# The Effect of Moringa-Based Supplementation on Fetal Birth Weight in Jeneponto Regency

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**Abstract:** *Background*: Low birth weight (LBW) is one of the main causes of morbidity and mortality besides preterm birth. Proper interventions during pregnancy can prevent an adverse pregnancy outcome. This study aims to see the effect of Moringa leaf capsule on birth weight.

*Methods*: This study was double blind randomized controlled trial (DB-RCT) which consisted of three groups namely, Moringa powder (PG), Moringa extract (EG), and iron-folate (IG) groups. The intervention was given for 12 weeks. The samples were 453 pregnant women in six sub-districts in Jeneponto Regency. Data on birth weight and placental weight were measured by trained midwives. The weight of the placenta was measured to determine the placental ratio to birth weight. In addition, some socio-economic variables such as age, gestational age, eating frequency, smoking, and Hb levels were measured in this study. Logistic and linear regression were conducted in this study.

*Result*: The Moringa leaf supplementation groups (PG and EG) delivered child with better weight than iron supplementation (3240.03±453.82, 3161.91±527.70, 3100.89±412.15, respectively). The placenta to birth weight ratio (PBWR) showed that IG group became lowest, merely 16.19%. The most influenced factor to LBW is the unhappiness of the women with her pregnancy (OR = 26.3, 95% CI = 1.227 - 566.474, p = 0.037).

*Conclusion*: Moringa powder supplementation can be used as an alternative in improving new born baby weight. Pregnant women need to be happy and avoid stress to prevent LBW.

**Keywords:** Low birth weight, iron supplementation, maternal nutritional status, Moringa Oleifera.

## INTRODUCTION

In a last decade, maternal and child mortality issues are becoming increasingly popular especially in the developing countries. The failure of Indonesian government to achieve Millennium Development Goals (MDG) targets by 2015, reducing maternal and child mortality, gave a valuable experience in providing better solution to address these problems. Based on the report, in 2015, maternal mortality in Indonesia reached 305 per 100,000 live birth [1]. Nutrition in early pregnancy or even before pregnancy plays pivotal role to prevent death caused by pregnant complication [2]. Basically, adverse pregnancy outcome, such as preterm birth, low birth weight, intrauterine growth retardation, defect, and neonatal mortality are preventable with a proper intervention [3].

The basic of nutritional problems, according to the conceptual framework by UNICEF, is related to the environment, socio-economic, and political aspects. To address malnutrition problem, specific and sensitive interventions should be implemented as an effort to improve maternal health status [4,5]. One of the efforts, such as providing micronutrient intervention, could be done [6]. However, this such program should be started earlier since the beginning of pregnancy or pre-pregnancy period. A good nutrition and health status in early pregnant period result in optimal gestational weight gain during pregnancy [7]. Gestational weight gain is strongly associated to growth and development of fetus and placental weight.

Moringa Oleifera, contained micronutrients like Fe, zinc, and folic acid, is proven to effectively increase Haemoglobin (Hb) concentration which may have equal role to iron-folic supplementation [8]. Based on our previous studies, Moringa extract is also used to prevent the DNA damage occurrence [9], and even contribute to a better birth weight of the children [10]. It is important to prevent low birth weight because of its subsequent negative impact on children appeared in the future, such as stunting, impaired cognitive, and risk of non-communicable diseases [11,12]. Globally, the prevalence of low birth weight (LBW) is 15.5% [11], while in Indonesia it reached 12.9% in 2012 and

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decreased to 10.2% in 2013 [13,14]. This study aims to examine the effect of Moringa leaf supplementation to new born baby weight in Jeneponto Regency.

## MATERIALS AND METHODS

This study is the part of grant study entitled the effect of Moringa extract capsule for anemia prevention in pregnant women in Jeneponto Regency. The study design was double blind randomized controlled trial (DB-RCT). The intervention materials given consisted of three groups, namely Moringa powder (PG), Moringa aqueous extract (EG), and Iron-folic (IG) and administered to participant for 12 weeks. All these intervention capsules were similarly designed, weight and size. The raw materials of Moringa Oleifera plants were collected from Jeneponto Regency, while iron folic acid was obtained from Province Health Office of South Sulawesi, Indonesia.

