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Risk Factors Associated with Elderly Diabetes Patients

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ABSTRACT

Background: Diabetes mellitus is a chronic disease with increasing global prevalence, including in Indonesia. Among the elderly, its management is more complex due to age-related physiological changes and comorbidities. This study aimed to identify and analyze risk factors associated with diabetes in the elderly population.

Subjects and Method: This retrospective cross-sectional study analyzed medical records of 1,634 inpatients with type 2 diabetes mellitus at PKU Muhammadiyah Hospital Yogyakarta from January 2021 to July 2023. Total sampling was used. Data on demographics, comorbidities, and laboratory values were analyzed using Chi-square test.

Results: Of 1,634 patients, 853 (52.52%) were aged >65 years. Significant risk factors associated with elderly diabetes included elevated erythrocytes (OR= 1.60; 95% CI= 1.32–1.96; p <0.001), urea (OR= 1.51; 95% CI= 1.23–1.86; p <0.001), lymphocytes (OR= 1.26; 95% CI = 1.04–1.53; p= 0.020), hemoglobin (OR= 1.38; 95% CI = 1.14–1.68; p <0.001), systolic blood pressure (OR= 1.33; 95% CI= 1.07–1.65; p= 0.009), stroke (OR= 1.59; 95% CI = 1.09–2.32; p= 0.016), creatinine (OR= 1.24; 95% CI= 1.02–1.51; p= 0.028), and hypertension (OR= 1.29; 95% CI = 1.03–1.63; p= 0.028). Conversely, cholesterol (OR= 0.89; 95% CI= 0.65–1.23; p<0.001), and glucose (OR= 0.65; 95% CI= 0.51–0.83; p <0.001) were inversely associated.

Conclusion: Elderly diabetes is significantly associated with multiple clinical and laboratory indicators. These findings highlight the importance of comprehensive monitoring to improve elderly diabetes management.

Keywords: elderly, diabetes, diabetes management, hypertension

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BACKGROUND

Diabetes is characterized as a metabolic disorder with clinical manifestations including chronic hyperglycemia, abnormalities in blood lipid and protein levels, and other symptoms that increase the risk of morbidity and mortality. Healthy eating habits and regular exercise are effective prevention methods for diabetes (Demirtas *et al.*, 2015). The prevalence of type 2 diabetes mellitus (T2DM) is consistently on the rise due to urbanization, aging populations, and lifestyle changes, particularly affecting individuals over 65 years of age(Saeedi *et al.*, 2019; LeRoith *et al.*, 2019). According to projections by the International Diabetes Federation (IDF), the global adult prevalence of diabetes

mellitus is expected to increase to 10.2% (578 million people) by 2030 and 10.9% (700 million people) by 2045. In 2019, the prevalence among adults was projected to be 9.3% (463 million people[2]. Diabetes ranks among the top 10 causes of death in adults worldwide, responsible for 4 million deaths globally(Xu *et al.*, 2018). Indonesia is among the top 10 countries in terms of diabetes prevalence, with 10.7 million people affected (Kementerian Kesehatan RI). The impact of diabetes on mortality rates and the financial stability of healthcare facilities is a significant concern (Harding *et al.*, 2019).

The majority of diabetes cases are diagnosed between the ages of 40 and 59, with 80 percent of these individuals residing in low to middle-income countries (Whiting *et al.*, 2011). Hyperglycemia, a side effect of diabetes, adversely affects numerous organs due to the chronic nature of the disease itself. The incidence of diabetes complications, hospitalizations, and mortality is significantly higher among the elderly diabetic population (Chew *et al.*, 2013)(Ki *et al.*, 2014). Research findings have established a correlation between diabetes and specific blood characteristics, such as lower red blood cell counts and higher white blood cell and platelet counts in individuals with diabetes(Arkew *et al.*, 2021)(Engström *et al.*, 2014)(Milosevic and Panin, 2019). Individuals with diabetes are also at a higher risk of developing comorbidities, including hypertension, obesity, hyperlipidemia, chronic kidney disease, and cardiovascular diseases(Iglay *et al.*, 2016).

