

Analysis of complications in type 2 diabetes mellitus patients at Ibnu Sina Hospital in 2023

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) is a metabolic disorder characterized by hyperglycemia due to decreased insulin secretion or insulin resistance. T2DM can lead to microvascular complications, such as neuropathy, nephropathy, and retinopathy, as well as macrovascular complications, including heart disease, stroke, and peripheral vascular disease. **Objective:** This study aimed to determine the relationship between age, gender, HbA1c levels, and the duration of T2DM with the complications experienced by T2DM patients at Ibnu Sina Hospital Makassar. **Method:** This was a descriptive observational study with a cross-sectional design involving 40 T2DM patients. Data were collected using secondary patient records. **Results:** The most common complication found was diabetic neuropathy, affecting 19 patients (47.5%). Statistical analysis using the chi-square test showed a significant relationship between age and complications ($p = 0.002$) and between HbA1c levels and complications ($p = 0.004$). Gender showed no significant relationship with complications. The duration of T2DM could not be analyzed due to incomplete data. **Conclusion:** Age and HbA1c levels are significantly associated with the occurrence of complications in T2DM patients at Ibnu Sina Hospital in 2023. Regular monitoring and strict glycemic control are essential to minimize the risk of complications.

Introduction

Diabetes Mellitus is a metabolic disease caused by the pancreas not producing insulin or the body not properly using the insulin produced by the pancreas¹. Diabetes Mellitus is classified into four types: Type 1 Diabetes Mellitus, Type 2 Diabetes Mellitus, gestational diabetes, and other specific types of diabetes². Type 2 Diabetes Mellitus is a metabolic disease characterized by hyperglycemia resulting from reduced insulin secretion by pancreatic beta cells or impaired insulin

function (insulin resistance). This disease is marked by either impaired insulin secretion or insulin resistance³.

Type 2 Diabetes Mellitus can lead to complications caused by hyperglycemia, which may increase the polyol pathway and lead to the formation of non-enzymatic glycosylated proteins, triggering oxidative stress. This can result in increased blood viscosity, causing hypertension and affecting other body systems such as the heart, brain, peripheral blood vessels, kidneys, eyes, and nerves⁴.

There are two types of complications that can occur in patients with Type 2 Diabetes Mellitus: microvascular and macrovascular complications. Microvascular complications include nerve system disorders (neuropathy), kidney system disorders (nephropathy), and eye disorders (retinopathy), while macrovascular complications include heart disease, stroke, and peripheral vascular disease⁵.

According to data from the IDF Diabetes Atlas, the global prevalence of Diabetes Mellitus among individuals aged 20–79 years is estimated to increase from 10.5% in 2021 to 12.2% in 2045⁶. Data from the Global Burden of Disease indicates that the global prevalence of Type 2 Diabetes Mellitus is projected to rise to 7,079 per 100,000 individuals by 2030⁷. The World Health Organization (WHO) also states that the number of Diabetes Mellitus cases in Indonesia is expected to increase to 21.3 million by 2030⁸. Indonesia ranks seventh in the world for the highest number of Diabetes Mellitus cases, with 10.3 million people affected⁹. Based on data from the Basic Health Research (RISKESDAS) in 2018, the prevalence of Diabetes Mellitus in South Sulawesi Province was reported at 1.8%¹⁰. Additionally, according to the 2020 Health Profile from the South Sulawesi Provincial Health Office, the prevalence of Diabetes Mellitus in Makassar City reached 22.99%¹¹.

According to research conducted by Afsana et al. in 2019, the most common microvascular complication was nephropathy, while the most common macrovascular complication was coronary artery disease¹². Meanwhile, research by Ririn in 2020 found that the most frequent microvascular complication was nephropathy in women, and the most common macrovascular complication was foot ulcers in women¹³.

The novelty of this study lies in the sampling location, which was conducted at Ibnu Sina Hospital in 2023, with a total sample

of 40 participants who met the inclusion and exclusion criteria. The inclusion criteria for this study were Type 2 Diabetes Mellitus patients over the age of 45, with a disease duration of more than one year and who experienced both macrovascular and microvascular complications. Patient data meeting these inclusion criteria were obtained from medical records.