The sample of grant study was 616 obtained from six sub districts in Jeneponto Regency. The sample of this study should be delivered in government's health services. Therefore, until the end of data collection, merely 453 samples could be analyzed. Data on birth weight and placental weight were measured by midwives who had been recruited and trained for this study. The weights of the newborn babies and placenta were recorded to the nearest gram. Low birthweight is categorized as birth weight less than 2,500 grams or 5.5 pounds [11]. The weight of the placenta was measured to determine the placental and birth weight ratio in order to obtain an overview of the utero condition of fetus [15]. In this study, placental-body weight ration (PWBR) was calculated as ratio of placental weight to new born baby weight multiplied by 100%.

Some variables of socio-economic, such as age, gestational age, food frequency, smoking, and Hb level were including measured. In addition, receiving iron-supplementation, in the first trimester and had been stopped when the participant enrolled to this study, is measured as well. These variables were measured by using structured questionnaire. Besides, anemia status has been included as one of the factor associated with low birth weight. This, anemia status was determined using Diaspect (Diaspect$^{TM}$).

## RESULT

The result of this study revealed a significant difference among groups for gestational age, birth weight, and placental weight (Table **1**). For birth weight, the Moringa leaf supplementation groups (powder and aqueous extract) have had higher value than iron supplementation. However, post hoc analysis shows that there was a significant different only between PG and IG (3240.03±453.82 vs 3100.89±412.15, p=0.033). The placental-body weight ratio result showed that IG group had the lowest proportion, roughly 16.19%, while PG and EG reached 17.48% and 16.88% (p=0.008). Similarly, there is a difference between PG, EG, and IG (566.52±140.53, 531.03±159.16, 502.80±152.97, respectively).

**Table 1: Participant Characteristics**

| Variable (N=453) | PG (n=155) mean±SD | EG (n=146) mean±SD | IG (n=152) mean±SD | Total mean±SD | p |
|---|---|---|---|---|---|
| Age, years | 27.43±6.51 | 27.53±6.44 | 26.49±6.18 | 27.15±6.38 | 0.301 |
| Gestational age[&], weeks | 18.04±4.53 | 16.93±4.40 | 16.93±3.89 | 17.31±4.30 | **0.033** |
| Education[*] (n=442), years | 9.05±3.50 | 8.78±3.77 | 8.69±3.79 | 8.84±3.68 | 0.676 |
| Mean of parity[#] (n=320) | 1.53±0.70 | 1.63±0.73 | 1.49±0.65 | 1.55±0.69 | 0.352 |
| Maternal MUAC, cm | 25.70±3.10 | 25.90±2.79 | 25.69±2.66 | 25.76±2.85 | 0.775 |
| Maternal Hb, gr/dL | 10.65±1.50 | 10.57±1.73 | 10.96±1.50 | 10.73±1.58 | 0.077 |
| Birth weight, grams | 3240.03±453.82[a] | 3161.91±527.70 | 3100.89±412.15[a] | 3168.17±468.56 | **0.033** |
| Low birth weight, n (%) | 4 (18.2) | 7 (31.8) | 11 (50.0) | 22 (4.9) | 0.165 |
| Placental weight, grams | 566.52±140.53[b] | 531.03±159.16 | 502.80±152.97[b] | 533.70±152.86 | **0.001** |
| Placental-body weight ratio (PBWR), % | 17.48±3.54[c] | 16.88±4.55 | 16.19±4.27[c] | 16.86±4.16 | **0.008** |

[&]there is no significant between groups; MUAC (Mid-upper arm circumference).
*Moringa powder (PG)=149, Moringa extract (EG)=144, and iron-folic (IG)=149; [#]PG=120, EG=104, IG=96.

