October – December, 2023
Original Article
DOI: http://dx.doi.org/10.30867/action.v8i4.1210

AcTion: Aceh Nutrition Journal
Pages: 579 - 587
p-issn 2527-3310; e-issn 2548-5741

Effect of multiple micronutrient supplementation in pregnant women on infant birth weight

Pengaruh pemberian multipel mikro nutrien pada ibu hamil terhadap berat badan lahir bayi

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Article History:
Received: April 7, 2023; Revised: July 6, 2023; Accepted: August 12, 2023; Published: December 5, 2023.

Publisher:
Politeknik Kesehatan Aceh
Kementerian Kesehatan RI

Abstract

The nutritional requirements of pregnant women increase with the gestational age. A low nutritional status is poor for both mothers and infants. Infant birth weight is influenced by nutritional intake during pregnancy. Therefore, multiple micronutrients (MMN) are needed for mothers during pregnancy to prevent low birth weight. This study aimed to determine the effect of MMN on infant birth weight at the Asian Waluyo Jati Clinic. The research method used a quasi-experimental design, with a posttest-only control group design involving 50 pregnant women (25 intervention and 25 control groups). This study was conducted at the Asih Waluyo Jati Clinic, Yogyakarta, in 2022. The intervention group received MMN supplementation starting in the second trimester and standardized prenatal care, whereas the control group received standardized prenatal care throughout pregnancy. Both groups were monitored during the second trimester of pregnancy until delivery. Data were analyzed using the Mann–Whitney U test. The results showed a difference in the mean birth weight of the infants in both groups (1,64 grams). MMN supplementation in the intervention group and standard pregnancy care effectively increased the infants' birth weight by 1,64 grams (p= 0,000). In conclusion, MMN supplementation increased the average birth weight of infants.
Keywords: Double burden, infants, weight, pregnancy

Abstrak

Kebutuhan nutrisi ibu hamil meningkat seiring bertambahnya umur kehamilan. Status gizi yang rendah berdampak buruk bagi ibu dan bayi. Berat badan lahir bayi dipengaruhi asupan nutrisi selama kehamilan. Oleh karena itu, dibutuhkan Multiple Mikro Nutrien (MMN) bagi ibu selama kehamilan guna mencegah barat badan lahir bayi rendah. Penelitian bertujuan untuk mengetahui pengaruh MMN terhadap berat badan lahir bayi di Poliklinik Pratama Asih Waluyo Jati. Metode penelitian menggunakan desain quasi eksperimen, dengan posttest-only control group design melibat sebanyak 50 ibu hamil yang dibagi menjadi 25 ibu hamil kelompok intervensi dan 25 ibu hamil kelompok kontrol. Penelitian telah dilakukan pada klinik Asih Waluyo Jati, Yogyakarta tahun 2022. Pengumpulan data pada elompok intervensi menerima suplemen MMN mulai trimester ke 2 dan asuhan kehamilan standar, sedangkan kelompok kontrol menerima asuhan kehamilan standar selama kehamilan. Kedua kelompok dipantau dari kehamilan trimester 2 sampai persalinan. Data dianalisis menggunakan uji Mann Whitney. Hasil penelitian menunjukkan terdapat selisih rerata berat badan lahir bayi pada kedua kelompok 1,64 gram. Pemberian suplemen MMN pada kelompok intervensi dan asuhan kehamilan standar efektif dalam meningkatkan berat badan lahir bayi sebesar 1,64 gram (p= 0,000). Kesimpulan, pemberian MMN dapat meningkatkan rerata berat badan lahir bayi.
Kata Kunci: Bayi, berat badan, kehamilan, nutrisi ganda

Introduction

Maternal mortality rate (MMR) is one of the Human Development Index (HDI) indicators. AKI describes the number of maternal deaths during pregnancy, childbirth, and postpartum (Kementerian Kesehatan RI, 2020). The pregnancy period is a process of fetal growth and development that affects the health of mothers and children (Harna et al., 2020). Maternal health during pregnancy is influenced by nutritional needs. The mother's nutritional needs during pregnancy increase with age. This is a physiological process in which the fetus develops in the mother's body (Moreno-Fernandez et al., 2020).

