



## Relationship between the characteristics of respondent with fasting blood glucose levels in patients' diabetes mellitus type 2

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### Abstract

**Background:** Diabetes Mellitus (DM) is a metabolic disorder which is marked by an increase in fasting blood glucose level caused by the damage to the function of pancreas influenced by factors of age, sex, and education.

**Purpose:** To examine relationship between characteristics (age, sex and education) of respondent with fasting blood glucose level in patients diabetes mellitus type 2 in Purwosari public health center Surakarta.

**Method:** This research type and design used is quantitative research, analytic observational research methods with cross sectional research approach. The sample in this research is 92 people with technique purposive sampling. Data collection using questionnaire's characteristic responden and fasting blood glucose levels with glucometer. The study was conducted in January – February 2020 at Purwosari public health center Surakarta. Data analysis using Chi square test with significance < 0.05.

**Result:** The majority of respondents have hyperglycemia of 57 people with age range 65 – 79 years, female, level of education is high school. The results of this study indicate that there is a relationship of age (p value = 0,006) with fasting blood glucose; sex (p value = 0,017) with fasting blood glucose; education (p value = 0,030) with fasting blood glucose.

**Keywords:** Age; Sex; Education; Fasting Blood Glucose; Diabetes Mellitus Type 2

### 1. Introduction

Diabetes Mellitus (DM) is a metabolic disorder of carbohydrate, fat, and protein metabolism which affects insulin secretion, insulin action or both [1] which is characterized by chronic hyperglycemia, both intermediate-immune (type 1), insulin resistance. (DM type 2), gestational or other such as environmental, genetic defects, infections, and certain drugs [2]. When the patient cannot achieve normal or near normal blood glucose levels after diet and exercise therapy, pharmacological interventions should be considered [3]. The use of insulin is the initial treatment for patients with type 1 diabetes and type 2 diabetes who most often use insulin therapy to help maintain glycemic control [4].

Overall there were approximately 108 million sufferers who pioneered DM in 1980. However, the number of people with DM increased to about 422 million in 2014. The prevalence of DM has doubled since 1980 and increased from 4.7%

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to 8.5% in the world's adult population [5]. According to the results of ministry of health showed that the prevalence of DM based on a doctor's diagnosis in the population aged 15 years by province in 2018 the incidence of DM in Central Java Province was higher with a percentage (2.1%) than the percentage of DM incidence in Indonesia (2, 0%) [6] [7]. The data is data that has been diagnosed by a doctor, while it is believed that there are more that have not been diagnosed. Data from the 2014 Balitbangkes Ministry of Health, DM is the third highest cause of death in Indonesia with a percentage of 6.7% [8] where glucose tolerance is impaired by about 29.9% and fasting blood glucose 36.6%. The proportion of people in rural areas who suffer from diabetes mellitus is almost the same as people in cities.

An increase in fasting blood glucose levels is caused by impaired pancreatic function. One of the events that causes high fasting blood sugar levels is the consumption of foods containing high sugar [2]. Many people with type 2 DM do not understand and realize that their blood glucose levels are already high. This is due to several factors, including factors that can be changed are food intake, especially carbohydrates, fats and proteins, drug intake, smoking behavior, stress, family support, physical activity and education level that can affect the patient's knowledge [9], while the factors that cannot be changed are age, gender and genetic factors [10]. The prevalence of diabetes sufferers in urban areas is higher due to better socio-economic conditions, high levels of education and less physical activity than in rural areas [11]. The increase that occurred in the City area was caused by an unhealthy lifestyle with the habit of eating unhealthy food so that blood glucose levels increased [12].

## 2. Material and methods

This study uses the type and design of quantitative research, analytical observational research method with a cross sectional research approach. The population in this study were 106 people with type 2 diabetes mellitus with a total of 560 visits. The sample used was 92 respondents with purposive sampling technique. Characteristics of data were collected using a questionnaire of respondents' characteristics and fasting blood glucose levels using a glucometer. The study was conducted from January to February 2020 at the Purwosari Public Health Center, Surakarta. The variables in this study were independent variables, namely age, gender, and education level. Meanwhile, the dependent variable is fasting blood glucose levels. Univariate data analysis used frequency distribution and bivariate data analysis used chi square test with a significance  $< 0.005$ .

