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Factors Associated with Diabetes Mellitus among Adults Aged ≥ 25 Years in DKI Jakarta: Analysis of the Indonesian Health Survey 2023

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Abstract

Background*: The global prevalence of diabetes mellitus (DM) continues to rise and is projected to increase significantly by 2045. In Indonesia, DKI Jakarta reports the highest prevalence of DM. This study aimed to examine factors associated with DM among adults aged ≥ 25 years in DKI Jakarta using data from the 2023 Indonesian Health Survey.*

Methods*: A cross-sectional study was conducted using secondary data from the 2023 Indonesian Health Survey, which employed a stratified multistage sampling design. A total of 6,185 respondents aged ≥ 25 years residing in DKI Jakarta were included. Data were collected in 2023 and analysed from January to July 2025. Multiple logistic regression analysis was performed to estimate adjusted odds ratios (aORs) and 95% confidence intervals (CIs) for factors associated with DM.*

Results*: Significant risk factors for DM among adults aged ≥ 25 years in DKI Jakarta included age (OR=21.99; 95% CI: 13.13–36.85; p<0.001), sex (OR=1.63; 95% CI: 1.23–2.15; p=0.001), educational level (OR=1.86; 95% CI: 1.20–2.90; p<0.001), depression (OR=3.71; 95% CI: 1.81–7.58; p<0.001), and a hystory of hypertension (OR=5.05; 95% CI: 3.83–6.66; p<0.001). Based on multivariable analysis, older age was the most strongly associated factor (aOR = 16.081; 95% CI: 9.24–27.98; p<0.001).*

Conclusions*: Several sociodemographic and health-related factors were associated with DM among adults in DKI Jakarta. Strengthening diabetes prevention and control efforts through the Posbindu PTM and GERMAS programmes by the DKI Jakarta Health Office is warranted.*

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Keywords*: Adult, Age, Diabetes mellitus, Risk factors.*

INTRODUCTION

Non-communicable diseases (NCDs) were the primary driver of global mortality, accounting for almost three-quarters of all deaths worldwide. One of the rapidly increasing NCDs was diabetes mellitus (DM). The global population of people with diabetes aged 20–79 reached approximately 537 million in 2021, with a projected increase to 783 million by 2045. Indonesia ranks among the top five countries with the highest burden of DM cases in the Western Pacific region, with an estimated 19.5 million cases in 2021.[1]

The province of DKI Jakarta recorded the highest DM prevalence in Indonesia, with 3.1% across all age groups and 3.9% among individuals aged ≥ 15 years.[2] Urban lifestyle characteristics such as sedentary behavior, occupational stress, and high intake of sugar and fat are major contributing factors to this increase.[3,4] Although many studies have examined DM risk factors, few have specifically focused on adults aged ≥ 25 years, who are at increased risk due to accumulated exposure to risk factors since a young age. This study focused on the ≥ 25 age group because, according to IHS 2023 data, the prevalence of DM begins to increase significantly in the 25-34 age group. The age limit of 25 years was chosen because early adulthood is when long-term metabolic risks first become clinically apparent. Furthermore, this age allows identification of type 1 DM cases diagnosed in childhood, as well as other types of DM that develop with age.

The objective of this study was to identify the determinants of DM among individuals aged ≥ 25 years in DKI Jakarta Province, using data from the IHS 2023. This study hypothesized that elderly age, female, lower educational level, light-to-moderate employment status, lower socioeconomic level, obesity, insufficient physical activity, inadequate fruit and vegetable consumption, depression, and a history of hypertension were associated with a higher risk of DM among individuals aged ≥25 years in DKI Jakarta.

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This study employed a cross-sectional design using secondary data from the 2023 Indonesian Health Survey (IHS). The urgency of this research lies in the need for evidence-based information to strengthen DM control strategies, particularly in urban areas with a high disease burden. The uniqueness of this study lies in its comprehensive analysis of socio-demographic, behavioral, psychological, and clinical factors using multiple logistic regression.

