Open Access

Belitung Nursing Journal
Volume 10(1), 41-47

https://doi.org/10.33546/bnj.3112

Identifying diabetes risks among Indonesians: A cross-sectional study in a community setting

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Abstract

Background: There is an upward surge in diabetes patients worldwide, including in Indonesia, annually. Diabetes can lead to new diseases that burden patients' lives further. Nurses can reduce this problem by identifying people at risk of developing diabetes and educating them on how to prevent diabetes.

Objective: The study aimed to determine the risk of diabetes in the Indonesian population.

Methods: The descriptive research involved a sample of 1216 Indonesians living in North Sumatra Province. Participants were nondiabetic individuals selected using the convenience method from May to October 2020. This study utilized the Indonesian version of the Finnish Diabetes Risk Score (FINDRISC) tool and employed various statistical analyses, including frequencies, percentages, chi-square test, and Fisher's exact test.

Results: Of the total samples, 372 were males (30.6%), and 844 were females (69.4%). The risk of developing diabetes was classified as low (57.1%), slightly elevated (36.4%), moderate (5.3%), high (1.0%), and very high (0.2%). Only one of the eight risk factors that differed significantly between men and women was a history of elevated blood glucose levels, with a *p*-value of 0.02.

Conclusion: The study identified a portrait of the number and percentage of diabetes risk factors in a community setting in Indonesia. Nurses must provide education on diabetes prevention to not only members of the local community at the research site but also the general public, nationally and globally.

Keywords

FINDRISC; risk factors; diabetes; screening; Indonesia; blood glucose

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Article info:
Received: 10 November 2023
Revised: 15 December 2023
Accepted: 29 January 2024

E-ISSN: 2477-4073 | P-ISSN: 2528-181X

Background

Worldwide, the estimated number of diabetics in the 20–79 age group was 366 million in 2011 and had grown to 537 million by 2021. In Indonesia, the number was 19.5 million in 2011 and will increase to 28.6 million in 2040 (International Diabetes Federation, 2021) with the following complications: neuropathy (64%), retinopathy (42%), microvascular (28%), macrovascular (16%), and nephropathy (7%), respectively (Soewondo et al., 2010). Type 2 diabetes mellitus (T2DM) is the most common type, accounting for more than 90% of cases (Ley et al., 2018).

There are specific subgroups of the population with risk factors that directly cause or are associated with diabetes: age 46 years and over, body mass index (BMI) of 25 kg/m^2 or more, family medical history, sedentary habits, ethnicity (race), fasting blood glucose increases and blood glucose two hours after eating increases, history of increased blood glucose during pregnancy, hypertension, elevated levels of HDL cholesterol or triglycerides, polycystic ovary syndrome, and vascular disease (American Diabetes Association, 2003). People with elevated fasting blood glucose and increased blood glucose two hours after eating are most likely to develop T2DM (up to 7% within the first year). Individuals with obesity and non-diabetic hyperglycemia are expected to develop type 2 diabetes by a likelihood of 11% (Dallosso et al., 2023).

Sex has also been identified as a risk factor for diabetes (Nazarko, 2023). However, research on the relationship between gender and T2DM still needs to be done because it is inconclusive (Aregbesola et al., 2017). Globally, diabetes is more prevalent in men than in women, particularly middle-aged individuals (Tramunt et al., 2020). Sex differences affect the incidence of diabetes in young and middle-aged individuals (Huebschmann et al., 2019). T2DM is more common in men; however, women are diagnosed at a younger age (McPherson & Bancks, 2023). Men have a higher risk of developing diabetes at a younger age, whereas women have a higher risk of developing complications. This difference is related to biological and psychological factors (Li et al., 2021). A study in Sweden found that the prevalence rate of diabetes was higher in men than in women, at 14.6% and 9.1%, respectively (Nordström et al., 2016). Differences in the development of diabetes and its complications are partly influenced by sex hormones through the regulation of glucose homeostasis and

insulin secretion (Ciarambino et al., 2022). Information about sex differences in diabetes is needed to gain a deeper understanding of the biological background and its psychosocial impact so that diabetes management can be more personal (Kautzky-Willer et al., 2023).

Without intervention, the prevalence of diabetes will continue to increase, leading to increased disability and morbidity. Therefore, preventive measures should be implemented to control diabetes. One of them is screening people at risk for diabetes and implementing preventive interventions (Ishaque et al., 2016). Screening aims to identify healthy individuals who are likely to develop a disease. Screening is not the same as diagnostic examination. At the screening stage, the patient had no symptoms, whereas at diagnosis, the patient showed several clinical symptoms. The screening activity will find individuals with T2DM risk (Gray et al., 2018).

