



## The Relationship Between HbA1C Levels and Diabetic Complications in Patients with Type II Diabetes Mellitus at RSU Royal Prima Medan

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### Abstract

North Sumatra is home to a considerable population of Diabetes Mellitus (DM) patients, specifically individuals aged 15 years and above, totaling 49,572. Among the cities in the province, Medan stands out with the highest prevalence of Type II DM patients. The data indicates that in 2018 alone, the number of DM patients in Medan reached 7,826, solidifying its status as the primary contributor to the overall prevalence of DM in North Sumatra. The focal point of this research is to assess the understanding of the connection between HbA1c levels and complications in Type II Diabetes Mellitus patients, particularly those receiving care at Royal Prima Hospital in Medan. Employing a cross-sectional research design, the study involved 85 participants selected through purposive sampling, and data analysis was conducted using SPSS software. The study's outcomes highlight a significant relationship between HbA1c levels and complications in Type II Diabetes Mellitus patients at Royal Prima Hospital in Medan. This association is substantiated by the chi-square test results, yielding a p-value of 0.000, which is less than the significance threshold of 0.05. This statistical significance implies a robust and noteworthy correlation between HbA1c levels and the occurrence of complications in patients with Type II Diabetes Mellitus at the mentioned hospital.

## Introduction

Diabetes mellitus (DM) is a group of metabolic diseases with hyperglycemia characteristics that occur due to abnormalities in insulin secretion, insulin action or both (PERKENI, 2019). The prevalence of this disease is estimated to reach 9.1 million, which occupies a percentage of 5.7% for Indonesians in the age range above 15 years, the data was obtained from the 2018 Riskesdas. The prevalence of DM sufferers in Indonesia in 2021 is 19.47 million people. In Medan City itself, it is known that the prevalence of DM tends to be high and increases every year. This is shown through data from Riskesdas 2018 that in North Sumatra patients with DM who have age characteristics above 15 years touch a number of 49,572 where the top position is Medan City with the most Type II DM patients. The data also shows that DM patients in Medan have reached a prevalence of 7,826 in 2018, thus proving that Medan city is the highest contributor to the prevalence of DM disease in the North Sumatra region (Rahmania, 2023).

This diabetes disease can cause chronic complications which are distinguished according to the size of the complications, namely macro and microvascular. Macrovascular complications are the highest cause of mortality. Based on the data obtained, macrovascular complications can cause death with a high percentage of 59% for Type II DM patients in the UK (Ratnasari et al, 2019). While in Indonesia, microvascular complications are the highest cause of mortality

(Corina, 2018). When a disease such as stroke, cardiovascular disease, or peripheral artery disease occurs, it is referred to as macrovascular complications of diabetes. However, if the disease is retinopathy, nephropathy, and neuropathy, it is a microvascular complication of diabetes (PERKENI, 2019). DM patients are most commonly affected by diabetic neuropathy, which usually affects the nerves in the extremities. Impaired sensory function usually results in abnormal sensation and progressive numbness in patients with DM, which, if treated poorly, can lead to diabetic ulcers caused by trauma or externally due to abnormal pressure distribution. These complications can develop on the inner bone (Boulton, 2019).

One in six people with diabetes worldwide develop diabetic foot ulcers (Zheng, 2018). In Indonesia alone, data shows that 1 in 4 people with diabetic foot ulcers can experience amputation, where the percentage of foot amputations for these patients is 25%. This disease has a high mortality rate of 17 to 23%. The mortality rate is still 14.3% one year after amputation and 37% three years after amputation even after amputation (Setiyorini et al., 2018). Based on the research findings, it was found that the most chronic complications were Type II DM patients where microvascular complications were 57% with the most diabetic neuropathic complications at 45.6% followed by diabetic nephropathy at 33.7%. While for macrovascular complications, as many as 43% with the most complications being diabetic foot ulcers at 22.9% (Corina, 2018).

Early diagnosis carried out in DM sufferers can provide assistance for DM sufferers to find out early about what are the worst phenomena that can be experienced when suffering from DM. The criteria for the diagnosis of DM are established through the examination of blood sugar levels both plasma glucose criteria such as fasting blood glucose, then HbA1C examination and random blood glucose examination. One diagnosis that can be used from several methods above is glycated hemoglobin where this examination can reduce complications that occur. In this examination, HbA1C can measure the amount of hemoglobin that binds glucose in the last 3 months (Hardianto, 2020).