METHOD

Participants and Study Design

This quantitative study employed a cross-sectional design using secondary data from the IHS 2023, a nationwide community-based household survey by the Ministry of Health. The IHS 2023 utilized a stratified multistage sampling design. Respondents were recruited from randomly selected households, and data were collected through face-to-face interviews conducted by trained enumerators. Data used in this study were collected throughout 2023 and represent the urban population of DKI Jakarta. The study population included all individuals aged ≥ 25 years in DKI Jakarta who participated in the IHS 2023. Inclusion criteria included individuals aged ≥ 25 years and domiciled in DKI Jakarta. Exclusion criteria were respondents with incomplete or missing data on the study variables. After applying the inclusion and exclusion criteria, a total of 6,185 individuals with complete data formed the analytical sample. Because this study used secondary data, no additional sample size calculation was performed. Instead, all eligible respondents from the IHS dataset were analyzed, ensuring adequate statistical power for multivariate logistic regression. All analyses applied sampling weights provided by IHS 2023 to account for the complex survey design and ensure representativeness of the Jakarta population.

Several potential sources of bias may affect this study. First, recall bias may arise because diabetes status and several behavioral variables (e.g., physical activity, smoking, and dietary habits) in IHS 2023 were self-reported, which could lead to misclassification. Second, social desirability bias is possible, as respondents may underreport unhealthy behaviors or overreport healthier practices during face-to-face interviews. Third, selection bias may arise from excluding respondents with incomplete data. Because this study used secondary survey data, the ability to control or mitigate these biases during data collection was limited. To minimize bias, normalized sampling weights from the IHS 2023 dataset were applied to restore population representativeness and reduce selection-related bias during analysis.

Measurements and Procedure

The outcome of interest was diabetes mellitus (DM), defined as a self-reported physician diagnosis. Independent variables included age, sex, education level, employment status, socioeconomic status, obesity, physical activity, fruit and vegetable consumption, depression, and a history of hypertension. Data were obtained from the Indonesian Health Survey 2023 (*Survei Kesehatan Indonesia 2023* or *IHS 2023*), a nationally representative survey using standardized questionnaires administered through face-to-face interviews by trained personnel. Variable definitions followed the IHS 2023 guidelines and international standardized instruments. Age, sex, education level, employment status, and socioeconomic status were obtained from the IHS 2023 household questionnaire, whereas obesity and a history of hypertension were obtained from the individual questionnaire.

Age was categorized according to the WHO adult age classifications: young adults (25–44 years), middle-aged (45–59 years), and elderly (≥60 years). Sex was classified as male or female based on biological characteristics. Education level was categorized as low (never attended school, incompleted/completed elementary school), moderate (junior or senior high school), and high (diploma or university). Employment status was categorized into light-to-moderate (unemployed, students, civil servants, state-owned employees, private employees, military, police, and entrepreneurs) and heavy occupational groups (farmers, fishermen, laborers, drivers, and domestic workers), reflecting typical physical activity intensity, based on classifications adapted from the Food and Agriculture Organization (FAO). Socioeconomic status was assessed using a household wealth index constructed through principal component analysis (PCA) and classified into low, middle, and high tertiles. Obesity was defined based on measured body mass index (BMI), with a cut-off of ≥25 kg/m² according to the WHO Asian classification.

Physical activity was measured using the Global Physical Activity Questionnaire (GPAQ) and classified as sufficient (≥150 minutes of moderate-to-vigorous physical activity per week) or insufficient. Fruit and vegetable consumption was measured using the WHO STEPwise (STEPS) dietary assessment module and categorized as adequate (≥5 servings/day in a week) or inadequate. Depression was assessed using the Mini International Neuropsychiatric Interview (MINI) and classified dichotomously ("yes" or "no") based on the recommended cut-off. A history of hypertension was defined using self-reported physician diagnosis and measured elevated blood pressure (systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg).

Statistical Analysis

Bivariate associations between independent variables and DM were assessed using the chi-square test. Variables were subsequently entered into a multivariable logistic regression model to identify factors independently associated with DM. Missing data were handled using listwise deletion as applied to the IHS dataset. Potential confounders were controlled for in the multivariable model, with variable selection guided by theoretical relevance, prior evidence, and statistical significance in the bivariate analysis. No interaction terms were included due to the study's focus on main effects. All statistical analyses were performed using a statistical software.

