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# Sociodemographic and Lifestyle Factors Associated with Undiagnosed Diabetes in Indonesia: Findings from the Basic Health Research Work of Riskesdas 2018

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**Abstract**

Background. As a developing nation, there has been an increasing trend in non-communicable diseases, including diabetes mellitus (DM) in Indonesia. However, a remarkable proportion of DM cases in this archipelagic country is likely undiagnosed.

Objective. This study assessed the sociodemographic and lifestyle factors related to undiagnosed DM in Indonesians.

Methodology. This cross-sectional study analyzed secondary data from the 2018 Indonesian Basic Health Research (Riskesdas). It involved 3,755 study subjects, 3,619 individuals with high blood glucose levels meeting the DM criteria and 136 individuals with controlled DM. Multivariable regression analysis examined the associations between socio-demographic and lifestyle factors and undiagnosed diabetes.

Results. The study revealed that 80% of the DM cases among the subjects were undiagnosed. Multivariable analysis confirmed that age group, area of residence, employment, wealth quintiles and physical activity were significantly associated with higher odds of undiagnosed diabetes. Notably, sex, smoking status and vegetable consumption did not show any association with the diagnosis status of diabetes.

Conclusion. A significant portion of DM cases in Indonesia remain undiagnosed, especially among young adults, rural residents, agricultural workers and lower socioeconomic groups. Improved healthcare access, targeted screening and enhanced health education are essential to ensure early diagnosis and effective management of diabetes.

*Key words: undiagnosed diabetes, diabetes mellitus, non-communicable diseases, diabetic*

## INTRODUCTION

According to the International Diabetes Federation (IDF), almost one out of two adults with diabetes mellitus (DM) are unaware they have the condition.[1] There are various types of diabetes, but most of the undiagnosed cases are Type 2 Diabetes Mellitus (T2DM), comprising up to 95% of all diabetes incidence.[2] The symptoms of diabetes are often not prominent or noticeable, leading to delayed diagnosis for several years after onset when complications have already occurred.[3] Some may present with the classic symptoms of polyuria, polydipsia and polyphagia with associated weakness and weight loss. However, many people with T2DM are asymptomatic and remain silent for many years, such that at diagnosis, they may already have features of long-term complications like neuropathy, retinopathy or even nephropathy.[4] This makes early detection and timely treatment essential in preventing long-term damage and managing the disease effectively.[5,6]

The burden of undiagnosed diabetes has profound implications on both individual health and national healthcare systems. Delayed diagnosis often leads to an increased risk of severe complications, including cardiovascular diseases, kidney failure and nerve damage. These, in turn, increase healthcare costs and strain health services. Moreover, individuals unaware of their condition cannot take the necessary steps to control their blood glucose levels through lifestyle changes or medication, further exacerbating the progression of their disease.[1,6]

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Globally, Indonesia ranks fifth in terms of the highest number of individuals affected by DM, and this prevalence is projected to rise significantly in the coming years.[1] As almost three-quarters of DM cases are undiagnosed, this archipelagic country ranks third in the total number of undiagnosed diabetes cases.[1] This data poses a challenge to increasing DM awareness among Indonesian citizens. Without diagnosis, unaware patients with diabetes will not be able to seek adequate treatment or modify their lifestyle to control their blood glucose.

Earlier studies have assessed the prevalence of DM and identified its potential risk factors in Indonesia.[7–9] Yet, there remains a significant gap in understanding the risk factors specifically associated with undiagnosed diabetes in the country. Few studies have explored this issue nationally, making identifying interventions for those most at risk difficult. Therefore, this study aims to fill this knowledge gap using nationwide data from the Riskesdas 2018 data to assess the sociodemographic and lifestyle factors associated with undiagnosed diabetes. By identifying the patient characteristics that delineate those diagnosed with DM from those undiagnosed, this research will provide crucial insights that can inform targeted screening and prevention strategies in Indonesia.