## 3. Results

**Table 1** Characteristic of Participant

Characteristics	Category	frequency (n)	Percentage (%)	$\bar{X} \pm SD$
Age	20-64 Year	41	44.6	61,39 ± 11,854
	64-79 Year	51	55.4	
Gender	Man	38	41.3	
	Woman	54	58.7	
Education Level	Uneducated	2	2.2	
	Primary School	16	17.4	
	Junior high school	23	25.0	
	Senior high school	35	38.0	
	diploma	1	1.1	
Job	work	30	32.6	
	no work	62	67.4	
Marriage Status	Married	89	96.7	
	Not married	3	3.3	

Based on the results of the study in table 1, it shows that of the 92 respondents with type 2 DM at the Purwosari Health Center the average age is 61.39 years, the majority are aged 65-79 years as many as 51 respondents (55.4%), gender, namely female as many as 54 respondents ( 58.7%), education level, namely high school as many as 35 respondents (38.0%), employment status namely not working as many as 62 respondents (67.4%), and marital status namely married as many as 89 respondents (96.7%). Based on the results of the study in table 2 above, it is shown that of 92 respondents who experienced no hypoglycemia, normal fasting blood glucose levels were 35 respondents (38.0%), and there were 57 respondents who experienced hyperglycemia, with a minimum value of 90 mg/dL, the maximum value 215 mg/dL and the average fasting blood glucose level is 149.58 mg/dL.

**Table 2** Fasting blood glucose level

	Frequency (n)	Percentage (%)	$\bar{X} \pm SD$
Hypoglicemia < 80 mg/dL	0	0.0	149,58±35,787
Normal 80 - 130 mg/dL	35	38.0	
Hyperglycemia > 130 mg/dL	57	62.0	
Total	92	100.0	

**Table 3** The relationship between respondent characteristics (age) and fasting blood glucose levels in type 2 DM patients

Age (Year)	fasting blood glucose level								P value
	Hypo glicemia < 80 mg/dL		Normal 80 - 130 mg/dL		Hyper glicemia > 130 mg/dL		Total		
	n	%	n	%	n	%	n	%	
20 - 64	0	0.0	22	23.9	19	20.7	41	44.6	0.006*
65 - 79	0	0.0	13	14.1	38	41.3	51	55.4	
Total	0	0.0	35	38.0	57	62.0	92	100	

\*chi square test = 0.006

The results of the bivariate analysis using the chi square test based on table 3 it was found that from 41 respondents with an age range of 20 - 64 years, there were 22 respondents (23.9%) normal fasting blood glucose levels who experienced hyperglycemia as many as 19 respondents (20.7%), and no There are respondents who experience hypoglycemia. Furthermore, from 51 respondents with an age range of 65 - 79 years who experienced hyperglycemia as many as 38 respondents (41.3%), there were 13 respondents (14.1%) with normal fasting blood glucose levels and none of the respondents experienced hypoglycemia.

**Table 4** The relationship between respondent characteristics (gender) and fasting blood glucose levels in patients with type 2 diabetes mellitus

Gender	Fasting Blood Glucose Level								P value
	Hypo glicemia < 80 mg/dL		Normal 80 - 130 mg/dL		Hyper glicemia > 130 mg/dL		Total		
	n	%	n	%	n	%	n	%	
Man	0	0	9	9.8	29	31.5	38	41.3	0.017*
Woman	0	0	26	28.3	28	30.4	54	58.7	
Total	0	0	35	38.0	57	62.0	92	100	

\*chi square test = 0.017

Based on the chi square test on the relationship between respondent characteristics (age) and fasting blood glucose levels in type 2 DM patients with a significance of  $p < 0.05$  ( $0.006 < 0.05$ ), then  $H_0$  is rejected and  $H_a$  is accepted, this means that there is a significant relationship between the characteristics of the respondents (age) and fasting blood glucose levels in patients with type 2 diabetes.

The results of the bivariate analysis using the chi square test based on table 4 it was found that from 38 male respondents who experienced hyperglycemia as many as 29 respondents (31.5%), there were 9 respondents (9.8%) with normal fasting blood glucose levels and none of the respondents experienced hypoglycemia. Furthermore, of the 54 female respondents who experienced hyperglycemia, 28 respondents (30.4%), there were 26 respondents (28.3%) with normal fasting blood glucose levels and none of the respondents experienced hypoglycemia.

Based on the chi square test on the relationship between respondent characteristics (gender) and fasting blood glucose levels in type 2 DM patients with a significance of  $p < 0.05$  ( $0.017 < 0.05$ ), then  $H_0$  is rejected and  $H_a$  is accepted, this means that there is a significant relationship. There is a significant relationship between respondent characteristics (gender) and fasting blood glucose levels in patients with type 2 diabetes.

