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#26464 REVIEW

SUMMARY REVIEW EDITING

SUBMISSION

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Title Relationship between Characteristics of Type II Diabetes Mellitus Patients and HbA1c Levels
Section Articles
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SUPPORT AND TOOLS



Relationship between Characteristics of Type II Diabetes Mellitus Patients and HbA1c Levels

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<p>Track Record Article</p> <p>Accepted:</p> <p>Published:</p>	<p>Abstract</p> <p>Background: Diabetes mellitus (DM) is a global health problem with increasing prevalence in Indonesia. According to the 2007 Basic Health Research (Riskesdas), the prevalence of DM reached 5.7%, and most cases remain undiagnosed, resulting in suboptimal disease control. A critical parameter for monitoring long-term glycemic control is Hemoglobin A1c (HbA1c), which reflects the average blood glucose level over the past 2–3 months. HbA1c monitoring helps healthcare providers assess the effectiveness of therapy and patient adherence to Type 2 DM management. Objective: This study aims to analyze the relationship between the demographic characteristics of Type II DM patients —age, gender, and occupation —and HbA1c levels at Port Medical Center (PMC) Hospital during the period 2021–2023. Methods: This study used a cross-sectional analytical design. Secondary data were collected from the medical records of 75 patients who met the inclusion and exclusion criteria. Independent variables included age, gender, and occupation, while the dependent variable was HbA1c levels. Statistical analysis was performed using the Chi-Square test and Fisher's Exact Test if the expected cell frequency was less than 5, with a significance level of $p < 0.05$. Results and Discussion: The analysis showed no significant association between gender and HbA1c levels ($p = 0.851$). However, there was a significant association between age ($p = 0.010$) and type of employment ($p = 0.024$) and HbA1c levels. These findings indicate that age influences glucose control, consistent with previous research that suggests insulin resistance increases with age due to physiological metabolic changes. Furthermore, sedentary work and high stress levels can affect blood glucose levels by increasing cortisol levels and promoting unhealthy lifestyles. These results emphasize the importance of a diabetes management approach that considers demographic and lifestyle factors in planning clinical interventions and patient education. Conclusion: Age and occupation were significantly associated with HbA1c levels in patients with type II diabetes at Port Medical Center Hospital, while gender showed no significant association. Efforts to improve glycemic control should be focused on the elderly and those with low physical activity through educational programs, lifestyle modifications, and routine HbA1c monitoring.</p> <p>Keyword: Diabetes Mellitus Type II, HbA1c, Age, Occupation</p>
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Commented [rs2]: 1. Avoid excessive detail in the Background section (Riskesdas figures can be shortened or updated to the latest version, for example, 2018/2019). The Results and Discussion sections can be condensed to focus on the main findings and their implications. Use consistent tense — research abstracts generally use the past tense for methods and results, and the present tense for background and conclusion.

2. Use "Type II Diabetes Mellitus (T2DM)" or "Type 2 DM" consistently, don't switch between them. It's best to use "HbA1c levels" consistently, not just "HbA1c" sometimes.

3. The term "Port Medical Center (PMC) Hospital" — if "Center" and "Hospital" are different, clarification is needed; if they are the same, one is sufficient.

4. The p-value can be written uniformly in international journal format, for example, " $p < 0.05$ " or " $p = 0.010$."

INTRODUCTION

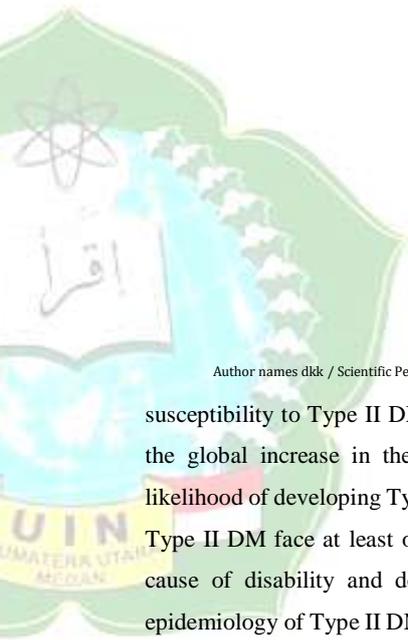
Diabetes mellitus (DM) has become a global epidemic and poses a serious threat to public health worldwide, including in Indonesia. The prevalence of DM continues to increase, primarily due to unhealthy modern lifestyles, such as poor diet and limited physical activity. As a chronic condition, DM management requires a holistic, targeted approach with a primary focus on blood sugar control. In this regard, measuring Hemoglobin A1c (HbA1c) is a crucial tool in evaluating and monitoring blood sugar control in patients with DM (Anon 2025). According to a 2017 study by Zhen Yang, the number of people with diabetes mellitus globally has quadrupled over the past three decades, making it the ninth leading cause of death. Approximately one in eleven adults worldwide now has diabetes mellitus, with 90% of those having Type II DM. Asia is the focal point of the rapidly growing global Type II DM epidemic, with China and India being the main centers. While genetic factors contribute to a person's

Commented [rs3]: The paragraph is too long and repetitive (especially the explanation of global epidemiology and the function of HbA1c).

Some descriptive sections are too detailed for an introduction (for example, the breakdown of provincial percentages from Riskesdas and the local story of Ternate could be summarized).

The final paragraph doesn't explicitly mention the research gap or rationale—it simply states the researchers' interest ("researchers are interested in knowing...").

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susceptibility to Type II DM, poor diet and a sedentary lifestyle are the main factors driving the global increase in the disease. Furthermore, exposure early in life can increase the likelihood of developing Type II DM later in life (Zheng, Ley, and Hu 2018). Most people with Type II DM face at least one complication, with cardiovascular problems being the leading cause of disability and death. This review offers an up-to-date overview of the global epidemiology of Type II DM, highlighting risk factors such as diet and lifestyle that contribute to the development of Type II DM and its complications (Rahayu, Saraswati, and Setyawan 2018).

According to the International Diabetes Federation (IDF), several countries are experiencing an increase in diabetes cases among people aged 20 to 79, including Indonesia, which has 10.7 million sufferers. Indonesia ranks seventh among the top 10 countries identified by the IDF with the highest diabetes rates in the world for that age group. The IDF also estimates that by 2030, the total number of diabetes patients in Indonesia is expected to increase by around 3 million (Pathan et al. n.d.). In addition to age and gender, socioeconomic status is also a risk factor for Type II DM (Walker et al. 2014). Research by Kivimäki et al. (2018) found that individuals consistently exposed to poor socioeconomic environments are more likely to be obese, have hypertension, have fatty liver disease, and develop diabetes (Kivimäki et al. 2018). This is because individuals with low socioeconomic status often have poor eating habits, are less physically active, smoke more frequently since adolescence, and experience negative changes in glucose metabolism. Piccolo et al (2016) also stated that socio-economic factors have the most significant impact on the prevalence of Type II DM among racial/ethnic minorities in the United States (Piccolo et al. 2016). Socio-economic status here includes education level, income, and employment status.

The 2007 National Basic Health Research (Riskesdas) data showed that 5.7% of Indonesia's population suffered from diabetes, with more than 70% of cases untreated. With the highest incidence in West Kalimantan and North Maluku Provinces (11.1%) and the lowest in East Nusa Tenggara Province (1.8%), significant disparities exist across the country. In 2008, residents of the suburbs of Ternate, a small island in eastern Indonesia, had a very high prevalence of diabetes mellitus (19.6%). These results are consistent with the 2007 Riskesdas, which revealed the highest prevalence of diabetes in West Kalimantan and North Maluku Provinces, which include Ternate City. The practice of intermarriage among close relatives in these regions may contribute to an increased risk of inherited diabetes, and multivariate analysis revealed a family history of diabetes as a significant risk factor in this study. Over the

Commented [rs4]: Too many long and complex sentences → reduce redundancy and convert them into concise, active sentences.

Avoid phrases like "this review offers..." because you're not writing a review article, but original research.

Use consistent tenses: present tense for general facts, past tense for previous research results.

Example:

originaly:

Diabetes mellitus (DM) has become a global epidemic and poses a serious threat to public health worldwide, including in Indonesia.

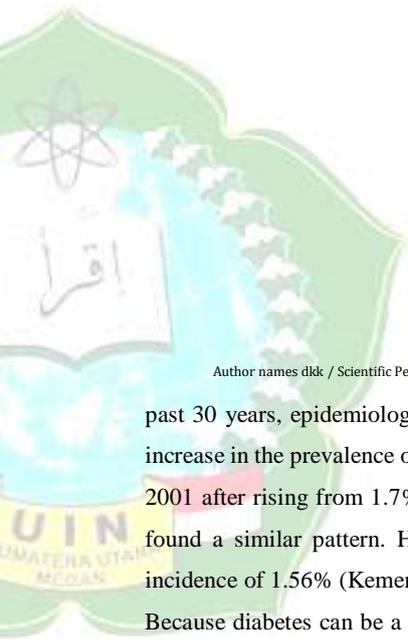
Revision:

Diabetes mellitus (DM) is a major global health concern that continues to threaten public health, including in Indonesia.

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Commented [rs6]: The reference used is too old. Please review the journal rules.

Commented [rs7]: There has been no clear confirmation of research gaps — for example, that previous research has not discussed much about the relationship between demographic characteristics (age, gender, occupation) and HbA1c levels in the Indonesian context.



past 30 years, epidemiological studies conducted in Indonesian cities have shown a marked increase in the prevalence of diabetes. The incidence in Jakarta more than doubled to 12.8% in 2001 after rising from 1.7% in 1982 to 5.7% in 1993. A study conducted in Ujung Pandang found a similar pattern. However, a study conducted in rural Ende found a much lower incidence of 1.56% (Kemenkes 2018).

Because diabetes can be a global issue, rapid monitoring and control are essential to prevent chronic impacts. Various techniques exist for evaluating blood glucose levels, including the HbA1c (glycohemoglobin) test. HbA1c measurement is the most effective method for monitoring blood sugar levels and provides insight into blood glucose levels over the past 2-3 months. Uncontrolled diabetes mellitus can lead to various chronic complications, affecting both large and small blood vessels (Suharni, Zulkarnaini, and Kusnadi 2021). Patients with HbA1c levels above 7% face a double risk of developing complications. Therefore, HbA1c testing plays an important role in diagnosing, managing long-term blood sugar control, and predicting the development of Type II DM. HbA1c reflects long-term blood sugar control, unlike daily blood glucose measurements, which only reflect current conditions. Elevated HbA1c levels indicate poor blood sugar control, which can increase the risk of serious diabetes complications, including heart disease, kidney failure, nerve damage, and vision problems.

Therefore, regular monitoring of HbA1c levels is key to diabetes management. HbA1c measurements help doctors and patients evaluate the effectiveness of their treatment plans and lifestyle choices. High HbA1c levels can signal the need to review and adjust diabetes management strategies, such as adjusting medication doses, changing diet, or increasing physical activity. Overall, HbA1c measurements not only provide information about a person's blood sugar control but also serve as an essential tool in assessing the risk of complications and directing appropriate preventive measures (Prihantini, Adintia, and Utomo 2023). This makes HbA1c measurement a key component of comprehensive diabetes management, helping doctors and patients design strategies to achieve optimal blood sugar control and minimize the risk of serious complications. Based on the background above, researchers are interested in knowing the relationship between the characteristics of Type II diabetes mellitus patients at PMC Hospital.

METHODS

This study used an observational analytical design with a cross-sectional approach to assess the relationship between patient characteristics and HbA1c levels. Data were obtained secondary from the medical records of Type II Diabetes Mellitus patients at Port Medical Center (PMC)

Commented [rs8]: Data Source:

The phrase "Data were obtained secondary from the medical records" could be clarified to "secondary data were obtained from patients' medical records" for more natural grammar.

You could also add whether there are any consent or ethics procedures regarding the use of patient data.

Sampling and Representativeness:

Purposive sampling is described, but it doesn't mention whether the sample is representative of the population or how potential bias is controlled.

It could be added: "Purposive sampling was applied to include only patients meeting inclusion criteria, acknowledging potential selection bias."

Independent Variable:

Variables such as age, gender, and occupation are usually categorical, but if age is categorized or remains numeric, it must be explained. For example: "Age was categorized into three groups: <40, 40-60, and >60 years."

Statistical Analysis:

It is recommended to state whether the data were tested for normality before inferential analysis, especially if there are numeric variables.

If HbA1c is analyzed as a continuous numeric value, the chi-square test may not be appropriate. It should be confirmed that HbA1c is categorized (e.g., <7%, ≥7%).

Hospital during the 2021–2023 period. The study population included all Type II DM patients who visited during this period, and a sample of 75 patients was selected using a purposive sampling technique based on inclusion criteria (Type II DM diagnosis, complete HbA1c data) and exclusion criteria (history of other types of DM or incomplete data). The independent variables consisted of age, gender, and occupation, while the dependent variable was the last recorded HbA1c level. Data were analyzed using IBM SPSS Statistics version 26.0. The analysis was conducted in two stages: 1) Descriptive analysis to describe respondent characteristics (frequency and percentage), 2) Inferential analysis used the Chi-Square test to determine the relationship between the independent variables and HbA1c. Fisher's exact test was used if the chi-square requirement was not met. The significance level was set at $p < 0.05$ as the statistical threshold.

RESULTS

Table 1 Distribution of Characteristics of Type II DM Patients Based on HbA1c (n=75)

HbA1c	Frequency (n)	Percentage (%)
>6.5	21	28
5.7-6.4	27	36
<5.7	27	36
Total	75	100

According to table 1, HbA1c levels in Type II DM patients at PMC Hospital are divided into three categories: >6.5%, 5.7% - 6.4%, and <5.7%. Based on the data obtained, 21 patients (28%) fall into the >6.5% category, 27 patients (36%) fall into the 5.7% - 6.4% category, and 27 patients (36%) fall into the <5.7% category. Based on the above data, the profile of Type II DM patients at PMC Hospital based on HbA1c levels, the most common category is <5.7% and >6.5%, with 27 patients (36%). This result is not in accordance with many journals, one of which is the research by Nur Ramadhan and Nelly Marissa entitled "Characteristics of Type II Diabetes Mellitus Patients Based on HbA1c Levels at Jayabaru Health Center, Banda Aceh City." which states that Type II DM patients have HbA1c levels above 6.5%. (Ramadhan and Marissa 2015).

Table 2 Distribution of Characteristics of Type II DM Patients Based on Age (n=75)

Age	Frequency (n)	Percentage (%)
25 - 35 years	25	33.3
36 - 45 years	21	28
46 - 55 years	17	22.7

Commented [rs9]: Redundancy in Explanation:

For example, in Table 1: "...21 patients (28%) fall into the >6.5% category... 27 patients (36%) fall into the 5.7%–6.4%... 27 patients (36%) fall into the <5.7% category."
→ Could be combined for more conciseness: "HbA1c levels were >6.5% in 21 patients (28%), 5.7–6.4% in 27 patients (36%), and <5.7% in 27 patients (36%)."

Inaccurate/Inconsistent Interpretation:

Table 1 states, "The most common categories are <5.7% and >6.5%, with 27 patients (36%)." → This is confusing, as >6.5% is only in 21 patients (28%), not 27. Needs correction.

In Table 2, there is an error in the numbers: "5 patients (6.7%) fell into >65 years, 5 patients (7%) fell into >65 years" → There should be a consistent number.

Comparison with the Literature:

Some references are cited, but the interpretation is not entirely logical: for example, regarding gender, the literature states that women are more susceptible, but in the PMC sample, there were more men. This could be explained by possible population differences or other factors.

Language and Layout:

Many repetitions of phrases such as "Based on the data obtained..."
→ Could be replaced with variations: "Data showed that..." or "The analysis revealed..."

Use a consistent format for percentages (%) and writing numbers.

HbA1c Analysis:

The table and narrative do not clarify whether HbA1c is treated as a category or continuous. The table shows categories, but the interpretation could include commentary on whether HbA1c levels are considered normal, prediabetic, or diabetic.

Consistency of Terms:

For example, if Table 7 says "Occupational" → it should be consistent: "Occupation."

Check for typos: "Occopational" (Table 7 heading).

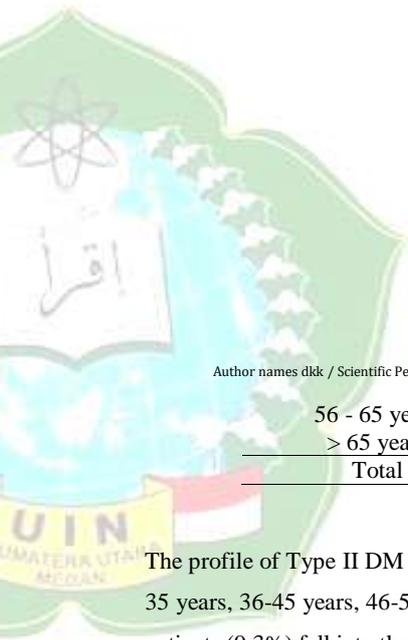
Interpretation of Significance:

The p-value is explained, but the OR or effect size can be added if available to better understand the strength of the relationship.

Narrative Structure:

Currently, each table is followed by an interpretation and literature review. It could be more systematic:

Display table → 2. Summarize distribution → 3. Bivariate relationship → 4. Compare with literature.



56 - 65 years	7	9.3
> 65 years	5	6.7
Total	75	100

The profile of Type II DM patients at PMC Hospital is divided into 5 age groups, namely 25-35 years, 36-45 years, 46-55 years, 56-65 years, and >65 years. Based on the data obtained, 7 patients (9.3%) fall into the 56-65 years category, 17 patients (22.7%) fall into the 46-55 years category, 5 patients (6.7%) fall into the >65 years category, 5 patients (7%) fall into the >65 years category and 25 patients (33.3%) fall into the 25-35 years category. Based on the research results, the most common age group in the young adult group is 25-35 years, a total of 25 people (33.3%). These findings align with those of Nur Wahidah et al. (2022), who also identified young adults as the most prevalent age group. The analysis showed a relationship between total cholesterol levels, LDL levels, smoking status, smoking intensity, and consumption of sugary drinks and the incidence of diabetes mellitus in young adults in Indonesia. Of these factors, consumption of sugary drinks played the most significant role in the development of diabetes mellitus in young adults in Indonesia (Wahidah and Rahayu 2022).

Table 3 Distribution of Characteristics of Type II DM Patients Based on Gender (n=75)

Gender	Frequency (n)	Percentage (%)
Male	47	62.7
Female	28	37.3
Total	75	100

The gender profile of Type II DM patients at Port Medical Center Hospital shows that 47 patients (62.7%) are male and 28 patients (37.3%) are female. The study results show that there are more male Type II DM patients at PMC Hospital than female patients. Specifically, there are 47 male patients (62.7%) and 28 female patients (37.3%). This is consistent with (Hestiana 2017), who found that 71.9% of Type II diabetes sufferers are women, compared to only 28.1% of men. Women are more susceptible to Type II diabetes due to factors such as obesity. According to Riskesdas (2013) data, the obesity rate in women is higher than in men, with the prevalence of obesity in women rising from 14.8% in 2007 to 32.9% in 2013 (Balgis, Sumardiyono, and Handayani 2022; Luthfa 2016).

Conversely, the obesity rate in men was 13.9% in 2007 and increased to 19.7% in 2013. Another factor that makes women more susceptible to diabetes mellitus is pregnancy (gestational diabetes). Women who give birth to babies weighing > 4 kg face a seven times



higher risk of developing diabetes mellitus than women who give birth to babies of normal weight (Bakri et al. 2023).

