Syntax Literate: Jurnal Ilmiah Indonesia p–ISSN: 2541-0849
e-ISSN: 2548-1398
Vol. 10, No. 2, Februari 2025

# DETERMINANT FACTORS OF TYPE 2 DIABETES MELLITUS AMONG OLDER ADULTS IN KELATING VILLAGE.

**Indry Agatha Rihi Pake[1*], I Made Gede Dwipayana Putra[2], Jessica Adrya[3], Dewa Ayu Tri Jayaningrat[4], I Made Suma Wirawan[5]**
Wangaya General Teaching Hospital, Indonesia[1,2,3,4]
Universitas Mahasaraswati Denpasar, Indonesia[5]
Email: indry.agatha@gmail.com[*]

**Abstract**

Type 2 diabetes mellitus (DM) increased in the elderly population due to metabolic changes and decreased function of pancreatic β cells. This study aims to determine the prevalence of type 2 diabetes mellitus in the elderly and examine the risk factors—such as age, gender, blood pressure, and uric acid levels—that influence the incidence of type 2 DM. This cross-sectional study involved 31 elderly people (≥60 years) in Segara Santhi, Kelating Village, Tabanan, who were selected using purposive random sampling. Fasting blood glucose and uric acid levels were checked using Accu-Chek after fasting for at least 8 hours. Data analysis used the Fisher's Exact Test with a significance of $p<0.05$. The results show prevalence of type 2 DM was 64.5% (20 of 31 respondents). Age and type 2 DM had no significant association ($p= 0.262$). However, there was a significant association between type 2 DM and gender ($p = 0.012$) and uric acid levels ($p = 0.029$), but not with blood pressure ($p = 1,000$). The prevalence of type 2 DM in the elderly in Segara Santhi is quite high, but age is not the main factor. Other factors such as diet, physical activity, and genetic predisposition may play a greater role. Further studies with larger sample sizes and multivariate analysis are needed to understand the risk factors for type 2 DM in the elderly more specifically.

**Keywords:** Elderly, Insulin Resistance, Risk Factors, Uric acid, Blood pressure

## Introduction

Diabetes mellitus (DM) is currently one of the global threats and health problems of great concern as a non-communicable disease the target of world leaders' management (PERKENI, 2021; World Health Organization, 2016). Based on the cause, diabetes is divided into 4 groups, type 1 DM, type 2 DM, gestational DM, and other types of DM. The Central Statistics Agency of Indonesia in 2003, estimated the number of diabetes in the Indonesian population aged over 20 years is 133 million people, with a prevalence of DM of 14.7% in urban areas and 7.2% in rural areas (PERKENI, 2021; World Health Organization, 2016). The prevalence of type 2 DM is increasing in the world, the increase that occurs is much faster, perhaps influenced by changes in diet and the increasing incidence of obesity, other factors that play a role in decreasing physical activity. The prevalence of DM increases with age. The prevalence of DM in the United States is estimated at 0.25% in individuals aged <20 years, 4.2% in individuals aged 18-44 years, and 17.5% in people aged 45-64 years. In individuals aged >65 years, the prevalence rate of DM is 26.8% related to the data per data that occurs worldwide (Jameson et al., 2018).

According to the 2018 Riskesdas report, the prevalence of DM diagnosed by doctors in Indonesia, aged over 15 years was 2%. This shows that there has been an increase in the prevalence of DM in Indonesia compared to the 2013 Riskesdas data, which was 1.5%. According to age grouping, the 55–64 and 65–74 age groups are the

ones that have DM and It is anticipated that the number of old people will keep growing (Musdalifah & Nugroho, 2020; Riskesdas, 2018). An older person who is independent, industrious, and in good health makes a difference (Milita et al., 2021). On the other hand, the strain on the population of working age will rise if the number of senior individuals who are not in good health rises (Creatore et al., 2010). The most common problems faced by the elderly are health problems, one of which is diabetes. DM is known as a silent killer disease because many patients are not aware before complications occur (Widyaswara et al., 2022). Complications that occur due to DM are disorders of the blood vessels, both macrovascular and microvascular, as well as disorders of the nervous system or neuropathy. Macrovascular complications generally affect organs such as the heart, brain, and blood vessels, while microvascular complications can occur in the eyes and kidneys. DM will have an impact on the quality of human life and there is a significant increase in costs, therefore all parties, both society and government, are involved in preventing an increase in cases of diabetes mellitus (Creatore et al., 2010; Milita et al., 2021; PERKENI, 2021; Widyaswara et al., 2022). Based on this background, the researcher intends to examine the risk factors—such as age, gender, blood pressure, and uric acid levels—that influence the incidence of type 2 DM in Kelating Village.