From the findings of the exposure, Type II DM is a problem in the health sector which needs serious attention because of the high disease and mortality rates in Indonesia. According to several studies, the likelihood of various diabetic complications will depend on the level of glycemic control as measured by HbA1c. However, there has never been a study that examines this problem at RSU Royal Prima Medan so the researcher is interested in conducting research with the title "The Relationship between HbA1C Levels and Diabetes Complications in Type II Diabetes Mellitus Patients at RSU Royal Prima Medan".

## Methods

This type of research is the Cross-sectional method. Efforts to collect data on independent and dependent variables can be carried out only once at the same time. This research was conducted at a health care facility, namely RSU Royal Prima Medan. Furthermore, this study was conducted from August to October 2023. The population in this study were patients suffering from type II DM at RSU Royal Prima Medan. The research sample referred to the entire population of patients suffering from Type II DM, which was selected based on information contained in medical records and met the predetermined criteria. The method of selecting samples in this study was carried out by purposive sampling, namely sampling techniques by selecting subjects against certain criteria. This study was taken based on the medical records of Type II DM patients at RSU Royal Prima Medan based on the inclusion and exclusion criteria. If all data has been collected and extracted from medical records, then the data will be processed by utilizing SPSS software where the results of the data processing will be presented in the form of frequency tables. Data loading samples that have been collected are then analyzed through SPSS software. The hypothesis test used is Chi square.

## Results and Discussion

Demographic characteristics regarding the age and gender of respondents in Type II Diabetes Mellitus patients were revealed through the results of the study. The following are the findings of the demographic analysis:

Table 1. Demographic Characteristics of Respondents

		Usia			Cumulative Percent
		Frequency	Percent	Valid Percent	
Valid	40 - 50 Tahun	35	41.2	41.2	41.2
	51 - 60 Tahun	50	58.8	58.8	100.0
Total		85	100.0	100.0	

		Jenis Kelamin			Cumulative Percent
		Frequency	Percent	Valid Percent	
Valid	Laki-laki	34	40.0	40.0	40.0
	Perempuan	51	60.0	60.0	100.0
Total		85	100.0	100.0	

From the analysis of the table listed above, it can be concluded that the age group of 56-65 years dominates, covering as many as 50 people (58.82%), while the age group of 40-55 years has a total of 35 patients (41.18%). Furthermore, the research findings also illustrate the greater prevalence of female patients, 51 people (60%), compared to male patients with Type II DM who reached 34 people (40%).

Table 2. Characteristics of Type II DM Patients with HbA1c Levels

		Kadar HbA1c		
		Kadar >7	Kadar <7	Total
Usia	40-55 Tahun	Count 16	Count 19	Count 35
		% of Total 18.8%	% of Total 22.4%	% of Total 41.2%
Usia	56-65 Tahun	Count 35	Count 15	Count 50
		% of Total 41.2%	% of Total 17.6%	% of Total 58.8%
Total		Count 51	Count 34	Count 85
		% of Total 60.0%	% of Total 40%	% of Total 100%
JK	Laki-laki	Count 20	Count 14	Count 34
		% of Total 23.5%	% of Total 16.5%	% of Total 40.0%
JK	Perempuan	Count 31	Count 20	Count 51
		% of Total 36.5%	% of Total 23.5%	% of Total 60.0%
Total		Count 51	Count 34	Count 85
		% of Total 60.0%	% of Total 40.0%	% of Total 100%
Komplikasi	Komplikasi	Count 51	Count 34	Count 85
		% of Total 60.0%	% of Total 40%	% of Total 100%
Komplikasi	Tidak Komplikasi	Count 0	Count 34	Count 34
		% of Total 0.0%	% of Total 40.0%	% of Total 40%
Total		Count 51	Count 34	Count 85
		% of Total 60.0%	% of Total 40.0%	% of Total 100.0%
Diagnosa Komplikasi	Tidak Komplikasi	Count 34	Count 0	Count 34
		% of Total 40.0%	% of Total 0.0%	% of Total 40.0%
	Hiperglikemia	Count 0	Count 9	Count 9
		% of Total 0.0%	% of Total 10.59%	% of Total 10.59%
	Hipoglikemia	Count 0	Count 3	Count 3
		% of Total 0.0%	% of Total 3.53%	% of Total 3.53%
	CKD	Count 0	Count 12	Count 12
	% of Total 0.0%	% of Total 14.12%	% of Total 14.12%	
CHF	Count 0	Count 16	Count 16	
	% of Total 0.0%	% of Total 18.82%	% of Total 18.82%	
Ulkus Diabetikum	Count 0	Count 11	Count 11	
	% of Total 0.0%	% of Total 12.94%	% of Total 12.94%	
Total		Count 34	Count 51	Count 85
		% of Total 40%	% of Total 60.0%	% of Total 100.0%