Table 4 Distribution of Characteristics of Type II DM Patients Based on Occupation (n=75)

Occupational	Frequency (n)	Percentage (%)
Civil Servants (PNS)	1	1.3
Private Employees	63	84.0
Self Employed/Freelancers	0	0
Students/College Students	0	0
Retired/Unemployed	11	14.7
Total	75	100

The profile of Type II DM patients at PMC Hospital based on their occupation is divided into 4 categories: Civil Servants, Private Employees, Self-Employed/Freelancers, Students, and Retirees/Unemployed. Based on the data obtained, there were no patients in the Self-Employed/Freelancers and Students categories, 1 patient (1.3%) was in the Civil Servant (PNS) category, 63 patients (84%) were in the Private Employee category, and 11 patients (14.7%) were in the Retirees/Unemployed category.

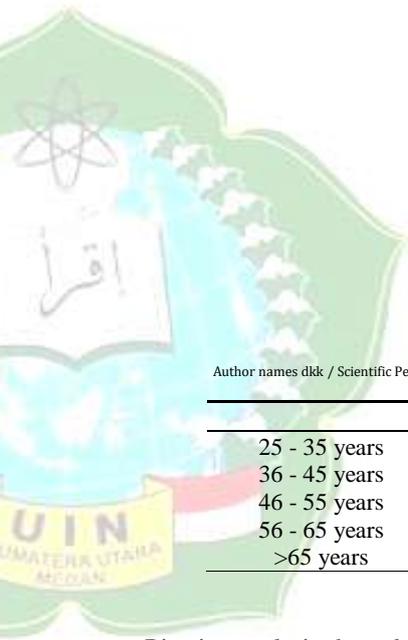
Table 5 Relationship between Gender and HbA1c Levels

Gender	HbA1c levels			Total	P-Value
	> 6.5	5.7 – 6.4	< 5,7		
Male	13	16	18	47	0.851
Female	8	11	9	28	

Bivariate analysis showed a p-value of 0.851 ($p > 0.05$), indicating no significant association between gender and HbA1c levels in the studied population. This indicates that, according to the data, gender does not have a statistically significant impact on HbA1c levels. This finding suggests that other factors, such as lifestyle, diet, physical activity, and other health conditions, may have a more significant influence on HbA1c levels than gender. Therefore, efforts to prevent and manage diabetes mellitus should focus on modifiable factors, rather than solely relying on gender differences.

Table 6 Relationship between Age and HbA1c Levels

Age	HbA1c levels	Total	P-Value
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	> 6.5	5.7 – 6.4	< 5,7	
25 - 35 years	3	11	11	25
36 - 45 years	2	9	10	21
46 - 55 years	9	6	2	17
56 - 65 years	4	1	2	7
>65 years	3	0	2	5

0.010

Bivariate analysis showed a p-value of 0.010 ($p < 0.05$), indicating a significant relationship between age and HbA1c levels in the studied population. This finding indicates that with increasing age, HbA1c levels tend to increase. This is consistent with findings in the journal (Bakri et al. 2023), which stated that the risk of developing diabetes mellitus increases with age, and individuals aged > 40 years are more susceptible to glucose intolerance (Committee 2023). This may be due to decreased pancreatic function and increased insulin resistance that occurs with increasing age. This finding demonstrates the importance of monitoring HbA1c levels in older populations to detect and manage diabetes mellitus more effectively.

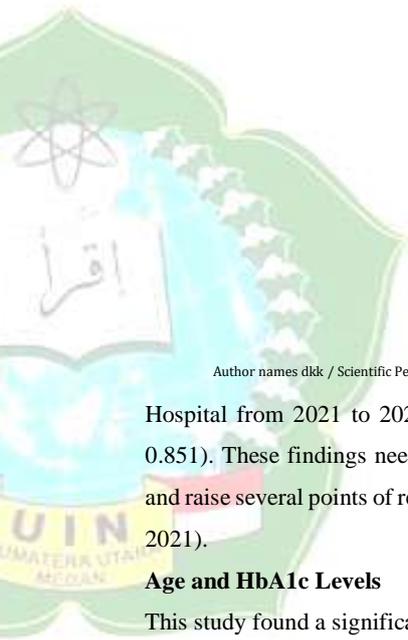
Table 7 Relationship between Occupational and HbA1c levels

Occupational	HbA1c levels			Total	P-Value
	> 6.5	5.7 – 6.4	< 5,7		
Civil Servants (PNS)	1	0	0	1	0.024
Private Employees	13	25	25	63	
Self Employed/Freelancers	0	0	0	0	
Students/College Students	0	0	0	0	
Retired/Unemployed	7	2	2	11	

Bivariate analysis showed a p-value of 0.024 ($p < 0.05$), indicating a significant relationship between job type and HbA1c levels in the studied population. These results suggest that jobs with low physical activity, irregular work schedules, or high stress are associated with higher HbA1c levels. For example, jobs that require prolonged sitting or stressful work can increase the risk of insulin resistance and poorly controlled blood sugar levels. These findings emphasize the importance of creating a health-promoting work environment, such as making time for physical activity, managing work stress, and promoting healthy eating habits. These efforts can help manage and prevent elevated HbA1c levels among workers.

DISCUSSION

The results of this study indicate that age and occupation significantly correlate with HbA1c levels in patients with Type II Diabetes Mellitus (T2DM) at Port Medical Center (PMC)



Hospital from 2021 to 2023. However, gender did not show a significant association ($p = 0.851$). These findings need to be understood within the current literature and local context, and raise several points of reflection and practical implications (Widiasari, Wijaya, and Suputra 2021).

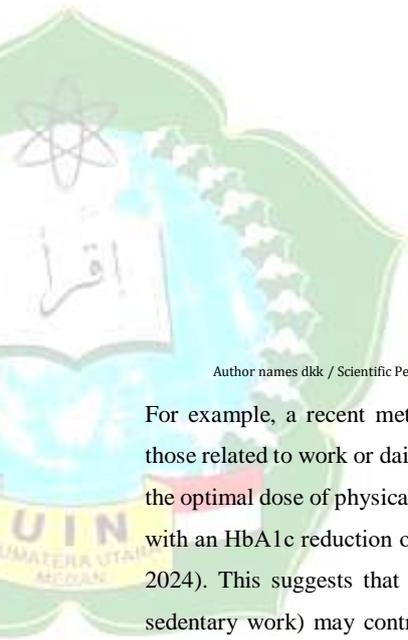
Age and HbA1c Levels

This study found a significant association between age and HbA1c levels ($p = 0.010$). Current literature indicates that the relationship between age and HbA1c in patients with DM/diabetes is complex and sometimes differs from expectations (Hestiana 2017). For example, a study from Mongolia and Japan involving diabetic patients showed a negative association between age and HbA1c after correction for various variables; in other words, increasing age actually resulted in slightly lower HbA1c values ($\beta = -0.112$; $p < 0.001$), independent of diabetes duration, complications, and red blood cell parameters (Byambasukh et al. 2024). Meanwhile, in the general non-diabetic population, HbA1c typically tends to increase with age, which is associated with physiological changes such as decreased β -cell function, increased insulin resistance, and longer red blood cell lifespan (Stedman et al. 2025)

This means that research findings showing an effect of age on HbA1c can be interpreted in two ways: as a risk factor for poor glucose control, or as an indicator of patient groups with different therapy maintenance (e.g., older patients may have been on therapy longer, have complications, or have different lifestyles). Although the Mongolian-Japanese literature suggests a negative correlation, in the context of this study, it appears that higher age is associated with higher HbA1c — consistent with the hypothesis that, with increasing age, factors such as comorbidities, insulin resistance, suboptimal lifestyle modifications, or changes in kidney/liver function can worsen glucose control. Furthermore, recent guidelines for older adults (65+) emphasize that diabetes management in older adults should be personalized due to physiological changes, risk of hypoglycemia, and different treatment needs (Gallardo-Gómez et al. 2024). From this perspective, these findings support the need for special attention in HbA1c monitoring and lifestyle interventions in older adults.

Occupation and HbA1c Levels

The results showed a significant association between occupation and HbA1c levels ($p = 0.024$). Although specific literature on occupation (e.g., sector, shift work, occupational physical activity) and HbA1c is limited, there is sufficient evidence that work-related physical activity, work lifestyle (e.g., sedentary work or night shifts), and job stress can affect glycemic control.



For example, a recent meta-analysis showed that physical activity interventions (including those related to work or daily activities) in people with T2DM resulted in reduced HbA1c, and the optimal dose of physical activity was estimated to be approximately 1,100 MET min/week, with an HbA1c reduction of -0.66% to -1.02% in uncontrolled cases (Gallardo-Gómez et al. 2024). This suggests that occupations that promote physical activity (e.g., those with less sedentary work) may contribute to better HbA1c control than highly sedentary occupations (Tjendera and Yulia 2019). Furthermore, a systematic review of working-age adults with diabetes showed that interventions that increase physical activity—potentially through modifications to work type or post-work activities—have a positive impact on HbA1c (Zhao et al. 2024).

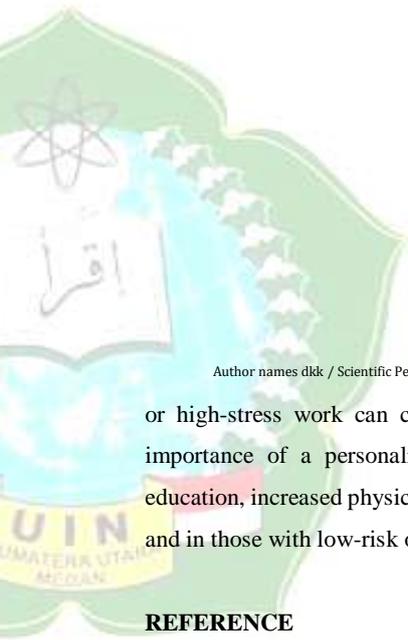
Gender and HbA1c Levels

This study did not find a significant association between gender and HbA1c. Recent research has shown that HbA1c patterns differ by gender and age, particularly in non-diabetic or prediabetic populations. For example, the median HbA1c in women <45 years of age was slightly lower than in men (34 vs. 35 mmol/mol), but this difference disappeared in the ≥ 45 age group (Putri, Nugroho, and Adi 2022).

This suggests that the effect of gender may be more subtle or dependent on age, ethnic group, or other factors (e.g., hormones, menstruation, menopause) and may not have emerged as a significant association in your study with a sample of 75 patients. Therefore, the results showing no gender effect could be due to sample size, age distribution, or employment type, or to insufficient variability in gender-job characteristics in this study sample. However, this may also reinforce the notion that age and employment are key factors in glucose control among DM patients at PMC Hospital.

CONCLUSIONS

This study shows that age and occupation are significantly associated with HbA1c levels in patients with Type II Diabetes Mellitus at Port Medical Center (PMC) Hospital during the 2021–2023 period, whereas gender was not significantly associated. With increasing age, glycemic control tends to decline due to metabolic changes and comorbidities, while sedentary



or high-stress work can contribute to higher HbA1c levels. These results emphasize the importance of a personalized care approach to DM management, focusing on lifestyle education, increased physical activity, and routine HbA1c monitoring, especially in the elderly and in those with low-risk occupations.

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Relationship between Characteristics of Type II Diabetes Mellitus Patients and HbA1c Levels

<p>Track Record Article</p> <p>Accepted:</p> <p>Published:</p>	<p style="text-align: center;"><i>Abstract</i></p> <p>Background: Diabetes mellitus (DM) is a global health problem with increasing prevalence in Indonesia. According to the 2007 Basic Health Research (Riskesdas), the prevalence of DM reached 5.7%, and most cases remain undiagnosed, resulting in suboptimal disease control. A critical parameter for monitoring long-term glycemic control is Hemoglobin A1c (HbA1c), which reflects the average blood glucose level over the past 2–3 months. HbA1c monitoring helps healthcare providers assess the effectiveness of therapy and patient adherence to Type 2 DM management. Objective: This study aims to analyze the relationship between the demographic characteristics of Type II DM patients —age, gender, and occupation—and HbA1c levels at Port Medical Center (PMC) Hospital during the period 2021–2023. Methods: This study used a cross-sectional analytical design. Secondary data were collected from the medical records of 75 patients who met the inclusion and exclusion criteria. Independent variables included age, gender, and occupation, while the dependent variable was HbA1c levels. Statistical analysis was performed using the Chi-Square test and Fisher's Exact Test if the expected cell frequency was less than 5, with a significance level of $p < 0.05$. Results and Discussion: The analysis showed no significant association between gender and HbA1c levels ($p = 0.851$). However, there was a significant association between age ($p = 0.010$) and type of employment ($p = 0.024$) and HbA1c levels. These findings indicate that age influences glucose control, consistent with previous research that suggests insulin resistance increases with age due to physiological metabolic changes. Furthermore, sedentary work and high stress levels can affect blood glucose levels by increasing cortisol levels and promoting unhealthy lifestyles. These results emphasize the importance of a diabetes management approach that considers demographic and lifestyle factors in planning clinical interventions and patient education. Conclusion: Age and occupation were significantly associated with HbA1c levels in patients with type II diabetes at Port Medical Center Hospital, while gender showed no significant association. Efforts to improve glycemic control should be focused on the elderly and those with low physical activity through educational programs, lifestyle modifications, and routine HbA1c monitoring.</p> <p>Keyword: Diabetes Mellitus Type II, HbA1c, Age, Occupation</p>
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INTRODUCTION

Diabetes mellitus (DM) has become a global epidemic and poses a serious threat to public health worldwide, including in Indonesia. The prevalence of DM continues to increase, primarily due to unhealthy modern lifestyles, such as poor diet and limited physical activity. As a chronic condition, DM management requires a holistic, targeted approach with a primary focus on blood sugar control. In this regard, measuring Hemoglobin A1c (HbA1c) is a crucial tool in evaluating and monitoring blood sugar control in patients with DM (Anon 2025).

According to a 2017 study by Zhen Yang, the number of people with diabetes mellitus globally has quadrupled over the past three decades, making it the ninth leading cause of death. Approximately one in eleven adults worldwide now has diabetes mellitus, with 90% of these having Type II DM. Asia is the focal point of the rapidly growing global Type II DM epidemic, with China and India being the main centers. While genetic factors contribute to a person's

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susceptibility to Type II DM, poor diet and a sedentary lifestyle are the main factors driving the global increase in the disease. Furthermore, exposure early in life can increase the likelihood of developing Type II DM later in life (Zheng, Ley, and Hu 2018). Most people with Type II DM face at least one complication, with cardiovascular problems being the leading cause of disability and death. This review offers an up-to-date overview of the global epidemiology of Type II DM, highlighting risk factors such as diet and lifestyle that contribute to the development of Type II DM and its complications (Rahayu, Saraswati, and Setyawan 2018).

According to the International Diabetes Federation (IDF), several countries are experiencing an increase in diabetes cases among people aged 20 to 79, including Indonesia, which has 10.7 million sufferers. Indonesia ranks seventh among the top 10 countries identified by the IDF with the highest diabetes rates in the world for that age group. The IDF also estimates that by 2030, the total number of diabetes patients in Indonesia is expected to increase by around 3 million (Pathan et al. n.d.). In addition to age and gender, socioeconomic status is also a risk factor for Type II DM (Walker et al. 2014). Research by Kivimäki et al. (2018) found that individuals consistently exposed to poor socioeconomic environments are more likely to be obese, have hypertension, have fatty liver disease, and develop diabetes (Kivimäki et al. 2018). This is because individuals with low socioeconomic status often have poor eating habits, are less physically active, smoke more frequently since adolescence, and experience negative changes in glucose metabolism. Piccolo et al (2016) also stated that socio-economic factors have the most significant impact on the prevalence of Type II DM among racial/ethnic minorities in the United States (Piccolo et al. 2016). Socio-economic status here includes education level, income, and employment status.

The 2007 National Basic Health Research (Riskesdas) data showed that 5.7% of Indonesia's population suffered from diabetes, with more than 70% of cases untreated. With the highest incidence in West Kalimantan and North Maluku Provinces (11.1%) and the lowest in East Nusa Tenggara Province (1.8%), significant disparities exist across the country. In 2008, residents of the suburbs of Ternate, a small island in eastern Indonesia, had a very high prevalence of diabetes mellitus (19.6%). These results are consistent with the 2007 Riskesdas, which revealed the highest prevalence of diabetes in West Kalimantan and North Maluku Provinces, which include Ternate City. The practice of intermarriage among close relatives in these regions may contribute to an increased risk of inherited diabetes, and multivariate analysis revealed a family history of diabetes as a significant risk factor in this study. Over the

past 30 years, epidemiological studies conducted in Indonesian cities have shown a marked increase in the prevalence of diabetes. The incidence in Jakarta more than doubled to 12.8% in 2001 after rising from 1.7% in 1982 to 5.7% in 1993. A study conducted in Ujung Pandang found a similar pattern. However, a study conducted in rural Ende found a much lower incidence of 1.56% (Kemenkes 2018).

Because diabetes can be a global issue, rapid monitoring and control are essential to prevent chronic impacts. Various techniques exist for evaluating blood glucose levels, including the HbA1c (glycohemoglobin) test. HbA1c measurement is the most effective method for monitoring blood sugar levels and provides insight into blood glucose levels over the past 2-3 months. Uncontrolled diabetes mellitus can lead to various chronic complications, affecting both large and small blood vessels (Suharni, Zulkarnaini, and Kusnadi 2021). Patients with HbA1c levels above 7% face a double risk of developing complications. Therefore, HbA1c testing plays an important role in diagnosing, managing long-term blood sugar control, and predicting the development of Type II DM. HbA1c reflects long-term blood sugar control, unlike daily blood glucose measurements, which only reflect current conditions. Elevated HbA1c levels indicate poor blood sugar control, which can increase the risk of serious diabetes complications, including heart disease, kidney failure, nerve damage, and vision problems.

Therefore, regular monitoring of HbA1c levels is key to diabetes management. HbA1c measurements help doctors and patients evaluate the effectiveness of their treatment plans and lifestyle choices. High HbA1c levels can signal the need to review and adjust diabetes management strategies, such as adjusting medication doses, changing diet, or increasing physical activity. Overall, HbA1c measurements not only provide information about a person's blood sugar control but also serve as an essential tool in assessing the risk of complications and directing appropriate preventive measures (Prihantini, Adintia, and Utomo 2023). This makes HbA1c measurement a key component of comprehensive diabetes management, helping doctors and patients design strategies to achieve optimal blood sugar control and minimize the risk of serious complications. Based on the background above, researchers are interested in knowing the relationship between the characteristics of Type II diabetes mellitus patients at PMC Hospital.

METHODS

This study used an observational analytical design with a cross-sectional approach to assess the relationship between patient characteristics and HbA1c levels. Data were obtained secondary from the medical records of Type II Diabetes Mellitus patients at Port Medical Center (PMC)

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Hospital during the 2021–2023 period. The study population included all Type II DM patients who visited during this period, and a sample of 75 patients was selected using a purposive sampling technique based on inclusion criteria (Type II DM diagnosis, complete HbA1c data) and exclusion criteria (history of other types of DM or incomplete data). The independent variables consisted of age, gender, and occupation, while the dependent variable was the last recorded HbA1c level. Data were analyzed using IBM SPSS Statistics version 26.0. The analysis was conducted in two stages: 1) Descriptive analysis to describe respondent characteristics (frequency and percentage), 2) Inferential analysis used the Chi-Square test to determine the relationship between the independent variables and HbA1c. Fisher's exact test was used if the chi-square requirement was not met. The significance level was set at $p < 0.05$ as the statistical threshold.