Several studies on the risk factors for diabetes in the elderly have been conducted using community data. For instance, research in India by Ujjwal Das & Nishamani Kar (2023) found that obesity, a family history of diabetes, marital status, educational level, and belonging to less affluent families are associated with an increased risk of diabetes in the elderly(Das and Kar, 2023). Another study by Yan et al. in China indicated that elderly diabetes patients closely correlate with decreased cholesterol levels(Yan *et al.*, 2023).

Further research by Oktaviyani et al. (2022) in Indonesia revealed that the risk factors for diabetes in the elderly include age, gender, educational level, marital status, domicile, and occupation (Oktaviyani *et al.*, 2022). Research on the risk factors for diabetes in the elderly utilizing clinical data, demographic data, and laboratory data is still scarce, especially in Indonesia. The objective of this study is to identify the factors associated with type 2 diabetes in elderly patients hospitalized in Rumah Sakit PKU Muhammadiyah Kota, Yogyakarta, Indonesia.

SUBJECTS METHOD

1. Study Design

This was a observational study. Study subject was type 2 diabetes mellitus patients hospitalized at PKU Muhammadiyah Kota, Yogyakarta from January 1, to July 31, 2021.

2. Population and Sample

Sample collection was conducted through total sampling of type 2 diabetes mellitus patients hospitalized at PKU Muhammadiyah Kota, Yogyakarta. The inclusion criteria were: (1) patients diagnosed with type 2 diabetes mellitus; (2) inpatient status; and (3) age above 18 years. Exclusion criteria included patients with incomplete data (1), blood pressure data (2), or other clinical parameters that were not recorded. The total sample size of this study was 1634 patients.

3. Study Variables

The dependent variables were comorbidities (such as hypertension, dyslipidemia,

chronic kidney disease, history of coronary artery disease, chronic obstructive pulmonary disease, and cancer), and blood test results (such as leukocytes, neutrophils, thrombocytes, hemoglobin, and platelets). The independent variables were age and gender.

4. Operational Definition of Variables

The operational definition of the study's variables includes the categorization of patient data into distinct independent and dependent variables. Age is classified into two groups: ≤59 years and >60 years, serving as the independent variable. The dependent variables encompass patient gender, the presence of comorbidities (including hypertension, dyslipidemia, chronic kidney disease, history of coronary artery disease, chronic obstructive pulmonary disease, and cancer), as well as blood test results such as leukocytes, neutrophils, thrombocytes, hemoglobin, and platelets. These variables were selected to explore potential associations and predictive relationships within the context of the research objectives.

5. Study Instruments

In this study, the research instrument employed involves the utilization of medical record data. This data serves as a primary source for collecting relevant information and provides an empirical basis for the analysis

6. Data analysis

The data presentation of this study employs descriptive statistics, represented as absolute numbers and percentages. All variables were converted to binary numbers (0 and 1), and then the chi-square test was utilized to determine the relationships between variables and the odds ratio (OR) values. IBM SPSS version 25.0 was used for statistical testing

7. Research Ethics

This study has successfully passed the ethical review conducted by the Ethics Committee of PKU Muhammadiyah Gamping, Yogyakarta under the reference number No. 131/KEP-PKU/VII/2023

RESULTS

1. Sample Characteristics

Out of 1634 patients, 781 individuals (48.09%) were ≤ 65 years old, and 853 individuals (52.52%) were > 65 years old (see Table 1).

Table 1. Chi-Square Test Results of Risk Factors Associated with Elderly Diabetes Patients

Independent Variables	Age ≤ 65 years old	Age >65 years old
	% (n)	% (n)
Demographic		
Low Education	9.91% (162)	9.42% (154)
Length of stay >7 days	20.38% (333)	22.77% (372)
Gender (Male)	22.07% (361)	25.69% (419)

