

The Functional Activities of Glucose on Pima Indian Heritage Gestational Diabetes Women

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Received: October 15, 2020; **Published:** November 07, 2020

The disorder, or state that the body cannot successfully use the insulin is known as diabetes. If the body can not maintain insulin levels properly, diabetes is one such disorder that damages all other body parts [1,2]. Generally, there are three types of diabetes such as Type-I diabetes, Type-II diabetes and gestational diabetes. Generally, Type-I diabetes occurs early in life, if the pancreas produces very little insulin, or it does not produce insulin, due to some abnormality. This is termed as insulin-dependent diabetes or juvenile diabetes [3-5]. The treatment does not cure Type-I diabetes, and it tries to control blood sugar levels with diet, insulin, and lifestyle to prevent complexity. Gestational diabetes occurs in pregnant women, and for them it is observed the higher glucose levels during pregnancy. Later there are chances that gestational diabetes can be converted into Type-II diabetes [6-8]. The current editorial note aims to examine the activities of glucose on some gestational diabetes Pima Indian heritage women. The following inquiries are searched in the current note:

- Is there any effect of glucose on gestational diabetes Pima Indian heritage women?
- If it is affirmative, what is the functional relationship of glucose on the other factors of gestational diabetes Pima Indian heritage women?
- What are the functional activities of glucose on gestational diabetes Pima Indian heritage women?

The above queries are explored in the current report based on a real data set of 768 Pima Indian heritage women with at least 21 years old along with 9 study characters. The dataset was originally collected by the National Institute of Diabetes and Digestive and Kidney Diseases. The purpose of the dataset is to predict whether or not a selected woman has diabetes, based on some diagnostic measurements included in the dataset. Some constraints were imputed on the selection of these subjects from a larger database. The data set is available in the UCI Machine Learning Repository. For immediate applications, the 9 study characters are restated as follows:

- Pregnancies: Number of times pregnancy
- Glucose: Plasma glucose concentration over 2 hours in an oral glucose tolerance test
- Blood Pressure: Diastolic blood pressure (mm Hg)
- Skin Thickness: Triceps skin fold thickness (mm)
- Insulin: 2-Hour serum insulin (μ U/ml)

- BMI: Body mass index (weight in kg/(height in m)²)
- Diabetes Pedigree Function: Diabetes pedigree function (a function which scores likelihood of diabetes based on family history)
- Age: Age (years)
- Outcome: Class variable (0= if non-diabetic, 1= if diabetic).

The above hypotheses can only be tested by deriving model of glucose on the remaining 8 factors. It has been observed that glucose is a continuous positive heteroscedastic random response that can be modeled by joint generalized linear models (JGLMs) using both the lognormal and gamma distributions [9,10]. It can be shown that joint gamma model fit of glucose gives better outcomes than lognormal fit, therefore, only the gamma model fit results are presented in table 1. Note that the fitted glucose model is data generated, so it should be justified by the graphical diagnostic plots that are revealed in figure 1. Figure 1a shows the absolute gamma fitted glucose model residuals plot against its predicted values, which is a nearly flat straight line, indicating that variance is constant with the running means. Figure 1b reveals the glucose fitted mean normal probability plot table 1. These two plots do not present any lack of fit. So, the selected gamma fitted glucose model (Table 1) is close to its true model. Therefore, the gamma fitted glucose mean and dispersion models are as follows.

Glucose gamma fitted mean ($\hat{\mu}$) model (from table 1) is

$$\hat{\mu} = \exp(4.414 - 0.006 \text{ skin thickness} + 0.001 \text{ blood pressure} + 0.004\text{BMI} + 0.001 \text{ BP*ST} + 0.002 \text{ Insulin} - 0.001 \text{ Insulin*BMI} + 0.004 \text{ Age} - 0.001 \text{ Insulin*Age} + 0.189 \text{ Types of patients}),$$

and the glucose gamma fitted variance ($\hat{\sigma}^2$) model (from table 1) is

$$\hat{\sigma}^2 = \exp(-4.242 + 0.002 \text{ Insulin} + 0.006 \text{ skin thickness} - 0.001 \text{ skin thickness*insulin} + 0.015\text{Age} + 0.013\text{BMI} + 0.233 \text{ Diabetes Pedigree function}).$$