RESULTS

Table 1 Distribution of Characteristics of Type II DM Patients Based on HbA1c (n=75)

HbA1c	Frequency (n)	Percentage (%)
>6.5	21	28
5.7-6.4	27	36
<5.7	27	36
Total	75	100

According to table 1, HbA1c levels in Type II DM patients at PMC Hospital are divided into three categories: >6.5%, 5.7% - 6.4%, and <5.7%. Based on the data obtained, 21 patients (28%) fall into the >6.5% category, 27 patients (36%) fall into the 5.7% - 6.4% category, and 27 patients (36%) fall into the <5.7% category. Based on the above data, the profile of Type II DM patients at PMC Hospital based on HbA1c levels, the most common category is <5.7% and >6.5%, with 27 patients (36%). This result is not in accordance with many journals, one of which is the research by Nur Ramadhan and Nelly Marissa entitled "Characteristics of Type II Diabetes Mellitus Patients Based on HbA1c Levels at Jayabaru Health Center, Banda Aceh City." which states that Type II DM patients have HbA1c levels above 6.5%. (Ramadhan and Marissa 2015).

Table 2 Distribution of Characteristics of Type II DM Patients Based on Age (n=75)

Age	Frequency (n)	Percentage (%)
25 - 35 years	25	33.3
36 - 45 years	21	28
46 - 55 years	17	22.7

56 - 65 years	7	9.3
> 65 years	5	6.7
Total	75	100

The profile of Type II DM patients at PMC Hospital is divided into 5 age groups, namely 25-35 years, 36-45 years, 46-55 years, 56-65 years, and >65 years. Based on the data obtained, 7 patients (9.3%) fall into the 56-65 years category, 17 patients (22.7%) fall into the 46-55 years category, 5 patients (6.7%) fall into the >65 years category, 5 patients (7%) fall into the >65 years category and 25 patients (33.3%) fall into the 25-35 years category. Based on the research results, the most common age group in the young adult group is 25-35 years, a total of 25 people (33.3%). These findings align with those of Nur Wahidah et al. (2022), who also identified young adults as the most prevalent age group. The analysis showed a relationship between total cholesterol levels, LDL levels, smoking status, smoking intensity, and consumption of sugary drinks and the incidence of diabetes mellitus in young adults in Indonesia. Of these factors, consumption of sugary drinks played the most significant role in the development of diabetes mellitus in young adults in Indonesia (Wahidah and Rahayu 2022).

Table 3 Distribution of Characteristics of Type II DM Patients Based on Gender (n=75)

Gender	Frequency (n)	Percentage (%)
Male	47	62.7
Female	28	37.3
Total	75	100

The gender profile of Type II DM patients at Port Medical Center Hospital shows that 47 patients (62.7%) are male and 28 patients (37.3%) are female. The study results show that there are more male Type II DM patients at PMC Hospital than female patients. Specifically, there are 47 male patients (62.7%) and 28 female patients (37.3%). This is consistent with (Hestiana 2017), who found that 71.9% of Type II diabetes sufferers are women, compared to only 28.1% of men. Women are more susceptible to Type II diabetes due to factors such as obesity. According to Riskesdas (2013) data, the obesity rate in women is higher than in men, with the prevalence of obesity in women rising from 14.8% in 2007 to 32.9% in 2013 (Balgis, Sumardiyo, and Handayani 2022; Luthfa 2016).

Conversely, the obesity rate in men was 13.9% in 2007 and increased to 19.7% in 2013. Another factor that makes women more susceptible to diabetes mellitus is pregnancy (gestational diabetes). Women who give birth to babies weighing > 4 kg face a seven times

higher risk of developing diabetes mellitus than women who give birth to babies of normal weight (Bakri et al. 2023).

Table 4 Distribution of Characteristics of Type II DM Patients Based on Occupation
(n=75)

Occupational	Frequency (n)	Percentage (%)
Civil Servants (PNS)	1	1.3
Private Employees	63	84.0
Self Employed/Freelancers	0	0
Students/College Students	0	0
Retired/Unemployed	11	14.7
Total	75	100

The profile of Type II DM patients at PMC Hospital based on their occupation is divided into 4 categories: Civil Servants, Private Employees, Self-Employed/Freelancers, Students, and Retirees/Unemployed. Based on the data obtained, there were no patients in the Self-Employed/Freelancers and Students categories, 1 patient (1.3%) was in the Civil Servant (PNS) category, 63 patients (84%) were in the Private Employee category, and 11 patients (14.7%) were in the Retirees/Unemployed category.

Table 5 Relationship between Gender and HbA1c Levels

Gender	HbA1c levels			Total	P-Value
	> 6.5	5.7 – 6.4	< 5,7		
Male	13	16	18	47	0.851
Female	8	11	9	28	

Bivariate analysis showed a p-value of 0.851 ($p > 0.05$), indicating no significant association between gender and HbA1c levels in the studied population. This indicates that, according to the data, gender does not have a statistically significant impact on HbA1c levels. This finding suggests that other factors, such as lifestyle, diet, physical activity, and other health conditions, may have a more significant influence on HbA1c levels than gender. Therefore, efforts to prevent and manage diabetes mellitus should focus on modifiable factors, rather than solely relying on gender differences.

Table 6 Relationship between Age and HbA1c Levels

Age	HbA1c levels	Total	P-Value
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	> 6.5	5.7 – 6.4	< 5,7	
25 - 35 years	3	11	11	25
36 - 45 years	2	9	10	21
46 - 55 years	9	6	2	17
56 - 65 years	4	1	2	7
>65 years	3	0	2	5

0.010

Bivariate analysis showed a p-value of 0.010 ($p < 0.05$), indicating a significant relationship between age and HbA1c levels in the studied population. This finding indicates that with increasing age, HbA1c levels tend to increase. This is consistent with findings in the journal (Bakri et al. 2023)., which stated that the risk of developing diabetes mellitus increases with age, and individuals aged > 40 years are more susceptible to glucose intolerance (Committee 2023). This may be due to decreased pancreatic function and increased insulin resistance that occurs with increasing age. This finding demonstrates the importance of monitoring HbA1c levels in older populations to detect and manage diabetes mellitus more effectively.

Table 7 Relationship between Occupational and HbA1c levels

Occupational	HbA1c levels			Total	P-Value
	> 6.5	5.7 – 6.4	< 5,7		
Civil Servants (PNS)	1	0	0	1	0.024
Private Employees	13	25	25	63	
Self Employed/Freelancers	0	0	0	0	
Students/College Students	0	0	0	0	
Retired/Unemployed	7	2	2	11	

Bivariate analysis showed a p-value of 0.024 ($p < 0.05$), indicating a significant relationship between job type and HbA1c levels in the studied population. These results suggest that jobs with low physical activity, irregular work schedules, or high stress are associated with higher HbA1c levels. For example, jobs that require prolonged sitting or stressful work can increase the risk of insulin resistance and poorly controlled blood sugar levels. These findings emphasize the importance of creating a health-promoting work environment, such as making time for physical activity, managing work stress, and promoting healthy eating habits. These efforts can help manage and prevent elevated HbA1c levels among workers.

DISCUSSION

The results of this study indicate that age and occupation significantly correlate with HbA1c levels in patients with Type II Diabetes Mellitus (T2DM) at Port Medical Center (PMC)

Hospital from 2021 to 2023. However, gender did not show a significant association ($p = 0.851$). These findings need to be understood within the current literature and local context, and raise several points of reflection and practical implications (Widiasari, Wijaya, and Suputra 2021).

Age and HbA1c Levels

This study found a significant association between age and HbA1c levels ($p = 0.010$). Current literature indicates that the relationship between age and HbA1c in patients with DM/diabetes is complex and sometimes differs from expectations (Hestiana 2017). For example, a study from Mongolia and Japan involving diabetic patients showed a negative association between age and HbA1c after correction for various variables; in other words, increasing age actually resulted in slightly lower HbA1c values ($\beta = -0.112$; $p < 0.001$), independent of diabetes duration, complications, and red blood cell parameters (Byambasukh et al. 2024). Meanwhile, in the general non-diabetic population, HbA1c typically tends to increase with age, which is associated with physiological changes such as decreased β -cell function, increased insulin resistance, and longer red blood cell lifespan (Stedman et al. 2025)

This means that research findings showing an effect of age on HbA1c can be interpreted in two ways: as a risk factor for poor glucose control, or as an indicator of patient groups with different therapy maintenance (e.g., older patients may have been on therapy longer, have complications, or have different lifestyles). Although the Mongolian-Japanese literature suggests a negative correlation, in the context of this study, it appears that higher age is associated with higher HbA1c — consistent with the hypothesis that, with increasing age, factors such as comorbidities, insulin resistance, suboptimal lifestyle modifications, or changes in kidney/liver function can worsen glucose control. Furthermore, recent guidelines for older adults (65+) emphasize that diabetes management in older adults should be personalized due to physiological changes, risk of hypoglycemia, and different treatment needs (Gallardo-Gómez et al. 2024). From this perspective, these findings support the need for special attention in HbA1c monitoring and lifestyle interventions in older adults.

Occupation and HbA1c Levels

The results showed a significant association between occupation and HbA1c levels ($p = 0.024$). Although specific literature on occupation (e.g., sector, shift work, occupational physical activity) and HbA1c is limited, there is sufficient evidence that work-related physical activity, work lifestyle (e.g., sedentary work or night shifts), and job stress can affect glycemic control.

For example, a recent meta-analysis showed that physical activity interventions (including those related to work or daily activities) in people with T2DM resulted in reduced HbA1c, and the optimal dose of physical activity was estimated to be approximately 1,100 MET min/week, with an HbA1c reduction of -0.66% to -1.02% in uncontrolled cases (Gallardo-Gómez et al. 2024). This suggests that occupations that promote physical activity (e.g., those with less sedentary work) may contribute to better HbA1c control than highly sedentary occupations (Tjendera and Yulia 2019). Furthermore, a systematic review of working-age adults with diabetes showed that interventions that increase physical activity—potentially through modifications to work type or post-work activities—have a positive impact on HbA1c (Zhao et al. 2024).

Gender and HbA1c Levels

This study did not find a significant association between gender and HbA1c. Recent research has shown that HbA1c patterns differ by gender and age, particularly in non-diabetic or prediabetic populations. For example, the median HbA1c in women <45 years of age was slightly lower than in men (34 vs. 35 mmol/mol), but this difference disappeared in the ≥ 45 age group (Putri, Nugroho, and Adi 2022).

This suggests that the effect of gender may be more subtle or dependent on age, ethnic group, or other factors (e.g., hormones, menstruation, menopause) and may not have emerged as a significant association in your study with a sample of 75 patients. Therefore, the results showing no gender effect could be due to sample size, age distribution, or employment type, or to insufficient variability in gender-job characteristics in this study sample. However, this may also reinforce the notion that age and employment are key factors in glucose control among DM patients at PMC Hospital.

CONCLUSIONS

This study shows that age and occupation are significantly associated with HbA1c levels in patients with Type II Diabetes Mellitus at Port Medical Center (PMC) Hospital during the 2021–2023 period, whereas gender was not significantly associated. With increasing age, glycemic control tends to decline due to metabolic changes and comorbidities, while sedentary

or high-stress work can contribute to higher HbA1c levels. These results emphasize the importance of a personalized care approach to DM management, focusing on lifestyle education, increased physical activity, and routine HbA1c monitoring, especially in the elderly and in those with low-risk occupations.

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REVIEW

1. The title does not fully reflect the scope of the study, as it only mentions "characteristics," while the characteristic variables are very limited (only age, gender, and occupation). The title lacks specificity.
2. The abstract does not include key statistical data such as OR values or significant characteristic distributions; it is purely descriptive.
3. The abstract does not mention methodological limitations, which are essential for an observational cross-sectional study.
4. The introduction is too long, repetitive, and includes global epidemiological information that does not directly support the study focus.
5. The study's novelty is unclear. There is no explicit statement of what research gap this study intends to address.
6. Several references are outdated (e.g., Riskesdas 2007) even though more recent data from Riskesdas 2013, 2018, and 2023 are available.
7. Some references used are non-journal sources, preprints, or grey literature, which weakens the academic quality of the manuscript.
8. The background section includes extensive theoretical explanations but lacks a critical lead-in toward the research question.

9. There is no explicit problem statement or clearly defined research question.
10. The purposive sampling technique poses a high risk of bias for prevalence studies; the methodological justification for choosing this technique is not provided.
11. The inclusion and exclusion criteria are too general and not described in detail (e.g., age cut-offs, duration of diagnosis, comorbidities).
12. The independent variable “occupation” is categorized in a non-valid manner because two categories contain zero respondents (self-employed and students).
13. The dependent variable (HbA1c) is not categorized consistently with ADA/WHO recommendations.
14. Ethical clearance, ethical approval number, and whether informed consent was required for secondary data use are not stated.
15. The statistical analysis only uses Chi-square; there is no control for confounding variables such as BMI, DM duration, DM therapy, comorbidities, and lifestyle factors.
16. Fisher’s Exact Test is mentioned, but the results are not consistently presented in the tables.
17. Table 1 presents HbA1c categories that do not follow ADA standards (normal <5.7; prediabetes 5.7–6.4; diabetes ≥ 6.5), and the narrative explanation is inaccurate.
18. Table 4 on occupation is not informative because several categories have zero respondents; the categories should be regrouped.
19. No effect size (such as OR or RR) is provided to support the interpretation of relationships.
20. The results narrative relies heavily on external references, whereas the results section should only describe the study’s findings.
21. The discussion does not focus on the study’s findings; it contains lengthy literature reviews that are not directly relevant.
22. The discussion introduces international literature that is not contextualized to the study design, variables, or characteristics of the sample.
23. The interpretation of findings lacks critical analysis and is not linked to methodological limitations (e.g., medical record bias, selection bias, confounding).
24. There is no explanation of why the study’s findings differ from certain literature, particularly regarding age and gender distributions.
25. The theoretical explanations are too lengthy and not sufficiently relevant to the empirical findings.
26. The Limitations section is not clearly presented; it should be provided as a separate sub-heading.
27. Major limitations such as the absence of confounder control, incomplete secondary data, and selection bias are not mentioned.
28. The limitation of the relatively small sample size ($n=75$) is not discussed.
29. The conclusion is too normative and leans toward policy recommendations without strong analytical support.
30. The conclusion overgeneralizes the results, implying causal relationships even though the cross-sectional design does not support causality.
31. The reference list lacks formatting consistency (inconsistent capitalization, incomplete DOIs, unclear adherence to APA/MLA/Vancouver style).
32. The number of references is insufficient for the standards of a scientific manuscript; it should include at least 25–30 references from Sinta 1/2 or Scopus-indexed journals.
33. Extensive revisions are required before this manuscript can be considered suitable for publication in an accredited journal.



Relationship between Characteristics of Type II Diabetes Mellitus Patients and HbA1c Levels

<p>Track Record Article</p> <p>Accepted:</p> <p>Published:</p>	<p style="text-align: center;">Abstract</p> <p>Background: Diabetes mellitus (DM) is a global health problem with increasing prevalence in Indonesia. According to the 2007 Basic Health Research (Riskesdas), the prevalence of DM reached 5.7%, and most cases remain undiagnosed, resulting in suboptimal disease control. A critical parameter for monitoring long-term glycemic control is Hemoglobin A1c (HbA1c), which reflects the average blood glucose level over the past 2–3 months. HbA1c monitoring helps healthcare providers assess the effectiveness of therapy and patient adherence to Type 2 DM management. Objective: This study aims to analyze the relationship between the demographic characteristics of Type II DM patients —age, gender, and occupation —and HbA1c levels at Port Medical Center (PMC) Hospital during the period 2021–2023. Methods: This study used a cross-sectional analytical design. Secondary data were collected from the medical records of 75 patients who met the inclusion and exclusion criteria. Independent variables included age, gender, and occupation, while the dependent variable was HbA1c levels. Statistical analysis was performed using the Chi-Square test and Fisher's Exact Test if the expected cell frequency was less than 5, with a significance level of $p < 0.05$. Results and Discussion: The analysis showed no significant association between gender and HbA1c levels ($p = 0.851$). However, there was a significant association between age ($p = 0.010$) and type of employment ($p = 0.024$) and HbA1c levels. These findings indicate that age influences glucose control, consistent with previous research that suggests insulin resistance increases with age due to physiological metabolic changes. Furthermore, sedentary work and high stress levels can affect blood glucose levels by increasing cortisol levels and promoting unhealthy lifestyles. These results emphasize the importance of a diabetes management approach that considers demographic and lifestyle factors in planning clinical interventions and patient education. Conclusion: Age and occupation were significantly associated with HbA1c levels in patients with type II diabetes at Port Medical Center Hospital, while gender showed no significant association. Efforts to improve glycemic control should be focused on the elderly and those with low physical activity through educational programs, lifestyle modifications, and routine HbA1c monitoring.</p> <p>Keyword: Diabetes Mellitus Type II, HbA1c, Age, Occupation</p>
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INTRODUCTION

Diabetes mellitus (DM) has become a global epidemic and poses a serious threat to public health worldwide, including in Indonesia. The prevalence of DM continues to increase, primarily due to unhealthy modern lifestyles, such as poor diet and limited physical activity. As a chronic condition, DM management requires a holistic, targeted approach with a primary focus on blood sugar control. In this regard, measuring Hemoglobin A1c (HbA1c) is a crucial tool in evaluating and monitoring blood sugar control in patients with DM (Anon 2025).

According to a 2017 study by Zhen Yang, the number of people with diabetes mellitus globally has quadrupled over the past three decades, making it the ninth leading cause of disability. Approximately one in eleven adults worldwide now has diabetes mellitus, with 90% of these having Type II DM. Asia is the focal point of the rapidly growing global Type II DM epidemic, with China and India being the main centers. While genetic factors contribute to a person's

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susceptibility to Type II DM, poor diet and a sedentary lifestyle are the main factors driving the global increase in the disease. Furthermore, exposure early in life can increase the likelihood of developing Type II DM later in life (Zheng, Ley, and Hu 2018). Most people with Type II DM face at least one complication, with cardiovascular problems being the leading cause of disability and death. This review offers an up-to-date overview of the global epidemiology of Type II DM, highlighting risk factors such as diet and lifestyle that contribute to the development of Type II DM and its complications (Rahayu, Saraswati, and Setyawan 2018).

According to the International Diabetes Federation (IDF), several countries are experiencing an increase in diabetes cases among people aged 20 to 79, including Indonesia, which has 10.7 million sufferers. Indonesia ranks seventh among the top 10 countries identified by the IDF with the highest diabetes rates in the world for that age group. The IDF also estimates that by 2030, the total number of diabetes patients in Indonesia is expected to increase by around 3 million (Pathan et al. n.d.). In addition to age and gender, socioeconomic status is also a risk factor for Type II DM (Walker et al. 2014). Research by Kivimäki et al. (2018) found that individuals consistently exposed to poor socioeconomic environments are more likely to be obese, have hypertension, have fatty liver disease, and develop diabetes (Kivimäki et al. 2018). This is because individuals with low socioeconomic status often have poor eating habits, are less physically active, smoke more frequently since adolescence, and experience negative changes in glucose metabolism. Piccolo et al (2016) also stated that socio-economic factors have the most significant impact on the prevalence of Type II DM among racial/ethnic minorities in the United States (Piccolo et al. 2016). Socio-economic status here includes education level, income, and employment status.

