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EFFECT OF MORINGA LEAF EXTRACT CAPSULE ADMINISTRATION ENRICHED WITH ROYAL JELLY (MRJ) ON MALONDIALDEHYDE (MDA) AND TOTAL LYMPHOCYTE COUNT (TLC) LEVELS IN PREGNANT MOTHERS

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Abstract

Background: Pregnancy is prone to oxidative stress, so the addition of antioxidants is needed, so supplements are needed, especially for vulnerable groups, such as children, and pregnant or lactating mothers. The nutritional needs of pregnant women are also found in plants that contain high nutrients ranging from macronutrients to micronutrients. In addition to moringa leaves, royal jelly consists of water (50%-60%), protein (18%), carbohydrates (15%), and lipids (3% - 6%). said to alleviate various health problems such as fatigue, anxiety, mild depression, insomnia and lack of energy and stamina. **Objective:** This study aims to assess the difference in giving moringa leaf extract enriched with royal jelly (MRJ) on MDA (Malondialdehyde) levels and total lymphocyte count in pregnant women. **Methods:** The research design is a Randomized Control Trial. Consists of two groups, namely 1) The intervention group was given MRJ capsules as much as 2 capsules a day for 3 months at a dose of 2 x 500 mg/capsule (1000mg) and the comparison group was given MMS 1 tablet every day which was given for 3 months. The tests used were normality test, hogomenitas, univariate analysis and bivariate analysis. **Results:** The results showed that the average MDA levels were -18.94 in the intervention group and -15.76 in the control group. There was a significant difference in MDA levels between the control group ($p = 0.003$) and marginal significance in the intervention group ($p = 0.053$). Similarly, the mean TLC levels were -3.37 in the intervention group and -2.41 in the control group. Significant differences were observed in TLC levels for both groups (intervention group $p = 0.003$, control group $p = 0.004$). **Conclusion:** The difference test between the intervention group and the control group on the different data shows that there is no similarity or insignificance between MDA levels and TLC levels.

Keywords: Pregnancy Nutrition, Antioxidant Supplementation, Moringa Leaf Extract, Royal Jelly.

INTRODUCTION

Pregnancy is a process that starts from fertilisation or the union of spermatozoa and ovum then continues with nidation or implantation. The event is calculated from the time of fertilisation until the birth of the baby and in normal pregnancy will take place within 40 weeks (10 months or 9 months). [1]. In normal pregnancy is accompanied by increased metabolism and requires high oxygenation, high metabolism to reduce oxidative stress. Oxidative stress is a state of *reactive oxygen species* (ROS) formation that exceeds the ability of the antioxidant balance system. Antioxidants are a body's defence system against the formation of excess ROS, so that the presence of excess ROS causes an increase in oxidative stress which has an impact on the disruption of the placentation process, abortion or miscarriage, and ischemic .[2]

When pregnancy is prone to oxidative stress, the addition of antioxidants is needed. [3]. In addition, oxidative stress can cause abortion which annually worldwide occurs around 73 million cases. 6 out of 10 pregnancies (61%) are unwanted pregnancies, 4 out of 10 (29%) end in intentional abortion.[4] Antioxidants needed are generally derived from food ingredients, such as vitamin C, vitamin E, beta-carotene, and flavonoids that are able to reduce free radicals (Yanuhar, 2015) so that supplements containing antioxidants are needed, especially for vulnerable groups, such as children, pregnant or lactating mothers and the elderly. [5]

Given the impact of macronutrient and micronutrient deficiencies in pregnant women, attention to maternal consumption during pregnancy is very important.[6] Fulfilment of maternal nutritional needs apart from food consumed daily also requires additional intake of food types (Siti Muliawati, et al, 2013). *Micronutrient multiple* (MMN) can be consumed during pregnancy with the hope of reducing the incidence of anaemia. Ramakrishnan et al 2012, have found that perinatal maternal MMN causes a decrease in the incidence of LBW.