## METHODOLOGY

### Study design

This study analyzed secondary data from the Indonesian Basic Health Research (Riset Kesehatan Dasar or Riskesdas, the abbreviation in Indonesian) 2018. Riskesdas is a nationwide survey conducted by the Ministry of Health of Indonesia every five years. The samples were selected through a two-stage stratified cluster sample drawn nationwide.[10] The population of interest in this study was Indonesians with diabetes, regardless of the diagnosis status. The inclusion criteria were non-pregnant subjects aged >15 years who were detected as having blood glucose levels corresponding with DM in the survey and those with controlled DM. The subjects with controlled DM were those whose blood glucose levels during the survey were normal but had been diagnosed with DM. Data will be excluded if any missing values are found in any of the analyzed variables.

Riskesdas' study participants were selected from the general population of Indonesia using probability proportional to size and linear systematic sampling methods. The survey achieved a 95% interview response rate at the national level. Biomedical data collection, including blood glucose measurements, was conducted on a subsample basis in 26 provinces for individuals aged 15 years and older. Data were obtained from 25,000 households, with a response rate of 77.7%.[10]

Three thousand six hundred nineteen individuals with high blood glucose levels were identified during the survey and included in the analyzed dataset. In addition, the dataset also consists of 136 individuals with controlled DM. Therefore, this study included 3,755 subjects, with the details of subject selection outlined in Figure 1. The sample size calculation/ power analysis was conducted post-hoc using G*Power software. The results indicate that the number of subjects used in this study far exceeds the required minimum sample size, providing robust statistical power to detect significant associations in the analysis.

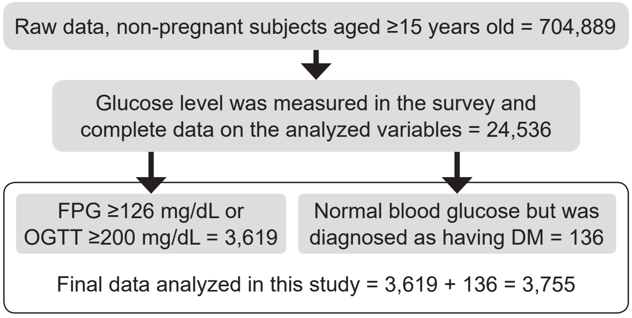

**Figure 1.** Data selection process.

### Variables

The selection of the subjects was based on their diabetes status during the survey. The subject was considered to have diabetes if, at the time of the survey, the fasting plasma glucose (FPG) was >126 mg/dL or the 2-hour oral glucose tolerance test (OGTT) was >200 mg/dL, which followed the consensus of the Indonesian Society of Endocrinology.[11] Subjects are defined as having undiagnosed diabetes when their blood glucose levels correspond to the diagnostic criteria for diabetes, but a doctor has not confirmed the diagnosis.[1]

The data on the diagnosis history relies on the survey item asking the subjects whether they had ever been diagnosed with DM by a health professional. The diagnosis status of diabetes is the dependent variable of this study. The independent variables in this study consist of several sociodemographic, lifestyle, and physical characteristics. The sociodemographic characteristics include sex, age group, area of residence, educational level, employment and wealth quintile. The area of residence is classified following the official regulations established by Statistics Indonesia, which considers several criteria, including population density and the proportion of households engaged in agriculture within the administrative area.[12] Wealth quintiles were adopted from data on average monthly expenditure as determined by Statistics Indonesia. They were categorized into five levels, with Q1 representing the lowest level of wealth and Q5 the highest.[13]

Lifestyle characteristics used as the independent variables include behaviors related to smoking, physical activity, and fruit and vegetable consumption. Physical activities are categorized into "active" and "inactive" based on the modified Global Physical Activity Questionnaire, a component of the WHO STEPS instrument.[10] Simple questionnaires and food cards were used to ask about the consumption frequency of several food groups. The fruit and vegetable consumption frequency was also asked and then categorized into ≥5 days/week and ≤5 days/week. Smoking status was categorized into daily, non-daily and never smoked. All those data and body weight and height measurements were collected using a validated questionnaire delivered by trained enumerators.[10]

### Ethical consideration

The primary data collection of Riskesdas 2018 received ethical approval, with the reference number LB.02.01/2/KE.267/2017, from the Ethical Committee of Health Research, NIHRD, Ministry of Health of Indonesia. Before participating in the survey, all subjects signed informed consent forms. Secondary analysis of the obtained data required no additional ethical clearance.

