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Older Adults Exhibit a Nine-Fold Increased Risk of Type 2 Diabetes Mellitus: Evidence from a Hospital-Based Cross-Sectional Analysis

Ni Putu Widyanti Suastiari[1)], Andiani[2)]

[1)]Faculty of Medicine, Universitas Wijaya Kusuma Surabaya, Indonesia
[2)]Department of Internal Medicine, Faculty of Medicine,
Universitas Wijaya Kusuma Surabaya, Indonesia

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ABSTRACT

Background: Type 2 diabetes mellitus represents a significant global health burden with increasing prevalence worldwide. Age and gender are recognized as important demographic risk factors influencing diabetes incidence. This study aimed to determine the relationship between age and gender with the incidence rate of type 2 diabetes mellitus at Bhayangkara Pusdik Brimob Watukosek Hospital.

Subjects and Method: This cross-sectional study conducted at internal medicine polyclinic, Bhayangkara Pusdik Brimob Watukosek Hospital, Pasuruan, East Java, Indonesia, from October 2020 to May 2021. Study subjects of 250 patients were selected using total sampling technique. Secondary data from medical records were analyzed using odds ratio calculations to determine associations between age (categorized as high-risk ≥45 years vs low-risk <45 years) and gender with type 2 diabetes mellitus incidence. Data were analyzed using a multiple logistic regression.

Results: Among 250 respondents, 140 (56.00%) were diagnosed with type 2 diabetes mellitus. High-risk age group comprised 136 respondents (54.40%), with 107 (76.40%) having diabetes. Female respondents totaled 148 (59.20%), with 80 (57.10%) having diabetes. Age demonstrated significant association with diabetes incidence (OR= 9.06; 95% CI= 5.15 to 15.93; p<0.001), indicating that high-risk age individuals were nine times more likely to develop diabetes compared to low-risk age individuals. Gender showed no significant association with diabetes incidence (OR= 0.82; 95% CI= 0.48 to 1.41; p=0.475).

Conclusion: Age has a significant relationship with type 2 diabetes mellitus, while gender shows no significant association.

Keywords: Age, gender, cross-sectional study, type 2 diabetes mellitus

Correspondence:
Ni Putu Widyanti Suastiari. Department of Internal Medicine, Faculty of Medicine, Wijaya Kusuma University. Jl. Dukuh Kupang 25 No.54, Surabaya 60225, East Java, Indonesia. Email: putuwidyanti03@gmail.com. Phone: +6282237809858.

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BACKGROUND

The prevalence of diabetes mellitus in both developed and developing countries has experienced substantial increases over recent decades (Sun *et al.*, 2022). According to the International Diabetes Federation, global diabetes prevalence reached 10.50% (536.6 million people) in 2021, with

projections indicating an increase to 12.20% (783.2 million people) by 2045 (Sun *et al.*, 2022). The Global Burden of Disease Study 2021 reported that 529 million people worldwide were living with diabetes, representing an age-standardized prevalence of 6.10% (Ong *et al.*, 2023). In Indonesia, diabetes prevalence is projected to increase dramatically from 9.19% in 2020 to 16.09% by 2045, highlighting the urgent need for comprehensive prevention and management strategies (Wahidin *et al.*, 2024).

Type 2 diabetes mellitus represents approximately 90% of all diabetes cases globally and is characterized by a progressive decline in pancreatic β-cell function combined with insulin resistance (Zheng, Ley and Hu, 2018). The pathophysiology involves multiple mechanisms including impaired insulin secretion, reduced insulin sensitivity in peripheral tissues, and increased hepatic glucose production (Petersen and Shulman, 2018). This metabolic dysfunction typically develops over years, with the pancreas initially compensating for insulin resistance through increased insulin production until β-cell failure occurs (Eizirik, Pasquali and Cnop, 2020).

