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Gestational diabetes mellitus and macrosomia: an analysis of secondary data

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ABSTRACT

Excessive fetal weight is considered as a health issues because it increases perinatal and maternal morbidity and mortality. The prevalence of macrosomia worldwide has increased over the past 2 to 3 decades. This study aimed to determine correlation between the incidence of gestational diabetes mellitus and macrosomia among pregnant women. The design of this study was analytical with a case control approach. Data used to analyze the incidence of macrosomia based on secondary data from 2014-2018. This research suggested that diabetes mellitus in pregnancy has a significant relationship with the incidence of macrosomia.

1. Introduction

Excessive fetal weight is one of risk factor increases perinatal, maternal morbidity and mortality (Ikeako et al., 2011). Makrosomia is a condition when the baby born with a body weight of more than 4000 grams (Lu et al., 2018; Shanty, 2013). Macrosomia could increases the risk of injury during the birth process both for the mother and baby. Previous literature mentioned that postpartum haemorrhage, birth canal laceration, and postpartum endometritis were caused by incidence of macrosomia (Ikeako et al., 2011; Wheler, 2003; Sinclair, 2003). Additionally, complications amongst infants and baby were also occurred, including hypoglycemia, infant seizures, hypoxia which results in damage to vital organs, the heart and digestive organs, shoulder dystocia, hypocalcemia, hyperbilirubin, polycythemia, thrombocytopenia, and asphexia. Babies born weighing more than 4000 grams have the potential to experience hypoglycemia after birth and obesity after adulthood (Elie, 2014; Lu et al., 2018).

Globally, the prevalence of macrosomia worldwide has increased over the past 2 to 3 decades. The incidence of fetal macrosomia varies greatly in various geographical regions, with a frequency range from 0.5% to 15% in 23 developing countries in Africa, Asia, and Latin America (Mengesha et al., 2017). In China, the prevalence of macrosomia increased from 6.0% in 1994 to 7.3% in 2014 (Wang et al., 2017). Based on the results of the 2013 Basic Health Research (Riskesdas), the percentage of birth weight of children with a body weight> 4000 grams was around 4.8% of the total number of births of national babies (Elie, 2014).

Recently, it has been known that macrosomia is often associated with maternal age, weight gain during pregnancy, multiparity, length of pregnancy, male fetus, delivery history of macrosomia, race, and ethnicity. Another risk factor that affects a large born baby is a history of gestational diabetes mellitus and obesity in the mother. These factors are important factors to determine the development

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of macrosomia (For the Multicentre Study Group on Mode of Delivery in Friuli Venezia Giulia et al., 2014; Cunningham et al., 2010; Ikeako et al., 2011).

The disorder of glucose tolerance that was first discovered during pregnancy is called Gestational diabetes mellitus (GDM). GDM is a condition in pregnant women who have not previously been diagnosed with diabetes, but then suddenly show high glucose levels during pregnancy (Kaaja and Rönnemaa, 2008). Glucose intolerance occurs between the ages of 24 and 28 weeks. The incidence of GDM increases every year due to lifestyle and changes in dietary patterns associated with high calorie food intake during pregnancy (Wang et al., 2018). There is evidence from preliminary study in a hospital within Yogyakarta province that the risk of incidence of macrosomia was 0.5% to 1.88% amongst pregnant women with GDM. Based on this background researchers were interested in conducting research to analyse the correlation between GDM incidence and macrosomia by using the secondary data in a hospital within Yogyakarta province.

2. Research Method

The design of this research was analytical with an approach method using case control. The population in this study were all babies born in 2014 to 2018 i.e. 12,635. The sample in this study was 55 babies, the total sample size was 110 babies, with a case and control sample ratio of 1: 1. The method of sampling both case and control samples was done by purposive sampling. This research was conducted in February 2019 using the Medical Record data from 2014 to 2018.

The instrument in this research was a checklist sheet (√) which came from secondary data in the form of medical records. Data processing techniques were carried out by careful editing, coding, entry, and cleaning. Data was then analyzed using Statistical Product and Service Solutions (SPSS) version 2.2 for Windows. Univariate data analysis was done to get the frequency distribution. Bivariate data analysis using Chi-square test. Regarding the Health Technology Assessment (HTA), researchers looked for journal references that could be related to aspects found in HTA about macrosomia.

Research ethics was carried out by researchers by submitting an application to the ethics commission of the University isy Aisyiyah Yogyakarta. The ethics commission gave approval to continue research with letter number 435 / KEP-UNISA / I / 2019

3. Result

3.1. Respondent Characteristic

Table 1. The Frequency Distributor of The Respondent

No	Characteristic	Group			
		Case		Controll	
		N	*%*	*N*	*%*
1.	Diabetes in Pregnancy				
	Yes	21	38,2	7	12,7
	No	34	61,8	48	87,3
2.	Parity				
	Risk	35	63,6	24	43,6
	Not Risk	20	36,4	31	56,4
3.	Mother's Age				
	Mother's Age ≥ 35 tahun	30	54,5	26	47,3
	Mother's Age < 35 tahun	25	45,5	29	52,7

Source: Secondary Data (2014-2018)

Based on table 1 it is known that in the case group and the control group the majority did not experience diabetes in pregnancy, 34 respondents (61.8%) in the case group and 48 respondents (87.3%) in the control group. Risk parity in the case group is very high at 35 respondents (63.6%), while in the parity control group there is no very high risk, 31 respondents (56.4%). In the case group of the mother's age> 35 years was higher 30 respondents (54.5%), while in the control group o the mother's age <35 years was higher, namely 29 respondents (52.7%).