Based on the cross tabulation analysis conducted, it can be concluded that the research findings show that respondents who have HbA1c levels  $> 7$ , as many as 51 people (60%). In this group, female patients dominated with a total of 31 people (36.5%), while the age group of 56-65 years became the majority group, covering 35 people (41.2%) of the total 51 patients with HbA1c levels  $> 7$ .

In the context of this study, all patients who had HbA1c levels >7 were categorized as diabetic patients with complications, including 51 patients (100%). Further analysis showed that 9 patients (10.59%) had Hyperglycemia, 3 people (3.53%) had Hypoglycemia, 12 patients (14.12%) had CKD, 16 people (18.82%) had CHF, and 11 people (12.94%) had Diabetic Ulcers. Thus, it can be concluded that all those who suffer from Type II DM and experience complications have HbA1c levels that exceed 7%.

Table 3. Relationship between HbA1c Level and Age of Respondents

	Value	df	p-value
Pearson Chi-Square	5.060 <sup>a</sup>	1	.024
Continuity Correction <sup>b</sup>	4.098	1	.043
Likelihood Ratio	5.063	1	.024
N of Valid Cases	85		

The data analysis above shows that the statistical significance in the relationship between HbA1c levels and age in patients with Type II Diabetes Mellitus at RSU Royal Prima Medan is 0.024, which is lower than the significance level of 0.05. This indicates that there is a significant relationship between HbA1c levels and age in patients with Type II diabetes mellitus.

Table 4. Relationship between HbA1c Levels and Gender of Respondents

	Value	df	P-value
Pearson Chi-Square	.033 <sup>a</sup>	1	.857
Continuity Correction <sup>b</sup>	.000	1	1.000
Likelihood Ratio	.033	1	.857
N of Valid Cases	85		

The data analysis above shows that the statistical significance in the relationship between HbA1c levels and gender in patients with Type II Diabetes Mellitus at RSU Royal Prima Medan is 0.857, which is higher than the 0.05 significance level. This indicates that there is no relationship between HbA1c levels and gender in patients with Type II diabetes mellitus.

Table 5. Relationship between HbA1c Level and Diabetes Complications

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	80.000 <sup>a</sup>	1	.000
Continuity Correction <sup>b</sup>	80.884	1	.000
Likelihood Ratio	114.412	1	.000
N of Valid Cases	85		

The data analysis above shows that the statistical significance in the relationship between HbA1c levels and complications in patients with Type II Diabetes Mellitus at RSU Royal Prima Medan is 0.000, which is lower than the 0.05 significance level. This indicates that there is a significant relationship between HbA1c levels and the incidence of complications in patients with Type II diabetes mellitus.

### General Characteristics of Respondents

The results indicated that the majority of respondents in the study were female. This fact illustrates that the patient's gender can play an important role in encouraging the onset of diabetes. In line with Oktavia et al. (2022) which states that the female population is higher than the male population in patients with Type II DM. According to Irawan in Rita (2018), the risk of diabetes is higher in women, which is because women tend to have fatter bodies. This research is also reinforced by Allorerung et al. (2016), which explains that women's association

with pregnancy can increase the risk of DM. Other factors such as pre-menstrual and post-menopausal syndrome also contribute to the accumulation of fat in the female body, which can increase the risk of diabetes.

The age group of respondents in the study results showed a dominance in patients with an age range of 56 - 65 years. The results of this study are supported by Prasetyani & Sodikin (2017) who noted that all Type II DM patients had an age of >50 years. This explanation is in line with Smeltzer, as stated by Aisyah & Wahyono (2021), that age has a correlation with an increase in blood sugar levels, where the older the patient's age, the higher the risk of developing Type II DM. Aging results in changes to the structure, function, and chemical composition of the body, including increased resistance to insulin.

