



ORIGINAL RESEARCH

RISK FACTORS OF DIABETES MELLITUS IN URBAN COMMUNITIES IN INDONESIA (IFLS 5)

Risk Factors of Diabetes Mellitus in Urban Communities in Indonesia (IFLS 5)

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ABSTRACT

Background: Over the last decades, the number of new diabetic cases and the prevalence of diabetes have tended to increase. The diabetes prevalence rate in Indonesia in 2020 reached 6.20%. **Purpose:** The aim of this study is to examine the relationship between the variables of age, level of education, smoking status, and Body Mass Index (BMI) and the prevalence of diabetes in the urban areas. **Methods:** This was a cross-sectional study and used secondary data from the Indonesia Family Life Survey (IFLS 5) in 2015. The data was analyzed using descriptive analysis and simple logistic regression. The dependent variable in this study was Diabetes Mellitus (DM); the independent variables were age, education level, smoking status, and BMI. **Results:** In terms of the respondents' characteristics, individuals were mainly over 35 years of age (130 respondents, 83.87%). The highest level of education was attained by 93 respondents (60.00%). There was a correlation between respondents who were over 35 years of age, with $p=0.01$; prevalence ratio (PR)=5.60; 95%CI=3.64–8.62) and the level of education ($p=0.01$; PR=1.69; 95%CI=1.22–2.34) with the incidence of diabetes in urban areas in Indonesia. There was no correlation between the smoking status ($p=0.55$; PR=0.67; 95%CI=0.01–2.73) and the BMI of respondents with the prevalence of diabetes in urban areas in Indonesia. **Conclusion:** The age and the level of education were linked to the incidence of diabetes in urban areas in Indonesia.

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ABSTRACT

Latar belakang: Beberapa dekade terakhir angka kasus baru dan

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prevalensi diabetes cenderung mengalami peningkatan. Prevalence rate (PR) diabetes di Indonesia tahun 2020 mencapai 6,20%. Tujuan: Penelitian ini bertujuan untuk melihat apakah terdapat hubungan antara variabel usia, tingkat pendidikan, status merokok, dan Indeks Massa Tubuh (IMT) dengan kejadian diabetes pada populasi urban. *Metode:* Penelitian ini merupakan penelitian cross sectional yang menggunakan data sekunder dari Indonesia Family Life Survey (IFLS 5) pada tahun 2015. Data dianalisis menggunakan analisis deskriptif dan regresi logistik sederhana. Variabel dependen dalam penelitian ini adalah penyakit diabetes mellitus. Variabel independen dalam penelitian ini adalah usia, tingkat pendidikan, status merokok, dan IMT. *Hasil:* Penelitian ini menunjukkan karakteristik responden sebagian besar berusia lebih dari 35 tahun yaitu sebanyak 130 responden (83,87%) dengan tingkat pendidikan mayoritas tingkat tinggi yaitu sebanyak 93 responden (60,00%). Ada hubungan antara usia lebih dari 35 tahun ($p=0,01$, $PR=5,60$, $95\%CI=3,64-8,62$) dan tingkat pendidikan ($p=0,01$, $PR=1,69$, $95\%CI=1,22-2,34$) dengan kejadian diabetes pada daerah urban di Indonesia. Tidak terdapat hubungan status merokok ($p=0,55$, $PR=0,67$, $95\%CI=0,01-2,73$) dan IMT dengan prevalensi diabetes pada daerah urban di Indonesia. *Kesimpulan:* Faktor usia dan tingkat pendidikan berhubungan dengan kejadian diabetes pada daerah urban di Indonesia.

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INTRODUCTION

Diabetes is a disorder characterized by hyperglycemia in the body. Diabetes can be classified into two types: type 1 and type 2. This classification is based on age (at the onset of diabetes), rate of loss of β -cell function, level of insulin resistance, the need to continue insulin for survival, and the presence of autoantibodies associated with diabetes (Leslie, Palmer, Schloot, & Lernmark, 2016). Obesity, sedentary lifestyle, unhealthy diet, and heredity are important risk factors that need to be considered because they affect the development of type 2 Diabetes Mellitus (DM) (Fareed, Salam, Khoja, Mahmoud, & Ahamed, 2017).

