

# Relationship Between Levels of Fasting Blood Glucose and HbA1C in Prediabetes Patients

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**Abstract** ---Prediabetes is a condition blood glucose levels are higher than normal but lower than diagnosis of diabetes mellitus. Parameters prediabetes according to the American Diabetes Association 2017, blood glucose levels  $\geq 100$  -  $< 126$  mg/dL in impaired fasting glucose,  $\geq 12$  mg/dL in impaired glucose tolerance and HbA1C level 5.7 - 6.4%. HbA1C test describe of the state blood glucose in the last 2-3 months. The study aimed to determine relationship of fasting blood glucose and HbA1C value in determining prediabetes. Methods of research is descriptive, using secondary data. Data collection was carried out during April to September 2018 at one of the private hospitals in East Bekasi. Total samples inclusion factor were 92 samples. The Spearman test results showed relationship is positive and weak ( $r = 0.230$ ) with  $\alpha = 0.05$  and the linear regression test line equation yields HbA1C value =  $5,430 + 0.003$  (blood glucose value) +  $0.005$  (age) with R value 0.309 between fasting blood glucose test and HbA1C values in prediabetes. The results of this study indicate that value of fasting blood glucose affects value of HbA1C. The higher blood glucose is more Hb molecules that bind to sugar.

**Keywords:** *prediabetes, blood glucose levels, HbA1C, glycated hemoglobin, fasting blood glucose*

## I. INTRODUCTION

Diabetes mellitus is a metabolic disorder that has become a global problem. Based on data from Riskesdas (2013) 5.7% of diabetics patient in Indonesia, almost 73.7% or around 8,485,329 million were not diagnosed with diabetes. This can be considered dangerous because a late diagnosis can cause many complications that occur in type 2 diabetes mellitus [1]. Fasting blood glucose test (hexokinase metode) uses venous blood is a gold standard for diagnosis of diabetes mellitus type 2 and is often used in hospitals [2,3]. According to International Diabetes Federation (IDF), American

Diabetes Association (ADA), Indonesian Endocrinology Association (Perkeni), the criteria diagnosis of diabetes can be confirmed if the condition of blood sugar during fasting is above 126mg/dl and 2 hours after meals (2 hours post prandial) above 200mg/dl. Impaired Fasting Glucose (IFG) condition if the fasting blood sugar level is between 100-125mg/dl while Impaired Glucose Tolerance (IGT) condition is impaired if the fasting blood sugar is above 126 mg/dl while the Impaired Glucose Tolerance (IGT) condition is impaired if the fasting blood sugar is above 126 mg/dl but 2 hours after eating 140-200mg/dl. Both IFG and IGT are also called prediabetes, which are strong candidates for future diabetes. Prediabetes is a danger sign, a yellow light, a marker of diabetes later, or a "candidate" for diabetes. Comparison of diabetes patients with prediabetes in Indonesia is 1: 3 [4].

Indonesia was ranked third in the world with the number of prediabetes as many as 29 million people beat China. Prediction in 2040 Indonesia will be ranked first number of prediabetes which is estimated to reach 36.8 million people. Laboratory tests for the prediabetes of the recommended is HbA1C test because these tests can be performed both on IGT and TGT patient [5]. HbA1C is a blood glucose test through measurement of hemoglobin A1C levels found in erythrocytes. HbA1C is hemoglobin that can bind to glucose (glycohemoglobin) [6]. The HbA1C test describes state of blood sugar in the last 2-3 months. Several recent studies recommend HbA1C test to diagnose or screening for prediabetes as a comparison of the examination of venous blood glucose tests [5, 7]. The use of two different methods of testing blood glucose is recommended to confirm and establish a diagnosis of someone prediabetes or diabetes [5]. HbA1C values for normal people are below 5.6%,

prediabetes is between 5.7 - 6.4%, diabetes is above 6.5% [4].