**Table 5** The relationship between respondent characteristics (education level) and fasting blood glucose levels in patients with type 2 diabetes mellitus

Education Level	Fasting Blood Glucose Level								P value
	Hypo glicemia < 80 mg/dL		Normal 80 - 130 mg/dL		Hyper glicemia > 130 mg/dL		Total		
	n	%	n	%	n	%	n	%	
Uneducated	0	0.0	0	0.0	2	2.2	2	2.2	0.030*
Primary School	0	0.0	3	3.3	13	14.1	16	17.4	
Junior High School	0	0.0	6	6.5	17	18.5	23	25.0	
Senior High School	0	0.0	15	16.3	20	21.7	35	38.0	
Diploma	0	0.0	1	1.1	0	0.0	1	1.1	
College	0	0.0	10	10.9	5	5.4	15	16.3	
Total	0	0.0	35	38.0	57	62.0	92	100	

\*chi square Test = 0.030

The results of bivariate analysis using the chi square test based on table 5 it was found that the education level of 57 respondents who experienced hyperglycemia there were 2 respondents (2.2%) who did not attend school. , 13 respondents (14.1%) elementary school, 17 respondents (18.5%) junior high school, 20 respondents (21.7%) high school, and 5 respondents (5.4%) Academy/PT. Furthermore, of the 35 respondents with normal fasting blood glucose levels, there were 3 respondents (3.3%) elementary school, 6 respondents (6.5%) junior high school, 15 respondents (16.3%) high school, 1 respondent (1.1%) DI /DII and 10 respondents (10.9%) Academy/PT.

Based on the chi square test on the relationship between respondent characteristics (education level) and fasting blood glucose levels in type 2 DM patients is 26,035 with a significance of  $p < 0.05$  ( $0.030 < 0.05$ ), then  $H_0$  is rejected and  $H_a$  is accepted, this means there is a significant relationship between respondent characteristics (education level) and fasting blood glucose levels in type 2 DM patients.

## 4. Discussion

### 4.1. Characteristics of Participants

The risk of developing diabetes will increase with age, especially over 40 years, as well as those who are less physically active, lose muscle mass, and gain weight [13]. According to Akhsyari (2016) someone aged over 45 years has an increased risk of developing diabetes and glucose intolerance caused by degenerative factors, namely decreased body functions, especially the ability of B cells to produce insulin to metabolize glucose [10].

Based on the results of this study, it shows that more women suffer from type 2 diabetes mellitus. According to Purwaningtyas (2015) explaining that men are more susceptible to type 2 DM than women but the reality in the field is that there are more women than men. This is because women in society have a higher life expectancy than men, so that more elderly women cause the number of women with type 2 DM to be higher [14]. According to Akhsyari (2016) stated that the tendency of a higher proportion of DM in women compared to men, this is related to the cause of obesity as a risk factor for DM which attacks women more [10].

Based on the results of this study, it shows that the level of high school education is more likely to suffer from type 2 diabetes mellitus. According to (Akhsyari (2016) the level of education can be related to the ability to receive health information, especially about diabetes mellitus, including health care [10]. education level can increase a person's knowledge about health. The more information that comes in, the more knowledge you get about health.

Based on the results of this study indicate that most of the respondent's work is not working. According to Akhsyari (2016) work status factors have a relationship with the incidence of diabetes mellitus. A person's job affects their level of physical activity, people who do not work have less physical activity, thus increasing the risk of obesity [10]. The type of work can trigger the onset of disease through the presence or absence of physical activity at work, so it can be said that a person's work affects his physical activity [3].

Based on the results of this study indicate that most of the respondents' marital status is married. Marital status is assessed from the presence or absence of a life partner. A life partner gives a very great meaning to a person, so that patients who are still bound in marriage will have a better quality of life. relationship with the status of quality of life, especially in the psychological condition. Not bound in marriage includes unmarried, divorced dead or divorced alive [15].

#### **4.2. Blood glucose levels**

Based on the results of research at the Purwosari Health Center the majority of respondents experienced hyperglycemia. In type 2 diabetes, the pancreas can still make insulin but the quality of the insulin is poor, it cannot function properly so that glucose in the blood increases [4]. Blood glucose level is a term that refers to the level of glucose in the blood. Blood sugar concentration, or serum glucose level, is tightly regulated in the body[5]. Diabetes Mellitus (DM) is a metabolic disorder of carbohydrate, fat, and protein metabolism which affects insulin secretion, insulin action or both, which is characterized by chronic hyperglycemia [1].

Hyperglycemia is a condition where blood glucose levels rise to normal (80-100 mg/dL), which occurs when the body produces too little insulin or when the body cannot use insulin properly. The causes of increased blood glucose levels are excessive carbohydrate intake, lack of physical activity, lack of insulin/ADO, side effects of other medications, other diseases, stress, menstruation, and dehydration. Then, a decrease in blood glucose levels (hypoglycemia), namely blood glucose levels <60 mg/dL or <80 mg/dL caused by insufficient intake of carbohydrates, alcohol, excess insulin/ADO, side effects of medication, and excessive physical activity [16].

