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Differences Post Delivery of Term Pregnancy Mean Maternal Serum Magnesium Level with Low Versus Normal Birth Weight

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ABSTRACT

Background. Impaired fetal growth is still a major problem in obstetrics. Birth weight is usually used as an indicator of the well-being of the newborn and as an indirect measure of intrauterine nutrition during pregnancy and the mother's nutritional status during pregnancy. Magnesium contribute as a cofactor for various enzymes in the human body for metabolic processes. Fetal magnesium is obtained from maternal by transport through the placenta. In conditions of low magnesium levels will affect the epigenetic process, HPA-axis and GH-IGF axis of the fetus which in turn will result in fetal growth disorders. This study aims to determine the differences postdelivery serum magnesium levels of women at term pregnancy who give birth with low vs normal birth weight. **Methods:** This study used an observational analytic method with a cross sectional approach. Conducted from April 2020-December 2020 at Dr. M. Djamil Padang Central General Hospital and Network Hospital Faculty of Medicine, Andalas University. Total of 44 samples were divided into 2 groups, women who gave birth with low and normal birth weight babies. Samples was carried out at the Pramitha Padang Private Clinical Laboratory. **Results:** The mean maternal serum magnesium level in low birth weight group was 1.97 ± 0.16 mg/dL lower than normal birth weight group was 2.06 ± 0.14 mg/dL. Statistic test using the independent sample T test showed no differences in both groups (p = 0.064). **Conclusion:** The mean maternal serum magnesium level in low birth weight 1.97±0.16 mg/dL. The mean maternal serum magnesium level in normal birth weight was 2.06 ± 0.14 mg/dL. There was no significant difference on both groups.

1. Introduction

Currently, fetal growth disorders are still a major problem in the field of obstetrics. Birth weight is usually used as an indicator of the well-being of the newborn and as an indirect measure of intrauterine nutrition during pregnancy and the nutritional status of the mother during pregnancy. The size and weight of the fetus at birth is a function of genetic potential and substrate intake to the fetus. Genetic factors are mostly responsible for controlling growth in the first half of pregnancy, while environmental factors play a greater role in the second half of pregnancy.[1,2]

Data obtained from WHO and UNICEF in 2015, as many as 20.5 million newborns globally experienced low birth weight. These babies will be more at risk of dying in the first month of life and the survivors will face lifelong consequences. In Indonesia, data from the BPS and the Ministry of Health shows that as many as 13% of children born in 2018 have low birth weight. National data records the prevalence of low birth weight in Indonesia from 33 provinces on average 6.2% of 56.6% of newborns with birth records.[3,4,5]

The West Sumatra Provincial Health Office reported

that of all babies weighed in 2016 in West Sumatra, it was found that 2.3% of LBW babies or 2,225 babies were found. This number increased from the previous year, where in 2015 the LBW rate was only 2.2%. Data obtained from the Padang City Health Office in 2018 found 295 LBW babies or 1.81%. This number has increased from the previous year where in 2017 there were 255 LBW babies or 1.50%.[6,7]

Magnesium acts as a cofactor for various enzymes in the body's metabolic processes. Fetal magnesium is obtained from the mother through the process of transportation through the placenta. There are 3 pathways by which decreased magnesium levels lead to impaired fetal growth. The first is a disturbance in the process of magnesium transport in the placenta causing a decrease in fetal magnesium levels. Evidence of active transport of magnesium in the placenta is through culture of trophoblast cells that reveal Na^{+}/Mg^{2+} exchange.[8,9] When magnesium levels decrease, there will be a decrease in the performance of the magnesium/inorganic channel (Mg/iP channel) so that it will interfere with the active transport of magnesium through the placenta to the fetus. Under conditions of low magnesium levels, it will affect the epigenetic process, the HPA-axis and the GH-IGF axis of the fetus, which in turn will result in impaired fetal growth. Magnesium plays an important role as a key factor in hormone metabolism. One of the growth hormones that is affected by magnesium concentration is insulin-like growth factor-1 (IGF-1). It is known from research that IGF-1 hormone levels are reduced in infants with LBW compared to infants with normal weight. This proves the role of the hormone IGF-1 on growth.[10,11]