RESULT

From the IHS 2023 dataset, a total 6,671 respondents were recorded in DKI Jakarta after excluding individuals aged <25 years and after excluding those who choose "other" occupations (n=6,303), as well as respondents with incomplete data on the obesity-related variable of weight (n=6,215) and height (n=6,205), as well as on the depression variable (n=61,85), the final analytical sample of 6,185 participants remained. Missing data mostly resulted from incomplete answers during interviews, IHSpped questions, or measurement errors in anthropometric variables. In the employment level variable, respondents who chose "other" were excluded because the occupational classification in this study was based on physical activity intensity, and the "other" category could not be clearly associated with any intensity level. A flowchart illustrating the selection process is presented in Figure 1.

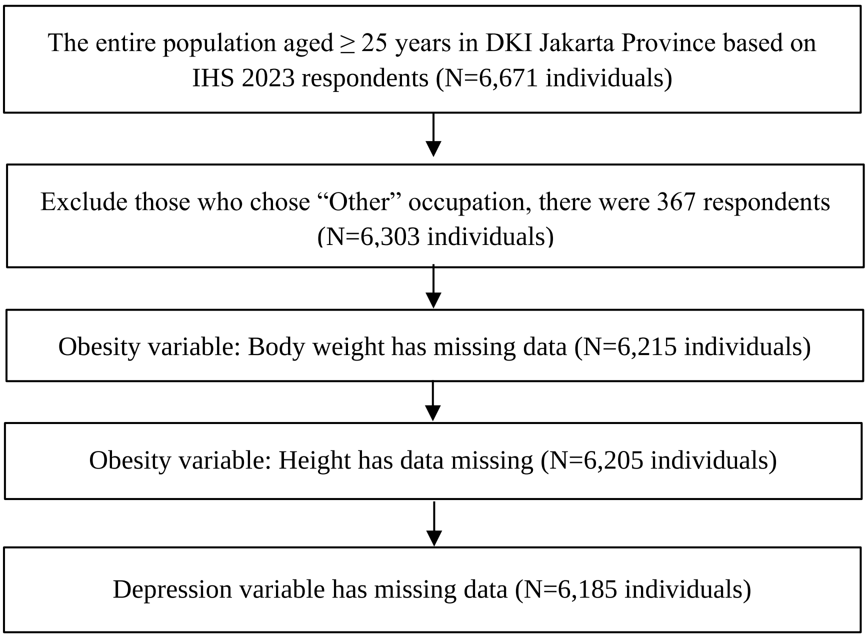

Figure 1. Sampling Flow

Based on Table 1, the prevalence of DM increased with age, from 9.2% in young adults to 53.3% in the elderly. The prevalence of DM is higher in females (62.1%) than in males (37.9%). The proportion of DM was higher in individuals with a moderate level of education (54.5%) than in those with a high (18.7%) or low (26.8%) level of education. Individuals with light-to-moderate employment status (92.9%) also had a higher prevalence of DM than those with heavy employment status (7.1%). Individuals with low socioeconomic status (35.8%) also had a higher prevalence of DM compared to those with high (34.7%) and middle (29.5%) socioeconomic status. The prevalence of DM was higher among individuals who were not obese (61.2%) than among those who were obese (38.8%). The proportion of DM was higher among individuals who were physically active (66.4%) than among those who are less active (33.6%). Individuals who consumed inadequate fruit and vegetables (93.9%) also had a higher prevalence of DM than those who consumed adequate amounts of fruits and vegetables (6.1%). The proportion of DM was higher in individuals who were not depressed (96.1%) than in those who were depressed (3.9%). The prevalence of DM was also higher in individuals without a history of hypertension (54.9%) than in those with a history (45.1%).