##### *4.2.1. The relationship between respondent characteristics (age) and fasting blood glucose levels in patients with type 2 diabetes*

Based on the results of research at Purwosari Health Center that there is a relationship between age and fasting blood glucose levels. Age has a close relationship with an increase in the amount of blood glucose, the older you get, the higher the risk of developing type 2 diabetes [3]. Old age affects diabetes because the body's physiological functions decrease and there is a decrease in insulin secretion or resistance so that the ability of the body's functions to control high blood glucose is less than optimal (Yosmar et al. 2018). According to World Health Organization that over the age of 30 years, blood glucose levels will rise 1-2 mg/dL/year when fasting and increase by 5.6-13 mg/dL 2 hours after eating [17].

The results of this study are in accordance with previous research conducted by Ahmed (2019) that there is a relationship between age and patients' blood glucose levels. A person aged 40 years has an increased risk of developing diabetes and glucose intolerance due to degenerative factors, namely decreased body function to metabolize glucose. In elderly people who suffer from DM, blood glucose levels tend to be difficult to control [18].

In line with the results of research by Chiwanga (2016) that there is a relationship between age and fasting blood glucose levels in laboratory service users at M. Djoen Sintang Hospital who found that ages over 45 years had the highest risk of increasing blood glucose levels. This is based on the fact that people over 45 years old are busy with work or not, so that their eating patterns are not maintained, lack of rest so that the risk of developing blood glucose levels is very high [12]. The results of research conducted jang et al (2019) show that there is a relationship between age and the incidence

of type 2 DM in the community at the I Wangon Health Center, the more a person's age increases, the greater the incidence of type 2 DM [5].

#### *4.2.2. The relationship between respondent characteristics (gender) and fasting blood glucose levels in type 2 DM patients*

Based on the results of research at Purwosari Health Center that there is a relationship between gender and fasting blood glucose levels. The incidence of type 2 DM in women is higher than men, women are more at risk of suffering from diabetes because physically women have a greater chance of increasing body mass index [19]. Research Boku (2019) shows that type 2 diabetes mellitus is more common in women, this may be associated with a higher risk of overweight and obesity in women than men [15].

The results of this study are in accordance with previous research conducted by Hakim (2017) there is a relationship between gender and blood glucose levels. In women who have experienced menopause, blood sugar levels are not controlled, because there is a decrease in the production of the hormones estrogen and progesterone. The hormones estrogen and progesterone can affect how the body's cells respond to insulin [8].

However, according to Rosyid et al (2020) there is a relationship between gender and fasting blood glucose levels suggesting that there are more males than females because when conducting research the number of respondents is more male. - men than women. The risk factor for increasing blood glucose levels is in men the accumulation of fat is concentrated around the abdomen, thus triggering central obesity which is more at risk of triggering metabolic disorders [3].

#### *4.2.3. The relationship between respondent characteristics (educational level) and fasting blood glucose levels*

Based on the results of research at the Purwosari Health Center that there is a relationship between education level and fasting blood glucose levels. According to Perdana et al (2013) increasing levels of education will increase awareness of healthy living and pay attention to lifestyle and eating patterns. Individuals with low education are able to have the risk of paying less attention to lifestyle and diet and what to do to prevent DM [20]. Education is the most effective thing in increasing knowledge. Several studies have shown that education can increase knowledge based on clinical theory, lifestyle, and a positive environment. The adherence of diabetic patients in taking diabetic treatment, diet patterns, physical activity has a major effect in controlling diabetes [3].

In line with research conducted by Muhasidah (2017) showed that there was a relationship between knowledge and blood glucose levels in type 2 DM patients at the Purwosari Public Health Center [21]. Likewise, the results of research from tombokan (2017) that there is a relationship between the level of education and the risk of diabetes mellitus in the Tanah Kalikewall sub-district [22].

However, this study contradicts the results of research conducted by Hidayah (2019) that there is no relationship between education level and blood glucose levels, there are several external factors that influence it, patients may know about how to control their blood glucose levels from counseling or brochures, but they do not want to control it or because they are bored with it so that their blood glucose levels worsen [23]. According to Ahmed (2019) there is no relationship between the level of education and the incidence of type 2 diabetes mellitus [18].

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## **5. Conclusion**

Based on the data analysis that has been carried out, fasting blood glucose levels in patients with type 2 DM at the Purwosari Health Center are mostly 65-79 years old, female, education level is high school, employment status is not working and marital status is married. Type 2 DM at the Purwosari Health Center showed that the fasting blood glucose level had hyperglycemia. There is a relationship between age and fasting blood glucose levels, gender with fasting blood glucose levels, and education level with fasting blood glucose levels, has a significant relationship.

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## **Compliance with ethical standards**

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### Disclosure of conflict of interest

The authors hereby declare that there is no conflict of interest among them or with any person/organization.

### Statement of informed consent

Prospective Participants were invited and oriented on the purpose of this study, namely to examine relationship between the characteristics of respondent with fasting blood glucose levels in patients diabetes mellitus type 2. Informed consent was obtained before the study and the participants were allowed to withdraw at any time.

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