### Statistical analysis

Descriptive statistics were performed to characterize the study population and to compare the prevalence of diagnosed and undiagnosed DM. Bivariate analyses were conducted to obtain crude odds ratio (OR) and their 95% confidence intervals (CI). Subsequently, with the factors that obtained a value of $p < 0.25$, a multivariable regression model was estimated to obtain adjusted odds ratios (aOR) with their 95% CI. Significance is determined at $p < 0.05$. A complex sample technique incorporating stratification, clustering, and weighting for unequal selection probabilities was used to ensure accurate population estimates and valid statistical measures in line with the study's design. The statistical analysis used the International Business Machines Statistical Package for the Social Sciences (IBM SPSS) version 25.

## RESULTS

Overall, the majority (80%) of DM cases among the study subjects were undiagnosed. Since all subjects in this study had DM, the fasting plasma glucose and the 2h postprandial glucose averages are higher than normal (Table 1). The average age of the study subjects was 51.39, and most of them were within the 50-59 age range.

The association between the dependent variable (undiagnosed diabetes) and each independent variable was explored by bivariate analysis. Based on this analysis, some variables were shown to have a statistically significant relationship with undiagnosed DM with a $p$-value <0.05. They include age group, area of residence, employment status, educational level, wealth quintile, physical activity, fruit consumption, and BMI (Table 2). All these variables were then included in the multivariable analysis. Meanwhile, gender, smoking status, and vegetable consumption were not showing statistically significant differences between the diagnosed and undiagnosed DM.

Among the analyzed sociodemographic characteristics, the only variable in the bivariate analysis that does not have a statistically significant relationship with undiagnosed DM is gender. On the other hand, smoking status and vegetable

**Table 1.** Mean of age, BMI, and blood glucose of the study subjects

| Characteristics | Mean (95% CI) | Standard Error |
|---|---|---|
| ***Age*** | 51.39 (50.83-51.95) | 0.285 |
| ***BMI*** | 25.53 (25.32-25.74) | 0.106 |
| ***Fasting plasma glucose*** | 143.97 (141.36-146.58) | 1.331 |
| ***2-hour post prandial glucose*** | 232.71 (229.45-235.97) | 1.663 |

**Table 2.** Distribution of subjects based on DM status

| Characteristics | N | DM status (%) | |
|---|---|---|---|
| | | Diagnosed | Undiagnosed |
| ***Overall*** | 3755 | 20.0 | 80.0 |
| ***Age group (years)*** | | | |
| 15-29 | 218 | 1.6 | 98.4 |
| 30-39 | 455 | 8.8 | 91.2 |
| 40-49 | 973 | 17.7 | 82.3 |
| 50-59 | 1071 | 26.6 | 73.4 |
| ≥60 | 1038 | 24.3 | 75.7 |
| ***Sex*** | | | |
| Male | 1209 | 20.9 | 79.1 |
| Female | 2546 | 19.6 | 80.4 |
| ***Area of residence*** | | | |
| Urban | 2266 | 25.3 | 74.7 |
| Rural | 1489 | 12.1 | 87.9 |
| ***Employment status*** | | | |
| Employed in public/private sectors | 274 | 21.6 | 78.4 |
| Entrepreneur | 558 | 25.1 | 74.9 |
| Farmer/fisherman | 737 | 9.9 | 90.1 |
| Informal worker | 533 | 17.7 | 82.3 |
| In school/not employed | 1653 | 23.4 | 76.6 |
| ***Educational level*** | | | |
| Graduated high school | 880 | 25.9 | 74.1 |
| Not graduated high school | 2875 | 18.2 | 81.8 |
| ***Wealth quintile (IDR)*** | | | |
| Q1 (0 – 378,350) | 711 | 10.6 | 89.4 |
| Q2 (>378,350 – 593,859) | 654 | 14.9 | 85.1 |
| Q3 (>593,859 – 838,710) | 657 | 15.9 | 84.1 |
| Q4 (>838,710 – 1,220,660) | 741 | 22.0 | 78.0 |
| Q5 (>1,220,660 – 2,592,001) | 992 | 31.4 | 68.6 |
| ***Smoking status*** | | | |
| Yes, daily | 669 | 17.8 | 82.2 |
| Yes, not daily | 291 | 23.0 | 77.0 |
| Never | 2795 | 20.3 | 79.7 |
| ***Physical activity*** | | | |
| Active | 2716 | 16.9 | 83.1 |
| Inactive | 1039 | 38.9 | 24.9 |
| ***Fruit consumption*** | | | |
| ≥5 days/week | 864 | 27.9 | 72.1 |
| <5 days/week | 2891 | 17.7 | 82.3 |
| ***Vegetable consumption*** | | | |
| ≥5 days/week | 2511 | 20.1 | 79.9 |
| <5 days/week | 1244 | 20.0 | 80.0 |
| ***BMI*** | | | |
| Underweight | 252 | 12.8 | 87.2 |
| Normal | 1565 | 20.5 | 79.5 |
| Overweight/obese | 1938 | 20.6 | 79.4 |

