

The Effect of Administering Vitamin D Supplement on Blood Glucose Level in Gestational Diabetes Mellitus Rats

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ABSTRACT

Gestational Diabetes Mellitus (DMG) occurs due to insulin resistance during pregnancy which causes glucose intolerance in various levels and hyperglycemia. The incidence of DMG in the world and in Indonesia continues to increase every year. Gestational diabetes mellitus can cause complications to the mother and the fetus both during pregnancy and after delivery. Administering vitamin D supplement can reduce blood glucose level and keep the fetal growth rate in normal limits. This study aimed to determine the effect of administering vitamin D supplement on glucose level and fetal growth rate in DMG rats.

This is an experimental study with post-test only control group design in 15 pregnant rats with gestational diabetes. Samples were divided into three groups, one control group and two treatment groups which were given vitamin D supplements at a dose of 9µg/kgBW and 18µg/kgBW for 14 days. Blood glucose level examination was done by using a glucometer and the fetal growth rate was done by using an analytical balance and millimeter paper. Statistical test was conducted by using One Way ANOVA, the significance was determined if $p < 0.05$. Mean \pm SD blood glucose levels (mg/dL) in the the control group (170.80 \pm 4.147), P1 group (126.00 \pm 1.581), P2 group (123.80 \pm 1.924) ($p < 0.001$). Statistically there was a significant difference in the administration of vitamin D supplements on blood glucose levels and there was no significant difference in fetal growth rates in DMG rats. The conclusion of this research is that effect administration of vitamin D supplements on blood glucose levels and it does not affect fetal growth rates in DMG rats.

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1. Introduction

Gestational Diabetes Mellitus (GDM) according to *World Health Organization* (WHO) in 2013 is the occurrence of glucose intolerance in several levels that is known firstly in pregnancy.

International Diabetes Federation (IDF) estimates that the total of GDM in the world in 2017 was of 18 million people (14%), in Southeast Asia region was higher (26,6%) than in Africa region (9,5%) (Cho *et al.*, 2018). The total of GDM in Indonesia is approximately 1,9-3,6%, while in West Sumatera from the research results done in two hospitals, pregnant women who experienced GDM were 655 people (19%) from 3,536 pregnant women who were screened (Fitria *et al.*, 2018).

Gestational Diabetes Mellitus (GDM) in mothers can cause polyhydramnios, gestational hypertension, pre-eclampsia/eclampsia, and can increase cesarean section delivery and the risk of developing type 2 diabetes (5-10 years to come) and GDM in subsequent pregnancies (Nouh *et al.*, 2017). GDM management uses two ways, namely non-pharmacological and pharmacological therapy. Pharmacological therapy such as administration of insulin and oral hypoglycemia drugs (glucuride and metformin) (Cunningham *et al.*, 2012). Other pharmacological therapies that can be given to GDM mothers are such as giving vitamin D supplements.

Research results report that taking vitamin D supplements can reduce blood glucose levels and insulin resistance (Asemi *et al.*, 2014; Ojo *et al.*, 2019), but other studies report different results (Anwar *et al.*, 2013; Yazhid *et al.*, 2016).

Based on the gaps in the results of previous studies, the researcher is are interested in conducting research on the effect of vitamin D supplementation on blood glucose levels and fetal growth rates in gestational diabetes mellitus rats.

2. Method

This study used a post-test only control group design with a sample of 15 gestational diabetes mellitus rats aged 8-12 weeks and an average body weight of 180-220 grams. GDM rats were divided into three groups: 1) control group (without being given vitamin D supplement), 2) treatment group 1 (given vitamin D supplement at a dose of 9 µg/kg BW) and 3) treatment group 2 (given vitamin D supplement at a dose of 18 µg/kg BW).

This research was conducted in January-March 2020. Implementation of research, maintenance of GDM rats and examination of glucose levels of GDM rats were carried out at the Animal House, Biomedical Laboratory, Faculty of Medicine, Andalas University. Measurement of blood glucose levels using glucometer. The research data were analyzed by using one way ANOVA with a significance of $p < 0.05$.

3. Result and Discussion

a) Rat Blood Glucose Levels

Table 1

The Mean Initial blood glucose levels, blood glucose levels after streptozotocin induction and On blood glucose levels after giving vitamin D supplements

Group	Initial blood glucose levels (mg/dL)			blood glucose levels after streptozotocin induction (mg/dL)		On blood glucose levels after giving vitamin D supplements (mg/dL)	
	N	Mean \pm SD	p-value	Mean \pm SD	p-value	Mean \pm SD	p-value
Control	5	73,4 \pm 3,36		170,2 \pm 2,58		170,8 \pm 4,14	
Treatment 1	5	72,6 \pm 3,20	0,817	170,8 \pm 2,77	0,933	126 \pm 1,58	0,001
Treatment 2	5	72,2 \pm 2,38		170,6 \pm 2,40		123,8 \pm 1,92	

Oneway ANOVA Test

Table 1 shows that there is no significant difference in baseline blood glucose levels (p 0.817) and blood glucose levels after streptozotocin induction (p 0.933) between groups. On blood glucose levels after giving vitamin D supplements, there is a significant difference (p 0.001) between groups. Then, to see the differences in each group, it is continued with the Post Hoc Test. The results of the Post Hoc Tests test analysis can be seen in the following table:

Table 2

The Post Hoc test on glucose levels after giving vitamin D supplements between groups

Group	significant difference in fasting blood glucose levels		
	Control	Treatment 1	Treatment 2
Control		0,000*	0,000*
Treatment 1	0,000*	-	0,710
Treatment 2	0,000*	0,710	

Post Hoc Test

(* there is a significant difference)

Table 2 shows the results of the Post Hoc test on glucose levels after giving vitamin D supplements between groups. Based on the results of the Post Hoc test, it can be concluded that there is a significant difference in fasting blood glucose levels after giving vitamin D supplements to the control group with treatment group 1 and treatment group 2 with p value < 0.05 .

Initial blood glucose levels indicate that the conditions of all experimental animals before treatment are similar and not experiencing hyperglycemia so that they can meet the research requirements, while blood glucose levels after being induced by streptozotocin have increased meaning that the use of streptozotocin at a dose of 40mg/kgBW so that mice experience GDM is correct.

Provision of vitamin D supplements can reduce blood glucose levels in GDM rats because vitamin D helps maintain glucose homeostasis by binding and activating vitamin D receptors in pancreatic beta cells and regulating insulin production in relation to blood glucose levels (De-Regil *et al.*, 2016).

Vitamin D in GDM plays a role in: 1) regulating the level of circulating glucose by binding to the vitamin D receptors of pancreatic β cells and modulating insulin secretion, 2) increasing insulin sensitivity for glucose transport and 3) regulating the balance between extracellular and intracellular calcium in the cell membrane for synthesis and secretion insulin so that vitamin D can reduce blood glucose levels in GDM mothers (Zhang *et al.*, 2015).

4. Conclusion

Based on the research results, it can be concluded that there is an effect of vitamin D supplementation on blood glucose levels and it does not affect fetal growth rates in GDM rats. Provision of vitamin D supplements can be one of the factors that can be considered for maintaining maternal health and pregnancy outcomes, because sufficient vitamin D status can reduce adverse pregnancy complication. Therefore, further research is needed on the effect of vitamin D supplementation on GDM in particular towards the growth rate of the fetus.

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