The objective of this study is to determine the relationship between age, gender, HbA1c levels, and the duration of Type 2 Diabetes Mellitus with the complications of Type 2 Diabetes Mellitus at Ibnu Sina Hospital in 2023 by observing the types of complications experienced by Type 2 Diabetes Mellitus patients.

Materials and Methods

Research Design

This study employed an analytical observational design with a cross-sectional approach. This design aimed to evaluate the relationship between independent and dependent variables measured at the same point in time.

Sample

The research sample consisted of Type 2 Diabetes Mellitus patients who received treatment at Ibnu Sina Hospital during 2023. The inclusion criteria covered patients with complete medical records in accordance with the study's requirements. The exclusion criteria included patients with incomplete medical records or those who did not meet other predetermined eligibility criteria.

Data Collection Technique

Samples were collected using consecutive sampling, where patients who met the inclusion and exclusion criteria were selected sequentially based on medical record data. The data obtained included clinical information,

demographic profiles, and relevant risk factors aligned with the study objectives.

Data Analysis Technique

Data were analyzed using SPSS (Statistical Product and Service Solutions) software. Univariate analysis was conducted using descriptive statistics to illustrate the frequency distribution of variables. Bivariate analysis was performed using the chi-square test to assess the relationship between independent and dependent variables.

Ethical Clearance

This study was approved by the Health Research Ethics Committee of Ibnu Sina Hospital. All patient data were kept confidential and used solely for research purposes. Patient information was anonymized to protect privacy, and the study was conducted in accordance with ethical research principles.

Results

Type 2 Diabetes Mellitus is a chronic metabolic disease that can lead to various complications, both microvascular and macrovascular, especially in patients with uncontrolled HbA1c levels. These complications are influenced by several factors, including age, gender, and glycemic control, all of which can have a significant impact on the patient's quality of life. This study aims to evaluate the characteristics of complications experienced by Type 2 Diabetes Mellitus patients at Ibnu Sina Hospital in 2023 and to analyze the relationship between age, gender, and HbA1c levels with the types of complications that occur. The data analysis in this study is expected to provide a deeper understanding of the contributing factors to complication risks in Type 2 Diabetes Mellitus patients.

Based on Table 1, the most common complication found was diabetic neuropathy, experienced by 19 samples (47.5%). The most frequent age group was the elderly (>65 years), with 21 samples (52.5%). The majority of the

samples were female, accounting for 27 participants (67.5%). Most of the samples had uncontrolled HbA1c levels (>7%), found in 22 samples (55.0%).

Table 1. Characteristics of Complications, Age, Gender, and HbA1c Levels

Sample Characteristics	N	%
Complications		
<i>Microvascular</i>		
1. Diabetic Neuropathy	19	47.5%
2. Diabetic Nephropathy	7	17.5%
3. Diabetic Retinopathy	0	0%
<i>Macrovascular</i>		
1. Heart Disease	4	10%
2. Non-Hemorrhagic Stroke	5	12.5%
3. Peripheral Artery Disease	5	12.5%
Age		
Elderly (45–65 years)	19	47.5%
Older Adults (>65 years)	21	52.5%
Gender		
Male	13	32.5%
Female	27	67.5%
HbA1c Levels		
Controlled (<7%)	18	45.0%
Uncontrolled (>7%)	22	55.0%
Total	40	100%

Source: Ibnu Sina Hospital (2023)

Based on Table 2, it was found that among the elderly age group (46–65 years), 17 samples (89.5%) experienced microvascular complications, while 2 samples (10.5%) experienced macrovascular complications. In the advanced age group (>65 years), 9 samples (42.9%) experienced microvascular complications and 12 samples (57.1%) experienced macrovascular complications. Bivariate analysis using the chi-square test showed a significant relationship between age and the type of complications in Type 2 Diabetes Mellitus, with a p-value of 0.002.

