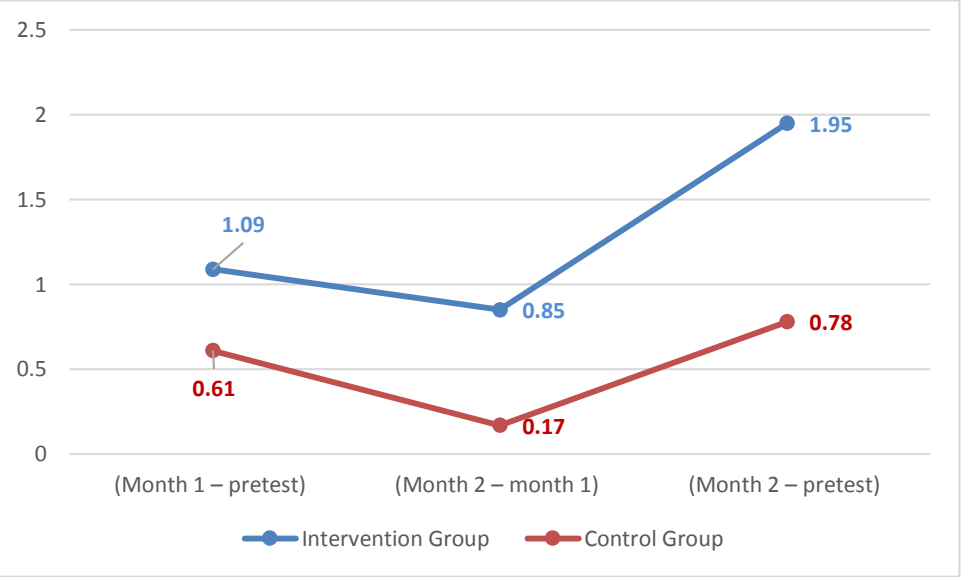

Figure 2. The Mean Difference in the Increase in Hemoglobin in the Intervention Group and the Control Group

In Figure 2, it can be seen that the difference in the increase in hemoglobin from pretest to the first month is higher than that of the first month to the second month. In addition, there was an increase during the two months of the study in both groups, with the difference in the increase in the intervention group being higher than the control group.

More importantly, independent t-test was conducted to determine the comparison of the mean difference in the increase in hemoglobin between the treatment group and the control group. The independent t-test conducted during the first month obtained $p=0.106$ ($p>0.05$) with mean difference of 0.48 which means that there was no statistically significant difference between the two groups. Besides, the independent t-test obtained on the difference in the increase in the second month was $p=0.050$ ($p<0.05$) with mean difference of 0.69 which indicates that there was statistically difference for the difference in the increase in the two groups. In addition, independent t-test results on the difference in the increase in hemoglobin for two months (month 2 – pretest) obtained $p=0.002$ ($p<0.05$) with mean difference of 1.17, which means that there was a statistically significant difference in the difference in the increase in hemoglobin for two months in the two groups.

Discussion

Based on table 4.9, it can be seen that the mean Hb level was 9.90 before consuming moringa leaf extract which then increased to 10.8 after consuming moringa leaf extract. The results of the paired t-test showed p value= 0.000 < α (0.05). Thus, it can be concluded that there is an effect of consumption of moringa leaf extract on increasing Hb levels in pregnant women in the work area of Siniu Community Health Center, Parimo Regency. Iron is an essential microelement for the body. This substance is mainly needed in hematopoiesis (blood formation) in the synthesis of hemoglobin (Hb)(7). The total amount of iron in the body averages 4-5 grams: approximately 65 percent is found in the form of hemoglobin (8); about 4 percent is in the form of 5 myoglobin, 1 percent is in the form of various heme compounds that increase intracellular oxidation; 0.1 percent combines with transferrin proteins in blood plasma; and 15-30 percent is mainly stored in the reticuloendothelial system and liver parenchymal cells, especially in the form of ferritin (9)(Arthur C. Guyton and John E. Hall, 2014). Moringa (*Moringa oleifera Lam*) is a local plant that has been known for centuries as a multipurpose, nutrient-dense and medicinal plant.(10) It contains more and various natural compounds than other types of plants. According to research results(11), moringa leaves contain very high amounts of vitamin A, vitamin B, vitamin C, calcium, potassium, iron and protein which are easily digested by the human body.(12) The high content of iron (Fe) in dried moringa leaves or in the form of moringa leaf powder, which is equivalent to 25 times higher than spinach, can be used as an alternative to treat anemia in pregnant women naturally. In this case, the content of moringa compounds has been researched and reported by(13) Ibok Odura W, O Ellis et al., (2018) who mentioned that 100 grams of moringa leaves contain 28.29 mg of iron. This plant, which has Latin name *Moringa oleifera* or in Indonesian *kelor,* has stems that are sparse and easily broken(14). The leaves are small, oval shaped arranged in one stalk. Moringa can grow very well in areas that have an altitude of between 300 and 500 meters above sea level.(15) Having many benefits and not too difficult to care for, many moringa trees are cultivated independently by means of cuttings. Moringa leaves are very good for consumption by pregnant women, nursing mothers, and toddlers(3)(16) (Satriadi, 2016). However, out of 32 respondents who consumed Moringa leaf extract, 1 respondent did not experience an increase or decrease in Hb levels, and 2 respondents experienced a decrease in Hb levels(17). Pregnant women who experienced a decrease in Hb levels after consuming moringa leaf extract could also be due to the characteristics of the respondents who were all in the second trimester of pregnancy. In this trimester, there is a risk of physiologic anemia caused by increased blood which is commonly called hydremia or hypervolemia(18). In fact, the increase in blood cells is less than the increase in plasma resulting in blood-thinning. Physiologically, blood-thinning occurs to help the heart which works harder during pregnancy(19).

Conclusions and Suggestions
Conclusions

Based on the results of data analysis, it can be concluded that there is an effect of consumption of moringa leaf extract on increasing Hb levels in pregnant women in the second and the third trimesters during COVID-19 pandemic in the work

area of Siniu Community Health Center, Parigi Moutong Regency Therefore, pregnant women should always consume blood supplement tablets accompanied by moringa leaf extract capsules to prevent anemia which can reduce stunting in Parigi Moutong Regency.

Suggestions

1. Health workers should implement the government policy on giving Fe tablets to pregnant women along with moringa leaf capsules to increase their Hb as an effort to reduce stunting.
2. Health workers and the society are expected to be able to complete the Antenatal Care (ANC) for pregnant women, including a complete Hb examination.
3. Health workers, especially integrated service post (Posyandu) cadres, are expected to improve monitoring of hemoglobin levels for pregnant women as well as monitoring the growth of toddlers at Posyandu as an attempt to reduce the risk of stunting.

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