Based on studies in low- and middle-income countries, complications from malnutrition that cause morbidity in mothers and their babies such as anaemia, hypertension and LBW, adversely affect the nutritional status of pregnant women which worsens fetal growth and development (Heidkamp et al, 2021). Pregnancy anaemia, iron deficiency is the most frequent and common condition. The adverse impact on the mother and fetus results in high maternal mortality and morbidity, fetal intrauterine growth retardation, namely LBW, preterm delivery to the potential for post partum hemorrhage in childbirth to the postpartum period. Pregnant women who are anaemic will experience increased oxidative stress with high levels of MDA and anti-oxidant capacity (TAC). [7].

World Health Organization data in 2019 recorded that the number of women aged 15-49 years who experienced anemia in the world was 29.9%.[8] Basic Health Research (Riskesdas), the incidence of anaemia in Indonesia is still high, there are 37.1% of pregnant women who experience anaemia. The Indonesian Minister of Health Policy No. 68 of 2014 regarding efforts to reduce the incidence of anaemia is through the provision of 90 Fe tablets during pregnancy, but these efforts are not optimal because the incidence of anaemia is still quite high. [9]. According to the Health Profile Report, the coverage of Fe administration in Indonesia is 85.1%. The provision of Fe to pregnant women is an effort to fulfil nutrients that are rich in macro and micro nutrients so that it can reduce the incidence of anaemia and complications in pregnancy that can cause death .[10]

Pregnant women have nutritional needs that must be met for themselves and the development of their foetus. When pregnant women experience nutrient deficiencies, fat, iron, and vitamins that cannot be produced in the body such as vitamin C, and vitamin B in the mother will be absorbed by the fetus. [11]. Maternal fat is a source of calories while maternal iron reserves are a source of iron for the foetus. The food components that must be fulfilled by pregnant women include balanced nutrition components. Balanced nutrition is the composition of daily food that contains nutrients in the amount that suits the body's needs. Nutrients that are important for pregnant women include folic acid, calcium, vitamin D, protein, and iron. [12]. In addition to eating healthy foods, mothers can also fulfil their nutritional needs by taking supplements.

The nutritional needs of pregnant women are also found in plants that contain high nutrients ranging from macronutrients to micronutrients. The plant is *Moringa oleifera* or more commonly called the Mor*inga* tree by the Indonesian people. Moringa leaf extract has a high composition of antioxidants so that it can ward off free radicals. However, the benefits of moringa leaf extract are not widely known by the public so that the use of moringa leaves as a nutritional supplement for pregnant women has not been widely used.[10] Various studies using moringa preparations both moringa leaf extract and moringa leaf flour in reducing MDA, research conducted by on the effect of moringa leaf extract on MDA in pregnant women and the results obtained that the administration of moringa leaf extract can inhibit the increase in MDA levels in pregnant women .[13] And high serum malondialdehyde levels increase the risk of abortus imminens. Therefore, the body needs antioxidants to neutralise it.[14]

Moringa Honey (MH) is currently emerging as a source of MMN. MH contains a wide range of nutrients as well as bioactive compounds. MOH itself contains protein (0.02%), carbohydrate (72.17%), polyphenols (0.13%), Flavonoids (0.028 Ppm), antioxidants (130,060 Ppm), vitamin C (278.62 Cps), Potassium (0.07%), Beta Carotene (118.24 Ppm), Iron (175 Ppm), Calcium (998 Ppm), Sodium (65 Ppm), Zinc (12 Ppm) and Magnesium 163 Ppm). (Rakhman, 2020). Toxicity tests have been carried out on Moringa honey with a low toxicity category characterised by an LC 50 value >500, where the higher the LC50 value, the lower the toxicity level so that Moringa honey is safe for consumption by pregnant women.

In addition to moringa leaves, royal jelly consists of water (50%-60%), protein (18%), carbohydrates (15%), lipids (3%-6%). it is said to alleviate various health problems such as fatigue, anxiety, mild depression, insomnia and lack of energy and stamina. Further research conducted in 2017 showed the potential of royal jelly to increase *High Density Lipoprotein* (Good cholesterol) (HDL) levels, decrease *Low Density Lipoprotein* (Bad cholesterol) (LDL) levels, and reduce menopause-related symptoms in postmenopausal women. Royal jelly can provide anti-infective and anti-inflammatory effects to anyone who consumes it. [15].