Table 1. Result Analysis between Diabetes Mellitus and Related Risk Factors

Variable	Diabetes Mellitus				Missing (N)	P-Value	OR	95% CI
	Yes		No					
	N	%	N	%				
Age								
Elderly	157	53.3	956	14.3	-	0,000*	21.994	13.128–36.851
Middle-Aged	150	37.6	2,314	31.5			7.028	4.237–11.656
Young Adult	39	9.2	3,385	54.2			1.000	Reference
Sex								
Female	226	62.1	3,691	50.2	-	0.001*	1.627	1.230 - 2.151
Male	120	37.9	2,964	49.8			1.000	Reference
Educational Level								
Low	90	26.8	1,026	13.8	-	0.000*	1.863	1.195–2.904
Moderate	188	54.5	4,360	68.3			0.762	0.530–1.096
High	68	18.7	1,269	17.9			1.000	Reference
Employment Status								
Light-to-Moderate	320	92.9	5,887	88.8	-	0.096	1.633	0.912–2.924
Heavy	26	7.1	768	11.2			1.000	Reference
Socioeconomic Status								
Low	110	35.8	2,209	35.8	-	0.453	0.898	0.648–1.243
Middle	113	29.5	2,237	33.0			0.803	0.568–1.135
High	123	34.7	2,209	31.2			1.000	Reference
Obesity								
Yes	142	38.8	2,309	33.8	98	0.133	1.238	0.936–1.637
No	204	61.2	4,346	66.2			1.000	Reference
Physical Activity								
Insufficient	101	33.6	1,532	28.1	-	0.066	1.293	0.982–1.703
Sufficient	245	66.4	5,123	71.9			1.000	Reference
Fruit and Vegetable Consumption								
Inadequate	327	93.9	6,337	95.0	-	0.447	0.815	0.480–1.384
Adequate	19	6.1	318	5.0			1.000	Reference
Depression								
Yes	10	3.9	69	1.1	20	0.000*	3.709	1.814–7.584
No	336	96.1	6,586	98.9			1.000	Reference
History of Hypertension								
Yes	161	45.1	962	14.0	-	0.000*	5.053	3.833–6.661
No	185	54.9	5,693	86.0			1.000	Reference

**Significant* < 0.05 (□ = 5%)

Bivariate analysis showed that five of the ten variables examined were significantly associated with DM, namely age (p<0.001), sex (p=0.001), education level (p<0.001), depression (p< 0.001), and history of hypertension (p< 0.001). These variables demonstrated increased odds of DM (OR>1) and were therefore considered potential risk factors.

In the bivariate analysis, age was strongly associated with DM. Compared with young adults, the elderly had markedly higher odds of DM (OR=21.99; 95% CI: 13.13–36.85), as did those who were middle-aged (OR=7.03; 95% CI: 4.24–11.66). Female participants had higher odds of DM compared with males (OR=1.63; 95% CI: 1.23–2.15). Lower education attainment was also associated with increased odds of DM, with individuals in the low education group having an OR of 1.86 (95% CI: 1.20–2.90) compared with those with a high education level. In addition, depression (OR=3.71; 95% CI: 1.81–7.58) and a history of hypertension (OR=5.05; 95% CI: 3.83–6.66) were both associated with higher odds of DM.

Based on the initial selection to determine the variables that can be included in the multivariate model with a p-value criterion of <0.25, eight variables met this criterion and were considered candidates for multivariable analysis: age, sex, education level, employment status, obesity, physical activity, depression, and history of hypertension. Then, multivariate analysis was performed using the enter method, whereby all candidate variables were initially included in the model. Variables were then removed sequentially based on statistical significance, starting with the highest p-value. During this process, changes in ORs were monitored to assess confounding variables, with a change of >10% indicating a confounding effect. Based on this criterion, sex, education level, employment status, obesity, and physical activity were retained as confounders. The final model identified three variables independently associated with DM: age, depression, and history of hypertension.

Multivariable logistic regression analysis demonstrated that age, depression, and history of hypertension were associated with DM. The elderly had substantially higher odds of DM compared with young adults (aOR=16.08; 95% CI: 9.24–27.98; p<0.001). Depression was also associated with increased odds of DM (aOR=4.02; 95% CI: 1.66–9.73; p=0.002), as was a history of hypertension (aOR=2.54; 95% CI: 1.85–3.49; p<0.001). No subgroup or sensitivity analyses were conducted, as the primary objective was to estimate overall associations using weighted IHS 2023 data

Table 2. Model of Related Risk Factors of Diabetes Mellitus

Variable	B	P-Value	Adjusted OR	95% CI
Age				
Elderly	2.778	0.000	16.081	9.244–27.975
Middle Age	1.778		5.953	3.553–9.974
Young Adult	0.000		1.000	Reference
Depression				
Yes	1.390	0.002	4.016	1.657–9.733
No	0.000		1.000	Reference
History of Hypertension				
Yes	0.931	0.000	2.538	1.845–3.490
No	0.000		1.000	Reference