The nutritional needs of pregnant women are determined by their macronutrient and micronutrient intakes. Several micronutrients are associated with an infants's birth weight, including zinc, calcium, folic acid, vitamin D, and iron (Zgliczynska & Kosinska-Kaczynska, 2021). The nutritional status of the mother has an influence on the health of the mother and the fetus in the womb. The nutritional needs of the mother increase by 15%; this increase is necessary to maintain the health and growth of the fetus. Maternal food consumption is around 40% for the continuity of fetal growth, while 60% is for maternal metabolism. Based on the nutritional adequacy figures in pregnant women, energy needs to be added by 180 kcal per day during the first trimester of pregnancy: protein (1 g/day), fat (2,3 g/day), and carbohydrates (25 g/day). In the second trimester, there was an addition of 300 kcal of energy, protein at 10 g/day, fat at 2,3 g/day, and carbohydrates at 40 g/day, and in the third trimester, there was an addition of 300 kcal of energy, protein at 30 g/day, fat at 2,3 g/day, and carbohydrates at 40 g/day (Kementerian Kesehatan RI, 2019).

Nutritional status in pregnant women is very important considering the quality of a child starts with the quality of nutrition in the first 1000 days life (from a pregnant to a child aged 2 years) (Beluska-Turkan et al., 2019). According to Zaif & Wijaya (2017), pregnant women who eat a healthy diet are less likely to have infants with a low birth weight than pregnant women who eat an adequate diet. A good diet for pregnant women must include sources of carbohydrates, proteins, fats, vitamins, and minerals (Alfahmi, 2023). The incidence of low birth weight is also influenced by maternal knowledge, parity, birth spacing, economic status, pregnancy checks, disease risk, nutritional status, and Chronic Energy Deficiency (CED) (Kristiana et al., 2017; Haryanto et al., 2017).

In pregnant women who suffer from CED, the volume of blood in the mother's body decreases, and the cardiac output of pregnant women is not enough, causing a decrease in blood flow to the placenta. Decreased blood flow to the placenta causes two things: reduced transfer of food substances from the mother to the placenta, which can cause fetal growth retardation, and smaller placental growth, resulting in infants born with a low birth weight (LBW) (Permana & Wijaya, 2019; Kementerian Kesehatan RI, 2018; Pathirathna et al., 2017).

Normally, an infants's birth weight ranges from 2500 to 4000 grams. Infants born weighing less than 2500 grams are called LBW. The incidence of low birth weight is one of the indicators of public health because it is closely related to mortality, morbidity, and malnutrition in the future (Wulandari et al., 2022). A Low Birth Weight (LBW) tends to experience impaired cognitive development and mental retardation and is more susceptible to infections that can lead to illness or even death (De Onis et al., 2019). Another impact that arises in adults who have a history of low birth weight is the risk of suffering from degenerative diseases that can cause economic burdens on individuals and communities. The results of the Riskesdas (Health National Survey) in 2018, showed that 6,2% of infants were born with less birth weight due to various causes, including fetal growth retardation (Kementerian Kesehatan RI., 2018).

Micronutrient deficiencies during pregnancy can adversely affect the birth of a infants. One of the effects of micronutrient deficiency during pregnancy is low weight (Zaif & Wijaya, 2017). Previous research has shown that the mother's diet during pregnancy affects the infants's birth weight (Fajriana & Buanasita, 2018). Quality nutrition is needed during pregnancy for the nutritional needs of the

mother and fetus (Moreno-Fernandez et al., 2020).

Some research suggests that the mother's nutritional needs are not only iron and folate for micronutrient supplements. Complete micronutrient supplementation with multiple micronutrients (MMN) is required. Poor nutrition in mothers during pregnancy can have a negative impact on the mother and fetus, including infants born with a birth weight below normal. A Low Birth Weight (LBW) infants have a chance of dying 10–20 times more than infants born with a normal birth weight. Prevention and control that can be done to overcome low birth weight are health education, supervision, and monitoring; prevention of hypothermia in infants; conducting therapy at no cost that can be done; measuring the nutritional status of pregnant women; and calculating and preparing steps in health (Pristya et al., 2020). Mothers who always maintain their health by consuming nutritious foods and applying a good lifestyle will give birth to healthy infants, while mothers who experience nutritional deficiencies have a risk of giving birth to LBW (Nussbaumer-Streit et al., 2020).

Therefore, this study aims to determine the effect of multiple micronutrients (MMN) on the infants's birth weight.