consumption are the lifestyle characteristics that did not have relationships with undiagnosed DM.

Table 3 presents a multivariable logistic regression analysis examining the relationship between the diagnosis status of diabetes (DM) and various independent variables. This analysis considers multiple factors simultaneously. The results showed that age group, employment status, area of residence, wealth quintile, physical activity, and BMI remain significantly associated with undiagnosed DM.

The odds ratios for age groups suggest that younger individuals are less likely to be diagnosed with DM, corroborating the bivariate analysis. The association between rural residence and having undiagnosed DM remains significant in the multivariable analysis. Farmers and fishermen are still more likely to have undiagnosed DM. The lower wealth quintiles are consistently associated with a higher likelihood of undiagnosed DM. The association between being physically inactive and having undiagnosed DM remains significant. The U-shaped relationship between BMI and DM diagnosis also persists in the multivariable analysis.

## DISCUSSION

Various factors contribute to a lack of awareness about diabetes, leading to late detection and potential complications. Since diabetes does not exhibit early signs, people with it typically ignore its symptoms until they become a problem in their daily lives.[14] Data from Riskesdas 2018 revealed that most (80%) diabetes cases in Indonesia were undiagnosed.

### Socio-demographic factors influencing diabetes diagnosis

Biological and psychosocial factors influence gender differences in diabetes risk and outcomes. Women are more likely to experience psychosocial stresses and increases in their BMI. Hormonal processes, like menstrual cycle syndrome and post-menopause, can facilitate fat accumulation, increasing the risk of developing type 2 diabetes.[15] Accordingly, Riskesdas showed that more women than men in Indonesia have diabetes. Another Indonesian study reported that gender is not statistically associated with DM.[9] Our analysis showed no difference between the two genders regarding the diagnostic status.

The current guidelines from the Indonesian Society of Endocrinology recommend that diabetes screening begin at age 40 for the general population.[11] Indeed, we found that diabetes is more prevalent among people aged 40 and over. However, analysis of Indonesia Family Life Survey (IFLS) data showed that respondents over 35 are already at a 5.6 risk of diabetes compared to respondents younger than 35.[7]

Moreover, the age-group-specific proportion of undiagnosed diabetes cases follows a pattern that differs from the overall diabetes prevalence in Indonesia. It is observed that DM cases in Indonesian young adults (15-29 years) are less likely to be diagnosed. This indicates that older individuals