2. Bivariate Analysis

Risk factors associated with diabetes in elderly were erythrocytes (OR= 1.604; 95%CI= 1.32 to 1.95; p<0.001), urea (OR= 1.51; 95% CI= 1.23 to 1.86; p<0.001), lymphocyte (OR= 1.259; 95%CI= 1.04 to 1.53; p= 0.020), hemoglobin (OR= 1.38; 95% CI= 1.14 to 1.68; p<0.001), systolic blood pressure (OR= 1.33; 95% CI= 1.07 to 1.65; p= 0.009), stroke (OR= 1.59; 95% CI= 1.09 to 2.32; p= 0.016), lymphocytes (OR= 1.26; 95% CI= 1.04 to 1.53; p= 0.020),

creatinine (OR= 1.24; 95% CI= 1.02 to 1.51; p= 0.028), hypertension (OR= 1.29; 95% CI= 1.03 to 1.63; p= 0.028), high holesterol (OR= 0.89; 95% CI= 0.65 to 1.23; p<0.001); blood glucose (OR= 0.65; 95% CI= 0.51 to 0.83; p<0.001) (Table 1 and Figure 1).

Table 1. Cross tabulation of factors associated with diabetes in elderly

Variables	OR (95% CI)	*p*
Systolic Blood Pressure	1.33 (1.07 - 1.65)	0.009
Lymphocyte	1.26 (1.04 - 1.53)	0.020
Erythrocyte	1.60 (1.32 - 1.96)	<0.001
Glucose	0.65 (0.59 - 0.83)	<0.001
Creatinine	1.24 (1.02 - 1.51)	0.028
Haemoglobin	1.38 (1.14 - 1.68)	0.001
Ureum	1.51 (1.23 - 1.86)	<0.001
Cholesterol	0.89 (0.65 - 1.23)	<0.001
Hypertension	1.29 (1.03 - 1.63)	0.028
Stroke	1.59 (1.09 - 2.32)	0.016

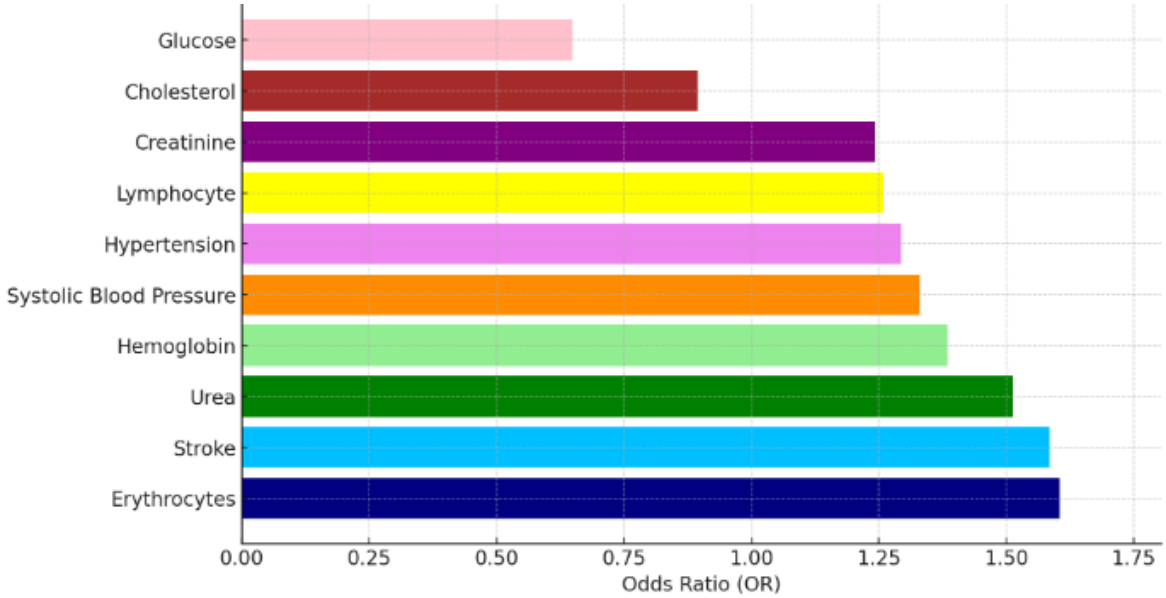

Figure 1. Parameters comparison based on OR value (p<0.05)

DISCUSSION

In this study, hypertension was found to be more prevalent among elderly patients (OR= 1.29; 95% CI= 1.03 to 1.63; p= 0.028). This finding is consistent with Sasaki et al. (2020), who reported that elderly participants with newly diagnosed type 2 diabetes and prediabetes have a modest risk of hypertension. They suggest that the early stages of diabetes and prediabetes represent critical periods for hypertension risk reduction. Similarly, Yang et al. (2019) found that higher blood pressure is associated with an increased risk of diabetes mellitus in middle-aged and elderly Chinese adults, implying that managing high blood pressure might be an important target for diabetes prevention.