2. Methods

This study uses an analytical observational method with a cross sectional approach conducted from April 2020 to December 2020 which was carried out at RSUP dr. M. Djamil Padang and network hospitals. Examination of the research sample was carried out at the Pramitha Padang Clinical Laboratory. The study population was pregnant women who gave birth at dr. M. Djamil and Network Hospitals. Inclusion criteria (willing to be a research subject, term pregnancy (≥37 weeks), body mass index ≥18.5 before pregnant). Exclusion criteria (fetal anomalies, pregnancy with coexisting disease such as diabetes mellitus, kidney disease, heart disease, hypertension and pregnancy with a history of smoking and alcohol consumption). Sampling was done by consecutive sampling, that mean part of the population that met the inclusion and exclusion criteria was included in the study until sample was completed.

3. Results

The characteristics of the research respondents consisted of maternal age, education, parity, and BMI before pregnancy which can be seen in table 1. Differences in magnesium level serum of postdelivery mothers who gave birth low and normal birth weight babies can be seen in table 2.

Table 1. General characteristics

Characteristics	Low birth weight (n = 22)	Normal birth weight (n = 22)
1	2	3
Maternal age (year), Mean ± SD	30.55 ± 6.08	30.14 ± 4.97
Education		
Primary school	2 (9%)	0 (0%)
Junior high school	2 (9%)	4 (18%)
Senior high school	14 (64%)	16 (73%)
Bachelor/University	4 (18%)	2 (9%)
Parity		
Primiparity	6 (27%)	8 (36%)
Multiparity	16 (73%)	14 (64%)
BMI before pregnant (Kg/m^2), Mean ± SD	22.27 ±2.32	22.93±2.01
Normal weight	19 (86%)	20 (91%)
Overweight	3 (14%)	2 (9%)
Obese	0 (0%)	0 (0%)
Fetal Birth weight (gr), Mean± SD	2223.18 ±312.44	3135.91±319.07

Table 2. Differences postdelivery mean serum magnesium levels mother versus fetal birthweight

Group	n	Serum Mg levels (mg/dL) Mean ± SD	Min-Max (mg/dL)	*p value**
Low birthweight	22	1.97 ± 0.16	1.66-2.22	0.064
Normal birthweight	22	2.06 ± 0.14	1.83-2.37	

*Independent sample T test

From table 2 it is known that the average serum magnesium level in the group of mothers who gave birth to babies with LBW was 1.97 ± 0.16 mg/dL lower than the group of mothers who gave birth to babies with normal weight, which was 2.06 ± 0.14 mg/dL. The results of statistical tests using the independent sample T test obtained a p value of 0.064 where the p value is greater than 0.05. Although there is a difference in the mean serum magnesium level of postpartum mothers between LBW with normal weight, but from statistical calculations there is no significant difference between the mean serum magnesium levels of postpartum mothers who give birth to babies with LBW and maternal serum magnesium levels of postdelivery who give birth low vs normal birth weight.

Table 3. Correlation of postdelivery maternal serum magnesium levels and birth weight

Group	n	Hypomagnesium		Normomagnesium		*p value**
		n	%	n	%	
Low Birth Weight	22	7	31.8	15	68.2	0.244
Normal Birth Weight	22	4	18.2	18	81.8	
Total	44	11	25	33	75	

From table 3, it was found that in the hypomagnesaemia group there were 7 mothers who gave birth to LBW babies and 4 mothers who gave birth to normal babies. From the statistical test conducted, it did not show any significance (P>0.05). Statistically, there was no relationship between postpartum maternal hypomagnesemia and LBW.