The 2007 National Basic Health Research (Riskesdas) data showed that 5.7% of Indonesia's population suffered from diabetes, with more than 70% of cases untreated. With the highest incidence in West Kalimantan and North Maluku Provinces (11.1%) and the lowest in East Nusa Tenggara Province (1.8%), significant disparities exist across the country. In 2008, residents of the suburbs of Ternate, a small island in eastern Indonesia, had a very high prevalence of diabetes mellitus (19.6%). These results are consistent with the 2007 Riskesdas, which revealed the highest prevalence of diabetes in West Kalimantan and North Maluku Provinces, which include Ternate City. The practice of intermarriage among close relatives in these regions may contribute to an increased risk of inherited diabetes, and multivariate analysis revealed a family history of diabetes as a significant risk factor in this study. Over the

past 30 years, epidemiological studies conducted in Indonesian cities have shown a marked increase in the prevalence of diabetes. The incidence in Jakarta more than doubled to 12.8% in 2001 after rising from 1.7% in 1982 to 5.7% in 1993. A study conducted in Ujung Pandang found a similar pattern. However, a study conducted in rural Ende found a much lower incidence of 1.56% (Kemenkes 2018).

Because diabetes can be a global issue, rapid monitoring and control are essential to prevent chronic impacts. Various techniques exist for evaluating blood glucose levels, including the HbA1c (glycohemoglobin) test. HbA1c measurement is the most effective method for monitoring blood sugar levels and provides insight into blood glucose levels over the past 2-3 months. Uncontrolled diabetes mellitus can lead to various chronic complications, affecting both large and small blood vessels (Suharni, Zulkarnaini, and Kusnadi 2021). Patients with HbA1c levels above 7% face a double risk of developing complications. Therefore, HbA1c testing plays an important role in diagnosing, managing long-term blood sugar control, and predicting the development of Type II DM. HbA1c reflects long-term blood sugar control, unlike daily blood glucose measurements, which only reflect current conditions. Elevated HbA1c levels indicate poor blood sugar control, which can increase the risk of serious diabetes complications, including heart disease, kidney failure, nerve damage, and vision problems.

Therefore, regular monitoring of HbA1c levels is key to diabetes management. HbA1c measurements help doctors and patients evaluate the effectiveness of their treatment plans and lifestyle choices. High HbA1c levels can signal the need to review and adjust diabetes management strategies, such as adjusting medication doses, changing diet, or increasing physical activity. Overall, HbA1c measurements not only provide information about a person's blood sugar control but also serve as an essential tool in assessing the risk of complications and directing appropriate preventive measures (Prihantini, Adintia, and Utomo 2023). This makes HbA1c measurement a key component of comprehensive diabetes management, helping doctors and patients design strategies to achieve optimal blood sugar control and minimize the risk of serious complications. Based on the background above, researchers are interested in knowing the relationship between the characteristics of Type II diabetes mellitus patients at PMC Hospital.

METHODS

This study used an observational analytical design with a cross-sectional approach to assess the relationship between patient characteristics and HbA1c levels. Data were obtained secondary from the medical records of Type II Diabetes Mellitus patients at Port Medical Center (PMC)

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Hospital during the 2021–2023 period. The study population included all Type II DM patients who visited during this period, and a sample of 75 patients was selected using a purposive sampling technique based on inclusion criteria (Type II DM diagnosis, complete HbA1c data) and exclusion criteria (history of other types of DM or incomplete data). The independent variables consisted of age, gender, and occupation, while the dependent variable was the last recorded HbA1c level. Data were analyzed using IBM SPSS Statistics version 26.0. The analysis was conducted in two stages: 1) Descriptive analysis to describe respondent characteristics (frequency and percentage), 2) Inferential analysis used the Chi-Square test to determine the relationship between the independent variables and HbA1c. Fisher's exact test was used if the chi-square requirement was not met. The significance level was set at $p < 0.05$ as the statistical threshold.

RESULTS

Table 1 Distribution of Characteristics of Type II DM Patients Based on HbA1c (n=75)

HbA1c	Frequency (n)	Percentage (%)
>6.5	21	28
5.7-6.4	27	36
<5.7	27	36
Total	75	100

According to table 1, HbA1c levels in Type II DM patients at PMC Hospital are divided into three categories: >6.5%, 5.7% - 6.4%, and <5.7%. Based on the data obtained, 21 patients (28%) fall into the >6.5% category, 27 patients (36%) fall into the 5.7% - 6.4% category, and 27 patients (36%) fall into the <5.7% category. Based on the above data, the profile of Type II DM patients at PMC Hospital based on HbA1c levels, the most common category is <5.7% and >6.5%, with 27 patients (36%). This result is not in accordance with many journals, one of which is the research by Nur Ramadhan and Nelly Marissa entitled "Characteristics of Type II Diabetes Mellitus Patients Based on HbA1c Levels at Jayabaru Health Center, Banda Aceh City." which states that Type II DM patients have HbA1c levels above 6.5%.(Ramadhan and Marissa 2015).

Table 2 Distribution of Characteristics of Type II DM Patients Based on Age (n=75)

Age	Frequency (n)	Percentage (%)
25 - 35 years	25	33.3
36 - 45 years	21	28
46 - 55 years	17	22.7

56 - 65 years	7	9.3
> 65 years	5	6.7
Total	75	100

The profile of Type II DM patients at PMC Hospital is divided into 5 age groups, namely 25-35 years, 36-45 years, 46-55 years, 56-65 years, and >65 years. Based on the data obtained, 7 patients (9.3%) fall into the 56-65 years category, 17 patients (22.7%) fall into the 46-55 years category, 5 patients (6.7%) fall into the >65 years category, 5 patients (7%) fall into the >65 years category and 25 patients (33.3%) fall into the 25-35 years category. Based on the research results, the most common age group in the young adult group is 25-35 years, a total of 25 people (33.3%). These findings align with those of Nur Wahidah et al. (2022), who also identified young adults as the most prevalent age group. The analysis showed a relationship between total cholesterol levels, LDL levels, smoking status, smoking intensity, and consumption of sugary drinks and the incidence of diabetes mellitus in young adults in Indonesia. Of these factors, consumption of sugary drinks played the most significant role in the development of diabetes mellitus in young adults in Indonesia (Wahidah and Rahayu 2022).

Table 3 Distribution of Characteristics of Type II DM Patients Based on Gender (n=75)

Gender	Frequency (n)	Percentage (%)
Male	47	62.7
Female	28	37.3
Total	75	100

The gender profile of Type II DM patients at Port Medical Center Hospital shows that 47 patients (62.7%) are male and 28 patients (37.3%) are female. The study results show that there are more male Type II DM patients at PMC Hospital than female patients. Specifically, there are 47 male patients (62.7%) and 28 female patients (37.3%). This is consistent with (Hestiana 2017), who found that 71.9% of Type II diabetes sufferers are women, compared to only 28.1% of men. Women are more susceptible to Type II diabetes due to factors such as obesity. According to Riskesdas (2013) data, the obesity rate in women is higher than in men, with the prevalence of obesity in women rising from 14.8% in 2007 to 32.9% in 2013 (Balgis, Sumardiyo, and Handayani 2022; Luthfa 2016).

Conversely, the obesity rate in men was 13.9% in 2007 and increased to 19.7% in 2013. Another factor that makes women more susceptible to diabetes mellitus is pregnancy (gestational diabetes). Women who give birth to babies weighing > 4 kg face a seven times

higher risk of developing diabetes mellitus than women who give birth to babies of normal weight (Bakri et al. 2023).

Table 4 Distribution of Characteristics of Type II DM Patients Based on Occupation (n=75)

Occupational	Frequency (n)	Percentage (%)
Civil Servants (PNS)	1	1.3
Private Employees	63	84.0
Self Employed/Freelancers	0	0
Students/College Students	0	0
Retired/Unemployed	11	14.7
Total	75	100

The profile of Type II DM patients at PMC Hospital based on their occupation is divided into 4 categories: Civil Servants, Private Employees, Self-Employed/Freelancers, Students, and Retirees/Unemployed. Based on the data obtained, there were no patients in the Self-Employed/Freelancers and Students categories, 1 patient (1.3%) was in the Civil Servant (PNS) category, 63 patients (84%) were in the Private Employee category, and 11 patients (14.7%) were in the Retirees/Unemployed category.

Table 5 Relationship between Gender and HbA1c Levels

Gender	HbA1c levels			Total	P-Value
	> 6.5	5.7 – 6.4	< 5,7		
Male	13	16	18	47	0.851
Female	8	11	9	28	

Bivariate analysis showed a p-value of 0.851 ($p > 0.05$), indicating no significant association between gender and HbA1c levels in the studied population. This indicates that, according to the data, gender does not have a statistically significant impact on HbA1c levels. This finding suggests that other factors, such as lifestyle, diet, physical activity, and other health conditions, may have a more significant influence on HbA1c levels than gender. Therefore, efforts to prevent and manage diabetes mellitus should focus on modifiable factors, rather than solely relying on gender differences.

Table 6 Relationship between Age and HbA1c Levels

Age	HbA1c levels	Total	P-Value
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	> 6.5	5.7 – 6.4	< 5,7	
25 - 35 years	3	11	11	25
36 - 45 years	2	9	10	21
46 - 55 years	9	6	2	17
56 - 65 years	4	1	2	7
>65 years	3	0	2	5

0.010

Bivariate analysis showed a p-value of 0.010 ($p < 0.05$), indicating a significant relationship between age and HbA1c levels in the studied population. This finding indicates that with increasing age, HbA1c levels tend to increase. This is consistent with findings in the journal (Bakri et al. 2023)., which stated that the risk of developing diabetes mellitus increases with age, and individuals aged > 40 years are more susceptible to glucose intolerance (Committee 2023). This may be due to decreased pancreatic function and increased insulin resistance that occurs with increasing age. This finding demonstrates the importance of monitoring HbA1c levels in older populations to detect and manage diabetes mellitus more effectively.

Table 7 Relationship between Occupational and HbA1c levels

Occupational	HBA1c levels			Total	P-Value
	> 6.5	5.7 – 6.4	< 5,7		
Civil Servants (PNS)	1	0	0	1	0.024
Private Employees	13	25	25	63	
Self Employed/Freelancers	0	0	0	0	
Students/College Students	0	0	0	0	
Retired/Unemployed	7	2	2	11	

Bivariate analysis showed a p-value of 0.024 ($p < 0.05$), indicating a significant relationship between job type and HbA1c levels in the studied population. These results suggest that jobs with low physical activity, irregular work schedules, or high stress are associated with higher HbA1c levels. For example, jobs that require prolonged sitting or stressful work can increase the risk of insulin resistance and poorly controlled blood sugar levels. These findings emphasize the importance of creating a health-promoting work environment, such as making time for physical activity, managing work stress, and promoting healthy eating habits. These efforts can help manage and prevent elevated HbA1c levels among workers.

DISCUSSION

The results of this study indicate that age and occupation significantly correlate with HbA1c levels in patients with Type II Diabetes Mellitus (T2DM) at Port Medical Center (PMC)

Hospital from 2021 to 2023. However, gender did not show a significant association ($p = 0.851$). These findings need to be understood within the current literature and local context, and raise several points of reflection and practical implications (Widiasari, Wijaya, and Suputra 2021).

Age and HbA1c Levels

This study found a significant association between age and HbA1c levels ($p = 0.010$). Current literature indicates that the relationship between age and HbA1c in patients with DM/diabetes is complex and sometimes differs from expectations (Hestiana 2017). For example, a study from Mongolia and Japan involving diabetic patients showed a negative association between age and HbA1c after correction for various variables; in other words, increasing age actually resulted in slightly lower HbA1c values ($\beta = -0.112$; $p < 0.001$), independent of diabetes duration, complications, and red blood cell parameters (Byambasukh et al. 2024). Meanwhile, in the general non-diabetic population, HbA1c typically tends to increase with age, which is associated with physiological changes such as decreased β -cell function, increased insulin resistance, and longer red blood cell lifespan (Stedman et al. 2025)

This means that research findings showing an effect of age on HbA1c can be interpreted in two ways: as a risk factor for poor glucose control, or as an indicator of patient groups with different therapy maintenance (e.g., older patients may have been on therapy longer, have complications, or have different lifestyles). Although the Mongolian-Japanese literature suggests a negative correlation, in the context of this study, it appears that higher age is associated with higher HbA1c — consistent with the hypothesis that, with increasing age, factors such as comorbidities, insulin resistance, suboptimal lifestyle modifications, or changes in kidney/liver function can worsen glucose control. Furthermore, recent guidelines for older adults (65+) emphasize that diabetes management in older adults should be personalized due to physiological changes, risk of hypoglycemia, and different treatment needs (Gallardo-Gómez et al. 2024). From this perspective, these findings support the need for special attention in HbA1c monitoring and lifestyle interventions in older adults.

Occupation and HbA1c Levels

The results showed a significant association between occupation and HbA1c levels ($p = 0.024$). Although specific literature on occupation (e.g., sector, shift work, occupational physical activity) and HbA1c is limited, there is sufficient evidence that work-related physical activity, work lifestyle (e.g., sedentary work or night shifts), and job stress can affect glycemic control.

For example, a recent meta-analysis showed that physical activity interventions (including those related to work or daily activities) in people with T2DM resulted in reduced HbA1c, and the optimal dose of physical activity was estimated to be approximately 1,100 MET min/week, with an HbA1c reduction of -0.66% to -1.02% in uncontrolled cases (Gallardo-Gómez et al. 2024). This suggests that occupations that promote physical activity (e.g., those with less sedentary work) may contribute to better HbA1c control than highly sedentary occupations (Tjendera and Yulia 2019). Furthermore, a systematic review of working-age adults with diabetes showed that interventions that increase physical activity—potentially through modifications to work type or post-work activities—have a positive impact on HbA1c (Zhao et al. 2024).

Gender and HbA1c Levels

This study did not find a significant association between gender and HbA1c. Recent research has shown that HbA1c patterns differ by gender and age, particularly in non-diabetic or prediabetic populations. For example, the median HbA1c in women <45 years of age was slightly lower than in men (34 vs. 35 mmol/mol), but this difference disappeared in the ≥ 45 age group (Putri, Nugroho, and Adi 2022).

This suggests that the effect of gender may be more subtle or dependent on age, ethnic group, or other factors (e.g., hormones, menstruation, menopause) and may not have emerged as a significant association in your study with a sample of 75 patients. Therefore, the results showing no gender effect could be due to sample size, age distribution, or employment type, or to insufficient variability in gender-job characteristics in this study sample. However, this may also reinforce the notion that age and employment are key factors in glucose control among DM patients at PMC Hospital.

CONCLUSIONS

This study shows that age and occupation are significantly associated with HbA1c levels in patients with Type II Diabetes Mellitus at Port Medical Center (PMC) Hospital during the 2021–2023 period, whereas gender was not significantly associated. With increasing age, glycemic control tends to decline due to metabolic changes and comorbidities, while sedentary

or high-stress work can contribute to higher HbA1c levels. These results emphasize the importance of a personalized care approach to DM management, focusing on lifestyle education, increased physical activity, and routine HbA1c monitoring, especially in the elderly and in those with low-risk occupations.

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COMMENTS:

- Abstract Structure:
 - Background: Cites outdated prevalence data (2007). Must use the most recent national/international figures (e.g., IDF Atlas 2021/2023).
 - Methods: "Cross-sectional analytical design" and sample size are stated. However, "purposive sampling" should be clarified as "consecutive" or "total" sampling based on records, as "purposive" implies non-probability selection which is a limitation.
 - Results: Findings are summarized, but key results lack numerical detail (e.g., ORs, effect sizes). Only p-values are given.
 - Conclusion: Aligned with results.
 - Update the background statistics in the abstract.
 - Replace "purposive sampling" with a more accurate description.
 - Include key effect measures (e.g., OR, trend) alongside p-values in the results summary.
 - Ensure keywords are formatted consistently (currently "Keyword:" should be "Keywords:").

Introduction and Literature Review

- Research Problem: Defined—relationship between patient characteristics and glycemic control.
- A major weakness. It relies heavily on older sources (2007, 2013, 2017, 2018) and local/non-indexed journals. The global epidemiology and pathophysiology are not framed with current, high-impact references (e.g., latest *Lancet* series on diabetes, *Nature Reviews Endocrinology*, *Diabetes Care*).
- The identified gap (knowing the relationship at PMC Hospital) is very localized. For an international journal, the gap must be contextualized within the broader scientific discourse (e.g., "while age is a known factor, its interaction with modern occupational stressors in Southeast Asia is poorly characterized").
- Comprehensively revise the literature review. Replace outdated and low-impact references with recent (2020-2024) publications from high-ranking international journals (e.g., *Diabetologia*, *Diabetes Care*, *The Lancet Diabetes & Endocrinology*). Clearly articulate a research gap that has wider relevance.
- Clarity: The objective is clear: to analyze the relationship between age, gender, occupation, and HbA1c.

- Recommendation: The objective is appropriate for the design. Ensure it is explicitly linked to the refined research gap in the introduction.

Methodology

- Cross-sectional is appropriate for assessing associations at one time point.
- Sample Size & Sampling: Sample size (n=75) is small. No justification (power calculation) is provided, weakening the findings. "Purposive sampling" from records is a significant limitation that can introduce selection bias.
- Clearly defined. However, HbA1c is categorized, which loses information. Consider presenting it as continuous as a sensitivity analysis. "Occupation" categories are very broad (e.g., "Private Employees" encompasses many roles).
- Adequately described for a retrospective record review.
- The use of Chi-square/Fisher's Exact test is basic but appropriate for categorical analysis. A key flaw is the absence of multivariable analysis. The independent associations of age and occupation cannot be disentangled without controlling for potential confounders (e.g., BMI, diabetes duration, medication, comorbidities).
- Acknowledge the small sample size and lack of power calculation as a primary limitation.
- Re-label the sampling method more accurately (e.g., "consecutive sample of available records").
- Perform and report a multivariable logistic or linear regression analysis, entering age, gender, and occupation (and key clinical confounders if data is available) to identify independent predictors.
- Justify the HbA1c cut-offs used based on clinical guidelines (ADA, IDF).

Results

- Presentation: Tables are provided but require significant improvement.
 - Table 1, 2, 3, 4 are purely descriptive and could be consolidated into one table.
 - Tables 5, 6, 7 (bivariate analysis) need clearer titles, consistent decimal formatting, and should include percentages within cells to aid interpretation (e.g., 13/47, 27.7%).
 - The reference to a "TyG index" in the previous manuscript's table appears to be a copy-paste error in Table 3 of the results section. This must be corrected.
- The reported p-values are correct for the tests used. However, without measures of association (Odds Ratios, Risk Ratios) and confidence

intervals, the clinical significance is unclear.

- Consolidate descriptive tables.
- Completely reformat analytical tables to include column/row percentages, and add a measure of association (e.g., OR with 95% CI) for each variable, even if from a subsequent regression model.
- Correct the erroneous "TyG index" text.

Discussion

- Attempts to interpret findings in light of some literature, but the comparisons are inconsistent. Some cited studies (e.g., Byambasukh et al., 2024) report findings contrary to this study, which is not adequately explained.
- The literature used for comparison is again a mix of local and a few international studies. The discussion does not engage deeply with the most authoritative and recent evidence.
- The discussion on limitations is inadequate. It must explicitly state: (1) small sample size, (2) cross-sectional design (cannot infer causality), (3) use of broad occupational categories, (4) lack of adjustment for key confounders (BMI, treatment, duration, diet, physical activity), (5) potential selection bias from single-center, record-based study, and (6) the categorical treatment of HbA1c.
- Restructure the discussion: First, reiterate key findings. Second, compare and contrast with current, high-impact international literature. Third, offer plausible explanations for the findings. Fourth, provide a detailed and frank limitations section
- Discuss the implications of finding no gender association in the context of other studies.
- Elaborate on the "occupation" finding with hypotheses about sedentary behavior, stress, or income level, acknowledging the crudeness of the measure.

