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Analysis of Factors Not Achieving Fasting Blood Glucose Levels of Diabetes Mellitus Patients at the Singgani Health Center Palu City

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ABSTRACT

Introduction: Diabetes Mellitus is still a serious health problem worldwide, especially in Indonesia. Due to its persistent nature and increasing prevalence, it appears that efforts to control this disease still face many challenges in its implementation in the community. Several risk factors play a role in the development of this disease. These include family history of diabetes, environmental influences, age, obesity, ethnicity, comorbidities, medication, occupation, unhealthy diet, and physical inactivity.

Objective: The purpose of this study was to determine the factors of not achieving fasting blood glucose levels in patients with diabetes mellitus at the Singgani Health Center in Palu City.

Method: This study used a cross-sectional design in patients with diabetes mellitus at the Singgani health center in Palu City, data collection was carried out using non-probability sampling techniques with purposive sampling techniques, with a total sample of 100. Data were obtained from the results of patient medical records, data analysis using descriptive analysis, namely the analysis method used to describe the characteristics of the research subjects and the character of blood glucose levels, then analyzed using SPSS, namely to see the analysis of factors not achieving fasting blood glucose levels statistically tested using Chi-Square.

Result: The results of the study were that most patients were in the category of unattainable fasting blood glucose levels, totaling 87 patients ≥ 110 mg/dl out of a total of 100 samples. As well as being influenced by sociodemographic characteristic factors, namely in employment status, namely in the group of patients not working in the category of fasting blood glucose not reached, totaling 62 patients, with an Odds Ratio of 2.32 with a significance value of p = 0.02.

Conclusion: The employment status of 62 patients in the non-working group had a 2.32 times risk of not achieving fasting blood glucose levels.

Keywords: Diabetes Mellitus; Fasting Blood Glucose Level; Not Reached

INTRODUCTION

Diabetes Mellitus is still a serious health problem worldwide, especially in Indonesia, due to its persistent nature and increasing prevalence. Patients with diabetes mellitus often experience difficulties due to long-term treatment along with nonpharmacological (1). Until now, the exact cause of diabetes mellitus is still not fully known. However, there are several risk factors including family history of diabetes, environmental influences, age, obesity, ethnicity, comorbidities, medication, occupation, unhealthy diet, and lack of physical activity (2). According to the International diabetes federation in (2021), indonesia ranked 5th in the world for the number of adult diabetics (aged 20-79 years), with approximately 19.5 million people or 10.9% of the population (3). As of 2022, central Sulawesi has 91,312 people with diabetes aged 15 years and above. However, only 25,630 people, or 28.1% of them received standardized health services. In Palu City alone, there were 23,677 people with diabetes mellitus, or 25.9% of the total patients in central Sulawesi, but only 1,314 people (5.54%) received standardized health services (4).

In a previous study conducted by Husna (2022), results showed that 19 participants (22.4%) had good control over their fasting blood glucose, while the remaining 66 participants (77.6%) did not manage to maintain such control (5). As well as research conducted by Suci and Bastira (2023) stated that individuals with abnormal blood glucose levels have a 93.302 times greater risk of deve loping diabetes mellitus than those who have blood glucose levels within normal limits. Factors such as age, body fat composition, the way the body metabolizes glucose, the use of certain drugs, diet, and lifestyle can affect the increase in fasting blood glucose levels (6).

Diabetes mellitus is divided into two types, namely type 1 diabetes and type 2 diabetes. Diabetes is caused by genetic factors, environment, age, and factors related to lifestyle and obesity (7). Blood glucose known as glucose is a glucose substance that circulates in the bloodstream, is derived from carbohydrates in the diet, and is stored in the form of glycogen in the liver and skeletal muscles, the character of optimal glycemic levels is key in managing type 1 and type 2 diabetes, inadequate glycemic control can lead to poor complications (8). One of the factors that play a role in the failure to achieve blood glucose control in patients with diabetes is the patient's non-adherence to treatment, as well as other factors, such as occupation, weight control, regulation of food intake and other accompanying factors such as socioeconomic status, low education and knowledge levels and depression experienced by patients (9). Increasing age can increase the risk of developing diabetes mellitus. In older individuals, the function of the body's organ systems tends to decline, which can result in less effective blood glucose control, thus increasing the likelihood of diabetes mellitus (10).