Model	Covariates	Gamma Fit			
		Estimate	S.E.	t(758)	p-Value
Mean Model	Constant	4.414	0.042	104.11	<0.001
	Blood pressure (BP) (x3)	0.001	0.002	1.22	0.223
	Skin Thickness (ST) (x4)	-0.006	0.003	-3.17	0.002
	BP*ST (x3*x4)	0.001	0.001	2.07	0.039
	Insulin (x5)	0.002	0.001	5.58	<0.001
	BMI (x6)	0.004	0.001	3.10	0.002
	Insulin*BMI (x5*x6)	-0.001	0.001	-2.64	0.009
	Age (x8)	0.004	0.001	5.30	<0.001
	Insulin*Age (x5*x8)	-0.001	0.001	-3.55	0.001
Types of patients (0.189	0.016	11.97	<0.001	
Dispersion Model	Constant	-4.242	0.279	-15.21	<0.001
	Skin Thickness (x4)	0.006	0.004	1.54	0.124
	Insulin (x5)	0.002	0.001	1.24	0.217
	Skin thickness*Insulin(x4*x5)	-0.001	0.001	-2.89	0.004
	BMI(x6)	0.013	0.008	1.65	0.099
	Age (x8)	0.015	0.005	3.23	0.001
	Diabetes Pedigree function (x7)	0.233	0.161	1.45	0.1480
AIC Value		6991.420			

Table 1: Mean and dispersion model of joint gamma glucose model fitting.

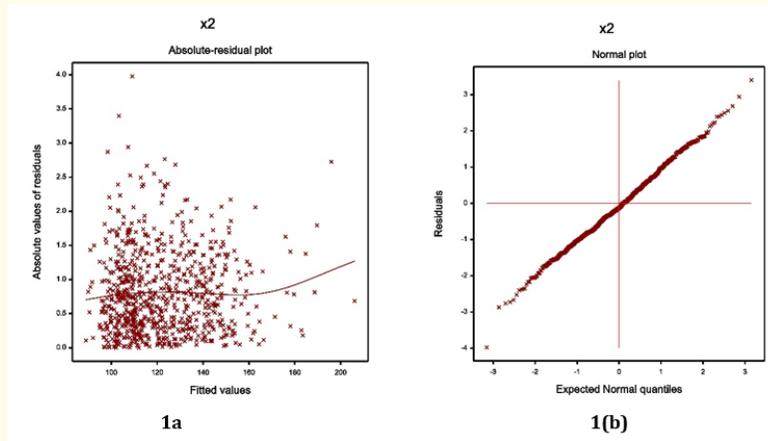


Figure 1: For the joint gamma glucose fitted model (Table 1), the (a) absolute residuals plot with respect to the glucose fitted values, and (b) the normal probability plot for the glucose mean model.

From table 1 and the above glucose fitted mean and dispersion models, the following associations of glucose with other factors can be reported:

- Mean glucose levels are directly related with the type of patient (0 = if non-diabetic, 1 = if diabetic) ($P < 0.001$), concluding that that mean glucose levels are higher for gestational diabetes women than normal. It supports the real practical situation.
- Mean glucose levels are directly related with age ($P < 0.001$), indicating that mean glucose levels are higher at older ages than younger, which is true in practice.
- Mean glucose levels are directly related with BMI ($P = 0.002$), while it is inversely related with the interaction effect Insulin*BMI ($P = 0.009$), concluding that glucose levels are higher for BMI women along with lower interaction effect of Insulin*BMI.
- Mean glucose levels are inversely related to skin thickness ($P = 0.002$), while they are positively associated with the interaction effect of skin thickness and blood pressure, (i.e. skin thickness*blood pressure) ($P = 0.039$), but blood pressure is insignificant. This indicates that mean glucose levels are higher with lower skin thickness along with higher interaction effect of skin thickness*blood pressure.
- Mean glucose levels are directly related to insulin ($P < 0.001$), while it is inversely related with the interaction effects of Insulin*Age ($P = 0.001$) and Insulin*BMI ($P = 0.009$), indicating that glucose levels are higher for the women with higher insulin levels along with lower interaction effects of Insulin*Age and Insulin*BMI. These results are very special for gestational diabetes women. For type 2 diabetes patients, it is observed that insulin is inversely associated with glucose, while these two interaction effects Insulin*Age and Insulin*BMI may be observed or not.
- Variance of glucose levels is directly related with age ($P = 0.001$), concluding that subjects at higher ages have highly scattered glucose levels.
- Variance of glucose levels is directly related with BMI ($P = 0.099$), indicating that subjects with higher BMI have highly scattered glucose levels.

- Variance of glucose levels is inversely related with skin thickness*Insulin ($P = 0.004$), concluding that subjects with lower interaction effects of thickness*Insulin have highly scattered glucose levels.

All the above interpretations are drawn from the derived glucose levels gamma fitting model (Table 1), where the standard errors of all the estimates (Table 1) are very small, indicating that estimates are stable. It is found herein that mean and variance of glucose levels for gestational diabetes women are highly associated with many factors, but there is no association with the number of times pregnancy. It can be concluded that glucose levels rise for gestational diabetes women, along with the increase of age, BMI, insulin levels, skin thickness*blood pressure, and decrease of skin thickness. Insulin*age, Insulin*BMI. Medical practitioners and gestational diabetes women will be benefited from the current note. Pregnant women should always care about their glucose levels regularly.

Conflict of Interest

The authors confirm that this article content has no conflict of interest.

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Volume 5 Issue 12 December 2020

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