Conclusion

- Reflect the findings but are overstated given the methodological limitations.
- Suggest general recommendations (education, lifestyle changes). They should be more specific and targeted. What *specific* interventions for "sedentary work"? How should clinical practice at PMC change?
- Scale back the conclusiveness of the statements to match the study's

design (e.g., "these *associations* suggest..."). Provide concrete, feasible implications for clinical practice and local health policy. Suggest a clear direction for future, more robust research.

- 10. Ethical Standards and Citations
- Ethical Approval: Not mentioned. For a study using patient records, a statement regarding ethical approval (or waiver) from an Institutional Review Board (IRB) is essential.
- References:

Quantity: Sufficient in number.

Many references are from local Indonesian journals, non-academic sources ("Anon 2025" - an NIDDK webpage), or are outdated. There is a lack of references from top-tier diabetes/public health journals (2018 is not "recent" for a fast-moving field).

Formatting: Inconsistent (e.g., journal names sometimes italicized, sometimes not; variable use of "et al.").

Recommendation:

Completely overhaul the reference list. A minimum of 80% should be from reputable, peer-reviewed, international journals (Scopus Q1/Q2 or Web of Science indexed). Prioritize references from the last 5 years (2019-2024).

Use a consistent reference style (e.g., APA, Vancouver) as required by the target journal.

Add a statement on ethical approval in the Methods section.



Relationship between Characteristics of T2DM Patients and HbA1c Levels

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<p>Track Record Article</p> <p>Accepted:</p> <p>Published:</p>	<p style="text-align: center;"><i>Abstract</i></p> <p>Background: T2DM(T2DM) is a growing global health concern. According to the International Diabetes Federation (IDF) Diabetes Atlas 2021–2023, the global prevalence of diabetes continues to rise, including in Indonesia. Long-term glycemic control in patients with T2DM is commonly evaluated using HbA1c levels, which reflect average blood glucose concentrations over the preceding 2–3 months and serve as a key indicator of treatment effectiveness and adherence. Objective: To analyze the relationship between demographic characteristics (age, gender, and occupation) and HbA1c levels among patients with T2DM at Port Medical Center Hospital during 2021–2023. Methods: This cross-sectional analytical study used secondary data from medical records of 75 patients with T2DM who met the inclusion and exclusion criteria. A total sampling approach was applied, including all eligible patient records within the study period. The independent variables were age, gender, and occupation, and the dependent variable was HbA1c levels. Statistical analysis was performed using the Chi-square test or Fisher’s Exact Test when expected cell counts were <5, with significance set at $p < 0.05$. Results: Gender was not significantly associated with HbA1c levels ($p = 0.851$; OR = 0.96, 95% CI: 0.34-2.70). However, older age was associated with higher odds of poor glycemic control ($p = 0.010$; OR = 11.0, 95% CI: 1.27 – 95.4). Similarly, certain occupations were significantly associated with elevated HbA1c levels ($p = 0.024$; OR = 9.21, 95% CI: 1.71–49.6). These findings suggest that age-related metabolic changes and occupational factors such as physical inactivity and work-related stress may contribute to suboptimal glycemic control. Conclusion: Age and occupation were significantly associated with HbA1c levels in patients with T2DM at Port Medical Center Hospital, while gender was not. Targeted interventions for older adults and individuals with low physical activity levels are needed to improve glycemic control through lifestyle modification, patient education, and routine HbA1c monitoring.</p> <p>Keywords: Type 2 Diabetes Mellitus, HbA1c, Level Age, Occupation</p>
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INTRODUCTION

Diabetes mellitus (DM) is a major global public health concern with a rapidly increasing prevalence, including in Indonesia. This growing burden is largely driven by lifestyle changes such as unhealthy dietary patterns and physical inactivity. T2DM(T2DM) accounts for approximately 90% of all diabetes cases worldwide and is associated with a high risk of chronic complications, particularly cardiovascular disease, which remains the leading cause of morbidity and mortality among affected individuals (Zheng et al., 2018). Effective long-term management of T2DM requires adequate glycemic control, commonly assessed using glycated hemoglobin (HbA1c), which reflects average blood glucose levels over the preceding two to three months.

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National surveys indicate that the prevalence of diabetes and pre-diabetes in Indonesia has increased over the past decade, with demographic and socioeconomic factors influencing these trends (Muharram et al., 2025). Studies in Indonesian clinical settings have characterized HbA1c distributions by age and gender, showing variations in glycemic control across demographic groups (Bakri et al., 2023; Byambasukh et al., 2024; Permatasari & Artanti, 2025; Suharni et al., 2021). However, most research to date has focused on general prevalence and clinical profiles of T2DM patients, with limited examination of how specific demographic characteristics such as age, gender, and occupation relate to HbA1c levels in the Indonesian context (Kautzky-Willer et al., 2023; Ramadhan & Marissa, 2015; Stedman et al., 2025).

HbA1c is widely recognized as a reliable marker of long-term glycemic status and a strong predictor of both microvascular and macrovascular complications (Bakri et al., 2023; Prihantini et al., 2023; Ramadhan & Marissa, 2015; Suharni et al., 2021). Although HbA1c measurement is routinely used in clinical practice, evidence regarding the relationship between demographic characteristics particularly age, gender, and occupation and HbA1c levels among patients with T2DM in Indonesia remains limited. In particular, few studies have explored this association in specific clinical settings. Addressing this gap is important for developing targeted and context-specific diabetes management strategies. Therefore, this study aims to analyze the association between demographic characteristics and HbA1c levels among patients with T2DM at Port Medical Center Hospital.

METHODS

This study employed an observational analytical design with a cross-sectional approach to examine the association between demographic characteristics and HbA1c levels among patients with T2DM(T2DM). Secondary data were obtained from patients' medical records at Port Medical Center (PMC) Hospital for the period 2021–2023. The use of patient data was approved by the institutional ethics committee, and patient confidentiality was maintained by anonymizing all records. The study population comprised all T2DM patients who attended PMC Hospital during the study period. A total of 75 patients were included using purposive sampling, which was applied to select patients who met the inclusion criteria (confirmed T2DM diagnosis and complete HbA1c data) and to exclude those with other types of diabetes mellitus or incomplete medical records. This sampling method was chosen to ensure data completeness, while acknowledging the potential for selection bias and limited representativeness. Data were

analyzed using IBM SPSS Statistics version 26.0. Descriptive analysis was performed to summarize respondent characteristics using frequencies and percentages. Prior to inferential analysis, data distribution was assessed to ensure the appropriateness of statistical testing. Inferential analysis was conducted using the Chi-square test to evaluate associations between independent variables and categorized HbA1c levels. Fisher's exact test was applied when Chi-square assumptions were not met. A p-value of <0.05 was considered statistically significant.

RESULTS

Table 1 Distribution of Characteristics of T2DM Patients Based on HbA1c (n=75)

HbA1c	Frequency (n)	Percentage (%)
>6.5	21	28
5.7-6.4	27	36
<5.7	27	36
Total	75	100

Table 2 Distribution of Characteristics of T2DM Patients Based on Age (n=75)

Age	Frequency (n)	Percentage (%)
25 - 35 years	25	33.3
36 - 45 years	21	28
46 - 55 years	17	22.7
56 - 65 years	7	9.3
> 65 years	5	6.7
Total	75	100

Table 3 Distribution of Characteristics of T2DM Patients Based on Gender (n=75)

Gender	Frequency (n)	Percentage (%)
Male	47	62.7
Female	28	37.3
Total	75	100

Table 4 Distribution of Characteristics of T2DM Patients Based on Occupation

(n=75)

Occupation	Frequency (n)	Percentage (%)
Civil Servants (PNS)	1	1.3
Private Employees	63	84.0
Self Employed/Freelancers	0	0
Students/College Students	0	0
Retired/Unemployed	11	14.7
Total	75	100

Based on the data in Table 1, Table 2, Table 3, and Table 4 showed that:

HbA1c levels in T2DM patients at PMC Hospital are divided into three categories: $>6.5\%$, $5.7\% - 6.4\%$, and $<5.7\%$. HbA1c levels were $>6.5\%$ in 21 patients (28%), $5.7-6.4\%$ in 27 patients (36%), and $<5.7\%$ in 27 patients (36%). The analysis revealed that the profile of T2DM patients at PMC Hospital based on HbA1c levels, the most common category is $<5.7\%$ and $5.7-6.4\%$, with 27 patients (36%).

The profile of T2DM patients at PMC Hospital is divided into 5 age groups, namely 25-35 years, 36-45 years, 46-55 years, 56-65 years, and >65 years. Data showed that 7 patients (9.3%) fall into the 56-65 years category, 17 patients (22.7%) fall into the 46-55 years category, 21 patients (28%) fall into the 36-45 years category, 5 patients (7%) fall into the >65 years category and 25 patients (33.3%) fall into the 25-35 years category. The analysis revealed that the most common age group in the young adult group is 25-35 years, a total of 25 people (33.3%). These findings align with those of Nur Wahidah et al. (2022), who also identified young adults as the most prevalent age group. The analysis showed a relationship between total cholesterol levels, LDL levels, smoking status, smoking intensity, and consumption of sugary drinks and the incidence of diabetes mellitus in young adults in Indonesia. Of these factors, consumption of sugary drinks played the most significant role in the development of diabetes mellitus in young adults in Indonesia (Wahidah & Rahayu, 2022).

The gender profile of T2DM patients at Port Medical Center Hospital shows that 47 patients (62.7%) are male and 28 patients (37.3%) are female. The study results indicate that there are more male patients with T2DM at PMC Hospital than female patients. Specifically, there are 47 male patients (62.7%) and 28 female patients (37.3%). This is consistent with (Hestiana, 2017), who found that 71.9% of T2DM sufferers are women, compared to only 28.1% of men. Women are more susceptible to T2DM due to factors such as obesity. According to Riskesdas (2013) data, the obesity rate in women is higher than in men, with the prevalence of obesity in women rising from 14.8% in 2007 to 32.9% in 2013 (Balgis et al., 2022; Luthfa, 2016).

Conversely, the obesity rate in men was 13.9% in 2007 and increased to 19.7% in 2013. Another factor that makes women more susceptible to diabetes mellitus is pregnancy (gestational diabetes). Women who give birth to babies weighing > 4 kg face a seven times higher risk of developing diabetes mellitus than women who give birth to babies of normal weight (Bakri et al., 2023).

The profile of T2DM patients at PMC Hospital based on their occupation is divided into 4 categories: Civil Servants, Private Employees, Self-Employed/Freelancers, Students, and

Retirees/Unemployed. Based on the data obtained, there were no patients in the Self-Employed/Freelancers and Students categories, 1 patient (1.3%) was in the Civil Servant (PNS) category, 63 patients (84%) were in the Private Employee category, and 11 patients (14.7%) were in the Retirees/Unemployed category.

Table 5. Relationship between Gender and HbA1c Levels

Gender	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
Male	13	16	18	47	0.96 (0.34–2.70)	0.851
Female	8	11	9	28	reference	

Bivariate analysis showed a p-value of 0.851 ($p > 0.05$), indicating no significant association between gender and HbA1c levels in the studied population. This indicates that, according to the data, gender does not have a statistically significant impact on HbA1c levels. This finding suggests that other factors, such as lifestyle, diet, physical activity, and other health conditions, may have a more significant influence on HbA1c levels than gender. Therefore, efforts to prevent and manage diabetes mellitus should focus on modifiable factors, rather than solely relying on gender differences.

Table 6. Relationship between Age and HbA1c Levels

Age	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
25 - 35 years	3	11	11	25	Reference	0.010
36 - 45 years	2	9	10	21	0.77 (0.12–4.87)	
46 - 55 years	9	6	2	17	8.25 (1.76–38.6)	
56 - 65 years	4	1	2	7	9.78 (1.29–73.9)	
>65 years	3	0	2	5	11.0 (1.27–95.3)	

Bivariate analysis showed a p-value of 0.010 ($p < 0.05$), indicating a significant relationship between age and HbA1c levels in the studied population. This finding indicates that with increasing age, HbA1c levels tend to increase. This is consistent with findings in the journal (Bakri et al., 2023)., which stated that the risk of developing diabetes mellitus increases with age, and individuals aged > 40 years are more susceptible to glucose intolerance (Committee, 2023). This may be due to decreased pancreatic function and increased insulin resistance that occurs with increasing age. This finding demonstrates the importance of monitoring HbA1c levels in older populations to detect and manage diabetes mellitus more effectively.

Table 7 Relationship between Occupational and HbA1c levels

Occupational	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
Civil Servants (PNS)	1	0	0	1	5.77 (0.22–149.2)	0.024
Private Employees	13	25	25	63	Reference	
Self Employed/Freelancers	0	0	0	0		
Students/College Students	0	0	0	0		
Retired/Unemployed	7	2	2	11	9.21 (1.71–49.6)	

Bivariate analysis showed a p-value of 0.024 ($p < 0.05$), indicating a significant relationship between job type and HbA1c levels in the studied population. These results suggest that jobs with low physical activity, irregular work schedules, or high stress are associated with higher HbA1c levels. For example, jobs that require prolonged sitting or stressful work can increase the risk of insulin resistance and poorly controlled blood sugar levels. These findings emphasize the importance of creating a health-promoting work environment, such as making time for physical activity, managing work stress, and promoting healthy eating habits. These efforts can help manage and prevent elevated HbA1c levels among workers.

DISCUSSION

This study demonstrated that age and occupation were significantly associated with HbA1c levels among patients with T2DM(T2DM) treated at Port Medical Center Hospital between 2021 and 2023, whereas gender was not significantly associated. These findings suggest that selected demographic and socioeconomic characteristics may influence long-term glycemic control, although their effects vary across populations and contexts (Widiasari et al., 2021).

Age and HbA1c Levels

This study found a significant association between age and HbA1c levels ($p = 0.010$). The significant association between age and HbA1c observed in this study indicates that older patients tended to have poorer glycemic control. Evidence from recent international studies shows that the relationship between age and HbA1c in patients with established diabetes is complex and inconsistent (Hestiana, 2017). In a large multicenter study from Mongolia and Japan, (Byambasukh et al., 2024) reported an inverse relationship between age and HbA1c after adjustment for diabetes duration, complications, and hematological parameters. In contrast, several population-based and clinical studies have reported higher HbA1c levels in older adults, particularly when comorbidities and functional decline are present. These discrepancies may be explained by differences in study design, population characteristics, and

analytical adjustments. The study by Byambasukh et al. included extensive adjustment for clinical and lifestyle confounders, whereas the present study relied on unadjusted medical record data. In the Indonesian clinical context, increasing age may be associated with longer disease duration, multiple comorbidities, reduced insulin sensitivity, and challenges in maintaining lifestyle modifications, all of which can contribute to suboptimal glycemic control. Recent international guidelines emphasize that diabetes management in older adults should be individualized, as age-related physiological changes and treatment complexity may affect HbA1c outcomes. From this perspective, the present findings highlight the importance of closer monitoring and tailored interventions for older patients with T2DM. Meanwhile, in the general non-diabetic population, HbA1c typically tends to increase with age, which is associated with physiological changes such as decreased β -cell function, increased insulin resistance, and longer red blood cell lifespan (Stedman et al., 2025)

Occupation and HbA1c Levels

The results showed a significant association between occupation and HbA1c levels ($p = 0.024$). Although specific literature on occupation (e.g., sector, shift work, occupational physical activity) and HbA1c is limited, there is sufficient evidence that work-related physical activity, work lifestyle (e.g., sedentary work or night shifts), and job stress can affect glycemic control. For example, a recent meta-analysis showed that physical activity interventions (including those related to work or daily activities) in people with T2DM resulted in reduced HbA1c, and the optimal dose of physical activity was estimated to be approximately 1,100 MET min/week, with an HbA1c reduction of -0.66% to -1.02% in uncontrolled cases (Gallardo-Gómez et al., 2024). This suggests that occupations that promote physical activity (e.g., those with less sedentary work) may contribute to better HbA1c control than highly sedentary occupations (Tjendera & Yulia, 2019). Furthermore, a systematic review of working-age adults with diabetes showed that interventions that increase physical activity—potentially through modifications to work type or post-work activities—have a positive impact on HbA1c (Zhao et al., 2024).

Gender and HbA1c Levels

This study did not find a significant association between gender and HbA1c. Recent research has shown that HbA1c patterns differ by gender and age, particularly in non-diabetic or* prediabetic populations. For example, the median HbA1c in women <45 years of age was slightly lower than in men (34 vs. 35 mmol/mol), but this difference disappeared in the ≥ 45 age group (Putri et al., 2022).

This suggests that the effect of gender may be more subtle or dependent on age, ethnic group, or other factors (e.g., hormones, menstruation, menopause) and may not have emerged as a significant association in your study with a sample of 75 patients. Therefore, the results showing no gender effect could be due to sample size, age distribution, or employment type, or to insufficient variability in gender-job characteristics in this study sample. However, this may also reinforce the notion that age and employment are key factors in glucose control among DM patients at PMC Hospital.

Study Limitation

This study has several important limitations. First, the relatively small sample size may have limited statistical power and reduced the ability to detect subtle associations, particularly for gender. Second, the cross-sectional design precludes causal inference between demographic characteristics and HbA1c levels. Third, occupational status was classified into broad categories, which may not accurately reflect differences in physical activity, stress, income, or job stability. Fourth, the analysis did not adjust for key confounding variables known to influence HbA1c, including body mass index, duration of diabetes, type and intensity of treatment, dietary intake, and physical activity. Fifth, the use of a single-center, record-based dataset introduces potential selection bias and limits the generalizability of the findings. Finally, HbA1c was analyzed as a categorical variable, which may have reduced sensitivity to detect more nuanced associations compared with continuous analysis.

Implication

Despite these limitations, the findings underscore the potential importance of age- and occupation-related factors in long-term glycemic control among patients with T2DM. The absence of a gender effect suggests that diabetes management strategies should prioritize modifiable lifestyle and socioeconomic factors rather than demographic characteristics alone. Future studies with larger, multicenter samples, longitudinal designs, detailed occupational assessments, and comprehensive adjustment for clinical and behavioral confounders are needed to clarify these relationships in the Indonesian context

CONCLUSIONS

This study found that age and occupation were associated with HbA1c levels among patients with T2DM at Port Medical Center Hospital from 2021 to 2023, while no association was observed with gender. These findings suggest that age- and work-related factors may influence glycemic control, although causal relationships cannot be determined due to the study design.

In clinical practice, older patients may benefit from closer HbA1c monitoring and individualized counseling. Patients with predominantly sedentary occupations may benefit from simple interventions such as advice on regular movement breaks, increased daily physical activity, and lifestyle counseling integrated into routine outpatient care. Including occupational information in patient assessments may help identify individuals at higher risk of poor glycemic control. Future studies with larger samples and longitudinal designs are needed to confirm these findings and to better understand how occupational and lifestyle factors affect HbA1c levels in patients with T2DM.