Based on the background and results of various previous studies which state that risk factors for diabetes mellitus can be caused by pharmacological, nonpharmacological, and sociodemographic factors, researchers are encouraged to explore risk factors, namely sociodemographics, clinical characteristics, and the significance of fasting blood glucose levels to know the factors of not achieving fasting blood glucose levels in patients with diabetes mellitus at the Singgani health center in Palu city.

METHOD

This research has received approval from the Medical and Health Research Ethics Committee of Tadulako University number: 2373/UN 28.1.30/KL/2024.

This study used a cross-sectional design in patients with diabetes mellitus at the Singgani Health Center in Palu City, data collection was carried out using non-probability sampling techniques with purposive sampling techniques, namely the selection was not randomized, but based on considerations based on certain evidence that met the inclusion and exclusion criteria of the population.

The inclusion criteria for patients in this study were: 1) age 18 years and above; 2) had received antidiabetic drug therapy for one month. Exclusion criteria included: 1) patients who did not have clear clinical data; 2) Patients undergoing hemodialysis; 3) Patients who were pregnant and breastfeeding; 4) The patient died. The total sample size was 100 patients.

Data were obtained from patient medical records, in this study, patient sociodemographic characteristics data included age, gender, education level, employment status, diagnosis, GDP (fasting blood glucose) levels, comorbidities, clinical manifestations, number of treatments, number of comorbidities, and history of treatment received by the patient. Data analysis using descriptive analysis is an analytical method used to describe the characteristics of the research subjects and the characteristics of fasting blood glucose levels. Then the analysis using SPSS is to see the analysis of factors not achieving fasting blood glucose levels statistically tested using Chi Square.

RESULTS

Table 1. Sociodemographic Characteristics Data

Characteristics	Description	Total (n=100)	%
Age	26 - 44 years	5	5
	45- 59 years	45	45
	60- 74 years	45	45
	≥ 75 years	5	5
Gender	Male	34	34
	Female	66	66
Education	No degree	85	85
	Bachelor	15	15
Jobs	Not working	75	75
	Work	25	25

Table 1 states the results that most patients with diabetes mellitus (DM) aged 45 - 59 years amounted to 45 (45%) and in the age range of 60 - 74 years amounted to 45 (45%), with a greater proportion being female with a total of 66 (66%). Most of the patients had an education level of non-graduate status (elementary, junior high, and high school) amounting to 85 (85%), and the majority of them were not actively working, totaling 75 (75%).

Table 2. Clinical Characteristics Data

Characteristics	Description	Total (n=100)	%
Clinical manifestations	Polyuria	10	10
	Insomnia	12	12
	Blurred vision	11	11
	Pain	29	29
	Paresthesia	25	25
	Cough	3	3
	Fever	3	3
	Dizziness	3	3
	Disordered sense of well-being	4	4
Treatment History	Metformin + Glimepiride	17	17
	Metformin + Glimepiride + Vitamin B complex	4	4
	Metformin + Novorapid	3	3
	Metformin + Vitamin B complex	15	15
	Novorapid	5	5
	Glimepiride	8	8
	Metformin	27	27
	Metformin + Glibenclamide	2	2
	Ryzodeg	2	2
	Levemir + Novorapid	7	7
	Glimepiride + vitamin B complex	6	6
	Levemir	1	1
	Levemir + Metformin	2	2
	Insulin	1	1
Comorbidities	None	42	42
	Dyspepsia	7	7
	HT + Diabetic Retinopathy	1	1
	Dyslipidemia + HT	1	1
	Common cold	3	3
	CAP + Dyspepsia	1	1
	HT + CBP	1	1
	HT	19	19

	ARI	4	4
	Dyspepsia + HT + ARI	1	1
	HHD	3	3
	HT + Myalgia	1	1
	Senile Cataract	1	1
	Abscess	2	2
	HT + OE	1	1
	HT + Diabetic neuropathic	2	2
	Wound infection	1	1
	HT + CC	1	1
	Dyslipidemia + HT	2	2
	Dyslipidemia	1	1
	Bronchial asthma	1	1
	CC + Myalgia	1	1
	Diabetic neuropathy	1	1
	Cataract + Dyslipidemia	1	1
	HT + LBP + Dyspepsia + Arthritis	1	1
Number of treatments	Single	44	44
	Combination	56	56
Number of comorbidities	No comorbidities	43	43
	1 comorbidity	42	42
	More than one comorbidity	15	15

Description: HT (Hypertension)
CC (Common cold)
CAP (Community-acquired pneumonia)
CBP (Chronic back pain)
HHD (Hypertensive heart disease)
OE (Otoitis externa)
LBP (Low back pain)

Table 2 states that the results of data on the clinical characteristics of patients with diabetes mellitus mostly have clinical manifestations, namely pain as many as 29 (29%), with the highest proportion in the history of antidiabetic drug use, namely metformin, namely 27 (27%), and has the highest comorbidity results, namely on average no comorbidities, namely 42 (42%). And in the number of treatments, most patients get combination therapy, namely 56 (56%), and do not have comorbidities, totaling 43 (43%).