Various studies using moringa preparations both moringa leaf extract and moringa leaf flour in reducing *Malondialdehyde* (MDA), research conducted by [16] Research conducted by (9) on the effect of moringa leaf extract on MDA in pregnant women found that the administration of moringa leaf extract can inhibit the increase in MDA levels in pregnant women (Nadimin, 2016). Several studies have shown a decrease in MDA in the saliva of smoking mothers who are intervened by honey. [17]. Research by D. Sahertian (2021) showed that the provision of moringa honey and regular honey in improving nutritional intake on MDA levels had a more significant effect on honey given with moringa at a dose of 15ml / day.

Research related to the effect of supplementing *moringa* leaf extract capsules (*Moringa oleifera leaves*) plus royal jelly has been conducted on pregnant women with anaemia. One research mentioned that there was an increase in hematocrit levels in anaemic pregnant women after being given MRJ supplements, while research conducted by Wilma (2020) Previous research related to MDA levels in the group of moringa plus royal jelly supplementation has been conducted on anaemic mothers, the results of which showed a significant decrease in MDA levels in the intervention group.[20]

METHOD

Research Design

This type of research uses a type of quantitative research with this research design using a *Randomised Control Trial*. This study uses a *single-blind* method where the research subject does not know the test material given. This study consisted of two groups . The intervention group is pregnant women who are given MRJ capsules as much as 2 capsules a day for 3 months at a dose of 2 x 500mg / capsule (1000mg) and the comparison group is selected and has the same characteristics but is given a different intervention, namely given MMS 1 tablet every day which is given for 3 months.

Location and time of research

This research was conducted in Batui Selatan and Moilong sub-districts, Banggai Regency, Central Sulawesi, which is the working area of Pertamina Medco Tomori's Joint Operating Body (JOB), an upstream oil and gas company. This research will be conducted from July to December 2023.

Population

Population is a generalisation area consisting of objects or subjects that have the quality or characteristics set by researchers to study and then draw conclusions. The population in this study used the target population, namely all pregnant women in trimester two in the Batui Selatan and Moilong Districts as many as 97 pregnant women.

Sample

Determination of the sample size for the first population used in the study can use the Lemeshow formula from (Sugiyono 2018)

$$n1 = n2 = 2\left\{\frac{(z\alpha + z\beta)S}{X1 - X2}\right\}^2$$

$$n1 = n2 = 2\left\{\frac{(1{,}64 + 0{,}84)5{,}67}{3{,}86}\right\}^2$$

$$n = 26{,}54 = 27$$

Description:

$Z\alpha$= Type 1 error of 5% = 1.64

$Z\beta$= Type 2 error of 20% = 0.84

S= Standard deviation from previous research 5.67

$X1 - x2$= difference in MDA between groups in the previous study (9.77-5.91) = 3.86 [22]

Estimated DO = 20%= 5.4

So sample size 27+5.4 = 32.4 = 33 per group

So that the sample size obtained is 30 + 3 = 33 respondents in each group. The sample with MRJ intervention was 33 respondents and the sample with MMS intervention was

33 respondents selected by randomisation. Sample selection is adjusted to the following criteria:

a) Inclusion criteria

1) Pregnant women in first and second trimester
2) Staying at the research site during the research process
3) Willing to follow the study protocol thoroughly Pregnant women.

b) Exclusion criteria

1) Have chronic and infectious diseases such as DM, hypertension
2) Have barriers to accessing health services

c) Drop out

1) Do not consume capsules for more than 7 consecutive days
2) Experiencing severe side effects from the intervention
3) Move to a location that cannot be reached by Health workers.