4. Discussion

The mean age of study subjects from both groups was 30.55 ± 6.08 for mothers who gave birth to babies with low birth weight and 30.14 ± 4.97 for those who gave birth to babies with normal weight. From a study conducted by Dennis and colleagues, it is shown that maternal age who is too young (under 16 years) has a tendency to give birth to babies with low birth weight.[12,13] The average age of the research subjects is in the recommended reproductive age range of 20-35 years. From the statistics, there was no difference in the average age of the study sample for mothers who gave birth to babies with LBW and normal babies. From parity, it was found that most of the research subjects were multiparous. Parity with low birth weight from the study had no correlation, but was linear depending on the maternal medical condition.[14]

Research subjects with multiparas obtained as many as 16 babies with low weight and 14 babies with normal weight. From the body mass index (BMI) of research subjects who were assessed based on BMI before pregnancy, the average was 22.27 ± 2.32 and included in the normal weight. Most of the study subjects had a normal BMI, where 19 samples of LBW mothers had normal weight, while for mothers who gave birth to babies with normal weight, 20 samples had normal BMI. Research reported by Patole and colleagues showed the effect of BMI on newborn weight. Where mothers with BMI <18.5 (less weight) were statistically proven to have a correlation with the incidence of increased low birth weight.[15,16]

There was no difference in the education of the research subjects in the two groups. In both groups, most of the research subjects had high school

education with a total of 14 people (64%) at low birth weight and 16 people (73%) at normal weight. Paramitasari's 2018 research, shows a negative relationship between maternal education and the incidence of LBW. This is related to the adequacy of information received by mothers during pregnancy and better nutritional needs for mothers with higher education levels (high school or college).[17]

Based on Kiserud's 2018 growth curve and research, the average birth weight of babies at term (≥37 weeks) is 3,000 grams.[18] This study obtained results that were not much different where the average birth weight of infants with term gestational age was 3,135.91 grams ± 319.07.

Based on the analysis of the independent sample T test, it was found that the average magnesium level in postpartum mothers who gave birth to babies weighing <2500 grams was 1.97 ± 0.16 mg/dL, while the average magnesium levels in postpartum mothers who gave birth to babies with normal weight obtained 2.06 ± 0.14 mg/dL. This shows that the serum magnesium level of postpartum mothers who give birth to LBW babies is lower than postpartum mothers who give birth to babies with normal weight. From the average serum magnesium levels of the two groups obtained from this study, it was shown that they were still in the normal range. The same thing was also reported by Khoushabi 2016 which showed there was no significant difference in serum magnesium levels of pregnant women in each trimester of pregnancy.[19]

This result differs from the study conducted by Baloch which stated that pregnant women tend to have lower magnesium levels than non-pregnant women due to increased maternal and fetal needs and increased excretion of magnesium by the kidneys. Excretion of magnesium in pregnant women is 25% more than in nonpregnant women as a result of increased glomerular filtration rate in the second and third trimesters of pregnancy.[20]

Hypomagnesaemia has also been reported in 16% of pregnant women in Nigeria and 40-60% of pregnant women in South Asia. Magnesium plays an important role in the well-being of the fetus and mother because it is one of the important elements for normal embryogenesis and good fetal growth, so magnesium deficiency will increase maternal, embryonic and neonatal morbidity.[21]

This difference in results is most likely due to the patient's dietary pattern which is considered to still meet the daily needs of vitamins and minerals during pregnancy. The research sample included in the study had a body mass index with a value of 18.5, meaning that based on BMI, the body was normal or overweight, so this condition indirectly reflected that the research sample still had good nutrition. This is in accordance with a report from Pathak and colleagues who stated that magnesium is an essential mineral obtained from food sources, so that meeting daily needs is highly dependent on individual dietary patterns.[21] According to Coelho, the daily diet pattern during pregnancy in the third trimester greatly affects the baby's birth weight.[22]

The results showed that the average serum magnesium level of postpartum mothers who gave birth to babies with low birth weight had lower serum magnesium levels, namely 1.97±0.16 mg/dL, compared to the average serum magnesium levels of postpartum mothers who gave birth to babies with normal weight. 2.06±0.14 mg/dL. The results of the statistical analysis of the independent sample T test showed p value = 0.06 (p value >0.05), it was concluded that there was no difference in serum magnesium levels of postpartum mothers who gave birth to babies with low and normal birth weights.