Table 3. Fasting Glucose Levels Outcome Data

Characteristics	**Description**	**Total (n=100)**	**%**
Achieved	100 - 110 mg/dl	13	13
Not achieved	≥ 110 mg/dl	87	87

Table 3 states the results of fasting blood glucose levels from a total of 100 samples in the category achieved 100 - 110 mg/dl amounted to 13 (13%) and the category not achieved ≥ 110 mg/dl amounted to 87 (87%), these results state that most patients are in the category not achieved, namely GDP levels ≥ 110 mg/dl.

Table 4. Chi-Square Results of Characteristics and Fasting Blood Glucose

Variables	Fasting blood glucose		OR	P value
	Achieved	Not achieved		
Age			1,45	0,64
26 - 44 years	1	4		
45- 59 years	2	43		
60- 74 years	10	35		
≥ 75 years	0	5		

Gender			0,99	0,321
Male	6	28		
Female	7	59		
Education			0,162	0,104
No degree	13	72		
Bachelor	0	15		
Jobs			2,23	**0,02***
Not working	13	62		
Work	0	25		
Number of treatments			0,43	0,66
Single	5	39		
Combination	8	48		
Number of comorbidities			0,28	0,93
No comorbidities	5	38		
1 comorbidity	6	36		
More than one comorbidity	2	13		

Table 4 shows the results of statistical analysis using the Chi-Square test for characteristics of fasting blood glucose levels. The data showed that most individuals aged 45 - 59 years were in the category with uncontrolled fasting blood glucose levels, totaling 43 people, with an OR of 1.45 and a p-value of 0.64, which means ≥ 0.05 and not significant. For gender, most women had uncontrolled fasting blood glucose levels, totaling 59 people, with an OR of 0.99 and a p-value of 0.321, also not significant because ≥ 0.05. In terms of education level, the majority of individuals who did not have a university degree had uncontrolled fasting blood glucose levels, totaling 72 people, with an OR of 0.162 and a p-value of 0.104, showing no significance because ≥ 0.05. On employment status, most individuals who did not work were in the uncontrolled fasting blood glucose category, totaling 62 individuals, with an OR of 2.32 and a p-value of 0.02, showing significance as ≤ 0.05. Regarding medication use, most individuals who used combination medication had uncontrolled fasting blood glucose levels, totaling 48 individuals, with an OR of 0.43 and a p-value of 0.66, which was not significant as it was ≥ 0.05. Finally, for the number of comorbidities, most individuals without comorbidities were in the category with uncontrolled fasting blood glucose levels, totaling 38 individuals, with an OR of 0.28 and a p-value of 0.93, also not significant as it was ≥ 0.05.

DISCUSSION

Table 1 indicates that most of the patients with diabetes mellitus (DM) aged 45 - 59 years amounted to 45 (45%) and in the age range of 60 - 74 years amounted to 45 (45%), with a higher proportion of women with a total of 66 (66%). Most of the patients had an education level of non-graduate status (elementary, junior high, and high school) of 85 (85%), and the majority of them were not actively working, totaling 75 (75%). The decline in physiological function in humans begins to appear sharply after the age of 40 years, diabetes mellitus is often diagnosed after individuals reach the age of 45 years, which is a period of high risk for this disease (11). In gender results, diabetes mellitus cases in women are more common, with a prevalence 25 times higher than men, women are more at risk of developing diabetes because they tend to have a greater chance of increasing body mass index (12). Education has a major impact on the incidence and prevention of diabetes mellitus. Individuals with low education often do not pay attention to healthy lifestyles and diets and do not know how to prevent diabetes. In addition, jobs that require little physical movement can cause energy not to be burned, which can lead to weight gain and a high risk of developing diabetes mellitus (13).