Diabetes is one of the non-communicable diseases (NCDs). The prevalence of NCDs is increasing rapidly throughout the world (Jansson et al., 2015). One in 10 people in the world lives with diabetes (International Diabetes Federation, 2019). A previous research study conducted in Ghana in 2017 concluded that diabetes was not related to age, sex, and Body Mass Index (BMI) (Agbogli, Annan, & Mak-Mensah, 2017), however, different results were revealed by other studies conducted in Nigeria in 2018, which revealed that city-dwelling, physical activity, old age, and unhealthy diets are essential factors to be

considered by people living with diabetes in Nigeria (Uloko et al., 2018). A research conducted by Elmadhoun, Noor, Ibrahim, Bushara, & Ahmed (2016) in urban community populations suggested that increasing age, low level of education, family history of diabetes, and the presence of a metabolic syndrome component are risk factors for diabetes in Sudan.

In 2019, Indonesia was ranked the seventh highest (after China, India, USA, Pakistan, Brazil, and Mexico) in terms of the highest number of diabetes patients in the world. There are approximately 10.70 million people >65 years of age. In 2019, Indonesia was also the fifth-ranked country in the world, in terms of the number of adults (20–79 years) with undiagnosed diabetes (International Diabetes Federation, 2019).

The results of a study conducted by Stanifer et al. (2016) revealed that most of the respondents (63 people) who suffered from diabetes lived in urban communities (75.00%) (Stanifer et al., 2016). Based on previous research studies, researchers are interested in knowing the risk factors for diabetics in urban communities. Using IFLS 5 data from 2015, this study aims to examine whether there is a relationship between the variables of age, education level, smoking status, and BMI and diabetes in urban areas.

METHODS

This was an analytical observational study, which used a cross-sectional design approach. This study used secondary data from the IFLS 5 in 2015. The population for this study was Indonesians, who were willing to be respondents for the survey. IFLS was a longitudinal study that was carried out from 1993 to 2014 in 13 provinces in Indonesia. Data collected from the IFLS is individual data, household data, and community data. This data is socioeconomic-and health-based. The variables observed for this study include diabetes, age, education level, smoking status, and BMI. The dependent variable was diabetes. Data on diabetes was obtained from HbA1c measurements. Respondents who had HbA1c >6.50, from the IFLS 5 survey results, were categorized as diabetics (Manik & Ronoatmodjo, 2019).

The independent variables for this study were age, education level, smoking status, and BMI. The age variable was classified as ≤ 35 years and >35 years. The educational level variable was classified into low and high. Respondents who did not go to school were included in the low education level category. The lowest level of education was elementary school or junior high school. Respondents who were in high school or college were included in the higher education level category. The smoking status variable was classified into smoking and not smoking. Smoking status was observed from the current condition of the respondents: whether they smoked or did not smoke. (Factors such as whether the respondents smoked in the past or the length of time the respondents smoked were discounted.) The BMI variable was categorized as underweight, normal, overweight, and obese. BMI was obtained by calculating the respondents' weights (in kilograms) and then dividing these weights by the respondents' heights (in meters).

The fifth wave of the IFLS data collection was conducted from 2014 to 2015 in 24 provinces in Indonesia. The required data on variables for this study was obtained from "file.dta", which was obtained from the website of the RAND Corporation using a questionnaire guide, including primary (individual) and household questionnaires to identify the variables that would be used. This study used secondary data, whose procedures were reviewed and approved by the Institutional Review Boards (IRBs) in the US. The IFLS 5 data was reviewed by the Gajah Mada University, as contained in the website of the RAND (Strauss,

Witoelar, & Sikoki, 2016). All approval requirements for both adult and child respondents were met and approved by the IRBs before the commencement of data collection in the field. Descriptive statistics were adopted to describe all the existing variables. This study employed a logistic regression analysis ($p < 0.05$) to analyze the variables of age, education level, smoking status, and BMI.

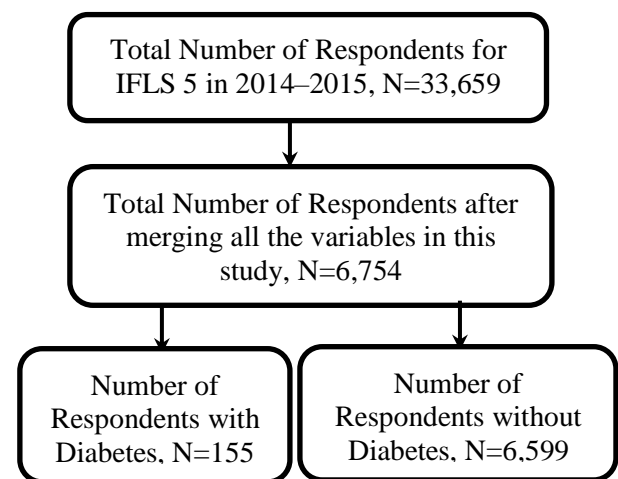


Figure 1. The Stage of Selecting Respondents for this Research

RESULTS

The sample size in this study was 6,754 respondents. The number of diabetic respondents was 155, and the number of respondents who did not have diabetes was 6,599. Among the respondents over 35 years of age (83.87%), the results of this study indicated that there were more diabetics than non-diabetics. The percentage of respondents who attained higher education was 60%. With regard to the smoking status, the difference in percentages between the diabetics and the non-diabetics was almost negligible: 98.70% and 98.10%.