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Relationship between Characteristics of T2DM Patients and HbA1c Levels

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<p>Track Record Article</p> <p>Accepted:</p> <p>Published:</p>	<p><i>Abstract</i></p> <p>Background: T2DM(T2DM) is a growing global health concern. According to the International Diabetes Federation (IDF) Diabetes Atlas 2021–2023, the global prevalence of diabetes continues to rise, including in Indonesia. Long-term glycemic control in patients with T2DM is commonly evaluated using HbA1c levels, which reflect average blood glucose concentrations over the preceding 2–3 months and serve as a key indicator of treatment effectiveness and adherence. Objective: To analyze the relationship between demographic characteristics (age, gender, and occupation) and HbA1c levels among patients with T2DM at Port Medical Center Hospital during 2021–2023. Methods: This cross-sectional analytical study used secondary data from medical records of 75 patients with T2DM who met the inclusion and exclusion criteria. A total sampling approach was applied, including all eligible patient records within the study period. The independent variables were age, gender, and occupation, and the dependent variable was HbA1c levels. Statistical analysis was performed using the Chi-square test or Fisher’s Exact Test when expected cell counts were <5, with significance set at $p < 0.05$. Results: Gender was not significantly associated with HbA1c levels ($p = 0.851$; OR = 0.96, 95% CI: 0.34-2.70). However, older age was associated with higher odds of poor glycemic control ($p = 0.010$; OR = 11.0, 95% CI: 1.27 – 95.4). Similarly, certain occupations were significantly associated with elevated HbA1c levels ($p = 0.024$; OR = 9.21, 95% CI: 1.71–49.6). These findings suggest that age-related metabolic changes and occupational factors such as physical inactivity and work-related stress may contribute to suboptimal glycemic control. Conclusion: Age and occupation were significantly associated with HbA1c levels in patients with T2DM at Port Medical Center Hospital, while gender was not. Targeted interventions for older adults and individuals with low physical activity levels are needed to improve glycemic control through lifestyle modification, patient education, and routine HbA1c monitoring.</p> <p>Keywords: Type 2 Diabetes Mellitus, HbA1c, Level Age, Occupation</p>
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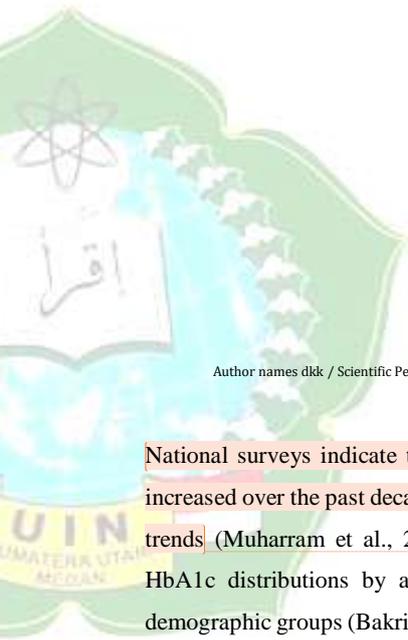
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INTRODUCTION

Diabetes mellitus (DM) is a major global public health concern with a rapidly increasing prevalence, including in Indonesia. This growing burden is largely driven by lifestyle changes such as unhealthy dietary patterns and physical inactivity. T2DM(T2DM) accounts for approximately 90% of all diabetes cases worldwide and is associated with a high risk of chronic complications, particularly cardiovascular disease, which remains the leading cause of morbidity and mortality among affected individuals (Zheng et al., 2018). Effective long-term management of T2DM requires adequate glycemic control, commonly assessed using glycosylated hemoglobin (HbA1c), which reflects average blood glucose levels over the preceding two to three months.

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•Present academic facts and issues or problems critically.
•Add a final paragraph explaining the research question or problem statement and the gaps in your research, as well as why it is important to research this topic. You must state this explicitly.

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National surveys indicate that the prevalence of diabetes and pre-diabetes in Indonesia has increased over the past decade, with demographic and socioeconomic factors influencing these trends (Muharram et al., 2025). Studies in Indonesian clinical settings have characterized HbA1c distributions by age and gender, showing variations in glycemic control across demographic groups (Bakri et al., 2023; Byambasukh et al., 2024; Permatasari & Artanti, 2025; Suharni et al., 2021). However, most research to date has focused on general prevalence and clinical profiles of T2DM patients, with limited examination of how specific demographic characteristics such as age, gender, and occupation relate to HbA1c levels in the Indonesian context (Kautzky-Willer et al., 2023; Ramadhan & Marissa, 2015; Stedman et al., 2025).

HbA1c is widely recognized as a reliable marker of long-term glycemic status and a strong predictor of both microvascular and macrovascular complications (Bakri et al., 2023; Prihantini et al., 2023; Ramadhan & Marissa, 2015; Suharni et al., 2021). Although HbA1c measurement is routinely used in clinical practice, evidence regarding the relationship between demographic characteristics particularly age, gender, and occupation and HbA1c levels among patients with T2DM in Indonesia remains limited. In particular, few studies have explored this association in specific clinical settings. Addressing this gap is important for developing targeted and context-specific diabetes management strategies. Therefore, this study aims to analyze the association between demographic characteristics and HbA1c levels among patients with T2DM at Port Medical Center Hospital.

METHODS

This study employed an observational analytical design with a cross-sectional approach to examine the association between demographic characteristics and HbA1c levels among patients with T2DM (T2DM). Secondary data were obtained from patients' medical records at Port Medical Center (PMC) Hospital for the period 2021–2023. The use of patient data was approved by the institutional ethics committee, and patient confidentiality was maintained by anonymizing all records. The study population comprised all T2DM patients who attended PMC Hospital during the study period. A total of 75 patients were included using purposive sampling, which was applied to select patients who met the inclusion criteria (confirmed T2DM diagnosis and complete HbA1c data) and to exclude those with other types of diabetes mellitus or incomplete medical records. This sampling method was chosen to ensure data completeness, while acknowledging the potential for selection bias and limited representativeness. Data were

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analyzed using IBM SPSS Statistics version 26.0. Descriptive analysis was performed to summarize respondent characteristics using frequencies and percentages. Prior to inferential analysis, data distribution was assessed to ensure the appropriateness of statistical testing. Inferential analysis was conducted using the Chi-square test to evaluate associations between independent variables and categorized HbA1c levels. Fisher's exact test was applied when Chi-square assumptions were not met. A p-value of <0.05 was considered statistically significant.

RESULTS

Table 1 Distribution of Characteristics of T2DM Patients Based on HbA1c (n=75)

HbA1c	Frequency (n)	Percentage (%)
>6.5	21	28
5.7-6.4	27	36
<5.7	27	36
Total	75	100

Table 2 Distribution of Characteristics of T2DM Patients Based on Age (n=75)

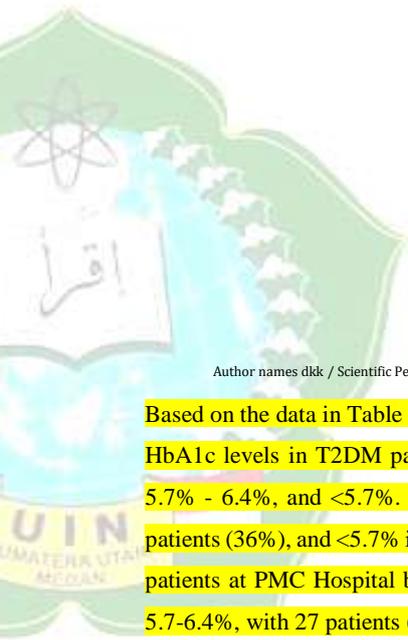
Age	Frequency (n)	Percentage (%)
25 - 35 years	25	33.3
36 - 45 years	21	28
46 - 55 years	17	22.7
56 - 65 years	7	9.3
> 65 years	5	6.7
Total	75	100

Table 3 Distribution of Characteristics of T2DM Patients Based on Gender (n=75)

Gender	Frequency (n)	Percentage (%)
Male	47	62.7
Female	28	37.3
Total	75	100

Table 4 Distribution of Characteristics of T2DM Patients Based on Occupation

Occupation	Frequency (n)	Percentage (%)
Civil Servants (PNS)	1	1.3
Private Employees	63	84.0
Self Employed/Freelancers	0	0
Students/College Students	0	0
Retired/Unemployed	11	14.7
Total	75	100



Based on the data in Table 1, Table 2, Table 3, and Table 4 showed that:

HbA1c levels in T2DM patients at PMC Hospital are divided into three categories: >6.5%, 5.7% - 6.4%, and <5.7%. HbA1c levels were >6.5% in 21 patients (28%), 5.7–6.4% in 27 patients (36%), and <5.7% in 27 patients (36%). The analysis revealed that the profile of T2DM patients at PMC Hospital based on HbA1c levels, the most common category is <5.7% and 5.7-6.4%, with 27 patients (36%).

The profile of T2DM patients at PMC Hospital is divided into 5 age groups, namely 25-35 years, 36-45 years, 46-55 years, 56-65 years, and >65 years. Data showed that 7 patients (9.3%) fall into the 56-65 years category, 17 patients (22.7%) fall into the 46-55 years category, 21 patients (28%) fall into the 36-45 years category, 5 patients (7%) fall into the >65 years category and 25 patients (33.3%) fall into the 25-35 years category. The analysis revealed that the most common age group in the young adult group is 25-35 years, a total of 25 people (33.3%). These findings align with those of Nur Wahidah et al. (2022), who also identified young adults as the most prevalent age group. The analysis showed a relationship between total cholesterol levels, LDL levels, smoking status, smoking intensity, and consumption of sugary drinks and the incidence of diabetes mellitus in young adults in Indonesia. Of these factors, consumption of sugary drinks played the most significant role in the development of diabetes mellitus in young adults in Indonesia (Wahidah & Rahayu, 2022).

The gender profile of T2DM patients at Port Medical Center Hospital shows that 47 patients (62.7%) are male and 28 patients (37.3%) are female. The study results indicate that there are more male patients with T2DM at PMC Hospital than female patients. Specifically, there are 47 male patients (62.7%) and 28 female patients (37.3%). This is consistent with (Hestiana, 2017), who found that 71.9% of T2DM sufferers are women, compared to only 28.1% of men. Women are more susceptible to T2DM due to factors such as obesity. According to Riskesdas (2013) data, the obesity rate in women is higher than in men, with the prevalence of obesity in women rising from 14.8% in 2007 to 32.9% in 2013 (Balgis et al., 2022; Luthfa, 2016).

Conversely, the obesity rate in men was 13.9% in 2007 and increased to 19.7% in 2013. Another factor that makes women more susceptible to diabetes mellitus is pregnancy (gestational diabetes). Women who give birth to babies weighing > 4 kg face a seven times higher risk of developing diabetes mellitus than women who give birth to babies of normal weight (Bakri et al., 2023).

The profile of T2DM patients at PMC Hospital based on their occupation is divided into 4 categories: Civil Servants, Private Employees, Self-Employed/Freelancers, Students, and

Retirees/Unemployed. Based on the data obtained, there were no patients in the Self-Employed/Freelancers and Students categories, 1 patient (1.3%) was in the Civil Servant (PNS) category, 63 patients (84%) were in the Private Employee category, and 11 patients (14.7%) were in the Retirees/Unemployed category.

Table 5. Relationship between Gender and HbA1c Levels

Gender	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
Male	13	16	18	47	0.96 (0.34–2.70)	0.851
Female	8	11	9	28	reference	

Bivariate analysis showed a p-value of 0.851 ($p > 0.05$), indicating no significant association between gender and HbA1c levels in the studied population. This indicates that, according to the data, gender does not have a statistically significant impact on HbA1c levels. This finding suggests that other factors, such as lifestyle, diet, physical activity, and other health conditions, may have a more significant influence on HbA1c levels than gender. Therefore, efforts to prevent and manage diabetes mellitus should focus on modifiable factors, rather than solely relying on gender differences.

Table 6. Relationship between Age and HbA1c Levels

Age	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
25 - 35 years	3	11	11	25	Reference	0.010
36 - 45 years	2	9	10	21	0.77 (0.12–4.87)	
46 - 55 years	9	6	2	17	8.25 (1.76–38.6)	
56 - 65 years	4	1	2	7	9.78 (1.29–73.9)	
>65 years	3	0	2	5	11.0 (1.27–95.3)	

Bivariate analysis showed a p-value of 0.010 ($p < 0.05$), indicating a significant relationship between age and HbA1c levels in the studied population. This finding indicates that with increasing age, HbA1c levels tend to increase. This is consistent with findings in the journal (Bakri et al., 2023), which stated that the risk of developing diabetes mellitus increases with age, and individuals aged > 40 years are more susceptible to glucose intolerance (Committee, 2023). This may be due to decreased pancreatic function and increased insulin resistance that occurs with increasing age. This finding demonstrates the importance of monitoring HbA1c levels in older populations to detect and manage diabetes mellitus more effectively.

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Table 7 Relationship between Occupational and HbA1c levels

Occupational	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
Civil Servants (PNS)	1	0	0	1	5.77 (0.22–149.2)	0.024
Private Employees	13	25	25	63	Reference	
Self Employed/Freelancers	0	0	0	0		
Students/College Students	0	0	0	0		
Retired/Unemployed	7	2	2	11	9.21 (1.71–49.6)	

Bivariate analysis showed a p-value of 0.024 ($p < 0.05$), indicating a significant relationship between job type and HbA1c levels in the studied population. These results suggest that jobs with low physical activity, irregular work schedules, or high stress are associated with higher HbA1c levels. For example, jobs that require prolonged sitting or stressful work can increase the risk of insulin resistance and poorly controlled blood sugar levels. These findings emphasize the importance of creating a health-promoting work environment, such as making time for physical activity, managing work stress, and promoting healthy eating habits. These efforts can help manage and prevent elevated HbA1c levels among workers.

DISCUSSION

This study demonstrated that age and occupation were significantly associated with HbA1c levels among patients with T2DM(T2DM) treated at Port Medical Center Hospital between 2021 and 2023, whereas gender was not significantly associated. These findings suggest that selected demographic and socioeconomic characteristics may influence long-term glycemic control, although their effects vary across populations and contexts (Widiasari et al., 2021).

Age and HbA1c Levels

This study found a significant association between age and HbA1c levels ($p = 0.010$). The significant association between age and HbA1c observed in this study indicates that older patients tended to have poorer glycemic control. Evidence from recent international studies shows that the relationship between age and HbA1c in patients with established diabetes is complex and inconsistent (Hestiana, 2017). In a large multicenter study from Mongolia and Japan, (Byambasukh et al., 2024) reported an inverse relationship between age and HbA1c after adjustment for diabetes duration, complications, and hematological parameters. In contrast, several population-based and clinical studies have reported higher HbA1c levels in older adults, particularly when comorbidities and functional decline are present. These discrepancies may be explained by differences in study design, population characteristics, and

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analytical adjustments. The study by Byambasukh et al. included extensive adjustment for clinical and lifestyle confounders, whereas the present study relied on unadjusted medical record data. In the Indonesian clinical context, increasing age may be associated with longer disease duration, multiple comorbidities, reduced insulin sensitivity, and challenges in maintaining lifestyle modifications, all of which can contribute to suboptimal glycemic control. Recent international guidelines emphasize that diabetes management in older adults should be individualized, as age-related physiological changes and treatment complexity may affect HbA1c outcomes. From this perspective, the present findings highlight the importance of closer monitoring and tailored interventions for older patients with T2DM. Meanwhile, in the general non-diabetic population, HbA1c typically tends to increase with age, which is associated with physiological changes such as decreased β -cell function, increased insulin resistance, and longer red blood cell lifespan (Stedman et al., 2025)

Occupation and HbA1c Levels

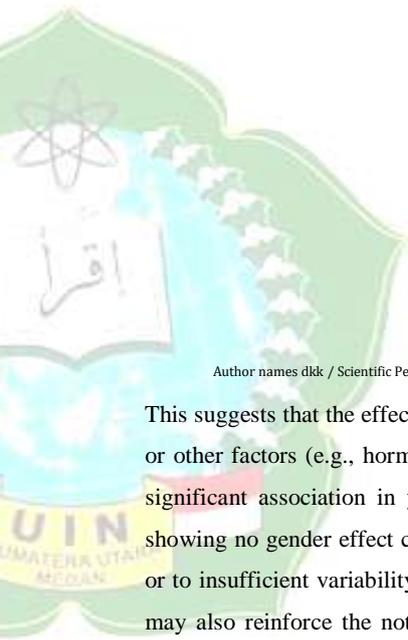
The results showed a significant association between occupation and HbA1c levels ($p = 0.024$). Although specific literature on occupation (e.g., sector, shift work, occupational physical activity) and HbA1c is limited, there is sufficient evidence that work-related physical activity, work lifestyle (e.g., sedentary work or night shifts), and job stress can affect glycemic control. For example, a recent meta-analysis showed that physical activity interventions (including those related to work or daily activities) in people with T2DM resulted in reduced HbA1c, and the optimal dose of physical activity was estimated to be approximately 1,100 MET min/week, with an HbA1c reduction of -0.66% to -1.02% in uncontrolled cases (Gallardo-Gómez et al., 2024). This suggests that occupations that promote physical activity (e.g., those with less sedentary work) may contribute to better HbA1c control than highly sedentary occupations (Tjendera & Yulia, 2019). Furthermore, a systematic review of working-age adults with diabetes showed that interventions that increase physical activity—potentially through modifications to work type or post-work activities—have a positive impact on HbA1c (Zhao et al., 2024).

Gender and HbA1c Levels

This study did not find a significant association between gender and HbA1c. Recent research has shown that HbA1c patterns differ by gender and age, particularly in non-diabetic or prediabetic populations. For example, the median HbA1c in women <45 years of age was slightly lower than in men (34 vs. 35 mmol/mol), but this difference disappeared in the ≥ 45 age group (Putri et al., 2022).

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This suggests that the effect of gender may be more subtle or dependent on age, ethnic group, or other factors (e.g., hormones, menstruation, menopause) and may not have emerged as a significant association in your study with a sample of 75 patients. Therefore, the results showing no gender effect could be due to sample size, age distribution, or employment type, or to insufficient variability in gender-job characteristics in this study sample. However, this may also reinforce the notion that age and employment are key factors in glucose control among DM patients at PMC Hospital.

Study Limitation

This study has several important limitations. First, the relatively small sample size may have limited statistical power and reduced the ability to detect subtle associations, particularly for gender. Second, the cross-sectional design precludes causal inference between demographic characteristics and HbA1c levels. Third, occupational status was classified into broad categories, which may not accurately reflect differences in physical activity, stress, income, or job stability. Fourth, the analysis did not adjust for key confounding variables known to influence HbA1c, including body mass index, duration of diabetes, type and intensity of treatment, dietary intake, and physical activity. Fifth, the use of a single-center, record-based dataset introduces potential selection bias and limits the generalizability of the findings. Finally, HbA1c was analyzed as a categorical variable, which may have reduced sensitivity to detect more nuanced associations compared with continuous analysis.

Implication

Despite these limitations, the findings underscore the potential importance of age- and occupation-related factors in long-term glycemic control among patients with T2DM. The absence of a gender effect suggests that diabetes management strategies should prioritize modifiable lifestyle and socioeconomic factors rather than demographic characteristics alone. Future studies with larger, multicenter samples, longitudinal designs, detailed occupational assessments, and comprehensive adjustment for clinical and behavioral confounders are needed to clarify these relationships in the Indonesian context

CONCLUSIONS

This study found that age and occupation were associated with HbA1c levels among patients with T2DM at Port Medical Center Hospital from 2021 to 2023, while no association was observed with gender. These findings suggest that age- and work-related factors may influence glycemic control, although causal relationships cannot be determined due to the study design.