## Research Methods

This study uses a cross-sectional design to identify the prevalence of Type 2 DM and factors associated with the condition among the elderly in Kelating Village, Tabanan Regency. The cross-sectional study was chosen because it allows for data collection at a single point in time, providing an overview of the fasting blood glucose (FBS) and uric acid levels in the blood of the elderly and the risk factors that may play a role. This study was conducted in Kelating Village, Kerambitan District, Tabanan Regency. Kelating Village was selected because no similar study had been undertaken there before. Purposive random sampling was applied to select the sample to fulfill the target of 31. According to the Ministry of Health of the Republic of Indonesia (2013), the age requirement for inclusion is 60 years or above. FBS is the study's dependent variable. Every senior in the Segara Santhi group who attended had their FBS levels measured, and evaluated, and the findings documented. A stick strip test with dry reagents and a device called "Accu Check" was used to measure blood glucose levels. All research samples were fasted for a minimum of eight hours before the examination. The FBS-level test results were entered into a register for analysis and displayed in a table. Statistical Product and Severe Solutions (SPSS) version 28.0 was used to analyze the data using the Fisher exact statistical test. A frequency distribution table is used to present the data.

## Results and Discussion

The study consisted of 31 respondents as research samples; 4 respondents aged ≥65 years were identified as elderly at risk, and 27 participants aged 60–64 years were identified as early elderly. Sample distribution by age, gender, fasting blood pressure, and blood glucose is displayed in Table 1 below.

**Table 1. Distribution of Characteristics of Research Respondents**

| No. | Participants Characteristics | Frequencies | Percentage (%) | Mean ± SD |
|---|---|---|---|---|
| 1 | **Gender** | | | |
| | Female | 23 | 74.2 | |
| | Malle | 8 | 25.8 | |
| 2 | **Age Group** | | | |

| No. | Participants Characteristics | Frequencies | Percentage (%) | Mean ± SD |
|---|---|---|---|---|
| | 60-64 years (Early Elderly) | 27 | 87.1 | 1.87 ± 0.34 |
| | ≥ 65 tahun (Elderly at High Risk) | 4 | 12.9 | |
| 3 | **Fasting Blood Glucose** | | | |
| | Without Type 2 DM (< 126 mg/dL) | 11 | 35.5 | 1.64 ± 0.48 |
| | Type 2 DM (≥ 126 mg/dL) | 20 | 64.5 | |
| 4 | **Blood Pressure** | | | |
| | Hypertension (≥ 140/90) | 10 | 32.3 | 0.32 ± 0.47 |
| | Without Hypertension (< 140/90) | 21 | 67.7 | |
| 5. | **Uric Acid Levels** | | | |
| | Without Hyperuricemia (< 7 mg/dL) | 14 | 45.2 | 1.45 ± 0.50 |
| | Hyperuricemia (≥7 mg/dL) | 17 | 54.8 | |
| | **Total Participants** | 31 | 100 | |

**Abbreviations:** DM, diabetes mellitus;

The results of the study in Table 1 show that 20 respondents (64.5%) of the Segara Shanti elderly group had FBS levels ≥ 126 mg/dl and 11 people (35.5%) had normal FBS levels.

