

RELATIONSHIP BETWEEN MATERNAL BLOOD GLUCOSE LEVEL AND NEWBORN'S BIRTH WEIGHT IN MATERNITY CLINIC OF MEDAN SELAYANG DISTRICT 2014

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Abstract

According to IDF in 2012, there were over 300 million people worldwide are suffering from diabetes and approximately 60 million from that population are women who eventually are at reproductive age (15-49 years of age). In Indonesia, incidence of gestational diabetes mellitus is around 1.9-3.6% and the prevalence is around 1.9-3.65%. In addition to that, prenatal deaths from mothers who previously had gestational diabetes mellitus accounts for 3.5%. Thus, this study aims to investigate the relationship between maternal blood glucose level and newborn's birth weight. This study is a quantitative study using cross sectional design. The population taken in this study was all pregnant women who attended Maternity Clinic of Medan Selayang District. From that population we assessed the total number of 51 people as our sample in which all were third trimester pregnant women who attended Maternity Clinic of Medan Selayang District from July to October 2014. Based on our study, we found that there is relationship between maternal blood glucose level and newborn's birth weight ($r = 0.569$) and relationship between maternal weight gain and newborn's birth weight ($r = 0.365$). Meanwhile there isn't any relationship appeared in gravidity status. The result obtained from using backward method showed r square 0.392, P value <0.05 and the most influential variable is maternal weight gain. Therefore, we suggest all health care providers to provide appropriate antenatal care in order to screen, control as well as manage the condition of gestational diabetes melitus.

Keywords: *blood glucose level, birth weight.*

Introduction

Diabetes Mellitus (DM) is one of non communicable diseases, marked by the increase of blood glucose level due to insufficient insulin secretion or insulin resistency. Based on the recent report of IDF (*International Diabetes Federation*) in 2012, there were over 300 million people worldwide are suffering from diabetes and approximately 60 million from that population are women who eventually are at reproductive age (15-49 years of age). Insulin resistency usually begins in the middle of the pregnancy (20-24 weeks of gestation). Through facilitated diffusion on placental membrane in fetus circulation, there happens to be an abnormal energy source content that may contribute to later complications.

In Indonesia, based on Sullivan-Mahan diagnosis criteria, it was reported that the prevalence of gestational diabetes mellitus is 1.9-3.65%. In case of individuals (pregnant women) who have familial history of diabetes mellitus, the prevalence is even increasing to 5.1 % and approximately 40 % of women that previously had gestational DM gave birth to overweight babies regardless the age of

gestation and around 20-50% babies who were born from gestational DM mothers suffer from hypoglycemia (blood glucose < 30 mg/dl). Proportion of diabetes melitus in women who are actually at reproductive age is 3.6%, therefore firm strategies are needed in order to decrease the prevalence and prevent the case.

Gestational diabetes mellitus will further lead to complications due to its effect on both metabolic and hormonal condition. The proportion of this type of disease accounts for 0.3-0.7%. Undetected or uncontrolled diabetes mellitus will not only danger the pregnancy but also the labor, therefore gestational DM is a life threatening condition for both mother and newborn. Babies who were born from mothers who previously had gestational diabetes mellitus will be more likely to suffer from type 2 diabetes mellitus. Aleida (2011) stated that gestational DM is a continous condition which means that it may happen to be persistent and women at reproductive age are more likely to develop that condition. Approximately 40-60% of women who had gestational diabetes mellitus develop diabetes or glucose intolerance afterwards.

Gestational diabetes mellitus doesn't only contribute to prenatal deaths but also prenatal morbidities. In addition to that, gestational DM also plays a role in increased cesarean-section and higher risk of chronic hypertension for the mothers. Women who suffered from gestational DM are more likely to give birth to overweight babies, thus explaining why these women undergo cesarean-section. Further more 20-50% of babies who were born from gestational diabetes mellitus mother suffer from hypoglycemia in the first 24 hours after birth. In the other hand, women who had diabetes mellitus prior to pregnancy are more likely to get more complicated pregnancy and labor, overweight babies, blood vessels narrowing and fetal death, babies with congenital defect at around 4.1%. In case of bad glycemic control through pregnancy, some other complications may appear, such as vascular complication which causes low birth weight, neurology defect (20%), hypoglycemia (25-25%), hypomagnesemia, hyperbilirubinemia (20-25 %), neonatal asphyxia(25%) and neonatal acute respiratory distress syndrome (ARDS).