Ethics

This study obtained ethical approval from the Faculty of Public Health, Hasanuddin University Makassar (Number: 4352/UN4.14.1/TP.01.02/2023). The sample consisted of 31 second trimester pregnant women in Batui Selatan and Moilong sub-districts in the intervention group, and 30 pregnant women in the control group. The intervention group received 2 MRJ capsules (total dose 1000mg) per day for 3 months, while the control group received MMS 1 tablet per day during the same period. Data were then systematically analysed through univariate and bivariate analysis after being presented in distribution tables for each variable.

RESULTS

Subject Characteristics

Distribution of Subject Characteristics

Characteristics	Group				P *value**
	Intervention (MRJ)		Control (MMS)		
	n	%	n	%	
Age					
At risk (<20 - >35 years)	0	0.0	5	16.7	0.018
Not at risk (20-35 years)	31	100.0	25	83.3	
Parity					
Never given birth	6	19.4	9	30.0	**0.174**
Primiparous	12	38.7	15	50.0	
Multiparous	13	41.9	6	20.0	
Grandemultipara	0	0.0	0	0.0	
Mother's education					
Higher (High School, Academic, University)	21	67.7	16	53.3	**0.249**
Low (SD, SMP)	10	32.3	14	46.7	
Revenue					
High (≥ minimum wage IDR 3,100,000.00)	4	12.9	5	16.7	**0.679**
Low (< minimum wage of IDR 3,100,000)	27	87.1	25	83.3	
Jobs					

Characteristics	Group				P value*
	Intervention (MRJ)		Control (MMS)		
	n	%	n	%	
Not working	4	12.9	5	16.7	**0.679**
Work	27	87.1	25	83.3	
Stress					
Normal (0-14)	0	0.0	0	0.0	**0.923**
Mild (15-18)	20	64.5	18	60.0	
Medium (19-25)	11	35.5	12	40.0	
Heavy (26-33)	0	0.0	0	0.0	
Very severe (>33)	0	0.0	0	0.0	

Source: Primary Data, 2024

**Chi-Square*

Table 1 shows the characteristics of the subjects, namely age, parity, maternal education, income, occupation and stress. Based on the table above, for the age group all respondents in the intervention group (MRJ) were in the non-risk category aged 20-35 years as many as 30 people or 100.0%, while in the control group (MMS) the majority were in the non-risk category aged 20-35 years as many as 25 people or 83.3%. In the parity category of the intervention group (MRJ) the majority were multiparous as many as 13 people or 41.9%, while in the control group (MMS) the majority were primiparous as many as 15 people or 50.0%. In the education category of the intervention group (MRJ) the majority were in the higher education category (high school, academic or university) as many as 21 people or 67.7%, while in the control group (MMS) the majority were in the higher education category (high school, academic or university) as many as 16 people or 53.3%. In the category of work, the majority of the intervention group (MRJ) were in the category of not working as many as 27 people or 87.1%, while in the control group (MMS) the majority were in the category of not working as many as 25 people or 83.3%. In the stress category, the majority of the intervention group (MRJ) were in the mild stress category as many as 20 people or 64.5%, while in the control group (MMS) the majority were in the mild stress category as many as 18 people or 60.0%. It is known that there is a difference in age in the two sample groups with a P value = 0.018, while parity, education, income, work and stress in the intervention and control groups are not different or homogeneous with a P value of 0.174, 0.249, 0.679, 0.679, 0.923 respectively.

Changes in Malondialdehyde (MDA) Levels

Distribution of Malondialdehyde (MDA) Level Characteristics Pre Post in Control Group and Intervention Group

Characteristics	Group			
	Intervention (MRJ)		Control (MMS)	
	n	%	n	%
Pre Malondialdehyde (MDA)				
Low (< 15 nmol)	3	10.0	5	19.2
Normal (15-35.3 nmol)	7	23.3	7	26.9
High (>35.3 nmol)	20	66.7	14	53.8
Post Malondialdehyde (MDA)				
Low (< 15 nmol)	8	26.6	15	55.6
Normal (15-35.3 nmol)	11	36.7	6	22.2
High (>35.3 nmol)	11	36.7	6	22.2

Source: Primary Data, 2024

Based on table 2, shows changes in malondialdehyde (MDA) levels pre intervention in the intervention group (MRJ) the majority had malondialdehyde (MDA) levels in the high category, namely 20 respondents (66.70%), while in the control group (MMS) the majority had malondialdehyde (MDA) levels in the high category, namely 14 respondents (53.80%). Changes in malondialdehyde (MDA) levels prepost intervention in the intervention group (MRJ) the majority had malondialdehyde (MDA) levels in the normal and high categories, namely 11 respondents (36.70%), while in the control group (MMS) the majority had malondialdehyde (MDA) levels in the low category, namely 15 respondents (55.60%).