**Table 2: Factors Associated to Low Birth Weight**

| Variable (N=453) | LBW n (%) | Normal n (%) | RR (95% CI) | p |
|---|---|---|---|---|
| Maternal age | | | | |
| At risk (<20 and >35 years old) | 13 (5.9) | 209 (94.1) | 1.503 (0.656 – 3.446) | 0.335 |
| Normal (20-35 years old) | 9 (3.9) | 222 (96.1) | | |
| Maternal education | | | | |
| Low (<Secondary school) | 11 (3.6) | 296 (96.4) | 0.456 (0.193 – 1.078) | 0.074 |
| High (>=Secondary school) | 11 (7.5) | 135 (92.5) | | |
| Maternal occupation | | | | |
| Working | 18 (4.9) | 349 (95.1) | 1.057 (0.349 – 3.208) | 0.922 |
| Not working | 4 (4.7) | 82 (95.3) | | |
| Took iron pills (n=139) | | | | |
| No | 2 (18.2) | 9 (81.8) | 3.325 (0.783 – 14.114) | 0.123 |
| Yes | 7 (5.5) | 121 (94.5) | | |
| Parity | | | | |
| 1st child | 13 (7.1) | 169 (92.9) | 4.929 (1.131 – 21.482) | **0.031** |
| >=2 children | 2 (1.4) | 136 (98.6) | | |
| Happy with the current pregnancy | | | | |
| No | 1 (16.7) | 5 (83.3) | 3.548 (0.565 – 22.277) | 0.210 |
| Yes | 21 (4.7) | 426 (95.3) | | |
| Chronic energy deficiency | | | | |
| Yes | 6 (6.1) | 93 (93.9) | 1.341 (0.539 – 3.336) | 0.530 |
| No | 16 (4.5) | 338 (95.5) | | |
| Availability of family members who smoke | | | | |
| Yes | 19 (5.1) | 353 (94.9) | 1.379 (0.418 – 4.550) | 0.596 |
| No | 3 (3.7) | 78 (96.3) | | |
| Planning the current pregnancy | | | | |
| No | 2 (5.9) | 32 (94.1) | 1.232 (0.301 – 5.052) | 0.773 |
| Yes | 20 (4.8) | 399 (95.2) | | |
| Maternal anaemia | | | | |
| Yes | 9 (5.3) | 160 (94.7) | 1.163 (0.508 – 2.664) | 0.720 |
| No | 13 (4.6) | 271 (95.4) | | |
| Supplementation | | | | 0.185 |
| PG | 4 (2.6) | 151 (97.4) | 0.357 (0.116 – 1.095) | |
| EG | 7 (4.8) | 139 (95.2) | 0.663 (0.264 – 1.662) | |
| IG | 11 (7.2) | 141 (92.8) | Ref. | |

CI= Confident interval.

The factors contributing to birth weight can be seen in Table **2**. Parity is a risk factor for LBW, women with the first pregnancy are 4.9 times likely to have LBW baby (95% CI = 1,131 - 21,482) than women with second pregnancy or more (p=0.031). In addition, maternal education has borderline significant value (p=0.074), but this variable is a protective factor. Low maternal education level has only 0.45 times of LBW risk (95% CI = 0.193 - 1.078) than those with higher education levels. Gestational age, working status, receiving iron supplementation capsules, maternal happiness, chronic energy deficiency status, household members who smoke, and planning for pregnancy are not risk factors for LBW (p> 0.05).

In multivariate analysis, variables with significant value (p <0.25) were taken, such as maternal education variable, receiving iron supplementation, parity, pregnancy happiness of the women, and type of intervention received. The most influential result is the level of maternal happiness due to pregnancy. Unhappy women due to their pregnancy are likely to have LBW baby 26.3 times (95% CI = 1.227 - 566.474, p = 0.037) compared to happy women with their pregnancies.

**Table 3: Multivariate Analysis of Factors Associated with LBW**

| Variable (N=453) | RR | 95% CI | p |
|---|---|---|---|
| Maternal education<br>Low (<Secondary school)<br>High (>=Secondary school) | 0.121 | 0.020 – 0.725 | **0.021** |
| Took iron pills (n=139)<br>No<br>Yes | 10.619 | 1.177 – 95.783 | **0.035** |
| Parity<br>1st child<br>>=2 children | 2.995 | 0.378 – 23.712 | 0.299 |
| Happy with the current pregnancy<br>No<br>Yes | 26.368 | 1.227 – 566.474 | **0.037** |
| Supplementation<br>PG<br>EG<br>IG | 0.403 | 0.153 – 1.063 | 0.066 |

CI= Confident interval.