A preliminary study that took place in Mahdarina Maternity Clinic in Medan Selayang District, assessing 7 pregnant women, showed a relationship between blood glucose level of third trimester pregnancy women and newborn's birth weight, $r = 0.44$. Based on that result, we are interested in investigating the relationship between blood glucose level of pregnant women and newborn's birth weight.

The objective of this study is to investigate the relationship between maternal blood glucose level and newborn's birth weight in Maternity Clinic of Medan Selayang District in 2014 by measuring several parameters, as well as to identify most influential factor that contributes to newborn's birth weight. Therefore, we hypothesized that there is a relationship between blood glucose level of pregnant women and newborn's birth weight. We expect that this study will provide additional information in order to increase health care by implementing early detection of the disease.

Method

This study was conducted by using cross sectional method in order to investigate

the relationship between maternal blood glucose level and newborn's birth weight. This study took place in Maternity Clinic of Medan Selayang District from July to October 2014.

The population of this study was all third trimester pregnant women that visited the Maternity Clinic of Medan Selayang District for medical check up through July till October 2014. Subjects are eligible when all the inclusion criteria can be fulfilled. Hence we determined several inclusion criteria as follows:

1. Third trimester pregnant women that has stated agreement to this study
2. Pregnant women without any previously recorded complications, such as hypertension, heart diseases, pulmonary diseases and infection.

We also determined the sample size by using this formula,

$$n = \left[\frac{(z_{\alpha} + z_{\beta})}{0.5 \ln \left[\frac{(1+r)}{(1-r)} \right]} \right]^2 + 3$$

($r = 0.44$ and $\beta = 0.1$), thus the sample size became 51.

In conducting this study we didn't only use the secondary data but also the primary data. Primary data was obtained from direct interview with respondents using questionnaire instrument and venous blood was taken to measure the glucose level by using *glucose meter*. Blood sampling was only conducted after the respondents had been informed. Birth weight was measured directly at the first few minutes after birth.

Instruments used during this study are as follows:

1. Questionnaire which assesses characteristics of respondents; age, age of current pregnancy, parity status, education level
2. Blood glucose measurement using *glucose meter*, alcohol swab, strip test, needle (*lancet*), and lancing device.
3. Baby scale

We also applied several consecutive procedures as follows:

A. Blood Sampling

1. Determining sample based on inclusion criteria.
2. Asking the agreement statement from the subjects through informed consent.
3. Assessing the questionnaire.
4. Instructing the participants to fast from 10 pm to 7 am next morning when blood

sample will be taken. In this research, blood sampling procedure was conducted by standardized lab analysts and midwives.

5. Preparing the patient.
6. Applying tourniquet in the upper arm.
7. Palpating the vein in which the blood will be taken.
8. Applying the alcohol swab on the surface of the site.
9. Using 3 ml syringe to take the blood, blood taken was 2 ml.
10. Putting off the tourniquet.
11. Transporting all blood sample to Health Laboratory of North Sumatra for blood glucose measurement.
12. Collecting the result of the measurement.

B. Weight gain was assessed from patient's medical record. Patient is considered having weight gain when there is an increase of weight prior to delivery from weight recorded before pregnancy. Amount of gained weight was obtained by subtracting weight prior to delivery from weight before pregnancy.

C. Newborn's birth weight was obtained from clinic's documentation.

All data were then analyzed using univariate, bivariate and multivariate analysis. Statistical analysis being used in this study was multiple linear regression.

Results

Table 1

Characteristics of patients at Maternity Clinic of Medan Selayang District 2014

Var.	n	Min	Max	Mea n	SD
Age	51	18	43	28.5 7	5.79
Blood Glucose	51	65	306	114. 53	44. 018
Parity	51	1	5	2	1
Weight Gain	51	7	21	10.0 2	2.55
Birth Weight	51	2500	420	3123 .53	434. 20

Based on the above result, majority of pregnant women are around the healthy reproductive age. The average blood glucose level is mostly above normal (114.53 mg/dL).

a. Bivariate Analysis

After assessing both variables (blood glucose level and birth weight), we found that there is a significant positive relationship which means that the more the blood glucose level of a pregnant woman, the more likely she will give birth to overweight babies ($r = 0.569$). The result using correlation and regression mode showed that newborn's birth weight is proportional to maternal blood glucose level ($2480.471 + 5.615$ (blood glucose)). Furthermore we also assessed the relationship of weight gain and newborn's birth weight in which we found significant ($r = 0.365$ and r square = 0,33 with $p < 0,05$).