**Table 2. Distribution of Respondents' Characteristics Based on Gender and Fasting Blood Glucose**

| No. | Gender | Fasting Blood Glucose | | Percentage (%) | Total | *p-value* |
|---|---|---|---|---|---|---|
| | | Type 2 DM | Without Type 2 DM | | | |
| **1** | Female | 5 | 18 | 74.1 | 23 | |
| **2** | Male | 6 | 2 | 25.8 | 8 | |
| | Total | 11 | 20 | 100 | 31 | 0.012 |

Table 2 provides a more detailed description of the respondents' distribution. Based on FBS levels and gender, 11 individuals (35.5%) were judged to have type 2 DM. Five females and six males were diagnosed with type 2 DM.

**Table 3. Results of Cross Tabulation Analysis between Fasting Blood Glucose and Gender**

| | Value | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| **Pearson Chi-Square** | 7.355[a] | 1 | .007 | | |
| **Continuity Correction[b]** | 5.212 | 1 | .022 | | |
| **Likelihood Ratio** | 7.242 | 1 | .007 | | |
| **Fisher's Exact test** | | | | .012 | .012 |
| **Linear-by-linear Association** | 7.118 | 1 | .008 | | |
| **N of Valid Cases** | 31 | 1 | | | |

Note:

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .26.
b. Computed only for a 2x2 table

Due to more than 20% of cells having an expected count of less than 5, Fisher's Exact Test was used instead of Fisher's Exact Test. As shown in Table 3, the analysis reveals a significant association between type 2 DM and gender (p = 0.012), indicating an association between the two variables.

**Table 4. Distribution of Respondent Characteristics Based on Age Group and Fasting Blood Glucose**

| No. | Age Group | Fasting Blood Glucose | | Percentage (%) | Total | p-value |
|---|---|---|---|---|---|---|
| | | Type 2 DM | Without Type 2 DM | | | |
| **1.** | 60-64 years (Early Elderly) | 2 | 8 | 32.3 | 10 | 0.262 |
| **2.** | ≥ 65 tahun ≥ 65 tahun (Elderly at High Risk) | 9 | 12 | 67.7 | 21 | |
| | Total respondent | 11 | 20 | 100 | 31 | |

Table 4 provides an overview of type 2 DM by age group. Up to 2 individuals in the early elderly (60–64 years old) age group have type 2 DM, and up to 9 individuals in the at-risk elderly (≥65 years old) age group have type 2 DM.

**Table 5. Results of Cross Tabulation Analysis between Age Groups and Fasting Blood Glucose**

| | Value | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| **Pearson Chi-Square** | 1.546[a] | 1 | .214 | | |
| **Continuity Correction[b]** | .709 | 1 | .400 | | |
| **Likelihood Ratio** | 1.634 | 1 | .201 | | |
| **Fisher's Exact test** | | | | .262 | .202 |
| **Linear-by-linear Association** | 1.496 | 1 | .221 | | |
| **N of Valid Cases** | 31 | | | | |

Note:
a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.84..
b. Computed only for a 2x2 table

The analysis using Fisher's Exact Test (Table 5) indicates no significant association between age groups and type 2 DM (p= 0.262). These findings suggest that age categories are not correlated with type 2 DM.

**Table 6. Respondent Characteristics by Blood Pressure and Fasting Blood Glucose Distribution**

| No. | Blood Pressure | Fasting Blood Glucose | | Percentage (%) | Total | *p-value* |
|---|---|---|---|---|---|---|
| | | Type 2 DM | Without Type 2 DM | | | |
| **1.** | Hypertension (≥140/90) | 3 | 8 | 35.5 | 11 | 1.000 |
| **2.** | Without Hypertension < 140/90 | 13 | 7 | 64.5 | 20 | |
| | Total respondent | 21 | 10 | 100 | 31 | |

Table 6 shows an overview of type 2 DM effects on blood pressure. Type 2 DM is present in up to 3 individuals with blood pressure ≥ 140/90 and up to 13 individuals with blood pressure < 140/90.

**Table 7. Results of Cross Tabulation Analysis between Blood Pressure and Fasting Blood Glucose**

| | Value | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| **Pearson Chi-Square** | ·194[a] | 1 | .660 | | |
| **Continuity Correction[b]** | .002 | 1 | .969 | | |
| **Likelihood Ratio** | .197 | 1 | .657 | | |
| **Fisher's Exact test** | | | | 1.000 | .490 |
| **Linear-by-linear Association** | .188 | 1 | .665 | | |
| **N of Valid Cases** | 31 | 1 | | | |

Note:
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 3.55.
b. Computed only for a 2x2 table

According to Table 7, type 2 DM and blood pressure are unrelated. Type 2 DM and blood pressure insignificantly correlate, according to analysis using the Fisher Exact Test (p = 1,000).