In Table 2, many respondents above 35 years of age experienced diabetes (130 respondents, 84%). Based on statistical tests conducted by considering the age group of people >35 years with diabetes, a p value of 0.01 was obtained; PR value was 5.60; and 95%CI=3.64–8.62. The results meant that respondents >35 years of age were at risk of getting diabetes in the urban areas. Respondents >35 years of age were 5.60 times at risk of suffering from diabetes compared to respondents who were ≤ 35 years of age.

The variable of low education level had a p value of $0.01 < 0.05$, with a PR value of 1.69 and a

95%CI=1.22–2.34. These results indicated that low education levels were related to the incidence of diabetes in urban areas. Respondents who attained a low level of education were 1.69 times at risk of developing diabetes compared to respondents who claimed to attain a high level of education.

At the time of conducting the statistical tests, the BMI variable was divided into several categories. In the underweight category, the p value was 0.85, with a PR value of 0.08 (95%CI=0.08–7.34). With regard to the normal weight category, the p value was 0.75, with a PR value of 1.37 (95%CI=0.18–10.05). In the overweight category, the p value was 0.46, with a

PR value of 2.13 (95%CI=0.29–15.59). In the obese category, the p value was 0.48, with a PR value of 2.07 (95%CI=0.27–15.47). This meant that there was no BMI variable in any category that had a relationship with the incidence of diabetes in urban areas.

The smoking status variable was determined based on statistical tests, which revealed that respondents who smoked had a p value of 0.55>0.05, with a PR value of 0.67 (95%CI=0.01–2.73). This indicated that smoking was not a risk factor for the incidence of diabetes in urban areas of Indonesia (based on IFLS 5 data).

Table 1
Distribution Characteristics of Respondents

| Variable | Diabetes | | Non-Diabetes | | Total | |
|------------------------|----------|--------|--------------|--------|-------|--------|
| | n | % | n | % | n | % |
| Age (years) | | | | | | |
| ≤51.89 | 25 | 16.13 | 3,424 | 35.00 | 3,449 | 51.06 |
| >48.11 | 130 | 83.87 | 3,175 | 35.00 | 3,305 | 48.94 |
| Education Level | | | | | | |
| Low | 62 | 40.00 | 3,500 | 53.03 | 3,562 | 52.74 |
| High | 93 | 60.00 | 3,099 | 46.97 | 3,192 | 47.26 |
| Smoking Status | | | | | | |
| Smoking | 2 | 1.30 | 126 | 1.90 | 128 | 1.89 |
| Non-Smoking | 153 | 98.70 | 6,473 | 98.10 | 6,626 | 98.10 |
| Total | 155 | 100.00 | 6,599 | 100.00 | 6,754 | 100.00 |

Source: Strauss, Witoelar, & Sikoki (2016)

Table 2
Relationship Between Age, Education Level, BMI, and Smoking Status and Diabetes

| Variable | Occurrence Diabetes | | | | PR | 95% CI | p-value |
|------------------------|---------------------|--------|-------|--------|------|------------|---------|
| | Yes | | No | | | | |
| | n | % | n | % | | | |
| Age (Years) | | | | | | | |
| ≤35 | 25 | 16.13 | 3,424 | 51.89 | 0.01 | 3.64–8.62 | 0.01 |
| >35 | 130 | 83.87 | 3,175 | 48.11 | 5.60 | 0.00–0.01 | |
| Education Level | | | | | | | |
| Low | 62 | 40.00 | 3,500 | 53.04 | 1.69 | 1.22–2.34 | 0.01 |
| High | 93 | 60.00 | 3,099 | 46.96 | 0.02 | 0.01–0.02 | |
| Body Mass Index | | | | | | | |
| Underweight | 4 | 2.58 | 356 | 5.39 | 0.08 | 0.08–7.34 | 0.80 |
| Normal | 59 | 38.06 | 3,039 | 46.05 | 1.37 | 0.18–10.05 | 0.75 |
| Overweight | 63 | 40.64 | 2,127 | 32.23 | 2.13 | 0.29–15.59 | 0.46 |
| Obese | 29 | 18.70 | 1,005 | 15.23 | 2.07 | 0.27–15.47 | 0.48 |
| Smoking Status | | | | | | | |
| Smoking | 2 | 1.30 | 126 | 1.91 | 0.67 | 0.01–2.73 | 0.55 |
| Non-Smoking | 153 | 98.70 | 6,473 | 98.09 | 0.23 | 0.02–0.02 | |
| Total | 155 | 100.00 | 6,599 | 100.00 | | | |