One of the tools for screening people with T2DM risk is the FINDRISC. This tool is the most frequently used worldwide, with a sensitivity of 78 – 81% and a specificity of 76 – 77% (Lindstrom & Tuomilehto, 2003). The FINDRISC has also been proven valid and reliable for various populations worldwide and has officially been adopted by the international diabetes federation as a T2DM screening measuring instrument (Barengo et al., 2019).

Many programs across the globe continue to prevent the growth of diabetes prevalence. Some programs have been implemented in many countries for individuals at risk of T2DM. They were advocated for behavioral changes in diet and physical activity (Marsden et al., 2023). To meet these challenges, healthcare providers must adopt a strategic approach based on evidence-based interventions to address risk factors and improve clinical outcomes for those at risk for T2DM (Moore-Harper et al., 2023). Nurses are healthcare providers in a unique position to succeed in diabetes prevention programs because they can fit into all levels of healthcare and the human life span. Nurses provide care for diabetes prevention through assessment, diagnosis, treatment, service coordination, and education (Moore-Harper et al., 2023).

In Indonesia, a program focused on diabetes prevention called the integrated coaching posts (*Posbindu, Pos Pembinaan Terpadu*) for non-communicable diseases (NCDs) (Health Social Security Administrator, 2014). *Posbindu* was established in 2011 to promote health and prevent non-communicable diseases. Nurses are the most numerous health workers in the *Posbindu* program and are always involved in all activities (Health Social Security Administrator, 2014). Several studies have been conducted on diabetes risk factors in Indonesia, including identifying developmental factors during childhood with the incidence of diabetes when they are adults between the ages of 20-40 years (Tanoey & Becher, 2021), examining fasting blood glucose levels among older adults (Oktaviyani et al., 2022), and identifying the most dominant risk factors for diabetes (Nugroho et al., 2020). In addition, these studies used secondary data from the Indonesian Family Life Survey and Basic Health Research on people diagnosed with diabetes. To date, few studies have been conducted on the risk of developing diabetes in Indonesia using the FINDRISC to determine the risk of diabetes in the Indonesian population.

Methods

Study Design

This descriptive study used a cross-sectional approach and was conducted in a community in North Sumatra Province, Indonesia.

Samples/Respondents

The strategy used to determine the number of samples was the same as that used in similar studies (Israel, 2003). The samples were 15% of the total population, following a similar study conducted by Acosta et al. (2018). With a population of 8,024 older adults in the district of Deli Tua, Deli Serdang Regency, North Sumatra Province, Indonesia, the sample size was 1,216 persons (Deli Serdang Regency Central Statistics Agency, 2018). The inclusion criteria for the sample included adults and older people who had never been diagnosed with diabetes, were fluent in Bahasa Indonesia, and expressed willingness to participate.

Instruments

The research employed the FINDRISC instrument, designed to estimate the likelihood of individuals developing diabetes mellitus over the next ten years. It includes eight variables: age, body mass index (BMI), abdominal circumference, physical activity habits, fruit or vegetable consumption, history of antihypertensive drug use, history of hyperglycemia, and family history of diabetes. The total scores range from 0 to 26 (Lindstrom & Tuomilehto, 2003). However, the BMI and abdominal circumference variable scores were adjusted for the Indonesian population size (An et al., 2013; WHO Expert Consultation, 2004). The instrument was translated into Bahasa Indonesia in 2017 by the Australia Centre Medan located in Medan City, Indonesia (Australia Centre Medan, 2017) after obtaining approval from its original developer (Jaana Lindström and Jaakko Tuomilehto, Finland). The calculations and estimations of T2DM development are presented in **Table 1**.

Table 1 The FINDRISC score range

Score	Category
0 – 6	Low-risk In the next 10 years, it is estimated that 1 in 100 (1%) will develop T2DM
7 – 11	Slightly elevated-risk In the next 10 years, it is estimated that 1 in 25 (4%) will develop T2DM
12 – 14	Moderate-risk In the next 10 years, it is estimated that 1 in 6 (17%) will develop T2DM
15 – 20	High-risk In the next 10 years, it is estimated that 1 in 3 (33%) will develop T2DM
21 – 26	Very high-risk In the next 10 years, it is estimated that 1 in 2 (50%) will develop T2DM

Data Collection

This study was conducted between May and October 2020 in a local community in Indonesia (Deli Tua District, Deli Serdang Regency, North Sumatra Province), and six health cadres trained previously using the instrument were enlisted. Prior to

collecting data, the objectives and steps were explained in detail to all respondents.