**Table 8. Distribution of Respondent Characteristics Based on Uric Acid and Fasting Blood Glucose**

| No. | Uric Acid Levels | Fasting Blood Glucose | | Percentage (%) | Total | *p-value* |
|---|---|---|---|---|---|---|
| | | Type 2 DM | Without Type 2 DM | | | |
| 1. | Hyperuricemia (≥7 mg/dL) | 9 | 8 | 29.0% | 17 | 0.029 |
| 2. | Without Hyperuricemia (< 7 mg/dL) | 2 | 12 | 25.8% | 14 | |
| | Total respondent | 11 | 20 | 100 | 31 | |

In table 8. shows an overview of type 2 DM on uric acid levels. A total of 9 respondents with uric acid levels ≥7 mg/dL or hyperuricemia accompanied by type 2 DM and as many as 2 respondents with uric acid levels <7 mg/dL accompanied by type 2 DM.

**Table 9. Results of Cross Tabulation Analysis between Uric Acid and Fasting Blood Glucose**

| | Value | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| **Pearson Chi-Square** | 5.0114[a] | 1 | .025 | | |
| **Continuity Correction[b]** | 3.456 | 1 | .063 | | |
| **Likelihood Ratio** | 5.333 | 1 | .021 | | |
| **Fisher's Exact test** | | | | .029 | .057 |
| **Linear-by-linear Association** | 4.850 | 1 | .028 | | |
| **N of Valid Cases** | 31 | 1 | | | |

Note:
a. 1 cells (25.5%) have expected count less than 5. The minimum expected count is 4.97.
b. Computed only for a 2x2 table

Table 9 summarizes the outcomes of the Fisher Exact Test. Explain how uric acid levels are affected by type 2 DM, specifically p = 0,029.

**Discussion**

The theory of aging divides the age limit into certain phases. At the age of 35 to 45 years, a transition stage occurs, where symptoms of aging begin to appear and show a decline in the body's physiological functions that can cause various diseases. The clinical stage, which starts at age 45 and encompasses a deterioration in all bodily system functions, including the immune system, metabolism, and cardiovascular health, is when the symptoms and indicators of aging become more apparent (Musdalifah & Nugroho, 2020).

According to this study, 2 out of 10 respondents with type 2 DM are between the ages of 60 and 64, and 9 out of 21 respondents with the disease are over 65. Overall, the risk incidence of disease in the elderly is 67.7%. The Fisher's Exact Test revealed no association between type 2 DM and age group (p = 1,000). These results show that, across all age categories examined, the prevalence of type 2 DM in the study population is comparatively uniform. These findings run counter to some earlier research that demonstrated that increased insulin resistance and pancreatic β-cell dysfunction make older age the primary risk factor for type 2 diabetes. Amaia et al. showed that early elderly people have a 2.28 times greater risk than elderly people for type 2 DM (p-value = 0.000). This reflects the specific characteristics of the population studied, where other risk factors such as diet, lifestyle, physical activity, and genetic predisposition may play a greater role than age alone in determining the occurrence of type 2 DM (Milita et al., 2021). Although DM is usually diagnosed in middle-aged or elderly people, a new trend for type 2 diabetes is emerging at an earlier age as a result of unhealthy lifestyles.

There were 6 older males and 5 older women who reported having type 2 DM. Based on these findings, it was determined that gender and the prevalence of type 2 DM were significantly correlated (p = 0.012). These findings are corroborated by research by Professor Naveed Sattar of the Institute of Cardiovascular and Medical Science, which shows that the amount of body fat determines risk. Specifically, men are more likely to develop central obesity, which increases the risk of metabolic disorders and, consequently, DM (Creatore et al., 2010). Another study supports the findings, According to Rahmi et al. assessment of the prevalence of DM in the Padang population, men are more likely than women to develop the disease (Musdalifah & Nugroho, 2020). DM can affect anyone, both women and men, where there are factors that cause DM such as genetics/heredity, besides that it can also be influenced by unhealthy diet patterns, obesity, and stress (Creatore et al., 2010).