Among male samples, 8 samples (61.5%) experienced microvascular complications and 5 samples (38.5%) experienced macrovascular complications. Meanwhile, among female samples, 18 samples (66.7%) experienced microvascular complications and 9 samples (33.3%) experienced macrovascular complications. Bivariate analysis using the chi-

square test showed no significant relationship between gender and the type of complications

in Type 2 Diabetes Mellitus, with a p-value of 0.750.

Table 2. The Relationship Between Age, Gender, and HbA1c Levels with Type 2 Diabetes Mellitus Complications

Sample Characteristics	Complications						p-value
	Microvascular		Macrovascular		Total		
Age							0.002
Elderly (46–65 years)	17	89.5%	2	10.5%	19	100%	
Older adults (>65 years)	9	42.9%	12	57.1%	21	100%	
Gender							0.750
Male	8	61.5%	5	38.5%	13	100%	
Female	18	66.7%	9	33.3%	27	100%	
HbA1c Levels							0.004
Controlled (<7%)	16	88.9%	2	11.1%	18	100%	
Uncontrolled (>7%)	10	45.5%	12	54.5%	22	100%	

Source: Primary Data

In the samples with controlled HbA1c levels (<7%), 16 samples (88.9%) experienced microvascular complications, while 2 samples (11.1%) experienced macrovascular complications. In contrast, in the samples with uncontrolled HbA1c levels (>7%), 10 samples (45.5%) experienced microvascular complications, while 12 samples (54.5%) experienced macrovascular complications. Bivariate analysis using the chi-square test showed a significant relationship between HbA1c levels and the type of complications in Type 2 Diabetes Mellitus, with a p-value of 0.004.

Discussion

Sample characteristics based on complications of type 2 Diabetes Mellitus

Hyperglycemia can lead to increased levels of angiotensin II, which in turn causes hypertension. Hypertension results in the thickening and narrowing of arterial blood vessels. This narrowing affects the transportation of metabolic substances in the

blood, thereby disrupting blood glucose levels, and the thickening of blood vessels also

impacts blood supply to the peripheral nerves. Hypertension is considered a risk factor for diabetic neuropathy through microvascular mechanisms that involve hyalinization of the basal lamina of blood vessels and trigger thrombosis in the intraneural arterioles, which then leads to hypoxia, ischemia of nerve tissues, and hypersensitization of peripheral nerves due to reduced blood flow to the nerves, ultimately causing diabetic neuropathy¹⁴.

This mechanism explains why, in the present study, the majority of the samples experienced diabetic neuropathy complications, with 19 samples (47.5%). These findings are consistent with a study conducted by Dwi Amelisa et al. in 2015, which reported that out of 197 samples of patients with Type 2 Diabetes Mellitus who experienced microvascular complications, 161 (81%) had diabetic neuropathy¹⁵. Similarly, a study by Putri Aulia Cahyani et al. in 2024 reported that the most common microvascular complication was diabetic neuropathy, occurring in 18 patients (78.3%)¹⁶.

Relationship between age and complications of type 2 diabetes mellitus

The imbalance between the body's repair mechanisms and the production of free radicals

tends to increase with age. Hyperglycemia and aging both contribute to elevated production of reactive oxygen species (ROS), which impacts the progression of Type 2 Diabetes Mellitus. Additionally, as individuals age, the capacity for cellular repair declines, and mitochondrial dysfunction further reduces insulin sensitivity and promotes the death of pancreatic beta cells¹⁴. This explains the findings of this study, where the majority of elderly participants experienced Type 2 Diabetes Mellitus complications, with 21 samples (52.5%).

Based on the bivariate analysis using the chi-square test, there was a significant relationship between age and Type 2 Diabetes Mellitus complications, with a p-value of 0.002. These results are consistent with the study conducted by Antania Sasombo et al. in 2021, which reported that out of 72 Type 2 Diabetes Mellitus patients, 39 (54.2%) were elderly (>65 years old)¹⁷. This study also supports previous research conducted by Agus Winangun in 2021 at Bhayangkara Pusdik Brimob Watukosek Hospital, which found a significant relationship between age and Type 2 Diabetes Mellitus complications¹⁸.