**Table 3.** Results from the bivariate analysis

| Variables | | OR | *P*-value |
|---|---|---|---|
| ***Age group (years)*** (reference = 15-29) | 30-39 | 0.172 (0.03-1) | <0.001 |
| | 40-49 | 0.078 (0.014-0.42) | |
| | 50-59 | 0.046 (0.009-0.248) | |
| | 60 or more | 0.052 (0.01-0.281) | |
| ***Sex*** (reference = Male) | Female | 1.08 (0.871-1.341) | 0.713 |
| ***Area of residence*** (reference = Urban) | Rural | 2.471 (2.009-3.04) | <0.001 |
| ***Employment status*** (reference = In school/not employed) | Employed in public/private sectors | 1.107 (0.756-1.621) | <0.001 |
| | Entrepreneur | 0.911 (0.671-1.236) | |
| | Farmer/fisherman | 2.773 (2.096-3.67) | |
| | Informal worker | 1.414 (1.023-1.955) | |
| ***Education*** (reference = Graduated high school ) | Not graduated high school | 1.567 (1.236-1.986) | <0.001 |
| ***Wealth quintile*** (reference = Q5) | Q1 | 3.872 (2.808-5.338) | <0.001 |
| | Q2 | 2.614 (1.838-3.716) | |
| | Q3 | 2.418 (1.766-3.309) | |
| | Q4 | 1.624 (1.23-2.143) | |
| ***Smoking status*** (reference = Never) | Yes, daily | 1.17 (0.891-1.538) | 0.442 |
| | Yes, not daily | 0.851 (0.598-1.211) | |
| ***Physical activity*** (reference = Active) | Inactive | 0.52 (0.418-0.647) | <0.001 |
| ***Fruit consumption*** (reference = ≥5 days/week) | <5 days/week | 1.848 (1.459-2.34) | <0.001 |
| ***Vegetable consumption*** (reference = ≥5 days/week) | <5 days/week | 1.004 (0.803-1.256) | 0.517 |
| ***BMI*** (reference = Normal) | Underweight | 1.764 (1.143-2.722) | 0.020 |
| | Overweight/obese | 0.996 (0.801-1.238) | |

are more likely to be aware of their diabetes status and have received a medical diagnosis. Our analysis showed that developing diabetes at a young age (under 30 years) significantly increases the risk of going undiagnosed when compared to developing it later in life.

Countries with high incomes tend to have a higher prevalence of diabetes compared to poorer countries.[16] On the other hand, people from lower socioeconomic backgrounds may face challenges in accessing healthcare and health education, potentially leading to delayed detection of diseases such as diabetes. A previous study reported that socioeconomic status influences the prevalence of DM in Indonesia.[8] Our analysis reveals that factors such as type of employment, area of residence, and wealth index also affect the diagnosis status of diabetes. The inverse relationship between socioeconomic factors and diabetes diagnosis status observed in our study mirrors findings from Bangladesh,[17] where the wealthy are more likely to have diabetes. Still, the poor are less likely to be diagnosed and treated.

Although diabetes is more prevalent in urban areas, rural residents have a significantly higher percentage of undiagnosed cases in Indonesia. Our results show that rural residents are at least 1.5 times more likely to have undiagnosed diabetes compared to urban residents (Table 4). This disparity may be due to the limited access to healthcare services in rural areas, leading to fewer diagnoses among rural residents. While individuals in rural areas are less likely to develop diabetes compared to urban dwellers,[9] they may have a poorer understanding of diabetes screening and management due to limited access to healthcare centers.[14] This lack of accessibility, coupled with the perception that diabetes is an urban issue, may contribute to rural communities' reluctance to undergo diabetes screening, resulting in a higher proportion of undiagnosed cases in rural areas.

Another survey reported a higher risk of getting DM among unemployed Indonesians compared to those employed,[9] which aligns with the results from Riskesdas 2018. Notably, asymptomatic patients are typically diagnosed during routine health check-ups for LIC policy, job recruitment, or before surgery.[4] Meanwhile, agricultural field workers in Indonesia do not typically access such facilities. Occupations such as farming and fishing, which are common in lower wealth quintiles, are associated with a higher likelihood of undiagnosed diabetes, according to our analysis. This could be due to limited healthcare access and lower health awareness among these populations.

It was reported that low educational attainment is associated with diabetes occurrence in urban areas of Indonesia,[7] contrasting findings from multiple low and middle-income countries where higher education levels were linked to increased diabetes vulnerability.[18] In our study, not graduating from high school is only seen as being associated with undiagnosed DM in bivariate analysis but not in the multivariable analysis. This may suggest that the contribution of educational level is not as significant as financial and employment status for undiagnosed diabetes. Nevertheless, health illiteracy is known as an important barrier to seeking healthcare.[14]

### Lifestyle and undiagnosed diabetes

Previous studies show that lack of physical activity is associated with diabetes incidence. Thus, many health promotion activities are directed to the increase of physical