Age emerges as one of the most significant non-modifiable risk factors for type 2 diabetes mellitus development. Research demonstrates that diabetes risk increases substantially after age 45 years, with the aging process contributing to progressive physiological decline(Chia, Egan and Ferrucci, 2018). Age-related changes include decreased pancreatic β-cell function, progressive insulin resistance, reduced physical activity, and increased adiposity (Bellary *et al.*, 2021). The cellular mechanisms underlying age-related β-cell dysfunction involve mitochondrial dysfunction, oxidative stress, endoplasmic reticulum stress, and impaired insulin secretion capacity (Khin, Lee and Jun, 2023). Studies consistently show that individuals aged ≥60 years have significantly higher odds of developing type 2 diabetes mellitus, with some research reporting odds ratios as high as 7.53 compared to younger age groups (Elshaikh *et al.*, 2024).

Gender differences in type 2 diabetes mellitus prevalence present complex patterns that vary across populations and age groups. Some studies indicate male predominance in diabetes prevalence, particularly in middle-aged populations, while others show minimal gender-based differences (Tramunt *et al.*, 2020). A study demonstrates that men are typically diagnosed with type 2 diabetes mellitus at younger ages and lower body mass index compared to women (Kautzky-Willer, Leutner and Harreiter, 2023). However, women face unique risk factors including hormonal fluctuations during menopause, higher body fat composition, and polycystic ovary syndrome (Huebschmann *et al.*, 2019).

The hospital setting provides valuable opportunities for examining diabetes epidemiology and risk factors. Hospital-based studies offer advantages including access to comprehensive medical records, standardized diagnostic procedures, and diverse patient populations (ElSayed *et al.*, 2024). Understanding demographic risk factors in specific healthcare settings enables targeted prevention strategies and improved clinical management protocols. This study aimed to investigate the relationship between age and gender with type 2 diabetes mellitus incidence at Bhayangkara Pusdik Brimob Watukosek Hospital, contributing to the growing body of evidence on diabetes epidemiology in Indonesian healthcare settings.

SUBJECTS METHOD

1. Study Design

This study employed a cross-sectional design to examine the relationship between age and gender with type 2 diabetes mellitus incidence. Cross-sectional studies are particularly suitable for assessing prevalence and associations between variables at a single point in time (Setia, 2016). The study was conducted at Bhayangkara Pusdik Brimob Watukosek Hospital, Surabaya, Indonesia, from October 2020 to May 2021.

2. Population and Sample

The target population consisted of all patients with type 2 diabetes mellitus visiting internal medicine polyclinic. The source population (accessible population) comprised all patients visiting the internal medicine polyclinic at Bhayangkara Pusdik Brimob Watukosek Hospital from October 2020 to May 2021. Total sampling technique was employed, resulting in 250 respondents meeting the inclusion criteria. Inclusion criteria comprised patients aged 18 years and above with complete medical records and clear diabetes diagnosis documentation. Exclusion criteria included patients with incomplete demographic data, unclear diabetes diagnosis, or type 1 diabetes mellitus.

3. Study Variables

The dependent variable in this study was type 2 diabetes mellitus incidence. The independent variables were age (categorized as high-risk ≥45 years and low-risk <45 years) and gender (categorized as male or female).

4. Operational Definition of Variables

Type 2 diabetes mellitus was defined based on clinical documentation using American Diabetes Association criteria including fasting plasma glucose ≥7.0 mmol/l, oral glucose tolerance test 2-hour plasma glucose ≥11.1 mmol/l, or HbA1c ≥6.5% (American Diabetes Association, 2024). Age was defined as chronological age at the time of hospital visit, categorized into high-risk (≥45 years) and low-risk (<45 years) groups based on established diabetes risk stratification guidelines (ElSayed, Aleppo, Bannuru, Bruemmer, Collins, Ekhlaspour, Gaglia, *et al.*, 2024). Gender was defined as biological sex documented in medical records, categorized as male or female.

5. Study Instruments

Data on type 2 diabetes mellitus diagnosis were obtained from medical records based on clinical documentation and laboratory results. Patient demographic data including age and gender were collected from medical record documentation. All data were extracted using a standardized data collection form designed specifically for this study to ensure consistency and completeness of information.

6. Data Analysis

Data analysis utilized odds ratio calculations to determine associations between independent variables (age and gender) and the dependent variable (type 2 diabetes mellitus incidence). Statistical analysis was performed using logistic regression with significance set at $p<0.050$. Confidence intervals were calculated at 95% level. The strength of association was measured using odds ratio with 95% confidence interval.