Methods

This study is a quasi-experimental study with a posttest-only control group design. It has been conducted at Asih Waluyo Jati Clinic, Yogyakarta at 2022. With a population of all 2nd trimester pregnant women at Asih Waluto Jati Clinic. The sample was 50 pregnant women who were of gestational age in the 2nd trimester, divided into two groups, namely the intervention group and the control group. The inclusion criteria of the sample were normal pregnant women and 2nd trimester pregnant women, while the exclusion criteria were pathological pregnant women.

Sampling is done by random sampling using a random number generator based on data from the cohort register of pregnant women. The first 25 numbers were used as samples for the intervention group, and the next 25 numbers for the control group (Sugiyono, 2019).

In the intervention group, Multiple Micro Nutrients (MMN) were given in the form of supplements with a composition of folic acid, fe fumarate, copper, manganese, calcium, vitamin B complex, vitamin C, and vitamin D taken once every day from the second trimester until delivery, and standard pregnancy care was carried out, while in the control group, standard pregnancy care was carried out until delivery.

Table 1. MMN intervention in both groups between pretest and posttest

Group	Treatment	Post-test
Intervention group	Given Multiple Micro Nutrients (MMN) in the form of supplements with a composition of folic acid, fe fumarate, copper, manganese, calcium, vitamin B complex, vitamin C, and vitamin D taken once every day from the second trimester until delivery and carried out standard pregnancy care	Measurement of the infants's birth weight
Control group	Carry out standard pregnancy care until delivery	

Data processing begins with editing, which is checking the completeness of data that has been filled in from the MCH book and registers owned by the mother, followed by providing coding for each variable studied, where for risky measurement results are given a higher code. Categorizing infant birth weight using child anthropometric standards, divided into 3, namely normal birth weight (2500–4000 grams), low birth weight (<2500 grams), and more birth weight, or macrosomia (≥ 4000 grams), the infants's gender is male and female. The age of pregnant women is divided into two categories: healthy reproductive age (>20 years to 35 years) and unhealthy reproductive age (age < 20 years and >35 years); parity is the primiparous category (first time giving birth); multipara (>1 to 5 times giving birth); and grande multipara (>5 times giving birth). Processing involves entering data that has been coded according to the table of computer device

programs. Continue cleaning by checking again against the data that has been entered to see whether there is an error or not in the computer device program.

The analysis in the study was carried out starting with univariate analysis and continuing with bivariate analysis. Univariate analysis to describe the variables studied and bivariate analysis to measure the effect of MMN supplementation on infant birth weight Statistical analysis uses nonparametric tests because the data are not normally distributed. Therefore, the difference in the average birth weight of infants between the intervention and control groups was analyzed using the Mann-Whitney test.

Ethical clearance was obtained from the Research Ethics Committee of the Faculty of Health, Jenderal Achmad Yani University, Yogyakarta, with ethical approval number Skep/376/KEPK/XII/2022.

Result and Discussion

The study included 50 respondents. Based on the results of the analysis, data on the characteristics of respondents are shown in Tables 2 and 3.

Table 2. Maternal characteristics based on age and parity

Maternal and Infants Characteristics	Intervention Group		Control Group	
	n	%	n	%
Age				
20-35 years	18	72,0	19	76,0
>35 years	7	28,0	6	24,0
Parity				
Primipara	11	44,0	9	36,0
Multiparous	13	52,0	14	56,0
Grande Multipara	1	4,0	2	2,0
Sex				
Male	13	52,0	11	44,0
Female	12	48,0	14	56,0
Infants Birth Weight				
< 2500 grams	1	4,0	4	16,0
2500- 4000 grams	21	84,0	20	80,0
>4000 grams	3	12,0	1	4,0

Table 3. Differences in infants birth weight (BW)*

Group	Minimum	Maximum	Mean ± Deviation Difference	p-value
Infants BW in Intervention Group	2500	4000	2,12 ± 0,879	0,000
Infants BW in Control Group	2500	4000	3,76 ± 0,881	

*Infant weight data in grams

Table 2 based on the age of respondents, the majority of respondents were between 20 and 35 years old, with 72% of the intervention group and 76% of the control group, followed by those over 35 years old, with 28% of the intervention group and 24% of the control group. This table shows that there are still pregnant women who are classified as vulnerable, namely in the age group of >35 years. Meanwhile, based on parity, it showed that the majority of respondents in the intervention group (52%) and control group (56%) were multiparous, followed by primiparous, then grande multipara.