**II. MATERIALS AND METHODS**

The research method was descriptive observational analytic and the sampling technique was cross-sectional. Data was collected at the Clinical Pathology Laboratory of East Bekasi Private Hospital. The data taken is secondary data that is included in the inclusion criteria, which has a HbA1C test result of 5.7 - 6.4%, does a fasting blood sugar test, there is no routine history of carrying out the HbA1C test and fasting blood sugar. Data was collected from April to September 2018. The data was processed using the SPSS program to test the description, normality, spearman correlation test and regression with an error rate of 5% [8].

**III. RESULT**

*Descriptive Analysis Descriptive and Test Normality Data*

In this study sample data included in the inclusion criteria were 92 samples consisting of 43 men (46.7%) and 49 female (53.3%). The age distribution of 92 prediabetes samples obtained the youngest sample age is 10 years old, the oldest is 81 years old and modus is 49 years as many as 6 people. The mean age of the sample is 50.65 (SD 11.97) with normality distributed data using Kolgomorov-Smirnov test showing a significant value of 0.2 above 0.05. Distribution of fasting blood glucose test results obtained a median value of 100 mg/dL, the highest fasting blood glucose value obtained at 168 mg/dL and the lowest 71 mg/dL. Distribution of the HbA1C test results obtained a median value of 6.0%, the highest HbA1C value obtained at 6.4% and the lowest at 5.2%. The results of the normality test using the Kolgomorov-Smirnov test on fasting blood glucose and HbA1C tests showed values below 0.05 which means the data are not normally distributed. Table 1. below draws the descriptive results of the data obtained.

**Table 1 Descriptive Results And Normality of Prediabetes Samples**

Variabel	Result				
Total samples	n = 92 samples				
Sex	Female = 49 (53.3%)		Male = 43 (46.7%)		
Age	Youngest = 10 years	Modus = 49 years (6.5%)	Oldest = 81 years	Mean = 50 years (SD 11.97)	Kolgomorov-Smirnov test p>0.05 (normality)
Fasting blood glucose levels	Min = 71 mg/dL	Max = 168 mg/dL	Median= 100 mg/dL	Kolgomorov-Smirnov test p<0.05 (not normality)	
HbA1C	Min = 5.2 %	Max = 6.4 %	Median = 6.0 %	Kolgomorov-Smirnov test p<0.05 (not normality)	

*Correlation and regression analysis of fasting blood glucose levels and HbA1C*

The results of fasting glucose test and HbA1C showed abnormalities, so to determine the relationship between the two variables used the spearman test. Spearman test results showed a significant relationship between the

examination of fasting blood glucose and HbA1C in patients with prediabetes means that H0 was rejected. Spearman correlation value of 0.230 shows that the direction of the positive correlation with the strength of the correlation is weak. Table 2. presents the results of the Spearman correlation analysis.

**Table.2 Spearman correlation test results between fasting blood glucose and HbA1C in prediabetes at  $\alpha = 0.05$**

		Fasting blood glucose levels
HbA1C	r	0.230
	p	0.027
	n	92

From the results of the Spearman test, it can proceed to the linear regression test to predict the value of a dependent variable through the

independent variable. In this study the dependent variable is HbA1C and independent fasting blood glucose levels and age. The

results of the linear regression test can be seen in table 3.

**Table 3. Regression analysis of HbA1C with fasting blood glucose level and age in prediabetes**

Variable	R	Adjusted R <sup>2</sup>	Line equation	P value
fasting blood glucose level and age	0.309	0.075	HbA1C= 5.430+ 0.003 (fasting blood glucose level)+ 0.005(age)	0.012

The relationship of HbA1C with fasting blood glucose level in prediabetes showed a weak relationship (R = 0.309) and positive patterned. This means that the greater the value of fasting blood glucose, the greater HbA1C too. The adjusted R2 value means how much value (percent) of the

equation obtained is able to approach actual HbA1C test results. The adjusted R2 value obtained is 0.075 or 7.5% meaning that equation obtained is able to approach the HbA1C test results, the remaining 92.5% is explained by other variables (residues).