Data Analysis

Data analyses were performed using IBM SPSS version 23. Descriptive statistics (frequency and percentage) were used to analyze eight diabetes risk variables. The Chi-square and Fisher's exact tests were used to analyze the different proportions of diabetes risk variables. Moreover, Fisher's exact test was used to analyze the variables of physical activity and history of blood glucose levels because they did not meet the assumptions of the chi-square test. Differences were considered significant when the *p*-value was <0.05.

Ethical Considerations

This research obtained a letter of permission to conduct research from the research ethics committee of the Universitas Sumatera Utara, Indonesia (Number: 232/KEP/USU/2020), and all participants signed an informed consent form prior to data collection.

Results

Diabetes Risk Factors

The study results were based on a sample of 1,216 participants, consisting of 372 men (30.6%) and 844 women (69.4%). The diabetes risk factors and differences between men and women are shown in **Table 2**.

Table 2 The distribution of diabetes risk factors

Variable	FINDRISC points	Total (%)	Men (%)	Women (%)	$\chi 2$	*p*
Age (year)						
< 45	0	730 (60.0)	229 (61.6)	501 (59.4)	1.18	0.758
45-54	2	232 (19.1)	70 (18.8)	162 (19.2)		
55-64	3	165 (13.6)	50 (13.4)	115 (13.6)		
> 64	4	89 (7.3)	23 (6.2)	66 (7.8)		
BMI (kg/m^2)						
< 22	0	265 (21.8)	81 (21.8)	184 (21.8)	0.47	0.793
22-25	1	445 (36.6)	141 (37.9)	304 (36.0)		
> 25	3	506 (41.6)	150 (40.3)	356 (42.2)		
Waist circumference (cm; men/women)						
< 90/80	0	517 (42.6)	197 (53.0)	320 (37.9)	N/A	N/A
90-98/80-88	3	364 (29.9)	114 (30.6)	250 (29.6)		
> 98/88	4	335 (27.5)	61 (16.4)	274 (32.5)		
Physical activity						
Yes	0	1,208 (99.3)	369 (99.2)	839 (99.4)	-	0.706†
No	2	8 (0.7)	3 (.8)	5 (0.6)		
Consumption of vegetables, fruit or berry						
Every day	0	819 (67.4)	252 (67.7)	567 (67.2)	0.37	0.847
Not every day	1	397 (32.6)	120 (32.3)	277 (32.8)		
Medication for hypertension						
No	0	1,163 (95.6)	358 (96.2)	805 (95.4)	0.46	0.500
Yes	2	53 (4.4)	14 (3.8)	39 (4.6)		
History of high blood glucose						
No	0	1,205 (99.1)	372 (100)	833 (98.7)	-	0.022†*
Yes	5	11 (0.9)	0 (0.0)	11 (1.3)		
History of family with diabetes						
No	0	1,063 (87.4)	320 (86.0)	743 (88.0)	1.09	0.579
Yes: 2nd degree	3	50 (4.1)	18 (4.8)	32 (3.6)		
Yes: 1st degree	5	103 (8.5)	34 (9.2)	69 (8.2)		

Note: †Fisher's exact test | N/A Not Applicable | **p*-value <0.05

There are two protective factors against diabetes in the FINDRISC: physical activity and consumption of vegetables, fruits, and berries. More than 99% of the respondents engaged in physical activity for at least 30 minutes daily, and nearly 68% consumed vegetables and fruits daily. Regarding diabetes risk factors, most respondents were aged < 45 years (60.0%). The prevalence of BMI greater than 25 kg/m^2 was slightly higher in men (40.3%) than in women (42.2%). Regarding waist circumference, 16.4% of men had a waist circumference > 98 cm, and 32.5% of women had a waist circumference > 88 cm. At least 11 (0.9%) participants reported incidentally increased blood glucose levels, significantly higher in women than men. Of the respondents, 12.6% had a family history of diabetes, and most were first-degree family members (8.5%). Fisher's exact test was used to analyze the variables of physical activity and history of elevated blood glucose levels because they did not meet the assumptions of the chi-squared test. Chi-square and Fisher's exact tests showed that of the eight variables, only the history of elevated blood sugar levels significantly differed between men and women ($p = 0.02$).