Table 2 shows data on the clinical characteristics of patients with diabetes mellitus, most of whom have clinical manifestations, namely pain as many as 29 (29%), with the highest proportion in the history of antidiabetic drug use, namely metformin, namely 27 (27%), and has the highest comorbidity results, namely on average no comorbidities, namely 42 (42%). And in the number of treatments, most patients get combination therapy, namely 56 (56%), and do not have comorbidities, totaling 43 (43%). In patients with diabetes mellitus, pain often appears, which generally occurs in the feet caused by peripheral neuropathy, a condition that occurs due to high blood glucose levels that damage nerves in the feet and legs. Diabetic peripheral neuropathy is characterized by the presence of symptoms or signs of peripheral nerve dysfunction in diabetic patients (14). In the results of the number of treatments, most patients received combination therapy, namely as many as 56 (56%, when the target blood glucose level has not been achieved with the use of a single oral antidiabetic drug (OAD) or insulin, a combination therapy involving two, three, or even four types of OADs, or a combination of OADs with insulin, can be applied. This approach is also recommended if there is a failure to achieve the desired results using single or combined OADs or insulin (15). The comorbidity results stated that on average, there were no comorbidities,

which is not in line with Schmidt et al., (2021) estimating the prevalence of comorbidities in men and women both with and without diabetes. The results revealed that each comorbid condition had a higher prevalence in the group with diabetes compared to the group without diabetes (16).

Table 3 states the results of fasting blood glucose levels from a total of 100 samples in the achieved category 100 - 110 mg/dl amounted to 13 (13%) and the unachieved category ≥ 110 mg/dl amounted to 87 (87%), these results state that most patients are in the unachieved category, namely GDP levels ≥ 110 mg/dl. Unachieved blood glucose levels are influenced not only by adherence to diet, but also by various other factors, such as age, gender, medication adherence, level of physical activity, stress, knowledge, family support, obesity, hypertension, smoking habits, and duration of diabetes mellitus (17).

Table 4 states the results of Chi-Square statistical test data on characteristics with fasting blood glucose levels, namely most in the age range 45 - 59 years are in the category of fasting blood glucose is not achieved, totaling 43 with OR 1.45 and p-value is 0.64 means ≥ 0.05 is not significant, in gender, most women are in the category of fasting blood glucose is not achieved, totaling 59, with OR 0.99 and p value 0.321 means ≥ 0.05 is not significant. In educational status, the majority of non-graduate students are in the category of fasting blood glucose not reached, totaling 72, with an OR of 0.162 and a p-value of 0.104, which means ≥0.05 is not significant. In employment status, most of which are not working, are in the category of fasting blood glucose not reached, totaling 62, with an OR of 2.32 and a p-value of 0.02, meaning ≤ 0.05 is significant. In the number of treatments, most of which are the use of combination drugs in the category of fasting blood glucose is not achieved amounting to 48, with OR 0.43 and p value 0.66 means ≥ 0.05 is not significant. In the number of treatments, most of the use of combined drugs was in the category of fasting blood glucose not reached, totaling 48, with an OR of 0.43 and a p-value of 0.66, which means ≥0.05 is not significant. In the number of comorbidities, most did not have comorbidities in the category of fasting blood glucose not reached, totaling 38, with an OR of 0.28 and a p-value of 0.93, which means ≥ 0.05 is not significant.

Based on the results of the study, most of those in the age range of 45 - 59 years were in the category of fasting blood glucose not reached, totaling 43. The age range of 45 - 75 years has the highest prevalence, the risk of developing diabetes mellitus tends to increase after a person is 45 years old. This is due to decreased physical activity, increased body weight, decreased muscle mass, as well as the aging process that causes a progressive decline in β-cells. In addition, the incidence of diabetes also tends to increase with age, especially after reaching 40 years of age, as there is an increase in glucose intolerance at that age (18). The risk of glucose intolerance increases with age. People over 45 years old need to be screened for diabetes mellitus. In old age, increased glucose production by the liver (hepatic glucose production) is common, and insulin resistance and impaired insulin secretion become more common. This is partly due to the age factor and the process of pancreatic beta-cell damage (19).

Based on the results of the study on gender, most women were in the category of fasting blood glucose not reached, totaling 59. Gender shows that most suffer from diabetes mellitus are women (66%), women have a higher risk of developing diabetes mellitus. Physically, they are more likely to have an increased body mass index (BMI). In addition, monthly cycles such as premenstrual syndrome and conditions after menopause cause body fat to accumulate more easily, and hormone changes such as the decrease in estrogen and progesterone that occurs during menopause, can also affect blood glucose levels (20).