#### IV. DISCUSSION

Based on table 1, the prediabetes sample suffered more women (53.3%) than men (46.7%). Sex differences can affect factors of type 2 diabetes mellitus such as differences in the type of sex hormones in women and men, these differences have a major influence on energy metabolism, body composition, vascular function and inflammatory response. Thus, endocrine imbalance can cause the risk of prediabetes to type 2 diabetes mellitus, especially in women who have a greater risk of both biological factors and due to stress exposure. Patients with prediabetes with conditions of impaired glucose tolerance (IGT) are more experienced by women and prediabetes with conditions of impaired fasting glucose (IFG) are mostly experienced in men [9]. Prediabetes criteria according to The American Diabetes Association 2017 in Table 1. shows fasting glucose levels in IGT patients > 126 mg / dL and IFG are between > 100 - <126 mg / dL. Based on this, the results of this study indicate the average value of fasting blood glucose in men is 100.97 mg / dL and in women is 103.3 mg / dL. These results indicate prediabetes criteria in men and women are in the category of IFG.

activities on social media such as food, fast food restaurants that tend to entice someone to try and cause obesity. Prediabetes increases the risk of becoming type 2 diabetes mellitus and cardiovascular disease. Early identification and management of prediabetes diagnosis can reduce the incidence of diabetes and its complications [11]. Management of prediabetes screening or risk of diabetes with asymptomatic symptoms such as weight weighing in adolescents who are overweight or obese (BMI 25kg/m<sup>2</sup> or ≥23kg/m<sup>2</sup> in Asian Americans), routine blood glucose testing in someone 45 years old If the test shows normal, repeat test for at least 3 years after the last blood glucose test. Prediabetes can also be associated with obesity (especially abdominal or visceral obesity), dyslipidemia with high triglycerides, low HDL cholesterol and hypertension [12].

Prediabetes can be experienced everyone at any age, especially in people with obesity and age 45 years, in table 1 shows that most patients with prediabetes are 49 years old. prediabetes can be experienced by anyone at any age, especially in people with obesity and over the age of 45 years, in table 1 shows that most patients with prediabetes are 49 years old. Factors that can affect prediabetes condition such as level of education, level of opinion, place of residence, daily activities and family history of diabetes [10]. The majority of factors that influence prediabetes are social behavior factors. Nowadays people tend to share

HbA1C test is specific glycated hemoglobin that is formed due to addition of glucose to N-terminal amino acid valine in α-hemoglobin chain. In this study a weak relationship was found between fasting blood glucose yield and HbA1c. Despite having a weak association HbA1C is still used as a marker to diagnose prediabetes besides fasting blood glucose testing. This is because concentration of glycated hemoglobin (HbA1C) depends on the concentration of blood glucose and lifespan of a red blood cell which is typically 120 days, which means the relative proportion of HbA1C at any one time depends on the mean circulating blood glucose level over that 3 month period [13]. HbA1C test and fasting blood glucose results when used as a basis for making adjustments to the treatment of pre-diabetes mellitus [14]. Use of HbA1C as a screening marker has rapidly been adopted in

clinical practice by a growing number of countries where it may provide an excellent cost efficient approach to T2D screening providing it is shown to have adequate sensitivity and specificity [15]. Indonesia ranks seventh with 10 million diabetics and is predicted to increase to sixth with 16.2 million diabetics in 2040 by comparing type 2 diabetes mellitus with prediabetes 1 : 3 [16]. Diagnostic techniques can effective, efficient and accurate urgently needed to diagnose prediabetes so that it does not develop into type 2 diabetes mellitus in Indonesia as develop country. However, HbA1C tests expensive costs so that other testing methods that cheaper and can be converted to HbA1C are needed. The results of this study are expected to be

useful in helping to diagnose prediabetes conditions early for Indonesian society. Fasting blood glucose tests more applicable because the tools used are available almost every laboratory in Indonesia.

## V. CONCLUSION

There is a correlation between fasting blood glucose test and HbA1C results in patients with prediabetes with a weak ( $R = 0.309$ ) and positive relationship.

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