Diabetes Risk Score

Most respondents in this study were at low risk (57.2%), followed by slightly elevated risk (36.4%), moderate risk

(5.3%), high risk (1.0%), and very high risk (0.2%). The Chi-Square test showed no difference in the risk between men and women (p >0.05). The total scores for diabetes risk factors, risk categories, and differences between men and women are presented in **Table 3**.

Table 3 The distribution of total diabetes risk score

Score	Risk Category	Total (%)	Men (%)	Women (%)	$\chi 2$	p
0–6	Low	695 (57.1)	216 (58.1)	479 (56.7)	1.79	0.775
7–11	Slightly elevated	443 (36.4)	131 (35.2)	312 (37.0)		
12–14	Moderate	64 (5.3)	22 (5.9)	42 (5.0)		
15–20	High	12 (1.0)	3 (0.8)	9 (1.1)		
21–26	Very high	2 (0.2)	0 (0.0)	2 (0.2)		

Discussion

Diabetes Risk Factors

The findings showed that 40% of respondents were over 45 years old. The risk of developing diabetes increases with age. Individuals are often diagnosed at 45-64 years old (Centers for Disease Control and Prevention, 2023). Compared to 20-34 years old, 55-74 years old have a seven-fold higher incidence (Yang et al., 2016), whereas those aged under 30 years are rarely found (Ley et al., 2018). In Indonesia, the highest prevalence of diabetes is at the age of 55-64 (6.3%) (Ministry of Health Indonesia, 2018).

Almost 42% of respondents had a BMI > 25 kg/m^2. In Asian populations, individuals are classified as overweight if the BMI is between 22 to 25 kg/m^2 and classified as obese if the BMI is between 26 to 31 kg/m^2 (WHO Expert Consultation, 2004). Overweight and obesity cause insulin resistance, resulting in hyperinsulinemia, which ultimately causes failure of the pancreas to produce insulin, leading to diabetes (Kong et al., 2016). A systematic review found that individuals with a BMI > 29 kg/m^2 had a significantly increased risk of developing diabetes (Ismail et al., 2021).

Men with a waist circumference of 90 cm or more were 47.0%, and women with a waist circumference of 80 cm or more were 62.1%. Asian populations are already classified as having central obesity (An et al., 2013). Central obesity can lead to insulin resistance and an increased risk of developing diabetes (Nazarko, 2023). Central obesity is associated with insulin resistance and metabolic complications. Various studies have shown that the more fat in the viscera, the higher the risk of developing diabetes (Hsieh et al., 2014). Central obesity is also significantly associated with diabetes and undiagnosed diabetes (Kumar et al., 2016).

Ninety-nine percent (99%) of the respondents engaged in 30 minutes of daily physical activity. Brisk walking or physical activity with more strenuous intensity can reduce the risk of diabetes. Aerobic physical exercise or lifting weights for ≥ 150 minutes per week lowers the risk of diabetes by 34-45% in men. Moderate or high-intensity physical activity and muscle strength training may lower the risk of diabetes in women (Ley & Meigs, 2018). People with diabetes who are physically active can control their blood sugar levels by as much as 2.4 times compared with those who are not physically active (Asfaw & Dagne, 2022).

As many as 67.4% of the respondents consumed vegetables and fruits daily. Insufficient vegetable and fruit intake is a known risk factor for almost all NCDs, including T2DM (Lapuente et al., 2019). Conversely, consuming sufficient quantities of vegetables and fruits can reduce the risk of diabetes. A cohort study in Sweden revealed a link between increased vegetable and fruit consumption and a decreased risk of diabetes and prediabetes. However, consuming some vegetable and fruit subtypes still requires further research (Barouti et al., 2022). In addition, increasing the intake of fruits (especially berries) and vegetables can reduce the risk of diabetes (Wang et al., 2016).

A total of 4.4% of the respondents had a history of taking antihypertensive medications. Hypertension is also closely associated with diabetes. People with hypertension generally experience insulin resistance, so they have a higher risk of developing diabetes compared to normotensive people (Petrie et al., 2018). Antihypertensive drugs are risk factors for diabetes. Therefore, the selection of antihypertensive drugs must be considered appropriately (Ismail et al., 2021).

Few women (0.9 %) had elevated blood glucose levels. Other risk factors for diabetes in women include polycystic ovarian syndrome, high testosterone levels, and gestational diabetes. Conversely, low testosterone levels are a risk factor in men (Kautzky-Willer et al., 2023). Sex is a known risk factor for diabetes. Middle-aged men are more at risk than middle-aged women because men are more likely to store fat in their abdominal organs, while women store fat on their thighs (Nazarko, 2023).