Change in Total Lymphocyte Count (TLC)

Distribution of Total Lymphocyte Count (TLC) Characteristics Pre Post in Control Group and Intervention Group

Characteristics	Group			
	Intervention (MRJ)		Control (MMS)	
	n	%	n	%
Pre Total Lymphocyte Count (TLC)				
Low	12	38.70	13	43.30
High	19	61.30	17	56.70
Post Total Lymphocyte Count (TLC)				
Low	24	77.40	22	73.30
High	7	22.60	8	26.70

Source: Primary Data, 2024

Based on table above, shows changes in total lymphocyte count (TLC) levels pre intervention in the intervention group (MRJ) the majority had total lymphocyte count (TLC) levels in the high category, namely 19 respondents (61.30%), while in the control group (MMS) the majority had total lymphocyte count (TLC) levels in the high category, namely 17 respondents (56.70%). Changes in total lymphocyte count (TLC) levels post intervention in the intervention group (MRJ) the majority had total lymphocyte count (TLC) levels in the low category, namely 24 respondents (77.40%), while in the control group (MMS) the majority had total lymphocyte count (TLC) levels in the low category, namely 22 respondents (73.30%).

Bivariate Analysis

Normality Test

Data normality test was conducted using the Shapiro-Wilk test because the number of data in each group was less than 50. Data distribution is considered normal if the significance value is more than 0.05, and abnormal if it is less than 0.05. Data analysis was performed in an unpaired manner between the intervention and control groups. If both groups had a normal distribution, an independent t-test was used. Otherwise, the Mann-Whitney U test was used. For paired data analysis (pre and post), if both groups had normal distribution, paired t-test was used. Otherwise, the Wilcoxon signed-rank test was used.

The normality test results showed that most of the data in the intervention group had a normal distribution ($p>0.05$), except for the pre total lymphocyte count (TLC) variable. While in the control group, most of the variables had normal distribution ($p>0.05$), except for the variables of post malondialdehyde (MDA) level, post total

lymphocyte count (TLC), post total lymphocyte count (TLC), and difference in total lymphocyte count (TLC).

Homogeneity Test

The homogeneity test aims to determine whether the two data have the same variance. If the data have the same variance, the inference analysis uses parametric statistics, but if the data have unequal variances, then the inference analysis uses non-parametric statistics. The data homogeneity test uses the *Levene Test, the* data has a homogeneous distribution if the significance value is ≥ 0.05. Data does not have a homogeneous distribution if the significance value is < 0.05. The results of the homogeneity test are presented in Table 4.

The homogeneity test results showed that all data were homogeneous (p ≥ 0.05). Homogeneous data indicates that analysis bias can be avoided so that the conclusions obtained are more accurate.

Results of Differential Test of Baseline Data Variables

Differences of Pre MDA levels and TLC levels before and after the intervention in the groups of pregnant women who received MRJ and pregnant women who received MMS

Variables	Intervention (mean ± SD)	Control (mean ± SD)	P value
MDA levels	45.20 ± 24.47	32.67 ± 25.00	0,755[a]
TLC levels	20.86 ± 4.12	20.85 ± 3.27	0,708[b]

Source: Primary Data, 2024. [a]Independent t Test[b] Mann Whitney Test

Based on the results of the variable difference test in table 5 on data before intervention. It can be seen that the average MDA level of the intervention group is 45.20 with a standard deviation of 24.47, while the average MDA level of the control group is 32.67 with a standard deviation of 25.00. The average TLC level of the intervention group was 20.86 with a standard deviation of 4.12, while the average TLC level of the control group was 20.85 with a standard deviation of 3.27.