In clinical practice, older patients may benefit from closer HbA1c monitoring and individualized counseling. Patients with predominantly sedentary occupations may benefit from simple interventions such as advice on regular movement breaks, increased daily physical activity, and lifestyle counseling integrated into routine outpatient care. Including occupational information in patient assessments may help identify individuals at higher risk of poor glycemic control. Future studies with larger samples and longitudinal designs are needed to confirm these findings and to better understand how occupational and lifestyle factors affect HbA1c levels in patients with T2DM.

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Relationship between Characteristics of T2DM Patients and HbA1c Levels

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<p>Track Record Article</p> <p>Accepted:</p> <p>Published:</p>	<p style="text-align: center;">Abstract</p> <p>Background: Type 2 Diabetes Mellitus (T2DM) is a growing global health concern. According to the International Diabetes Federation (IDF) Diabetes Atlas 2021–2023, the global prevalence of diabetes continues to rise, including in Indonesia. Long-term glycemic control in patients with T2DM is commonly evaluated using HbA1c levels, which reflect average blood glucose concentrations over the preceding 2–3 months and serve as a key indicator of treatment effectiveness and adherence. Objective: To analyze the relationship between demographic characteristics (age, gender, and occupation) and HbA1c levels among patients with T2DM at Port Medical Center Hospital during 2021–2023. Methods: This cross-sectional analytical study used secondary data from medical records of 75 patients with T2DM who met the inclusion and exclusion criteria. A total sampling approach was applied, including all eligible patient records within the study period. The independent variables were age, gender, and occupation, and the dependent variable was HbA1c levels. Statistical analysis was performed using the Chi-square test or Fisher’s Exact Test when expected cell counts were <5, with significance set at $p < 0.05$. Results: Gender was not significantly associated with HbA1c levels ($p = 0.851$; OR = 0.96, 95% CI: 0.34–2.70). However, older age was associated with higher odds of poor glycemic control ($p = 0.010$; OR = 11.0, 95% CI: 1.27 – 95.4). Similarly, certain occupations were significantly associated with elevated HbA1c levels ($p = 0.024$; OR = 9.21, 95% CI: 1.71–49.6). These findings suggest that age-related metabolic changes and occupational factors such as physical inactivity and work-related stress may contribute to suboptimal glycemic control. Conclusion: Age and occupation were significantly associated with HbA1c levels in patients with T2DM at Port Medical Center Hospital, while gender was not. Targeted interventions for older adults and individuals with low physical activity levels are needed to improve glycemic control through lifestyle modification, patient education, and routine HbA1c monitoring.</p> <p>Keywords: Type 2 Diabetes Mellitus, HbA1c, Level Age, Occupation</p>
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INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) represents one of the most significant global public health challenges, with its prevalence continuing to rise across both developed and developing countries. According to international epidemiological data, T2DM accounts for approximately 90% of all diabetes cases worldwide, largely driven by rapid urbanization, unhealthy dietary patterns, sedentary lifestyles, population aging, and increasing obesity rates (Khan et al., 2019; Rob et al., 2025). Many countries, including those in Asia, Europe, and North America, have reported a steady increase in T2DM incidence accompanied by a growing burden of chronic complications, particularly cardiovascular disease, which remains the leading cause of morbidity and mortality among individuals with diabetes (Khan et al., 2019; Rob et al., 2025;

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Zheng et al., 2018). These global trends highlight that T2DM is not only a metabolic disorder but also a complex condition influenced by demographic, socioeconomic, and behavioral factors.

National surveys indicate that the prevalence of diabetes and pre-diabetes in Indonesia has increased over the past decade, with demographic and socioeconomic factors influencing these trends. According to the research result of Muharram et al, data showed that from 2013 to 2023, the prevalence of diabetes rose from 10.7% (95% CI: 10.2% to 11.2%) in 2013 to 11.8% (11.3% to 12.3%) in 2018, before declining to 11.3% (10.7% to 11.9%) in 2023 (Muharram et al., 2025). Studies in Indonesian clinical settings have characterized HbA1c distributions by age and gender, showing variations in glycemic control across demographic groups (Bakri et al., 2023; Byambasukh et al., 2024; Permatasari & Artanti, 2025; Suharni et al., 2021). However, most research to date has focused on general prevalence and clinical profiles of T2DM patients, with limited examination of how specific demographic characteristics such as age, gender, and occupation relate to HbA1c levels in the Indonesian context (Kautzky-Willer et al., 2023; Ramadhan & Marissa, 2015; Stedman et al., 2025).

HbA1c is widely recognized as a reliable marker of long-term glycemic status and a strong predictor of both microvascular and macrovascular complications (Bakri et al., 2023; Prihantini et al., 2023; Ramadhan & Marissa, 2015; Suharni et al., 2021). Although HbA1c measurement is routinely used in clinical practice, evidence regarding the relationship between demographic characteristics, particularly age, gender, and occupation, and HbA1c levels among patients with T2DM in Indonesia remains limited. In particular, few studies have explored this association in specific clinical settings.

Based on these gaps, the research problem addressed in this study is the limited understanding of how demographic characteristics, specifically age, gender, and occupation, are associated with HbA1c levels among patients with T2DM in Indonesia. This study aims to examine whether demographic characteristics are associated with HbA1c levels among patients with T2DM treated at Port Medical Center Hospital. Addressing this question is important to provide evidence that supports more personalized and effective diabetes management, contributes to risk stratification in clinical practice, and informs health policies aimed at improving glycemic control and reducing diabetes-related complications in Indonesia.

METHODS

This study employed an observational analytical design with a cross-sectional approach to examine the association between demographic characteristics and glycated hemoglobin (HbA1c) levels among patients with Type 2 Diabetes Mellitus (T2DM). Secondary data were obtained from patients' medical records at Port Medical Center Hospital for the period January 2021 to December 2023. Ethical approval for this study was granted by the Lembaga Penelitian dan Pengabdian kepada Masyarakat (LPPM), Christian University of Indonesia (Ethical Approval No.: 075/UKI.LPPM/PPM.00.00/ET.2024). The dependent variable in this study was HbA1c level. The independent variables were demographic characteristics, including: 1) Age; 2) Gender, classified as male or female; 3) Occupation. The study population consisted of all patients diagnosed with T2DM who attended Port Medical Center Hospital during the study period. Purposive sampling was used to select study subjects based on predefined criteria. A total of 75 patients met the eligibility requirements and were included in the analysis. The inclusion criteria were: (1) patients aged ≥ 18 years; (2) confirmed diagnosis of T2DM based on physician assessment and medical records; (3) availability of at least one documented HbA1c measurement during the study period; and (4) complete demographic data, including age, gender, and occupation. The exclusion criteria were: (1) patients diagnosed with other types of diabetes mellitus, such as Type 1 diabetes, gestational diabetes, or secondary diabetes; (2) patients with acute medical conditions that could markedly affect HbA1c interpretation, such as severe anemia or recent blood transfusion; and (3) medical records with missing or incomplete data relevant to the study variables. Data were analyzed using IBM SPSS Statistics version 26.0. Descriptive analysis was performed to summarize respondent characteristics using frequencies and percentages. Prior to inferential analysis, data distribution was assessed to ensure the appropriateness of statistical testing. Inferential analysis was conducted using the Chi-square test to evaluate associations between independent variables and categorized HbA1c levels. Fisher's exact test was applied when Chi-square assumptions were not met. A p-value of < 0.05 was considered statistically significant.

RESULTS

Table 1 Distribution of Characteristics of T2DM Patients Based on HbA1c (n=75)

HbA1c	Frequency (n)	Percentage (%)
>6.5	21	28
5.7-6.4	27	36
<5.7	27	36

Total	75	100
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Table 2 Distribution of Characteristics of T2DM Patients Based on Age (n=75)

Age	Frequency (n)	Percentage (%)
25 - 35 years	25	33.3
36 - 45 years	21	28
46 - 55 years	17	22.7
56 - 65 years	7	9.3
> 65 years	5	6.7
Total	75	100

Table 3 Distribution of Characteristics of T2DM Patients Based on Gender (n=75)

Gender	Frequency (n)	Percentage (%)
Male	47	62.7
Female	28	37.3
Total	75	100

Table 4 Distribution of Characteristics of T2DM Patients Based on Occupation (n=75)

Occupation	Frequency (n)	Percentage (%)
Civil Servants (PNS)	1	1.3
Private Employees	63	84.0
Self Employed/Freelancers	0	0
Students/College Students	0	0
Retired/Unemployed	11	14.7
Total	75	100

Based on the data in Table 1, Table 2, Table 3, and Table 4 showed that:

HbA1c levels in T2DM patients at PMC Hospital are divided into three categories: >6.5%, 5.7% - 6.4%, and <5.7%. HbA1c levels were >6.5% in 21 patients (28%), 5.7–6.4% in 27 patients (36%), and <5.7% in 27 patients (36%). The analysis revealed that the profile of T2DM patients at PMC Hospital based on HbA1c levels, the most common category is <5.7% and 5.7-6.4%, with 27 patients (36%).

The profile of T2DM patients at PMC Hospital is divided into 5 age groups, namely 25-35 years, 36-45 years, 46-55 years, 56-65 years, and >65 years. Data showed that 7 patients (9.3%) fall into the 56-65 years category, 17 patients (22.7%) fall into the 46-55 years category, 21 patients (28%) fall into the 36-45 years category, 5 patients (7%) fall into the >65 years category and 25 patients (33.3%) fall into the 25-35 years category. The analysis revealed that the most common age group in the young adult group is 25-35 years, a total of 25 people

(33.3%). These findings align with those of Nur Wahidah et al. (2022), who also identified young adults as the most prevalent age group. The analysis showed a relationship between total cholesterol levels, LDL levels, smoking status, smoking intensity, and consumption of sugary drinks and the incidence of diabetes mellitus in young adults in Indonesia. Of these factors, consumption of sugary drinks played the most significant role in the development of diabetes mellitus in young adults in Indonesia (Wahidah & Rahayu, 2022).

The gender profile of T2DM patients at Port Medical Center Hospital shows that 47 patients (62.7%) are male and 28 patients (37.3%) are female. The study results indicate that there are more male patients with T2DM at PMC Hospital than female patients. Specifically, there are 47 male patients (62.7%) and 28 female patients (37.3%). This is consistent with (Hestiana, 2017), who found that 71.9% of T2DM sufferers are women, compared to only 28.1% of men. Women are more susceptible to T2DM due to factors such as obesity. According to Riskesdas (2013) data, the obesity rate in women is higher than in men, with the prevalence of obesity in women rising from 14.8% in 2007 to 32.9% in 2013 (Balgis et al., 2022; Luthfa, 2016).

Conversely, the obesity rate in men was 13.9% in 2007 and increased to 19.7% in 2013. Another factor that makes women more susceptible to diabetes mellitus is pregnancy (gestational diabetes). Women who give birth to babies weighing > 4 kg face a seven times higher risk of developing diabetes mellitus than women who give birth to babies of normal weight (Bakri et al., 2023).

The profile of T2DM patients at PMC Hospital based on their occupation is divided into 4 categories: Civil Servants, Private Employees, Self-Employed/Freelancers, Students, and Retirees/Unemployed. Based on the data obtained, there were no patients in the Self-Employed/Freelancers and Students categories, 1 patient (1.3%) was in the Civil Servant (PNS) category, 63 patients (84%) were in the Private Employee category, and 11 patients (14.7%) were in the Retirees/Unemployed category.

Table 5. Relationship between Gender and HbA1c Levels

Gender	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
Male	13	16	18	47	0.96 (0.34–2.70)	0.851
Female	8	11	9	28	reference	

Bivariate analysis showed a p-value of 0.851 ($p > 0.05$), indicating no significant association between gender and HbA1c levels in the studied population. This indicates that, according to

the data, gender does not have a statistically significant impact on HbA1c levels. This finding suggests that other factors, such as lifestyle, diet, physical activity, and other health conditions, may have a more significant influence on HbA1c levels than gender. Therefore, efforts to prevent and manage diabetes mellitus should focus on modifiable factors, rather than solely relying on gender differences.

Table 6. Relationship between Age and HbA1c Levels

Age	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
25 - 35 years	3	11	11	25	Reference	
36 - 45 years	2	9	10	21	0.77 (0.12–4.87)	0.010
46 - 55 years	9	6	2	17	8.25 (1.76–38.6)	
56 - 65 years	4	1	2	7	9.78 (1.29–73.9)	
>65 years	3	0	2	5	11.0 (1.27–95.3)	

Bivariate analysis showed a p-value of 0.010 ($p < 0.05$), indicating a significant relationship between age and HbA1c levels in the studied population. This finding indicates that with increasing age, HbA1c levels tend to increase. This is consistent with findings in the journal (Bakri et al., 2023)., which stated that the risk of developing diabetes mellitus increases with age, and individuals aged > 40 years are more susceptible to glucose intolerance (Committee, 2023). This may be due to decreased pancreatic function and increased insulin resistance that occurs with increasing age. This finding demonstrates the importance of monitoring HbA1c levels in older populations to detect and manage diabetes mellitus more effectively.

Table 7 Relationship between Occupational and HbA1c levels

Occupational	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
Civil Servants (PNS)	1	0	0	1	5.77 (0.22–149.2)	0.024
Private Employees	13	25	25	63	Reference	
Self Employed/Freelancers	0	0	0	0	-	
Students/College Students	0	0	0	0	-	
Retired/Unemployed	7	2	2	11	9.21 (1.71–49.6)	

Bivariate analysis showed a p-value of 0.024 ($p < 0.05$), indicating a significant relationship between job type and HbA1c levels in the studied population. These results suggest that with low physical activity, irregular work schedules, or high stress are associated with higher HbA1c levels. For example, jobs that require prolonged sitting or stressful work can increase the risk of insulin resistance and poorly controlled blood sugar levels. These findings

emphasize the importance of creating a health-promoting work environment, such as making time for physical activity, managing work stress, and promoting healthy eating habits. These efforts can help manage and prevent elevated HbA1c levels among workers.

DISCUSSION

This study demonstrated that age and occupation were significantly associated with HbA1c levels among patients with T2DM(T2DM) treated at Port Medical Center Hospital between 2021 and 2023, whereas gender was not significantly associated. These findings suggest that selected demographic and socioeconomic characteristics may influence long-term glycemic control, although their effects vary across populations and contexts (Widiasari et al., 2021).

Age and HbA1c Levels

This study found a significant association between age and HbA1c levels ($p = 0.010$). The significant association between age and HbA1c observed in this study indicates that older patients tended to have poorer glycemic control. Evidence from recent international studies shows that the relationship between age and HbA1c in patients with established diabetes is complex and inconsistent (Shao et al., 2022). In a large multicenter study from Mongolia and Japan, (Byambasukh et al., 2024) reported an inverse relationship between age and HbA1c after adjustment for diabetes duration, complications, and hematological parameters. In contrast, several population-based and clinical studies have reported higher HbA1c levels in older adults, particularly when comorbidities and functional decline are present. These discrepancies may be explained by differences in study design, population characteristics, and analytical adjustments. The study by Byambasukh et al. included extensive adjustment for clinical and lifestyle confounders, whereas the present study relied on unadjusted medical record data. In the Indonesian clinical context, increasing age may be associated with longer disease duration, multiple comorbidities, reduced insulin sensitivity, and challenges in maintaining lifestyle modifications, all of which can contribute to suboptimal glycemic control. Recent international guidelines emphasize that diabetes management in older adults should be individualized, as age-related physiological changes and treatment complexity may affect HbA1c outcomes. From this perspective, the present findings highlight the importance of closer monitoring and tailored interventions for older patients with T2DM. Meanwhile, in the general non-diabetic population, HbA1c typically tends to increase with age, which is associated with physiological changes such as decreased β -cell function, increased insulin resistance, and longer red blood cell lifespan (Stedman et al., 2025)

Occupation and HbA1c Levels

The results showed a significant association between occupation and HbA1c levels ($p = 0.024$). Although specific literature on occupation (e.g., sector, shift work, occupational physical activity) and HbA1c is limited, there is sufficient evidence that work-related physical activity, work lifestyle (e.g., sedentary work or night shifts), and job stress can affect glycemic control. For example, a recent meta-analysis showed that physical activity interventions (including those related to work or daily activities) in people with T2DM resulted in reduced HbA1c, and the optimal dose of physical activity was estimated to be approximately 1,100 MET min/week, with an HbA1c reduction of 0.66% to -1.02% in uncontrolled cases (Gallardo-Gómez et al., 2024). This suggests that occupations that promote physical activity (e.g., those with less sedentary work) may contribute to better HbA1c control than highly sedentary occupations (Tjendera & Yulia, 2019). Furthermore, a systematic review of working-age adults with diabetes showed that interventions that increase physical activity, potentially through modifications to work type or post-work activities, have a positive impact on HbA1c (Zhao et al., 2024).

Gender and HbA1c Levels

This study found no significant association between gender and HbA1c. Recent research has shown that HbA1c patterns differ by gender and age, particularly in non-diabetic or prediabetic populations. For example, the median HbA1c in women <45 years of age was slightly lower than in men (34 vs. 35 mmol/mol), but this difference disappeared in the ≥ 45 age group (Putri et al., 2022), and then study by Ahmed et al in northern Sudan showed that there was no association between gender, BMI, and HbA1c in adults with HbA1c <6.5% (Ahmed et al., 2023; Huang et al., 2021; Younes et al., 2019). This suggests that the effect of gender may be more subtle or dependent on age, ethnic group, or other factors (e.g., hormones, menstruation, menopause) and may not have emerged as a significant association in your study with a sample of 75 patients. Therefore, the results showing no gender effect could be due to sample size, age distribution, or employment type, or to insufficient variability in gender-job characteristics in this study sample. However, this may also reinforce the notion that age and employment are key factors in glucose control among DM patients at PMC Hospital.

Study Limitation

This study has several important limitations. First, the relatively small sample size may have limited statistical power and reduced the ability to detect subtle associations, particularly for gender. Second, the cross-sectional design precludes causal inference between demographic

characteristics and HbA1c levels. Third, occupational status was classified into broad categories, which may not accurately reflect differences in physical activity, stress, income, or job stability. Fourth, the analysis did not adjust for key confounding variables known to influence HbA1c, including body mass index, duration of diabetes, type and intensity of treatment, dietary intake, and physical activity. Fifth, the use of a single-center, record-based dataset introduces potential selection bias and limits the generalizability of the findings. Finally, HbA1c was analyzed as a categorical variable, which may have reduced sensitivity to detect more nuanced associations compared with continuous analysis.

Implication

Despite these limitations, the findings underscore the potential importance of age- and occupation-related factors in long-term glycemic control among patients with T2DM. The absence of a gender effect suggests that diabetes management strategies should prioritize modifiable lifestyle and socioeconomic factors rather than demographic characteristics alone. Future studies with larger, multicenter samples, longitudinal designs, detailed occupational assessments, and comprehensive adjustment for clinical and behavioral confounders are needed to clarify these relationships in the Indonesian context

CONCLUSIONS

This study found that age and occupation were associated with HbA1c levels among patients with T2DM at Port Medical Center Hospital from 2021 to 2023, while no association was observed with gender. These findings suggest that age- and work-related factors may influence glycemic control, although causal relationships cannot be determined due to the study design. In clinical practice, older patients may benefit from closer HbA1c monitoring and individualized counseling. Patients with predominantly sedentary occupations may benefit from simple interventions such as advice on regular movement breaks, increased daily physical activity, and lifestyle counseling integrated into routine outpatient care. Including occupational information in patient assessments may help identify individuals at higher risk of poor glycemic control. Future studies with larger samples and longitudinal designs are needed to confirm these findings and to better understand how occupational and lifestyle factors affect HbA1c levels in patients with T2DM.