The results showed that 12.6% of the respondents had a family history of diabetes. Family history is a significant predictor of diabetes in the adult population, including in the U.S. (Annis et al., 2005), in China (Zhang et al., 2015), and in European countries (The InterAct Consortium, 2013). A systematic review supports this finding (Ismail et al., 2021).

Diabetes Risk Score

The findings show that of the 1,216 participants, 57.2% had low, 36.4% had slightly elevated, 5.3% had moderate, 1.0% had high, and 0.2% had very high FINDRISC scores. The score of ≥15 (high and very high-risk) was 1.2%. Similar results to this study were found by college students in Jordan. In their study, 1.8% of students were at high risk, and there were no very high risks (Al-Shudifat et al., 2017). However, Belgian research on occupational healthcare found a different result in terms of high and very high-risk at 5.5% (Vandersmissen & Godderis, 2015), in Pakistan among squatter settlements found 7.0% (Ishaque et al., 2016), in Sweden conducted through online workplaces were 8.4% (Gyberg et al., 2012), in India conducted at a primary health center found 10.1% (Saleem et al., 2017), in Turkey conducted in community settings found 17.1% (Atayoglu et al., 2020), in Jordan carried out in a dental setting found 21.1% (Alazzam et al., 2020), and the highest was found in Botswana in a general medical

outpatient found 43% was high and very high-risk categories (Omech et al., 2016).

Limitations

This study is limited by the use of convenience sampling techniques. Convenient sampling was used because this study was conducted during the COVID-19 pandemic, and many residents in the community were unwilling to receive a visit because they were afraid of being infected. The disadvantage of convenience sampling is the difference between the sample taken and the actual characteristics of the population, which may result in inappropriate representation (under-representation). Although this approach can capture most community members, there is still the potential for sampling bias because the samples taken are based on the willingness to participate. However, this study has advantages regarding the number of samples involving many respondents (1,216). A large sample size may represent more general findings.

Implication of the Study

This study was conducted in a community setting using the participants' complete addresses. Therefore, the data can be utilized as information by healthcare workers to select high-risk and very high-risk individuals to participate in a diabetes prevention program as part of their *Posbindu* goals. Healthcare workers, including nurses, can provide health education on diabetes prevention to community members based on risk factor variables. These findings provide a better understanding of the distribution of risk factors for diabetes. Hence, it is relevant and valuable to implement appropriate diabetes prevention programs in local, national, and global communities. Moore-Harper et al. (2023) stated that diabetes prevention strategies require involvement from multiple disciplines, including nursing. Diabetes prevention programs require nurses as frontline care providers.

Conclusion

These findings portray the number, percentage, and association of risk factors of T2DM in a community setting in Indonesia. Nurses can use these findings to educate high-risk individuals to avoid diabetes. Nurses can act as health-promoting agents to prevent diabetes by educating community members about the risks of diabetes. Health promotion is one of the best ways to maintain health and prevent diabetes. By identifying diabetes risk factors in the community and providing education on prevention, nurses can reduce the financial and clinical burden on individuals and the healthcare system. To minimize the problems caused by diabetes and maintain the continuity of diabetes prevention programs, future studies are recommended to identify and solve the problems faced by individuals with undiagnosed diabetes in the community.

Declaration of Conflicting Interest

There is no conflict of interest among all authors.

Funding

The Research Institute of Universitas Sumatera Utara, Indonesia, granted this research.

Acknowledgment

Researchers would like to thank the Research Institute of Universitas Sumatera Utara for providing financial support in this research and all participants for their kind cooperation.

Authors' Contributions

The authors of the Faculty of Nursing, Universitas Sumatera Utara, Indonesia, have contributed substantially in terms of design and conception, data collection, analysis, and interpretation, as well as intellectual content. The author of the Faculty of Nursing, Khon Kaen University, Thailand, contributed to the interpretation and intellectual content.

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Data Availability

All data is available from the corresponding author and can be provided upon reasonable request.

Declaration of Use of AI in Scientific Writing

There is nothing to declare.

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Cite this article as: Tarigan, M., Setiawan., Tarigan, R., Imelda, F., & Jongudomkarn, D. (2024). Identifying diabetes risks among Indonesians: A cross-sectional study in a community setting. *Belitung Nursing Journal, 10*(1), 41-47. https://doi.org/10.33546/bnj.3112