The data showed that there is an inequality or insignificance between the MDA levels of the intervention group and the control group with a p value of 0.755 and 0.708. There was no difference in MDA levels and TLC levels in the intervention group and control group at baseline data (before intervention).

Differential Test Results of Data Variables After Intervention

Differences of post MDA levels and TLC levels before and after the intervention in the groups of pregnant women receiving MRJ and pregnant women receiving MMS

Variables	Intervention (mean ± SD)	Control (mean ± SD)	P value
MDA levels	26.25 ± 18.43	16.91 ± 19.83	0,030[a]
TLC levels	17.49 ± 4.32	18.44 ± 5.36	0,453[a]

Source: Primary Data, 2024. Mann Whitney Test[a]

Based on the results of the variable difference test in Table of the data after the intervention between the intervention and control groups. It can be seen that the average MDA level of the intervention group is 26.25 with a standard deviation of

18.43, while the average MDA level of the control group is 16.91 with a standard deviation of 19.83. The average TLC level of the intervention group was 17.49 with a standard deviation of 4.32, while the average TLC level of the control group was 18.44 with a standard deviation of 5.36.

The data showed that there is a similarity or significance between the MDA levels of the intervention group and the control group with a p value of 0.030, which means that there are differences in MDA levels in the intervention group and the control group after the intervention. Meanwhile, there is no similarity or insignificance between the TLC levels of the intervention group and the control group with a p value of 0.453, which means that there is no difference in TLC levels in the intervention group and the control group after the intervention.

Differential Test Results Variable Difference Data

Differences in Changes in MDA Levels and TLC Levels before and after the intervention in the groups of pregnant women who received MRJ and pregnant women who received MMS

Variables	Before (mean ± SD)	After (mean ± SD)	P value[a,b]	Δ	P value[c,d]
MDA levels					
Intervention (n=31)	45.20 ± 24.47	26.25 ± 18.43	0,000[a]	-18.94 ± 24.93	0,655[c]
Control (n=30)	32.67 ± 25.00	16.91 ± 19.83	0,003[b]	-15.76 ± 23.88	
TLC levels					
Intervention (n=31)	20.86 ± 4.12	17.49 ± 4.32	0,003[b]	-3.37 ± 5.44	0,634[d]
Control (n=30)	20.85 ± 3.27	18.44 ± 5.36	0,004[b]	-2.41 ± 5.20	

Source: Primary Data, 2024.

[a] Paired Samples T test.

[b] Wilcoxon test

[c] Independent Samples T test

[d] Mann Whitney test

Based on the results of the variable difference test in Table 15 on the difference data between the intervention and control groups. It can be seen that the average MDA level of the intervention group is -18.94 with a standard deviation of 24.93, while the average MDA level of the control group is -15.76 with a standard deviation of 23.88.

The average TLC level of the intervention group was -3.37 with a standard deviation of 5.44, while the average TLC level of the control group was -2.41 with a standard deviation of 5.20.

The data in table 15 shows that there is a similarity or significance between MDA levels in the intervention group with a p value of 0.053 and MDA levels in the control group with a p value of 0.003.

There is a similarity or significant between the TLC levels of the intervention group with a p value of 0.003 and the control group with a p value of 0.004. The difference test between the intervention group and the control group on the difference data showed no similarity or insignificance between MDA levels with a p value of 0.655 and TLC levels with a p value of 0.634.

DISCUSSION

Effect of MDA levels before and after the intervention in the group of pregnant women receiving MRJ and MMS

During pregnancy, women experience various physical, biochemical, physiological and psychological changes due to the growth of the foetus in the womb. These are necessary to support the growing foetus, maintain the body's metabolism, and prepare for labour and breastfeeding. Each trimester has a different level of change. Pregnancy is a crucial period in shaping the quality of human resources in the future. because the growth and development of the child will be determined by the conditions when the fetus is in the womb. [23].