3.2. Analysis Result

From the analysis results, there were 110 (100%) with a ratio of 55 (50%) macrosomia and 55 (50%) not macrosomia. Of the 55 (50%) macrosomic infants, there were 21 (38.2%) of mothers with diabetes mellitus, 34 of them (not 61.8%) in pregnancy. For babies who were not macrosomia, those who had diabetes mellitus in pregnancy were 7 (12.7%) and not diabetes mellitus in pregnancy were 48 (87.3%).

Table 2. Cross-tabulation and chi-square test of Neonatal Health Outcome of Pregnant Women with Diabetes Mellitus

Diabetes in Pregnancy	Case		Control		P	OR	CI 95%
	N	*%*	*N*	*%*			
Diabetes	21	38,2	7	12,7	0,04	4,235	1,619-11,079
Not diabetes	34	61,8	48	87,3			

Source: Secondary Data (2014-2018)

The results of research based on the table above show that, in the variable diabetes mellitus in pregnancy the proportion of cases of diabetes mellitus in pregnancy was 38.2% greater than the control group ie 12.7%, while the proportion of cases that did not have diabetes mellitus in pregnancy 61.8%, smaller than the control group, 87.3%. Based on the results of the chis square test, the value of p = 0.04 (p> 0.05) means that there was a statistically significant relationship between diabetes mellitus in pregnancy and the incidence of macrosomia. From the results of the analysis obtained OR = 4.235 (95% CI: 1,619-11,079), so it could be concluded that mothers with diabetes mellitus in risky pregnancies 4.235 times greater to give birth to macrosomia babies than mothers without diabetes mellitus in pregnancy.

4. Discussion

The results of the research based on the table above show that there was a statistically significant relationship between diabetes mellitus in pregnancy with the incidence of macrosomia with a value of p = 0.04 OR = 4.235 (95% CI: 1,619-11,079) which indicated that mothers with diabetes mellitus in pregnancy the risk was 4.235 times greater for giving birth to a macrosomic baby than a mother who did not have diabetes mellitus in pregnancy.

This research was also in line with Srichumchit et al. (2015) 13 who showed mothers with GDM had a risk of macrosomia in the fetus with OR 1.48 (95% CI 1.28-1.71; P <0.001). According to Prawirohardjo (2009), during pregnancy there are hormonal changes which naturally occurred due to the adjustment of the body to meet the glucose needs of the fetus. In the first trimester of pregnancy, there is an increase in human placenta lactogen and prolactin which gradually increases up to at the end of the third trimester (week 35). Human placenta lactogen (hPL) has a chemical structure similar to prolactin and growth hormone. The main effects of hPL are on insulin and glucose metabolism.

The combination of *human placenta lactogen* (hPL) and prolactin triggers a kind of insulin resistance which can be detected by the presence of prandial 2-hour hyperinsulinemia. As a result of this insulin resistance mechanism, some pregnant women will experience relative hyperglycemia (gestVational diabetes mellitus). The condition of hyperglycemia in the mother is certainly very influential on the fetus, because the transfer of glucose from the mother's blood to the fetal circulation occurs diffusion through the placenta, so the fetus also experiences hyperglycemia. The condition of fetal hyperglycemia will subsequently trigger hyperinsulinemia in the fetus with the result that more fetal glycogen is synthesized, resulting in macrosomia (Aghajanian et al, 2007).

In pregnancy there is a change in endocrine metabolism and carbohydrates that support food intake for the fetus and preparation for breastfeeding. Glucose can diffuse permanently through the placenta to the fetus so that its level in fetal blood is almost like that of the mother's blood glucose. When maternal insulin cannot reach the fetus, the maternal blood glucose level will also affect blood glucose levels in the fetus. During pregnancy, the placenta produces the hormone insulin to meet the needs of glycogen in the fetus. In mothers with diabetes mellitus, placental insulin production will increase the amount of blood glucose entering through the placenta. High blood glucose in the mother will cause an increase in the response of insulin to be able to convert glucose into glycogen in the body of the fetus (Robins & Cotran, 2006).

Excess changes in glucose to glycogen will be stored by the fetus in the liver, thymus, adrenal glands, muscles, and fat. This is what drives the accumulation of fat and glycogen and the occurrence of organomegaly in tissues that are sensitive to insulin. Excess glucose levels will result in many glycogen being produced and resulting in increased fetal glycogen reserves. This results in fetal growth that exceeds the size it should be (Ong & Dunger, 2004). Pregnancy accompanied by high blood sugar levels and not well controlled, then the excess sugar will be continued into the baby's blood circulation. High sugar levels in the baby's blood circulation will stimulate the baby's pancreas to produce more insulin to process the sugar. This results in the baby having a large body weight and usually the baby's upper body size tends to enlarge. This has the potential to cause difficulties in the labor process, even at the age of adolescents and adults will have the risk of becoming obese and even obese (Sugianto, 2016). This is supported by Wendland et al., (2012) which shows the outcome of gestational diabetes is macrosomia. Wang et al., (2018) also said that the high glucose levels of maternal fasting together were at a risk of 1,933 times greater delivery of macrosomic infants.

5. Conclusion

Based on the results of the research, the results of the chis square test obtained a value of p = 0.04 (p> 0.05) which means that there was a statistically significant relationship between diabetes mellitus in pregnancy and the incidence of macrosomia. From the results of the analysis obtained OR = 4.235 (95% CI: 1,619-11,079), so it can be concluded that mothers with diabetes mellitus in risky pregnancies 4.235 times greater to give birth to macrosomia babies than mothers without diabetes mellitus in pregnancy.

6. Suggestion

People with diabetes mellitus in pregnancy should always monitor blood glucose levels in order to avoid complications that can occur due to high blood glucose levels. For further research, it is expected to be able to conduct research with better study designs, for example with case control studies accompanied by in-depth interviews or with *cohort* study designs.

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