The results of this study are similar to the case-control study conducted by Parizadeh in Iran in 2013 which evaluated the correlation of serum magnesium in 67 mothers who gave birth to babies with low birth weight and 49 mothers who gave birth to normal weight babies. The results obtained from statistical calculations showed an insignificant value (p=0.09).[8] This insignificant result is most likely due to the recommendation from the government through the ministry of health in meeting the nutritional needs of both vitamins and minerals during pregnancy. In Indonesia, the Ministry of Health continues to do the same thing through various nutrition programs and quality antenatal visits during pregnancy. So this

results in no significant reduction in the magnesium status of pregnant women.

A study conducted by Makrides in 2014 analyzed 10 randomized studies from various centers showing no significant difference in fetal outcomes in mothers who were given magnesium supplements during pregnancy and without magnesium supplements on the incidence of low birth weight.[23] This is different from the study conducted by Zarean in Iran which stated that there was a decrease in the incidence of stunted fetal growth and low birth weight in pregnant women who received magnesium supplements.[24] While the study conducted by Djanas et al. showed that magnesium supplementation was shown to significantly increase magnesium levels in the group of pregnant women with hypomagnesemia but not significantly in pregnant women with normal magnesium levels.[25]

In the group of infants born with low birth weight when compared with normal birth weight, there was no significant difference in maternal serum magnesium levels. This shows that the factors that affect the baby's birth weight are not only determined by magnesium. However, magnesium is one of the micronutrients that are needed in the process of forming the body composition of the fetus (fetal body composition). Other micronutrients needed in the formation of fetal body composition are iron (Fe), calcium (Ca), folic acid, and vitamin B12. This is in accordance with the concept of Christian and Stewart which states that maternal diet and micronutrients play an important role in the process of formation and development of the fetus.[26,27]

Various factors also affect low birth weight. Nutritional factors are believed to be the main factor that plays a role in infant birth weight. Based on a study conducted by Darnton and Mkparu in low-income countries (poor and developing countries) shows a poor diet during pregnancy causes poor maternal nutritional status, which in turn results in poor fetal outcomes as well.[26] This is supported by global data, most of the babies with low birth weight come from low-income countries, especially in South Asia and West/Central Africa where they contribute 27% and 14.3% of babies born with low birth weight globally. global. The World Health Organization has a target of accelerating nutrition improvement, which aims to reduce the low birth weight birth rate by 30% by 2025.[25]

This study shows that babies born with low birth weight may be caused by several factors other than maternal magnesium concentrations. It is known that calcium, iron, zinc, folic acid, and vitamin B12 or even epigenetic changes that occur during intrauterine play a role in determining the baby's birth weight.[26] Calcium and magnesium are cofactors of various enzymes and metabolic reactions in the body. These two minerals have a directly related effect on changes in placental vascular blood flow. Reduction of placental blood flow will eventually lead to placental insufficiency which interferes with the transport of nutrients from the mother to the fetus, resulting in impaired fetal growth characterized by low birth weight. However, this mechanism is not the only one suspected of causing low birth weight. The role of other micronutrients such as calcium is very important to stimulate the synthesis of NO (nitric oxide) which has the function of dilating uterine arteries during pregnancy. On the other hand, a decrease in magnesium levels will inhibit the release of NO. So if the calcium concentration is disturbed it will have implications for uteroplacental blood flow.

5. Conclusion

Based on the results of research and discussion, it can be concluded as follows: the average serum magnesium level in postpartum mothers who gave birth to babies with low birth weight was 1.97±0.16 mg/dL; the average serum magnesium level in postpartum mothers who gave birth to babies with normal birth weight was 2.06±0.14 mg/dL. There was no significant difference in the mean serum magnesium level between postpartum mothers who gave birth to babies with low and normal birth weights.

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