**Table 4: Linear Regression Analysis of Factors Associated with LBW**

| Variable | Coefficient Beta | 95% CI | p |
|---|---|---|---|
| Gestational age | -5.680 | -14.403 – 3.043 | 0.201 |
| Hb concentration | 8.910 | -14.713 – 32.532 | 0.459 |
| Placental weight | 1.581 | 1.336 – 1.826 | <0.001 |

The variables which may affect infant's weight are chosen from the variable that has p value <0.25, i.e. gestational age, Hb concentration, and placental weight (Table **4**). The results showed that only placental weight contributed to the increase in fetal weight. The increment of one gram placenta predicts an increase of 1,581 grams of fetal weight (95% CI = 1.336 - 1.826, p <0.001).

## DISCUSSION

Low birth weight, fundamentally caused by several factors in both internal and external. Internal factors are those come from the women themselves, such as previous pregnancy history, abnormality in cervix and uterus, maternal age, history of disease and nutritional status of the women before pregnancy. The external factors involved were environmental variables, socioeconomic, lifestyle, and psychological aspect [12,16] Weight and health conditions in early pregnancy determine the maternal weight gain during pregnancy [7], besides nutrient intake and other determinant factors. These factors may have an exhibited effect on the increase of fetus weight and its development [17,18].

The main finding of this study was PG group had the greatest mean of placental weight compared to the EG and PG groups. However, the mechanism of placental weight gain remains unclear. In addition, the weight ratio of placenta to body weight was measured. PG shows better results than EG and IG. Nevertheless, in total, PBWR in this study was only 16.86% and these results were lower than those reported in the Nigerian study, 18.2% [15]. The ratio between placenta weight to birth weight was used as a marker to determine the nutritional condition of the fetus as well as utero-placental function during pregnancy [15]. It means that PG and EG groups show better result in fetal nutritional conditions than IG groups. This is probably because the components inside Moringa not only high micronutrients but also contains several macronutrients which may contribute to maternal nutritional status and intake for the fetus [19].

Interestingly, women who were unhappy with their pregnancies are likely to have LBW baby compared to

those who are happy with their pregnancies. A study shows that women and spouses' unhappiness is closely related to LBW problems [20]. This mechanism may be explained through the effects of stress on adverse pregnancy outcomes. Unhappiness brings the women to stress psychologically and this is a very detrimental [21]. When social and physical aspects of pregnant women are poor, then it causes preterm birth, while poor mental health could be a predictor of LBW [22]. Therefore, maintaining a level of happiness and preventing stress among pregnant women may increase the likelihood of birth without complications or better pregnancy outcomes. Other factors, such as maternal education and receiving iron supplementation give different results from studies conducted in developing countries [14]. These results may occur because these factors indirectly related to birth weight.

Based on the linear regression result, the birth weight is closely related to the size of the placenta. One gram increase of placenta causes approximately an increase 1.58 gram of birth weight. Sufficient nutritional intake for the fetus is strongly influenced by the size of placenta and uterus. The greater the size of the placenta, the higher the fetal weight [12]. In this study, placental size was better in the PG group than IG. Anemia status of pregnant women may not contribute directly to baby weight. This mechanism may be through an impact of Moringa supplementation that possibly prevent DNA damage and reduce oxidative stress [23], with the result that the weight gain of placenta and fetal weight is better in this group.

The big sample size is the strength of this study; however, some limitations have been found as well. Un-standardized time of placental weight measurement may influence the results. Besides, the variation of baby weight scale owned by Community Health Center may also contribute to these results, although it has been calibrated.

## CONCLUSIONS

The study concluded that supplementation of Moringa powder capsule may be used as an alternative to increase the placental weight and birth weight of infants. A happiness and avoiding stress during pregnancy should be a concern of pregnant women to prevent adverse pregnancy outcomes later on.

## CONFLICT OF INTEREST

All authors declared no conflict of interest during this study.

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