**Table 4.** Multivariable logistic regression analysis between the diagnosis status of DM and the independent variables

| Variables | | OR | *P*-value |
|---|---|---|---|
| ***Age group (years)*** (reference = 15-29) | 30-39 | 0.176 (0.03-1.043) | <0.001 |
| | 40-49 | 0.08 (0.014-0.444) | |
| | 50-59 | 0.048 (0.009-0.267) | |
| | ≥60 | 0.055 (0.01-0.306) | |
| ***Area of residence*** (reference = Urban) | Rural | 1.557 (1.228-1.973) | <0.001 |
| ***Employment status*** (reference = In school/not employed) | Employed in public/private sectors | 1.283 (0.804-2.048) | <0.001 |
| | Entrepreneur | 1.015 (0.73-1.413) | |
| | Farmer/fisherman | 1.942 (1.418-2.661) | |
| | Informal worker | 1.387 (0.991-1.941) | |
| ***Education*** (reference = Graduated high school) | Not graduated high school | 1.111 (0.826-1.495) | 0.485 |
| ***Wealth quintile*** (reference = Q5) | Q1 | 2.373 (1.667-3.378) | <0.001 |
| | Q2 | 1.715 (1.174-2.505) | |
| | Q3 | 1.616 (1.156-2.259) | |
| | Q4 | 1.248 (0.935-1.665) | |
| ***Physical activity*** (reference = Active) | Inactive | 0.654 (0.517-0.828) | <0.001 |
| ***Fruit consumption*** (reference = ≥5 days/week) | <5 days/week | 1.24 (0.976-1.577) | 0.079 |
| ***BMI*** (reference = Normal) | Underweight | 1.374 (0.851-2.218) | 0.139 |
| | Overweight/obese | 1.239 (0.973-1.577) | |

activity.[19–22] Our study, however, shows that diabetic Indonesians who are physically active also have a higher risk of undiagnosed diabetes. Similar results were observed in a study from Bangladesh,[23] indicating a potential misconception that physical activity alone can safeguard against diseases.

Results from our study show that people with sufficient physical activity have a higher proportion of undiagnosed diabetes compared to those with less physical activity. The perception that physical activity reduces the risk of diabetes may lead individuals who are already physically active to skip blood sugar tests, potentially contributing to the progression of diabetes. Nevertheless, physical activity is a fundamental therapeutic aid in managing type 2 diabetes.[24] Additionally, inactive individuals with more screen time may exhibit a higher prevalence of diagnosed diabetes due to increased health awareness through information accessed through their gadgets.

Moreover, high physical activity levels can be job-related. It was reported that rural women tend to engage in more physical activity than urban women.[25] Our analysis shows that farmers and fishermen, the typical rural jobs that also require high physical activity for their work, are among the most at risk for undiagnosed diabetes. On the other hand, having a BMI beyond the normal range is found to increase the odds of undiagnosed diabetes, although the relationship was not statistically significant.

Cigarette smoking is known to exacerbate diabetes risk by impairing glucose tolerance and insulin sensitivity.[26–28] However, there is no association between smoking status and the prevalence of diabetes in urban Indonesia.[7] Similarly, our analysis did not reveal a significant relationship between smoking status and the diagnosis status of diabetes among diabetic Indonesians.

Dietary adherence poses challenges in diabetes care, especially amid cultural barriers.[14] Our study suggests that while fruit consumption initially appears associated with undiagnosed diabetes, this relationship diminishes in multivariable analysis, highlighting the complexity of dietary influences on diabetes outcomes. Nevertheless, a diet rich in fruits and vegetables is vital to prevent type 2 diabetes.[29]

An Indonesian study has suggested considering social support when designing dietary interventions for patients with type 2 DM, especially in rural settings.[30] As proposed by a study from another ASEAN country, internationally recommended diabetes prevention interventions may not be directly applicable here; instead, a localized program such as reducing rice consumption and considering prevailing health beliefs should be encouraged.[31] In the United States, the proportion of undiagnosed diabetes has declined drastically in the past decades. The undiagnosed cases comprise only a minor proportion (<5 %) of all diabetes cases in the country.[5] This is, of course, a contrasting difference with undiagnosed diabetes in Indonesia. While developing as a nation, trends of NCDs, including diabetes, continue to increase, but the healthcare system still needs to catch up to detect diabetes cases.