A significant relationship was observed between reduced levels of red blood cells (OR= 1.60; 95% CI= 1.32 to 1.96; p <0.001) and hemoglobin (OR= 1.38;

95% CI= 1.14 to 1.68; p <0.001) in elderly diabetic patients. Chronic diseases, common among older adults, can disrupt erythropoiesis due to chronic inflammation associated with aging. This inflammation may suppress erythropoietin production and alter iron metabolism, leading to anemia (Xanthopoulos et al., 2021). Additionally, deficiencies in nutrients essential for red blood cell production, such as iron, vitamin B12, and folate, frequently occur in the elderly due to poor dietary habits, malabsorption, or medications interfering with vitamin and electrolyte absorption, contributing to anemia (Lippi et al., 2014).

The study also found an increased risk of elevated urea levels in elderly diabetes patients (OR= 1.51; 95% CI= 1.23 to 1.86; p <0.001). Insulin resistance, a common condition in older diabetic patients, often leads to renal impairment, which results in increased urea levels (Bjornstad et al., 2019). Kurniawan and Kusrini (2020) reported that urea levels in diabetic patients were generally within normal limits, though younger patients (<45 years) showed an increased risk of elevated urea levels. The natural decline in kidney function with aging also contributes to increased blood urea, as the kidneys become less efficient in filtering waste. Diabetes exacerbates this decline by promoting diabetic nephropathy, further increasing the risk of elevated urea levels (Xie et al., 2018).

A significant association between stroke and elderly diabetes patients was also observed (OR= 1.60; 95%CI= 1.32 to 1.96; p<0.001). Advanced age correlates with longer diabetes duration, increasing the risk of both microvascular and macrovascular complications, including stroke (Zhang et al., 2021). Halter et al. (2014) demonstrated an increased risk of cardiovascular diseases such as stroke and heart failure among older adults with diabetes. Effective diabetes management in the elderly requires close monitoring and adjustments in diet, physical activity, and medications. Cognitive decline, limited mobility, and polypharmacy complicate management, increasing the risk of poor glycemic control and consequently stroke (Iwase et al., 2021). Furthermore, diabetes duration is a significant predictor of cardiovascular events in elderly men, including stroke (Yeap et al., 2015).

Interestingly, the study identified a decreased risk associated with blood glucose levels among elderly diabetic patients (OR= 0.65; 95% CI= 0.51 to 0.83; p <0.001). Ling et al. (2021) reported that elderly individuals with type 2 diabetes treated with sulfonylureas or insulin have an increased risk of severe hypoglycemia. Similar findings were reported by Piątkiewicz et al. (2016) and Lipska et al. (2023), indicating a higher incidence of severe hypoglycemia in elderly diabetic patients undergoing such treatments.

A decreased risk of elevated cholesterol levels was also found in elderly diabetic patients (OR= 0.89; 95% CI= 0.65 to 1.23; p<0.001). This aligns with Solymár et al. (2018), who observed reductions in body weight, total cholesterol, and LDL cholesterol in elderly patients treated with metformin. These findings highlight the potential lipid-lowering effects of metformin in the elderly diabetic population, suggesting benefits beyond glycemic control, including cardiovascular risk reduction.

Lastly, the study found a significant association between lymphocyte levels and diabetes in the elderly (OR= 1.26; 95% CI= 1.04 to 1.53; p= 0.020). Olson et al. (2022) also reported a relationship between increased lymphocyte counts and diabetes in elderly patients with a mean age of 80.2

years. However, this contrasts with da Silva et al. (2020), who found no significant association between lymphocyte levels and diabetes in the elderly.

AUTHORS CONTRIBUTION:

Husnul Khuluq: Conceptualization, methodology, and writing original draft. Dwiki Fitri: Data collection, analysis, and writing, review & editing. Tunjung Winarno: Supervision and project administration. Condrosuro Miyarso: Resources, data curation, and final approval of the manuscript

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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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