According to Pahlawati and Nugroho (2019), education and age are risk factors for diabetes mellitus that cannot be changed but have a close relationship with the emergence of this disease. There is a correlation between education level and the risk of developing diabetes mellitus; individuals with lower levels of education have a 1.27 times greater risk of developing diabetes than those with higher education (21). Several conditions and situations can increase a person's risk of developing diabetes mellitus. Lack of physical activity can also increase the risk up to 4.36 times (22).

Based on the results of the study on employment status, the majority, namely not working, are in the category of fasting blood glucose not reached, totaling 62, and p-value ≤ 0.05, which means significant. Work activity provides significant benefits because it can help control blood glucose levels through increased physical activity, and prevent complications. Work with low physical intensity can increase the risk of diabetes mellitus, as the body does not burn enough energy. As a result, excess energy is stored as fat, which can lead to obesity, one of the main risk factors for diabetes mellitus (23). In general, people with lower socioeconomic status often do not follow medical advice well. In contrast, those in the middle and upper socioeconomic levels tend to pay more attention to their health and are more likely to comply with doctors' advice (24).

Based on the results of the study on the number of comorbidities, most did not have comorbidities in the category of fasting blood glucose not reached, totaling 38 comorbidities, these results are not in line because patients who do not have comorbid conditions have a quality of life that is 4.7 times better than those who suffer from hypertension as a comorbidity. The number of comorbidities experienced by patients affects their quality of

life. Patients with only one comorbid condition showed a 3.8 times better quality of life compared to patients with more than one comorbidity (25).

Based on the results of the number of medications, most of the use of combination drugs is in the category of fasting blood glucose not reached, totaling 48, the use of inappropriate or irrational drugs can have a significant negative impact, so it is important to ensure that drugs are used rationally. Although rational drug use does not always guarantee an accurate diagnosis, it is important to administer the right medication. Given the high incidence, there is a need for appropriate and rational treatment for diabetes mellitus (DM) therapy. This involves evaluating the use of drugs that are safe, efficient, and appropriate to the patient's needs. The goal of appropriate drug use is to control blood glucose levels, to keep them at normal levels, thereby preventing hypoglycemia or low blood glucose levels from occurring (26).

Uncontrolled blood glucose levels or high blood glucose levels, not managed properly and sustained over a long period, can cause serious damage to various organs of the body. This condition can potentially lead to dangerous health complications, such as cardiovascular disease, neuropathy (nerve damage), nephropathy (kidney damage), as well as eye problems that can lead to retinopathy and blindness. However, with effective diabetes management, including strict blood glucose control and proper health care, the risk of these complications can be minimized or even prevented (27).

Diabetes is a chronic condition characterized by blood glucose levels that exceed normal. If not managed properly, diabetes can lead to various complications in organs such as the eyes, kidneys, heart, blood vessels, and nervous system, which can be life-threatening and affect the quality of life. Complications can be acute, such as sudden fluctuations in blood glucose levels, or chronic, which is the long-term impact of high blood glucose levels. (28). Apart from using medication, the management of diabetes mellitus can be done through diet, education, and exercise. Recommended physical activities for people with diabetes mellitus include walking, jogging, cycling, and gymnastics (29).

CONCLUSION

The results of the study were that most patients were in the category of unattainable fasting blood glucose levels, totaling 87 patients who were in the unattainable category (≥ 110 mg/dl) out of a total of 100 samples. As well as is also influenced by sociodemographic characteristic factors, namely in the employment status of most, namely not working, in the category of fasting blood glucose not reached, totaling 62, with an OR of 2.32 and a p-value of 0.02, meaning ≤0.05 significant, because low physical intensity can increase the risk of diabetes mellitus because the body does not burn enough energy. as a result, excess energy is stored as fat, which can lead to obesity, one of the main risk factors for diabetes mellitus and other clinical characteristics. So that the average patient is in the high category of high and uncontrolled fasting blood glucose levels which can cause various complications in acute and chronic organ systems. So the importance of monitoring fasting blood glucose levels and increasing pharmacological therapy, healthy lifestyles, and physical activity with routine so that blood glucose tolerance can be achieved.

SUGGESTION

The advice from researchers is that this research still has limitations so further research needs to be done, namely the correlation of patient compliance and quality of life with fasting blood glucose levels.

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