DISCUSSION

Age and Diabetes Mellitus

This study found that the elderly had higher odds of DM compared with young adults (OR=21.99; 95% CI: 13.13–36.85; p<0.001), indicating that the odds of DM among older individuals were nearly 22 times those observed in the younger age group. This finding is consistent with previous studies demonstrating a significant association between age and DM, including evidence from Indonesia showing a higher burden of DM among older populations.[5]

In the multivariable analysis, age remained the most strongly associated factor with DM (aOR=16.08; 95% CI: 9.24–27.98; p<0.001), suggesting that, after adjusting for other variables, older adults had more than 16-fold higher odds of DM compared with young adults. Age is a non-modifiable risk factor, and its influence on DM can be explained by progressive physiological changes affecting glucose metabolism. Aging is associated with declining pancreatic β-cell function, increased insulin resistance, and the accumulation of oxidative stress and chronic low-grade inflammation.[6]

As aging progresses, body cells such as muscle and liver become less responsive to insulin (insulin resistance), preventing glucose from entering cells and causing it to remain in the bloodstream, resulting in chronic hyperglycemia. Aging also reduces the number and function of pancreatic β-cells, leading to inadequate insulin production, especially in response to postprandial glucose (PPG), further exacerbating glycemic dysregulation. Oxidative stress and chronic inflammation may also contribute to pancreatic cell damage and reduced insulin efficacy.[1,7]

In addition, aging is often accompanied by unfavorable changes in body composition, including increased visceral adiposity and reduced muscle mass. Visceral fat triggers the release of proinflammatory cytokines that contribute to insulin resistance and chronic inflammation.[8] As individuals grow older, they become less physically active, which plays a key role in maintaining insulin sensitivity and reducing blood sugar levels through increased insulin production and controlling body weight. Lack of physical activity may therefore, exacerbate insulin resistance and increase the risk of obesity, which is also a risk factor for DM.[6]

Sex and Diabetes Mellitus

In this study, women had higher odds of DM compared with men (OR=1.63; 95% CI: 1.23–2.15; p=0.001), indicating approximately 63% greater odds of DM among females. This finding is consistent with a previous study reporting a significant association between sex and DM at the UPTDK RSU Haji Medan, with women having a 3.5 times higher risk of DM.[10]

Several biological and behavioral mechanisms may explain this association. Hormonal changes across the life course are known to influence fat distribution and glucose metabolism. Women are likely to accumulate central (visceral) adiposity as they grow older, which is strongly linked to insulin resistance.[5] In addition, women generally have a higher total body fat percentage than men, which may further contribute to metabolic dysregulation. Behavioral factors may also play a role. In some contexts, women, especially after marriage, may engage in lower levels of physical activity. During this phase, many women are busier with family responsibilities, resulting in limited time and opportunities for regular physical activity compared to men.[11] Additionally, the proportion of body fat in men is generally lower than in women. This condition causes fat accumulation in women to be higher, thereby increasing the risk of developing DM.[12] Therefore, when body weight exceeds normal limits, fat accumulates in body tissues, including blood vessel walls and metabolic organs, which can form plaques. This condition can trigger insulin resistance.

Educational Level and Diabetes Mellitus

Based on the findings, individuals with low educational attainment had higher odds of developing DM compared with those with higher education (OR=1.86; 95% CI: 1.20–2.90; p<0.001), indicating approximately 86% greater odds. This finding aligns with a study showing a significant association between educational level and DM. A higher level of education enhances an individual's ability to access, comprehend, and apply health information, thereby improving awareness and practices related to disease prevention.[13]

Individuals with higher educational attainment demonstrated a greater propensity for self-identifying as ill upon experiencing disease-related symptoms, relative to those with less education. Higher education has also been associated with more prompt health-seeking behavior and greater knowledge of DM risk factors, thereby making them more aware of the importance of maintaining their health. Accordingly, individuals with higher levels of education may have lower odds of developing diabetes because they generally have better health knowledge.[13]

Depression and Diabetes Mellitus

This study showed that individuals with depression had higher odds of DM (OR=3.71; 95% CI: 1.81–7.58; p<0.001), indicating approximately 3.7-fold greater odds compared with those without depression. This finding is in alignment with research showing a significant association between depression and blood glucose concentrations, whereby elevated levels of depressive symptoms are associated with poorer glycemic control.[14]