Our findings have important implications for public health strategies and clinical practice. First, addressing undiagnosed diabetes in Indonesia requires a multifaceted approach, combining improved access to healthcare with better public awareness of diabetes risks. Screening programs should target younger adults, rural populations, and those in lower socioeconomic groups, where the risk of undiagnosed diabetes is highest. Second, public health campaigns must continue to promote routine screenings, even for individuals with active lifestyles or those who perceive themselves as low risk.

An ecological study across Asian countries demonstrated that more robust healthcare governance is associated with higher rates of diabetes, potentially due to improved and earlier detection of diabetic patients.[32] Accurate identification of individuals with diabetes is crucial for initiating proper blood glucose control and preventing complications.[33] Early detection of type 2 diabetes allows for patient-centred management to enhance glycaemic control and reduce complications.[34] The Indonesian healthcare system should prioritize strengthening primary healthcare services, particularly in rural areas, to improve access to diagnostic tools and diabetes treatment.

### Limitations

Our study's cross-sectional design limits our ability to establish causal relationships between the diagnosis status of diabetes and the independent variables, calling for future longitudinal investigations. Additionally, the lack of other potential risk factors, such as marital status, family history, comorbidities, or access to healthcare, may have overlooked essential influences on undiagnosed DM.

This study did not account for individuals with impaired fasting glucose (IFG) or impaired glucose tolerance (IGT), which are high-risk conditions for type 2 diabetes. The Riskesdas dataset needed more specific questions on these conditions, limiting our ability to include them in the analysis. We also acknowledge the absence of HbA1c measurements, a more objective indicator of DM, and the lack of distinction between type 1 and type 2 DM, which could have enriched our insights into disease dynamics. Future research with more detailed data on glucose metabolism is recommended to capture the entire burden of undiagnosed diabetes better.

However, our study offers significant strengths, particularly in estimating the prevalence of undiagnosed diabetes in Indonesia using Riskesdas, a nationally representative survey. Using odds ratios to identify risk factors for undiagnosed DM enhances the robustness of our findings. Despite limitations, the nationwide sampling approach employed in our study bolsters the generalizability of our results and provides valuable insights for public health strategies targeting undiagnosed diabetes in Indonesia.

## CONCLUSION

As a developing nation, Indonesia is experiencing a continual rise in diabetes prevalence, reflecting an epidemiological transition towards non-communicable diseases. This trend significantly strains the country's healthcare system, which is challenged to detect more diabetes cases. Unfortunately, our analysis indicates that many diabetes cases remain undetected, highlighting the current limitations in our healthcare system's ability to diagnose this particular public health issue. Despite governmental campaigns against NCDs, including diabetes, it appears that these programs have not effectively reached vulnerable populations, such as rural communities, the economically disadvantaged, and workers in agriculture and informal sectors.

Ensuring all patients are accurately diagnosed and detected is essential for meaningful disease control. Identifying the unequal distribution of undiagnosed diabetes among different socioeconomic groups is crucial for setting priorities and resource allocation. The findings of our study will aid policymakers by highlighting disparities in undiagnosed diabetes distribution, guiding targeted interventions and resource allocation. Our analysis recommends initiating diabetes screening at a productive age, focusing on those in rural areas, agricultural and informal workers, and those from lower economic classes. By targeting screenings for high-risk groups and improving health literacy, Indonesia can move toward more equitable and effective diabetes management.

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**Statement of Authorship**
All authors certified fulfillment of ICMJE authorship criteria.

**CRediT Author Statement**
**ARF**: Conceptualization, Methodology, Formal Analysis, Writing – original draft preparation, Writing – review and editing; **J**: Writing – original draft preparation; **WTY**: Writing – original draft preparation; **BS**: Formal analysis, Writing – review and editing; **DEP**: Formal analysis.

**Data Availability Statement**
The Riskesdas 2018 data used in this study was supplied by the Health Development Policy Agency of the Ministry of Health of Indonesia under license. Requests for access to these data should be directed to the Health Development Policy Agency of the Ministry of Health of Indonesia.

**Author Disclosure**
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