In this study, there was no association between type 2 DM and blood pressure. The results of the Fisher's Exact Test were p = 1,000. Results that show no association were also found in a study conducted by Widyaswara G., et al. (2022) This study obtained no association results between systolic and diastolic blood pressure on type 2 DM, namely, p = 0.439 and p = 0.889 respectively (Widyaswara et al., 2022). Similar research was conducted by Hafid KA, et al. with the Pearson Correlation test obtained a value of p = 0.355 and r = -0.061 which stated that there was no relationship between type 2 DM and blood pressure (Sangadji et al., 2022). The results obtained by Gultom AG, et al. using

the Pearson test between systolic and diastolic pressure had no relationship with type 2 DM, with the results p = 0.161 and p = 0.158 respectively (Gultom & Ginting, 2023). The results of this study found no relationship between type 2 DM and blood pressure. In patients with type 2 DM, uncontrolled blood glucose levels can lead to problems including macroangiopathy, which has an impact on blood pressure. Age and lifestyle are two of the many variables that affect blood pressure, which can rise with age. Because it can lead to insulin resistance, which alters blood glucose levels and carbohydrate metabolism, hypertension can be a significant risk factor for DM. Insulin resistance, which frequently starts with obesity, and reduced insulin production by pancreatic β cells are the main causes of type 2 DM. Moreover, hyperinsulinemia in type 2 DM raises the risk of stroke and cardiovascular disease and can result in hypertension (Sangadji et al., 2022; Widyaswara et al., 2022).

Hyperuricemia contributes to the metabolic effects of fructose through the NALP3 inflammasome. This causes endothelial damage, increased insulin resistance, and hypertension. In addition to hexokinase, ketohexokinase can also mediate fructose metabolism53,54. Fructose is mainly metabolized by ketohexokinase with the enzyme fructokinase C (KHK-C) or KHK, and the resulting fructose-1-phosphate rapidly causes a decrease in ATP and phosphorylation levels. AMP deaminase activity increases due to a decrease in intracellular phosphatase; this causes the conversion of AMP to IMP, stimulates uric acid production, and accelerates the production of inosine monophosphate (IMP) and uric acid (Andres-Hernando et al., 2020; Zhang et al., 2020). Research on uric acid levels with fasting blood sugar levels in the Fisher Exact test (p = 0.057). The results of this study are the same as the results obtained by Siregar et al. (2015) with the results of the study using the Pearson Correlation test, a positive correlation between uric acid levels and FBS levels of r = 0.652 (p <0.0001) (Siregar & Nurkhalis, 2015). Research conducted by Wicaksani (2024) by using the Spearman statistical test, a significant correlation was obtained between uric acid levels and blood sugar levels, namely p = 0.001 with a strong correlation strength, namely r = 0.416.

## Conclusion

According to this study, 64.5% of the elderly Segara Santhi population in Kelating Village, Tabanan, have type 2 diabetes mellitus (DM). Age may not be the primary factor in the development of type 2 diabetes, since statistical analysis revealed no association between age group and incidence. Nonetheless, this study discovered a strong association between type 2 DM and hyperuricemia and gender, indicating that men are more likely than women to develop DM. Given the high prevalence of type 2 DM in this study's older group, efforts are required to raise public awareness, particularly among the elderly, regarding the significance of routine health checks and healthy lifestyle adjustments.

Given that no association between age and type 2 diabetes was discovered, future researchers are likely to conduct additional research with a bigger sample size and an analysis that takes into account other risk variables like nutrition, physical activity, and genetic factors. To lower the prevalence of type 2 diabetes among the elderly, the local government and medical professionals in Kelating Village may also want to consider implementing a community-based intervention program that emphasizes treating metabolic risk factors, promoting physical activity, and educating people about nutrition.

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