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Association between Patient Characteristics and HbA1c Levels in Type 2 Diabetes Mellitus

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<p>Track Record Article</p> <p>Accepted:</p> <p>Published:</p>	<p><i>Abstract</i></p> <p>Background: Type 2 Diabetes Mellitus (T2DM) represents an escalating global health issue. The International Diabetes Federation (IDF) Diabetes Atlas 2021–2023 reports a continued increase in global diabetes prevalence, including in Indonesia. Long-term glycemic control in T2DM is typically assessed using HbA1c levels, which indicate average blood glucose concentrations over the previous 2–3 months and serve as a primary measure of treatment efficacy and adherence. Objective: This study aimed to examine the association between demographic characteristics (age, gender, and occupation) and HbA1c levels among patients with T2DM at Port Medical Center Hospital from 2021 to 2023. Methods: A cross-sectional analytical design was employed, using secondary data extracted from the medical records of 75 patients with T2DM who satisfied the inclusion and exclusion criteria. A total sampling method was utilized, incorporating all eligible patient records during the study period. The independent variables included age, gender, and occupation, while the dependent variable was HbA1c level. Statistical analyses were conducted using the Chi-square test or Fisher’s Exact Test when expected cell counts were less than five, with statistical significance defined as $p < 0.05$. Results: Gender did not demonstrate a significant association with HbA1c levels ($p = 0.851$; OR = 0.96, 95% CI: 0.34–2.70). In contrast, older age was linked to increased odds of poor glycemic control ($p = 0.010$; OR = 11.0, 95% CI: 1.27–95.4). Additionally, specific occupations were significantly associated with elevated HbA1c levels ($p = 0.024$; OR = 9.21, 95% CI: 1.71–49.6). These results indicate that age-related metabolic changes and occupational factors, including physical inactivity and work-related stress, may contribute to inadequate glycemic control. Conclusion: Age and occupation were significantly associated with HbA1c levels among patients with T2DM at Port Medical Center Hospital, whereas gender was not. Targeted interventions for older adults and individuals with low physical activity are recommended to enhance glycemic control through lifestyle modification, patient education, and regular HbA1c monitoring.</p> <p>Keywords: Type 2 Diabetes Mellitus, HbA1c, Level Age, Occupation</p>
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INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) represents one of the most significant global public health challenges, with its prevalence continuing to rise across both developed and developing countries. According to international epidemiological data, T2DM accounts for approximately 90% of all diabetes cases worldwide, largely driven by rapid urbanization, unhealthy dietary patterns, sedentary lifestyles, population aging, and increasing obesity rates (Khan et al., 2019; Rob et al., 2025). Many countries, including those in Asia, Europe, and North America, have reported a steady increase in T2DM incidence accompanied by a growing burden of chronic complications, particularly cardiovascular disease, which remains the leading cause of

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morbidity and mortality among individuals with diabetes (Khan et al., 2019; Rob et al., 2025; Zheng et al., 2018). These global trends highlight that T2DM is not only a metabolic disorder but also a complex condition influenced by demographic, socioeconomic, and behavioral factors. National surveys indicate that the prevalence of diabetes and pre-diabetes in Indonesia has increased over the past decade, with demographic and socioeconomic factors influencing these trends. According to the research result of Muharram et al, data showed that from 2013 to 2023, the prevalence of diabetes rose from 10.7% (95% CI: 10.2% to 11.2%) in 2013 to 11.8% (11.3% to 12.3%) in 2018, before declining to 11.3% (10.7% to 11.9%) in 2023 (Muharram et al., 2025). Studies in Indonesian clinical settings have characterized HbA1c distributions by age and gender, showing variations in glycemic control across demographic groups (Bakri et al., 2023; Byambasukh et al., 2024; Permatasari & Artanti, 2025; Suharni et al., 2021). However, most research to date has focused on general prevalence and clinical profiles of T2DM patients, with limited examination of how specific demographic characteristics such as age, gender, and occupation relate to HbA1c levels in the Indonesian context (Kautzky-Willer et al., 2023; Ramadhan & Marissa, 2015; Stedman et al., 2025).

HbA1c is widely recognized as a reliable marker of long-term glycemic status and a strong predictor of both microvascular and macrovascular complications (Bakri et al., 2023; Prihantini et al., 2023; Ramadhan & Marissa, 2015; Suharni et al., 2021). Although HbA1c measurement is routinely used in clinical practice, evidence regarding the relationship between demographic characteristics, specifically age, gender, and occupation, and HbA1c levels among patients with type 2 diabetes mellitus (T2DM) in Indonesia remains limited. Few studies have examined this association within specific clinical settings. Therefore, the present study addresses the limited understanding of how demographic characteristics are associated with HbA1c levels among patients with T2DM in Indonesia. The objective is to determine whether age, gender, and occupation are associated with HbA1c levels among patients with T2DM treated at Port Medical Center Hospital. Addressing this research question will provide evidence to support more personalized and effective diabetes management, enhance risk stratification in clinical practice, and inform health policies to improve glycemic control and reduce diabetes-related complications in Indonesia.

METHODS

An observational analytical design with a cross-sectional approach was utilized to investigate the association between demographic characteristics and glycated hemoglobin (HbA1c) levels among patients with Type 2 Diabetes Mellitus (T2DM). Secondary data were collected from

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medical records of patients at Port Medical Center Hospital between January 2021 and December 2023. Ethical approval was obtained from the Lembaga Penelitian dan Pengabdian kepada Masyarakat (LPPM), Christian University of Indonesia (Ethical Approval No.: 075/UKI.LPPM/PPM.00.00/ET.2024). The dependent variable was HbA1c level, and the independent variables included demographic characteristics: age, gender (male or female), and occupation. The study population comprised all patients diagnosed with T2DM who attended Port Medical Center Hospital during the specified period. Purposive sampling was employed to select subjects based on predefined criteria. Seventy-five patients met the eligibility requirements and were included in the analysis. Inclusion criteria were: age ≥ 18 years, confirmed diagnosis of T2DM based on physician assessment and medical records, at least one documented HbA1c measurement during the study period, and complete demographic data (age, gender, and occupation). Exclusion criteria were: diagnosis of other types of diabetes mellitus (Type 1 diabetes, gestational diabetes, or secondary diabetes), presence of acute medical conditions that could significantly affect HbA1c interpretation (such as severe anemia or recent blood transfusion), and medical records with missing or incomplete data relevant to the study variables. Data analysis was conducted using IBM SPSS Statistics version 26.0. Descriptive analysis was performed to summarize respondent characteristics using frequencies and percentages. Prior to inferential analysis, data distribution was assessed to ensure the appropriateness of statistical testing. Inferential analysis was conducted using the Chi-square test to evaluate associations between independent variables and categorized HbA1c levels. Fisher's exact test was applied when Chi-square assumptions were not met. A p-value of <0.05 was considered statistically significant.

RESULTS

Table 1 Distribution of Characteristics of T2DM Patients Based on HbA1c (n=75)

HbA1c	Frequency (n)	Percentage (%)
>6.5	21	28
5.7-6.4	27	36
<5.7	27	36
Total	75	100

Table 2 Distribution of Characteristics of T2DM Patients Based on Age (n=75)

Age	Frequency (n)	Percentage (%)
25 - 35 years	25	33.3
36 - 45 years	21	28
46 - 55 years	17	22.7

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56 - 65 years	7	9.3
> 65 years	5	6.7
Total	75	100

Table 3 Distribution of Characteristics of T2DM Patients Based on Gender (n=75)

Gender	Frequency (n)	Percentage (%)
Male	47	62.7
Female	28	37.3
Total	75	100

Table 4 Distribution of Characteristics of T2DM Patients Based on Occupation (n=75)

Occupation	Frequency (n)	Percentage (%)
Civil Servants (PNS)	1	1.3
Private Employees	63	84.0
Self Employed/Freelancers	0	0
Students/College Students	0	0
Retired/Unemployed	11	14.7
Total	75	100

Based on the data in Table 1, Table 2, Table 3, and Table 4 showed that:

HbA1c levels in T2DM patients at PMC Hospital are divided into three categories: >6.5%, 5.7% - 6.4%, and <5.7%. HbA1c levels were >6.5% in 21 patients (28%), 5.7–6.4% in 27 patients (36%), and <5.7% in 27 patients (36%). The analysis revealed that the profile of T2DM patients at PMC Hospital based on HbA1c levels, the most common category is <5.7% and 5.7-6.4%, with 27 patients (36%).

The profile of T2DM patients at PMC Hospital is divided into 5 age groups, namely 25-35 years, 36-45 years, 46-55 years, 56-65 years, and >65 years. Data showed that 7 patients (9.3%) fall into the 56-65 years category, 17 patients (22.7%) fall into the 46-55 years category, 21 patients (28%) fall into the 36-45 years category, 5 patients (7%) fall into the >65 years category and 25 patients (33.3%) fall into the 25-35 years category. The analysis revealed that the most common age group in the young adult group is 25-35 years, a total of 25 people (33.3%). These findings align with those of Nur Wahidah et al. (2022), who also identified young adults as the most prevalent age group. The analysis showed a relationship between total cholesterol levels, LDL levels, smoking status, smoking intensity, and consumption of sugary drinks and the incidence of diabetes mellitus in young adults in Indonesia. Of these factors, consumption of sugary drinks played the most significant role in the development of diabetes mellitus in young adults in Indonesia (Wahidah & Rahayu, 2022).

The gender profile of T2DM patients at Port Medical Center Hospital shows that 47 patients (62.7%) are male and 28 patients (37.3%) are female. The study results indicate that there are more male patients with T2DM at PMC Hospital than female patients. Specifically, there are 47 male patients (62.7%) and 28 female patients (37.3%). This is consistent with (Hestiana, 2017), who found that 71.9% of T2DM sufferers are women, compared to only 28.1% of men. Women are more susceptible to T2DM due to factors such as obesity. According to Riskesdas (2013) data, the obesity rate in women is higher than in men, with the prevalence of obesity in women rising from 14.8% in 2007 to 32.9% in 2013 (Balgis et al., 2022; Luthfa, 2016). Conversely, the obesity rate in men was 13.9% in 2007 and increased to 19.7% in 2013. Another factor that makes women more susceptible to diabetes mellitus is pregnancy (gestational diabetes). Women who give birth to babies weighing > 4 kg face a seven times higher risk of developing diabetes mellitus than women who give birth to babies of normal weight (Bakri et al., 2023).

The profile of T2DM patients at PMC Hospital based on their occupation is divided into 4 categories: Civil Servants, Private Employees, Self-Employed/Freelancers, Students, and Retirees/Unemployed. Based on the data obtained, there were no patients in the Self-Employed/Freelancers and Students categories, 1 patient (1.3%) was in the Civil Servant (PNS) category, 63 patients (84%) were in the Private Employee category, and 11 patients (14.7%) were in the Retirees/Unemployed category.

Table 5. Relationship between Gender and HbA1c Levels

Gender	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
Male	13	16	18	47	0.96 (0.34–2.70)	0.851
Female	8	11	9	28	reference	

Bivariate analysis showed a p-value of 0.851 ($p > 0.05$), indicating no significant association between gender and HbA1c levels in the studied population. This indicates that, according to the data, gender does not have a statistically significant impact on HbA1c levels. This finding suggests that other factors, such as lifestyle, diet, physical activity, and other health conditions, may have a more significant influence on HbA1c levels than gender. Therefore, efforts to prevent and manage diabetes mellitus should focus on modifiable factors, rather than solely relying on gender differences.

Table 6. Relationship between Age and HbA1c Levels

Age	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
25 - 35 years	3	11	11	25	Reference	
36 - 45 years	2	9	10	21	0.77 (0.12–4.87)	
46 - 55 years	9	6	2	17	8.25 (1.76–38.6)	0.010
56 - 65 years	4	1	2	7	9.78 (1.29–73.9)	
>65 years	3	0	2	5	11.0 (1.27–95.3)	

Bivariate analysis showed a p-value of 0.010 ($p < 0.05$), indicating a significant relationship between age and HbA1c levels in the studied population. This finding indicates that with increasing age, HbA1c levels tend to increase. This is consistent with findings in the journal (Bakri et al., 2023)., which stated that the risk of developing diabetes mellitus increases with age, and individuals aged > 40 years are more susceptible to glucose intolerance (Committee, 2023). This may be due to decreased pancreatic function and increased insulin resistance that occurs with increasing age. This finding demonstrates the importance of monitoring HbA1c levels in older populations to detect and manage diabetes mellitus more effectively.

Table 7 Relationship between Occupational and HbA1c levels

Occupational	HbA1c levels			Total	OR (95% CI)	P-Value
	> 6.5	5.7 – 6.4	< 5,7			
Civil Servants (PNS)	1	0	0	1	5.77 (0.22–149.2)	
Private Employees	13	25	25	63	Reference	
Self Employed/Freelancers	0	0	0	0	-	0.024
Students/College Students	0	0	0	0	-	
Retired/Unemployed	7	2	2	11	9.21 (1.71–49.6)	

Bivariate analysis showed a p-value of 0.024 ($p < 0.05$), indicating a significant relationship between job type and HbA1c levels in the studied population. The results indicate that occupations characterized by low physical activity, irregular work schedules, or high stress are associated with elevated HbA1c levels. For instance, positions involving prolonged sitting or significant workplace stress may increase the risk of insulin resistance and inadequate glycemic control. These findings underscore the need to foster a health-promoting work environment by providing opportunities for physical activity, implementing strategies to manage occupational stress, and encouraging healthy dietary practices. Such interventions may help manage and prevent elevated HbA1c levels among employees.

DISCUSSION

The results indicate that age and occupation were significantly associated with HbA1c levels among patients with type 2 diabetes mellitus (T2DM) treated at Port Medical Center Hospital between 2021 and 2023, while gender was not significantly associated. These findings imply that specific demographic and socioeconomic characteristics may influence long-term glycemic control, although the magnitude and direction of these effects may differ across populations and settings (Widiasari et al., 2021).

Age and HbA1c Levels

A significant association was identified between age and HbA1c levels ($p = 0.010$). This finding suggests that older patients tend to experience poorer glycemic control. Recent international studies indicate that the relationship between age and HbA1c in individuals with established diabetes is complex and inconsistent (Shao et al., 2022). For example, a large multicenter study conducted in Mongolia and Japan reported an inverse relationship between age and HbA1c after adjusting for diabetes duration, complications, and hematological parameters (Byambasukh et al., 2024). Conversely, several population-based and clinical studies have found higher HbA1c levels in older adults, particularly when comorbidities and functional decline are present. These inconsistencies may result from variations in study design, population characteristics, and analytical adjustments. The study by Byambasukh et al. included extensive adjustment for clinical and lifestyle confounders, whereas the current study relied on unadjusted medical record data. In the Indonesian clinical context, increasing age may be associated with longer disease duration, multiple comorbidities, reduced insulin sensitivity, and challenges in maintaining lifestyle modifications, all of which can contribute to suboptimal glycemic control. Recent international guidelines recommend that diabetes management in older adults be individualized, as age-related physiological changes and treatment complexity may influence HbA1c outcomes. Therefore, these findings underscore the need for closer monitoring and tailored interventions for older patients with type 2 diabetes mellitus (T2DM) (Byambasukh et al., 2024). Meanwhile, in the general non-diabetic population, HbA1c typically tends to increase with age, which is associated with physiological changes such as decreased β -cell function, increased insulin resistance, and longer red blood cell lifespan (Stedman et al., 2025)

Occupation and HbA1c Levels

The results showed a significant association between occupation and HbA1c levels ($p = 0.024$). Although specific literature on occupation (e.g., sector, shift work, occupational physical activity) and HbA1c is limited, there is sufficient evidence that work-related physical activity, work lifestyle (e.g., sedentary work or night shifts), and job stress can affect glycemic control. For example, a recent meta-analysis showed that physical activity interventions (including those related to work or daily activities) in people with T2DM resulted in reduced HbA1c, and the optimal dose of physical activity was estimated to be approximately 1,100 MET min/week, with an HbA1c reduction of 0.66% to -1.02% in uncontrolled cases (Gallardo-Gómez et al., 2024). This suggests that occupations that promote physical activity (e.g., those with less sedentary work) may contribute to better HbA1c control than highly sedentary occupations (Tjendera & Yulia, 2019). Furthermore, a systematic review of working-age adults with diabetes showed that interventions that increase physical activity, potentially through modifications to work type or post-work activities, have a positive impact on HbA1c (Zhao et al., 2024).

Gender and HbA1c Levels

This study found no significant association between gender and HbA1c. Recent research has shown that HbA1c patterns differ by gender and age, particularly in non-diabetic or prediabetic populations. For example, the median HbA1c in women <45 years of age was slightly lower than in men (34 vs. 35 mmol/mol), but this difference disappeared in the ≥ 45 age group (Putri et al., 2022), and then study by Ahmed et al in northern Sudan showed that there was no association between gender, BMI, and HbA1c in adults with HbA1c <6.5% (Ahmed et al., 2023; Huang et al., 2021; Younes et al., 2019). This suggests that the effect of gender may be more subtle or dependent on age, ethnic group, or other factors (e.g., hormones, menstruation, menopause) and may not have emerged as a significant association in your study with a sample of 75 patients. The absence of a gender effect in the results may be attributable to factors such as sample size, age distribution, employment type, or limited variability in gender-job characteristics within the study sample. Nevertheless, these findings further support the conclusion that age and employment are significant determinants of glucose control among DM patients at PMC Hospital.

Study Limitation

Several important limitations should be considered. First, the relatively small sample size may limit statistical power, reducing the ability to detect subtle associations, particularly for gender.

Second, the cross-sectional design prevents causal inference regarding the relationship between demographic characteristics and HbA1c levels. Third, occupational status was classified into broad categories, which may not accurately capture differences in physical activity, stress, income, or job stability. Fourth, the analysis did not adjust for key confounding variables known to influence HbA1c, such as body mass index, diabetes duration, treatment type and intensity, dietary intake, and physical activity. Fifth, the use of a single-center, record-based dataset introduces potential selection bias and restricts the generalizability of the findings. Finally, analyzing HbA1c as a categorical variable may have reduced sensitivity to detect more nuanced associations compared with continuous analysis.

Implication

Despite these limitations, the findings highlight the potential significance of age- and occupation-related factors in long-term glycemic control among patients with type 2 diabetes mellitus (T2DM). The absence of a gender effect indicates that diabetes management strategies should focus on modifiable lifestyle and socioeconomic factors rather than demographic characteristics alone. Future research employing larger, multicenter samples, longitudinal designs, detailed occupational assessments, and comprehensive adjustment for clinical and behavioral confounders is necessary to clarify these relationships within the Indonesian context.

CONCLUSIONS

The study identified associations between age and occupation with HbA1c levels among patients with type 2 diabetes mellitus (T2DM) at Port Medical Center Hospital from 2021 to 2023, whereas no association was found with gender. These results indicate that age-related and occupational factors may influence glycemic control; however, causal relationships cannot be established due to the cross-sectional study design. In clinical settings, older patients may require more frequent HbA1c monitoring and tailored counseling. Patients engaged in predominantly sedentary occupations may benefit from interventions such as recommendations for regular movement breaks, increased daily physical activity, and lifestyle counseling incorporated into routine outpatient care. Incorporating occupational information into patient assessments could facilitate the identification of individuals at elevated risk for poor glycemic control. Further research with larger sample sizes and longitudinal designs is necessary to validate these findings and to elucidate the impact of occupational and lifestyle factors on HbA1c levels in patients with T2DM.

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