People with DM tend to experience higher levels of depression. Depression may disrupt the regulation of the hypothalamic-pituitary-adrenal (HPA) axis, which contributes to the physiological stress response. HPA axis activation initiates the secretion of cortisol and other hormones and stimulates the sympathetic nervous system, which increases catecholamine release

In individuals with depression, disruption of the negative feedback mechanism or overactivity of the HPA axis leads to chronic elevation of cortisol and catecholamines, contributing to increased blood glucose levels. This increase occurs because cortisol promotes hepatic gluconeogenesis from amino acids and fats in the liver and reduces insulin sensitivity in peripheral tissues, such as muscle and adipose tissue. In addition, catecholamines enhance glycogenolysis in the liver, further increasing circulating glucose levels.[15] Depressed individuals may also engage in adverse health behaviors, including physical inactivity, unhealthy dietary patterns, smoking, increased alcohol consumption, and sleep disturbances, which may lead to increased odds of DM. Depression is further associated with oxidative stress and chronic low-grade inflammation, which can damage pancreatic β-cell function, reduce insulin sensitivity, and accelerate metabolic dysfunction.[16]

History of Hypertension and Diabetes Mellitus

This study found that individuals with a history of hypertension had higher odds of developing DM compared with those without such a history (OR=5.05; 95% CI: 3.83–6.66; $p<0.001$), indicating approximately fivefold greater odds. These findings are consistent with other studies demonstrating a significant association between hypertension and DM.[17] Individuals with a history of hypertension have also been reported to have increased odds of DM compared with those without hypertension. Other studies further indicate a strong correlation between hypertension and the onset of DM among the elderly.[18]

Persistent hypertension can damage endothelial cells (the innermost layer of the vascular walls), thereby reducing nitric oxide (NO) production, which helps maintain blood vessel elasticity and adequate blood flow. This condition increases the risk of vascular complications, including arterial wall thickening and reduced vessel diameter. As a result, impaired perfusion to organs such as skeletal muscles and the pancreas may occur, leading to suboptimal insulin secretion and reduced glucose transport into cells. These changes can contribute to poorer glycemic control in individuals with DM.[19] In individuals with hypertension, reduced insulin sensitivity may lead to compensatory hyperinsulinemia. Hyperinsulinemia can stimulate sympathetic nervous system activity and promote renal sodium retention, which may further elevate blood pressure.[20] Therefore, hypertension and DM are closely interrelated through shared pathophysiological mechanisms.

This study has several limitations. First, the cross-sectional design precludes causal inference between exposure variables and diabetes mellitus. Second, the use of secondary data from the IHS 2023 limited control over variable definitions, data quality, and measurement procedures. Third, potential recall and reporting bias may be present, as several variables were based on self-reported information. Selection bias may also have occurred due to the exclusion of respondents with incomplete data. These limitations may influence the direction and magnitude of the observed associations and should be considered when interpreting the findings.

CONCLUSION

Older age, female sex, low education level, depression, and a history of hypertension were significantly associated with DM among individuals aged ≥ 25 years in DKI Jakarta. Among these factors, older age was identified as the most strongly associated factor in the multivariable analysis. These findings highlight the need for targeted public health strategies, and the DKI Jakarta Provincial Health Office is advised to strengthen DM control efforts by optimizing the implementation of the Posbindu PTM and GERMAS programs. This study received no specific funding. The data were obtained from the Health Development Policy Agency (*Badan Kebijakan Pembangunan Kesehatan* or BKPK) of the Ministry of Health, Indonesia, which had no role in the study design, data analysis, interpretation, or manuscript preparation.

ETHICS APPROVAL

This study received ethical approval from the Research Ethics Committee of the Faculty of Health Sciences, UIN Syarif Hidayatullah Jakarta (approval number: Un.01/F.10/KP.01.1/KE.SP/05.08.083/2025).

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COMPETING INTEREST

All authors declare that there are no conflicts of interest.

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UNDERLYING DATA

The data that support the findings of this study were derived from secondary data obtained from BKPK Kemenkes RI. The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request, subject to the data sharing policy of the data provider.

DECLARATION OF ARTIFICIAL INTELLIGENCE USE

We confirm that there is no artificial intelligence (AI) used at any stage of the study, including data collection, analysis, visualization, etc. All work in this study was conducted manually by the authors without the assistance of AI-based tools or systems.

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