7. Research Ethics

Research ethical issues including informed consent, anonymity, and confidentiality, were addressed carefully during the study process. This study utilized secondary data from medical records with appropriate institutional approval from Bhayangkara Pusdik Brimob Watukosek Hospital. Patient confidentiality was maintained throughout the data collection and analysis process by using coding systems and removing personal identifiers. The study

protocol adhered to the Declaration of Helsinki principles for medical research involving human subjects. The research ethical clearance approval letter was obtained from the Health Research Ethics Committee, Faculty of Medicine, Universitas Wijaya Kusuma Surabaya, Indonesia, No. 33/SLE/FK/UWKS/2021, on June 17, 2021.

RESULTS

1. Sample Characteristics

Among 250 respondents examined in this study, the mean age was 52.30 years (SD= 14.25 years) with age range from 25 to 78 years. The majority of respondents belonged to the high-risk age group (≥45 years), comprising 136 respondents (54.40%), while 114 respondents (45.60%) were in the low-risk age group (<45 years). Gender distribution showed female predominance with 148 respondents (59.20%) compared to male respondents totaling 102 (40.80%). Overall, 140 respondents (56.00%) were diagnosed with type 2 diabetes mellitus, while 110 respondents (44.00%) did not have diabetes diagnosis.

Table 1. Sample Characteristics of Study Population (N=250)

Characteristics	Category	Frequency	Percentage
Age	High-risk ≥45 years	136	54.40%
	Low-risk (<45 years)	114	45.60%
Gender	Female	148	59.20%
	Male	102	40.80%
Type 2 Diabetes Mellitus	Yes	140	56.00%
	No	110	44.00%

2. Bivariate Analysis

Relationship between Age and Type 2 Diabetes Mellitus

The analysis demonstrated a strong association between age and type 2 diabetes mellitus incidence. Among respondents in the high-risk age group (≥45 years), 107 out of 136 (78.68%) had diabetes compared to 33 out of 114 (28.95%) in the low-risk age group (<45 years). This association was statistically significant (OR= 9.06; 95% CI= 5.15 to 15.93; p<0.001), indicating that individuals in the high-risk age group were nine times more likely to develop type 2 diabetes mellitus compared to those in the low-risk age group.

Table 2. Relationship between Age and Type 2 Diabetes Mellitus Incidence

Relationship between Gender and Type 2 Diabetes Mellitus

Age Group	Type 2 DM Status		Total	OR	95%CI	p
	Yes	No				
High-risk (≥45 years)	107 (78.68%)	29 (21.32%)	136 (100%)	9.06	5.15 to 15.93	<0.001
Low-risk (<45 years)	33 (28.95%)	81 (71.05%)	114 (100%)			

Gender analysis revealed that 80 out of 148 female respondents (54.05%) had type 2 diabetes mellitus compared to 60 out of 102 male respondents (58.82%). This difference was not statistically significant (OR= 0.82; 95% CI= 0.48 to 1.41; p= 0.475), indicating that gender is not a significant risk factor for type 2 diabetes mellitus development in this population.

Table 3. Relationship between Gender and Type 2 Diabetes Mellitus Incidence

Gender	Type 2 DM Status		Total	OR	95%CI	p
	Yes	No				
Female	80 (54.05%)	68 (45.95%)	148 (100%)	0.82	0.48 to 1.41	0.475
Male	60 (58.82%)	42 (41.18%)	102 (100%)			
Total	140 (56.00%)	110 (44.00%)	250 (100%)			

DISCUSSION

The findings of this study demonstrate a strong association between age and type 2 diabetes mellitus incidence, with an odds ratio of 9.06 (CI95% 5.15 to 15.93; p <0.001), indicating that individuals in the high-risk age group are nine times more likely to develop diabetes compared to those in the low-risk age group. This finding aligns with current evidence demonstrating age as a primary risk factor for type 2 diabetes mellitus development (Bellou *et al.*, 2018). The relationship between advancing age and increased diabetes risk involves multiple pathophysiological mechanisms. Age-related changes include progressive pancreatic β-cell dysfunction, characterized by reduced insulin secretory capacity and impaired glucose responsiveness (Khin et al., 2023).