The relationship between gender and complications of type 2 diabetes mellitus

Both males and females can develop Type 2 Diabetes Mellitus, which is often caused by unhealthy eating habits and low levels of physical activity, leading to potential complications. Estrogen, which circulates in females, plays a protective role in the development of diabetes. However, women also tend to be at higher risk of developing Type 2 Diabetes Mellitus due to higher body mass index, menstrual cycles, and menopause, which can lead to fat accumulation. This fat accumulation may impede glucose transport into cells, resulting in hyperglycemia. High testosterone levels in males are associated with a lower risk of developing Type 2 Diabetes Mellitus due to the protective role of

testosterone on the pancreas. In conditions of glucotoxicity, elevated testosterone levels can reduce pancreatic cell apoptosis¹⁴. These mechanisms explain the findings of the present study, where the majority of the samples experiencing Type 2 Diabetes Mellitus complications were female.

Based on bivariate analysis, no significant relationship was found between gender and Type 2 Diabetes Mellitus complications, with a p-value of 0.750. This finding is consistent with research conducted by Ivan Dzaki et al. in 2023, which reported that the majority of Type 2 Diabetes Mellitus patients were female, totaling 109 patients (76.2%)⁵. The results of this study also support previous research conducted by Vanda Rizky et al. in 2023 at RSUD Karsa Husada Kota Batu, which found no significant relationship between gender and Type 2 Diabetes Mellitus¹⁹. Additionally, research by Heru Laksono et al. in 2022 reported that more female patients experienced Type 2 Diabetes Mellitus complications (36 patients, 48.6%), and no significant association was found between gender and the occurrence of Type 2 Diabetes Mellitus complications²⁰.

The relationship between HbA1c levels and complications of type 2 diabetes mellitus

HbA1c levels are closely related to blood glucose levels, as an HbA1c concentration is equivalent to an average blood glucose level of 126 mg/dL. An increase of 1% in HbA1c correlates with an approximate rise in blood glucose levels of 30 mg/dL, and a 2% increase in HbA1c correlates with a 50-70% higher likelihood of developing complications²¹. HbA1c (Glycated Hemoglobin) is a test used to measure glucose levels bound to hemoglobin A; the higher the HbA1c level in Type 2 Diabetes Mellitus patients, the greater the risk of developing complications. A normal HbA1c level indicates that the patient has been compliant with dietary management, exercise,

and medication, reflecting good blood glucose control over the past three months²².

This finding explains why, in the present study, most samples had uncontrolled HbA1c levels (>7%), with 22 samples (55.0%). Based on bivariate analysis using the chi-square test, a significant relationship was found between HbA1c levels and Type 2 Diabetes Mellitus complications, with a p-value of 0.004. These results are consistent with the study by Suharni et al. in 2021, which reported that the majority of Type 2 Diabetes Mellitus patients had uncontrolled HbA1c levels (>7%), totaling 22 individuals (73.3%)²². Additionally, the study by Komang Tiara Novi et al. in 2024 also reported a significant relationship between HbA1c levels and Type 2 Diabetes Mellitus complications²¹.

Conclusion

Based on the results of this study, it can be concluded that the most common complication was diabetic neuropathy. There was a significant relationship between age and HbA1c levels with Type 2 Diabetes Mellitus complications at Ibnu Sina Hospital in 2023, whereas no significant relationship was found between gender and Type 2 Diabetes Mellitus complications at the same hospital.

This study has limitations, particularly the absence of secondary data regarding the duration of Type 2 Diabetes Mellitus, which prevented the analysis of this variable. It is recommended that future researchers conduct studies with larger sample sizes and utilize both bivariate and multivariate analyses to allow for more comprehensive evaluation.

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researchers who wish to explore the same variables.

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