### **Incidence of Type II DM Based on HbA1c Levels**

In this study, it was found that HbA1c levels in Type II DM patients at RSU Royal Prima Medan were dominated by patients with HbA1c values >7. This finding is in line with the research of Haryati & Tyas (2022) which showed a high prevalence of Type II DM patients with HbA1c values exceeding 7, covering around 117 patients or around 94.4%. Furthermore, the achievement of HbA1c level control is considered successful if the HbA1c value is below 7%, while HbA1c values exceeding 7% are considered unsuccessful control.

From a gender perspective, Type II DM patients tended to have HbA1c levels >7 in a significant proportion. There were 20 individuals (23.5%) from the male group and 31 individuals (36.5%) from the female group with a total of 51 individuals (60%) falling into the category of HbA1c levels >7. This finding is in line with the results of research by Wulandari et al. (2020) at Sanglah General Hospital, Denpasar, which showed the dominance of uncontrolled HbA1c levels (levels >7) in both sex groups, greater in women.

From an age perspective, patients suffering from Type II DM in this study were dominated by the age group 56 - 65 years, which included 35 people (41.2%) of a total of 51 patients (60%) with HbA1c levels > 7. This finding is in line with the results of research by Utomo et al. (2015) in Malalayang District, Manado which showed that the age group of patients 50 - 60 years had the highest prevalence of HbA1c levels > 7. Additional information from the study of Gopinath et al. (2013) in India also supports these findings, with results showing the dominance of Type II DM patients with HbA1c levels > 7 in the age group > 60 years, reaching 75.5% of the total respondents. The findings of this study indicate the dominance of elderly patients with uncontrolled HbA1c levels (levels >7), further analysis states that there is a significant relationship between glycemic control and the age of the respondent.

### **Complications in Type II DM Patients Based on HbA1c Levels**

In this study, it was found that all Type II DM patients at RSU Royal Prima Medan who had HbA1c levels > 7 experienced complications. This finding is in line with the research of Putra et al. (2023), where Type II DM patients who have HbA1c levels >7 have an incidence rate of macrovascular complications of 75%. Another study by Samanta (2021) also confirms that HbA1c levels have a relationship with the appearance of complications, both microvascular and macrovascular in nature, and can cause damage to tissues and organs in about one third to half of individuals suffering from Diabetes Mellitus.

Patients suffering from Type II Diabetes Mellitus at RSU Royal Prima Medan showed variations in the diagnosis of different complications. The results noted that there were 9 patients with diagnoses of Hyperglycemia, 3 patients with Hypoglycemia, 12 patients with complications of Chronic Kidney Disease (CKD), 16 patients with complications of Congestive Heart Failure (CHF), and 11 patients with complications of Diabetic Ulcers. The presence of these complications is related to high levels of HbA1c, which can accelerate organ

damage and result in some Type II DM patients experiencing more than one type of complication (Nicholas et al., 2013).

### **Relationship between HbA1c Levels and Complications in Type II DM Patients**

The results showed that patients with Type II DM at RSU Royal Prima Medan significantly showed a relationship between HbA1c levels and diabetes complications. This can be seen through the chi-square test with a p-value of  $0.000 < 0.05$ , confirming that there is a relationship between HbA1c levels and the presence of complications. These results are in line with the research of Hanniya et al. (2017) which showed a correlation between HbA1c levels and macrovascular complications in Type II DM patients at Annisa Medical Center Hospital, Bandung. Furthermore, this finding is also supported by Sugandha & Lestari (2015) who reported that as many as 52% of patients showed HbA1c levels  $>7$  accelerating the onset of complications. Type II DM with HbA1c levels  $>7$  can lead to the consequences of complications that are both acute and chronic in nature.

### **Conclusion**

This study provides results showing that patients with Type II DM are dominated by women and the age of patients is 51-60 years. Meanwhile, patients with HbA1c levels showed that most had uncontrolled levels and experienced complications. In addition, there is a relationship between HbA1c levels and complications in Type II DM patients at Royal Prima Medan General Hospital.

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