Table 3 shows the majority of respondents had a female: 52% of the intervention group and 56% of the control group. Based on the birth weight of the infants, the majority of respondents had an infant with a birth weight of 2500–4000 grams, 84% intervention, and 80% control. This table shows that there are still mothers giving birth to infants with a low birth weight or a higher birth weight than normal infants.

Differences in birth weight between control and intervention group infants can be seen in Table 3. Based on Table 3, the average intervention group was 3,76 grams higher than the control group's 2,12 grams. The results of the Mann-Whitney test showed that there was a difference in the average birth weight of infants between the intervention group and the control group (p= 0,000).

Based on the average value, it can be seen that giving MMN to pregnant women can increase the infants's birth weight by 1,64 grams. This figure shows the increase in birth weight of infants after pregnant women are given MMN since the second trimester of pregnancy and standard pregnancy care during pregnancy compared to the control group. This means that the administration of MMN in the intervention group and standard pregnancy care during pregnancy until delivery is effective in increasing the infants's birth weight. This is because there are several influential factors, including the age of respondents during pregnancy, parity, sex of the infants, and MMN administration.

The age of 20–35 is the ideal age limit for a woman to reproduce (BKKBN, 2017). Beyond this age, the mother is at risk of pregnancy complications. At a young age, you usually get fewer pregnancy checks. This factor affects low birth weight and neonatal mortality (Vivatkusol et al., 2017). The young age of maturity of female reproductive organs makes them less ready and affects the readiness of the mother's body and maternal nutrition during pregnancy.

Pregnant women over 35 years are in high-risk pregnancies, which have risks such as gestational diabetes, gestational hypertension, placental abruption, placenta previa, perinatal death, macrosomia, and growth retardation (Aziz et al., 2020). This, of course, affects reproductive health (>35 years) and has an impact on children's growth and development. Pregnant women over 35 years old damage their trophic capacity, so they tend to give birth to infants with low birth weight.

Parity has a risk of low birthweight. The child's health risk is greater when the number of children in the family is more than three (Izudi et al., 2019). Due to the large number of children, the impact on the basic needs of children cannot be met in a way that is appropriate for development since the womb. A mother has too many children when a woman gives birth more than four times. Pregnancy and childbirth too often affect reproductive health. This also has an impact on inhibiting the growth of children while still in the womb. This condition makes too many pregnancies and childbirths a risk factor for the mother. Another thing is that the function of the uterus in mothers over 35 years old begins to weaken (BKKBN, 2017).

High parity can cause various health problems for both the mother and the infants. Repeated pregnancy and childbirth cause reproductive functions to decrease, reduced flexibility (elasticity) of tissues that have been repeatedly stretched during pregnancy can be at risk of antepartum bleeding, and can interfere with placental growth and fetal growth so as to give birth to LBW (Zgliczynska et al., 2021). Health and nutritional status are quite good in the primiparous possibility of giving birth with a normal birth weight. Infants with a low birth weight have a higher chance of becoming stunted, in contrast to normal infants. Infants with low birth weight indicate a lack of nutritional status of the mother during pregnancy, so that her growth is not optimal (Puspitaningrum, 2018).

Another factor in the occurrence of stunting in children is the mother's nutritional status, and there are health problems in fetal growth that result in low birth weight. Lack of nutrients can be seen from anthropometry when what can be measured on the fetal head circumference is smaller, which increases the risk of LBW (Gokhale & Rao, 2021).

Some micronutrients (MMN) given to pregnant women after the second trimester are rich in nutrients, especially folic acid, Fe, and B-complex. MMN contains the most important vitamins and minerals for pregnant women, namely: folic acid 400 mcg, Fe fumarate 91 mg, manganese 0,2 mg, copper 0,2 mg, vitamin B6 2,2 mg, vitamin B1 1,6 mg, vitamin B2 1,8 mg, vitamin B12 10 mcg, and vitamin C 50 mg. MMN as a hemoglobin builder, such as Fe, vitamin B12, and folic acid. The weight of the placenta is influenced by folic acid, which is a factor that determines fetal weight. Folic acid deficiency can be a risk factor for malformations in the fetus. Folate intake affects birth weight and birth length, while vitamin C can cause iron to be absorbed as much as possible in the body when consumed.