The study showed that Moringa leaf extract (MRJ) had a significant effect on changes in Malondialdehyde (MDA) levels in pregnant women. The majority of intervention group respondents had normal MDA levels after the intervention, while the majority of the control group had low MDA levels. This is due to the complete nutritional content, especially Vitamins A, C, and E, as well as iron in Moringa leaves that can reduce oxidative stress. Previous studies have also shown similar results, where moringa leaf extract is effective in reducing MDA levels in pregnant women. In the third trimester, pregnant women's nutritional needs increase, including protein, calories, and iron, which are important for maternal and foetal health.[24], [25] Moringa leaf extract can also increase antioxidant enzyme activity and mitochondrial metabolism, and help increase haemoglobin levels. Although the difference between the intervention and control groups was not significant, it may be due to factors such as sample size, dose, and duration of intervention. Overall, the use of moringa leaf extract in pudding can be a good alternative to increase pregnant women's nutritional intake and reduce high MDA levels.[26]

Research by Yulni et al (2020) found that intervention with moringa leaf extract (KRJ), temu putih extract (KTR), and placebo (PLC) resulted in significant differences in haemoglobin (Hb) levels before and after the intervention.[27] Both intervention groups, KRJ and KTR, showed a significant increase in mean Hb, with a p value of 0.001, while PLC had a p of 0.002. In addition, research by Bhachandra et al (2018) showed that administration of royal jelly and honey improved haematological parameters in pregnant women, including red blood cell count and haemoglobin.[28] This is due to the nutrient content in moringa and royal jelly that helps prevent iron deficiency anaemia. According to research by Rotella (2023), consumption of moringa extract and powder has no adverse effects and can improve the nutritional status of pregnant women and potentially increase breast milk production. [29] Another study by Haju (2020) showed that moringa can increase maternal weight, haemoglobin levels and newborn weight. In addition, the use of moringa can reduce oxidative stress and cortisol levels in pregnant women.[30] Nonetheless, further research is needed to support these findings. Oxidative stress, which can result in increased malondialdehyde (MDA) levels, can be prevented by increased intake of antioxidants, such as those found in moringa. Moringa leaves contain flavonoid compounds and vitamin C, which act as antioxidants that are effective in fighting oxidative stress. Through moringa consumption, pregnant women can improve their nutritional status and protect themselves from the negative effects of oxidative stress, which is important for maternal and foetal health.

Effect of TLC Levels Before and After Intervention in the Pregnant Women Group Receiving MRJ and MMS

Moringa leaves contain various macronutrients that pregnant women need such as thiamin, riboflavin, niacin, beta-carotene, calcium, iron, phosphorus, magnesium, zinc, vitamin C, antioxidants, and anti-inflammatories.[31] The study showed changes in total lymphocyte count (TLC) levels before and after the intervention in the groups receiving MMS and MRJ tablets. The MRJ group showed a significant decrease in TLC levels ($p < 0.05$), while the MMS group showed a lower decrease. Research by Hasriani et al (2020) showed that Moringa leaf tea is more effective in reducing leukocyte levels in pregnant women compared to iron (Fe) tablets.[32] Moringa can help increase birth weight, breast milk production, and reduce oxidative stress in pregnant women. Increased neutrophil levels during normal pregnancy are related to hormonal and immunological changes.[33] Pregnancy-related diseases are often caused by inflammation, which can be reflected in haematological markers such as the neutrophil-lymphocyte ratio.[34]

Research limitations

Limitations of the study include: difficulty in reaching distant samples, some samples were unable to perform post-checks, and lack of control over the type and honesty of respondents in mentioning the food consumed. Food recall was only conducted twice 24 hours, not covering specific food consumption patterns during the study.

CONCLUSIONS

The results of the study analysis concluded that there was no significant difference between the intervention using MRJ and MMS in reducing MDA and TLC levels. This means that both types of intervention were equally effective in reducing both parameters. This suggests that both MRJ and MMS have equal potential in reducing oxidative stress and changes in lymphocyte count in pregnant women.

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