We also found that newborn's birth weight is not related to maternal parity status ($r = 0.251$, r square = 0.06, $p = 0.76$).

b. Multivariate Analysis

The regression equation that we obtained is "Birth weight = $2085.106 + 5.133 * \text{blood glucose} + 45.194 * \text{gained weight}$ " which indicates that newborn's birth weight is influenced by both maternal blood glucose level and gained weight during pregnancy.

Discussion

1. Relationship between blood glucose level and newborn's birth weight

As seen in our study, there is a significant relationship between blood glucose level and newborn's weight. This is in accordance with another study from Robert that stated that overweight babies are more likely to be born from mothers who previously had higher blood glucose level. This is also supported by Research group that found that there is a strong relationship between maternal blood glucose level and newborn's weight. Another study by Vaishali et. al also supported this result in which higher maternal glucose level contributes to higher newborn's birth weight.

This study is in line with recent theory stating that there's always been metabolic changes (hormones, glucose) which plays a role in supplying adequate nutrition for the fetus. Fetus gain glucose from maternal supply

through the placental membrane, thus fetal blood glucose level will represent maternal blood glucose level as well. The regulatory mechanism for glucose level is primarily done by insulin. When mother is not able to secrete adequate insulin to lower her high blood glucose level, the fetus will then compensate this by secreting more insulin which will also stimulate the growth of the fetus and later may lead to insulin insensitivity in the baby.

2. Relationship between maternal parity status and newborn's birth weight

Our study found that there is no relationship between maternal parity status and newborn's birth weight. Through literature we found that the only difference between first and later pregnancy usually is felt as subjective feeling by mothers. Due to loosen endometrium, most women who are having the second pregnancy feel that their belly gets bigger much more quickly so that they feel that the babies are overweight or bigger than that in the first pregnancy (Murkoff et. al, 2006).

3. Relationship of maternal weight gain and newborn's birth weight

According to our study, there is a positive relationship between maternal weight gain and newborn's birth weight. This result is in accordance with Shin Kim and team that found that only 5.6% normoweight women without DM that gave birth to overweight babies compared to 12.6% overweight/ obese women without DM that gave birth to overweight babies. Meanwhile in overweight/ obese women with DM the proportion is even increasing to 17.3%.

Another study in Bunda Setia Maternity Clinic also found similar result that women who gained excessive weight during pregnancy are more likely to give birth to overweight babies (OR = 0.126).

Normally maternal weight gain during pregnancy is approximately 9 to 13.5 kg (Mandriwati,2008). In second and third trimester, weight gain as many as 0.4 kg each week is considered normal in healthy women. In the other hand, women who are underweight or overweight are encouraged to gain 6 to 8 kg during second and third trimester or 9 to 11 kg respectively.

Another study showed that weight gain is positively correlated to newborn's birth weight, $p < 0.01$, correlation strength: medium. Maternal weight is the result of addition of both maternal weight before pregnancy and weight during pregnancy. This serves as representation of maternal nutritional status prior to pregnancy. Maternal weight shows strong relationship to newborn's birth weight in which underweight mothers are tend to give birth to underweight babies, while in the other hand, overweight mothers are more likely to give birth to overweight babies. Phaneendra et. al also mentioned that both excessive and insufficient weight gain during pregnancy can lead to serious problem for both mother and baby.

Conclusion and Future Direction

1. There is a strong relationship between maternal blood glucose level and newborn's birth weight ($r = 0.569$) in Maternity Clinic of Medan Selayang District 2014.
2. There is no relationship between parity and newborn's birth weight in Maternity Clinic of Medan Selayang District 2014.
3. There is a relationship between maternal weight gain and newborn's birth weight ($r = 0.365$) in Maternity Clinic of Medan Selayang District 2014.
4. Blood glucose level during pregnancy showed r square = 0.392 indicating that this variable is able to explain 39.2% variation in the dependet variable (newborn's birth weight).
5. The most influential independent variable to newborn's birth weight is maternal weight gain.

Therefore, we suggest all health care providers to provide appropriate antenatal care in order to screen, control as well as manage the condition of gestational diabetes melitus.

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