Theoretically, iron absorption in the intestine has three phases, namely the luminal, mucosal, and systemic phases (Bakta, 2017). Fe, folic acid, and vitamin B12 make up hemoglobin. Hemoglobin delivers O2 to cells; besides that, it is also necessary to pay attention to the consumption of vitamin C. Vitamins cannot produce energy, but they can speed up metabolism in the body. Even if the body does not use too many vitamins, vitamin deficiency can cause disruptions in the body's metabolism. Previous research has also shown that 50mg of vitamin C consumed daily for 2 months can increase Hb levels (de Seymour et al., 2022). Giving multiple micronutrient (MMN) supplements affects the mother as well as the infants to be born. Supplementation improves hemoglobin levels and nutritional status in the mother, birth weight, and length, and reduces the risk of neonatal growth retardation. The nutritional status of the mother is an important factor in the growth and development of the fetus (Kocyłowski et al., 2018). In early pregnancy, fetal growth in the utero placental environment also experiences disorders that can slow overall growth, thus increasing the risk of low birth weight and increasing stunting problems in the future (Khairani et al., 2023).

Providing nutritional supplements and multi-micronutrient supplements is more effective for pregnant women (Pratiwi & Hamidiyanti, 2020). With a complete composition of MMN tablets in terms of micronutrients compared to individual food additives or supplements and the administration of Fe tablets alone or supplements with 2-3 nutritional combinations, it is helpful to improve the nutritional status of the mother. The content of these microsubstances increases the mother's appetite and prevents nausea and vomiting during pregnancy. By increasing maternal nutrient intake during pregnancy, better nutrition will impact the infants born (de Seymour et al., 2022).

Pregnant women are a nutrition-prone group, so they need adequate nutritional intake for the health of the mother and the fetus she contains (Ernawati, 2017). This is because of the occurrence of physiological changes in pregnant women, so pregnant women need more nutritional intake for the growth and development of the fetus they contain. Based on the results of a review by Kiely et al. (2021), the impact of deficiencies of micronutrients, namely iron, folic acid, and B12, on pregnant women is that mothers experience anemia characterized by symptoms of paleness, fatigue, weakness, and lethargy, which can cause impaired fetal growth and development, thereby increasing the risk of infants born prematurely and infants born with low body weight.

In addition, pregnant women are also encouraged to take multivitamin supplements to fulfill micronutrients (Pratiwi & Hamidiyanti, 2020). Micronutrients are nutrients in the form of vitamins and minerals needed by the body in small quantities but have a very important role in the formation of hormones, enzyme activity, and regulating the function of the immune system and reproductive system (Al Rahmad, 2023). Nutritional deficiencies that often occur in pregnant women, especially micronutrients, occur during the golden period, namely at the age of pregnancy entering the 24th week or in the 2nd trimester, so in this case it is necessary to fulfill enough micronutrients for pregnant women.

Mothers during pregnancy who consume MMN improve maternal health, birth weight, reduce anemia, prolong pregnancy, and reduce infant mortality. The limitation of this study is that researchers did not make further observations at the respondents' homes to find out whether respondents really took MMN supplements regularly and on time every day. But researchers have explained when and how to take MMN supplements. In addition, the sample size was relatively small, with 25 mothers in each group. Further researchers are expected to conduct research by considering a large number of samples from various populations.

Conclusion

There was a difference in the average birth weight of infants between the two groups. The administration of MMN and standard care for pregnant women in the intervention group was effective in increasing the birth weight of the infants. Adequate nutrition for pregnant women is very beneficial for the growth and development of the fetus and can determine the development of children in the future.

Advice for stakeholders, especially midwives, is expected to inform pregnant women about the importance of consuming additional nutrients by providing MMN supplements to prevent childbirth in low-birth-weight infants. For further researchers, it is necessary to apply further research with a larger and more diverse sample.

Acknowledgments

The author would like to thank the research subjects, namely pregnant women, who have been willing to be respondents in this study. Furthermore, the Asih Waluyo Jati Clinic and all parties who have helped carry out this research We also express our gratitude to Stikes Akbidyo for funding the implementation of this research.

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