Additionally, aging is associated with increased insulin resistance in peripheral tissues, decreased physical activity, and changes in body composition favoring increased adiposity. These degenerative processes collectively contribute to glucose homeostasis disruption and eventual type 2 diabetes mellitus development .

Research consistently supports the significant relationship between age and diabetes risk. A comprehensive cross-sectional study reported an adjusted odds ratio of 7.53 for individuals aged ≥60 years compared to younger age groups (Elshaikh *et al.*, 2024). Similarly, epidemiological studies demonstrate that diabetes prevalence increases substantially after age 45 years, with the most dramatic increases occurring in individuals over 65 years (Liu *et al.*, 2020). The current study's findings, showing an odds ratio of 9.06 for individuals ≥45 years, are consistent with this body of evidence and may reflect the broader age range used in the current analysis.

However, it is important to note that not all individuals in the high-risk age group develop type 2 diabetes mellitus, suggesting that other modifiable risk factors play crucial roles. These modifiable factors include obesity, physical inactivity, hypertension, dyslipidemia, smoking habits, and stress management (Zhao *et al.*, 2023). Individuals who maintain healthy lifestyle practices, including regular physical activity, balanced nutrition, and weight management, may significantly reduce their diabetes risk despite advancing age.

The study findings indicate no significant association between gender and type 2 diabetes mellitus incidence, with an odds ratio of 0.82 (95% CI= 0.48 to 1.41; p= 0.475). This result contrasts with some previous research suggesting higher diabetes risk in specific gender groups due to hormonal factors and body composition differences (Wang *et al.*, 2019). Current evidence regarding gender differences in type 2 diabetes mellitus prevalence presents mixed results across different populations and age groups.

The absence of significant gender association in this study may be attributed to several factors. Research indicates that women often exhibit greater awareness of

ideal body weight and may engage in more proactive dietary behaviors to maintain healthy weight, potentially reducing diabetes risk (Troncone *et al.*, 2020).

Additionally, the hospital-based study design may have introduced selection bias, as healthcare-seeking behaviors may differ between genders. Women may be more likely to seek preventive healthcare services and maintain regular medical follow-up, potentially leading to earlier detection and management of pre-diabetic conditions.

The study findings have important clinical implications for diabetes prevention and management strategies. The strong association between age and type 2 diabetes mellitus incidence emphasizes the need for intensified screening and prevention efforts targeting individuals aged ≥45 years. Healthcare providers should implement comprehensive risk assessment protocols for older adults, including regular glucose monitoring, lifestyle counseling, and early intervention strategies.

The absence of significant gender association suggests that diabetes prevention strategies should focus on modifiable risk factors rather than gender-specific approaches. Universal screening protocols and lifestyle interventions may be more effective than gender-targeted programs in this population (El-Sayed *et al.*, 2024).

Several limitations should be considered when interpreting these findings. The cross-sectional design limits causal inference, and the hospital-based setting may not represent the general population. Additionally, the study did not control for other important confounding variables such as body mass index, family history, socioeconomic status, and lifestyle factors, which could influence the observed associations.

Future research should employ longitudinal designs with comprehensive risk factor assessment and larger, more diverse populations to validate these findings and explore the complex interactions between demographic and lifestyle factors in type 2 diabetes mellitus development. The current study contributes to the growing body of evidence on diabetes epidemiology in Indonesian healthcare settings and provides valuable insights for clinical practice and public health policy development. The findings support the implementation of age-based screening protocols and emphasize the importance of comprehensive diabetes prevention strategies in hospital-based healthcare delivery systems.

AUTHORS CONTRIBUTION

Ni Putu Widyanti Suastiari formulated the research concept, designed the cross-sectional study methodology, extracted and collected data from medical records, conducted statistical analysis using logistic regression, interpreted study findings, wrote the original manuscript draft, and finalized manuscript revisions. Andiani supervised the overall research project, validated the study methodology and data collection procedures, guided statistical analysis and result interpretation, reviewed and revised the manuscript, and provided final approval for publication.

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CONFLICT OF INTEREST

The authors declare that the study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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