Source: Strauss, Witoelar, & Sikoki (2016)

DISCUSSION

Diabetes is a complex disease (Kharroubi & Darwish, 2015). The majority of people with diabetes complain of typical symptoms that are often not found in other conditions, such as polyphagia (easily feeling hungry), polydipsia (easily feeling thirsty), and polyuria (frequent urge to urinate) (Fatimah, 2015).

Characteristics of Respondents

In terms of the age characteristics of the diabetics included in this study, most of the respondents belonged to the age category >35 years. These findings are in agreement with the research conducted by Handayani, Hubaybah, & Noerjoedianto (2018), where it was revealed that the majority of the respondents who had diabetes belonged to the adult age group category of ≥ 45 years (46 respondents, 92.00%).

Most of the respondents who had diabetes in this study stated that they had attained a high level of education. Similar findings were obtained by a study conducted by Gumilas, Harini, Samodra, & Ernawati (2018) who studied the characteristics of people who had diabetes. It was revealed that most of the participants had attained a high level of education, i.e., some respondents attained a senior secondary level of education, and some had attained college level.

Based on the smoking status, the respondents' characteristics were determined as follows: Most of the respondents did not smoke at the time of the survey. These findings are supported by the study conducted by Aquarista (2017), where it was revealed that most of the respondents with diabetes, who come to the polyclinic in Haji Hospital Surabaya, were non-smokers (17 respondents, 81%).

Relationship between Age and the Incidence of Diabetes

High levels of obesity not only reduces life expectancy but also influences the high prevalence of diabetes. There is a relationship between diabetes and brain deficiency in adults (and the elderly) with insulin resistance and deficiencies in some vitamins. The results of this study suggested that respondents >35 years of age were at risk of getting diabetes. Respondents aged >35 years were 5.60 times more likely to suffer from diabetes compared to respondents ≤ 35 years of age. These findings are in line with the research conducted by Chentli, Azzoug, & Mahgoun (2015), who revealed that the majority of the elderly population

had diabetes due to insulin resistance. With this study, it can also be concluded that old age affects insulin resistance, which, in turn, triggers diabetes.

Masruroh (2018) mentioned that most humans will experience a rapid decline in physiological function after the age of 40 years, and with an increase in age, diabetes also affects the pancreas and other organs. According to this study, there was a relationship established between age and blood sugar levels in people with type 2 diabetes. A research conducted by Kurniawaty & Yanita (2016) also revealed that a person above 50 years of age faces an increased risk of developing type 2 DM due to decreased insulin sensitivity and reduced physical activity, which disrupts glucose metabolism. Research conducted by Al-saeed et al (2016) also suggested that the lowest crude death rate, among the diabetic population, was in the young age group.

Relationship between Education Level and the Occurrence of Diabetes

The results of this study indicated that having a low education level was associated with the incidence of diabetes. Respondents who had a low level of education were 1.69 times at risk of suffering from diabetes compared to respondents who attained a high level of education. These results are supported by a research that was carried out in Sudan, especially in urban areas, which indicated that there was a relationship between respondents who had low levels of education and the incidence of diabetes (Elmadhoun, Noor, Ibrahim, Bushara, & Ahmed, 2016).

There are studies related to deaths caused by diabetes, educational status, and gender. A research conducted by Vandenheede et al (2015) suggested that there are known effects of interaction between education and gender. The results of the study indicated that the burden of death due to diabetes was minimal among highly educated women.

The Relationship between Smoking Status and the Occurrence of Diabetes

Pancreatic fat and intestinal organs are involved in glucose metabolism and the production of protein TCF7L2. Nicotine induction in this metabolic structure permits glucose dysregulation (Bruschetta & Diano, 2019).

The results from this current study indicated that smoking was not a risk factor for the incidence of diabetes in Indonesia (based on the IFLS 5 data). These findings are in agreement with the study conducted by Iz & Maindi (2015), who

revealed that 51 respondents who smoked were not at risk of getting diabetes (68.90%). The statistical test results indicated that smoking, as a risk factor, was not proven to be significant in causing type 2 diabetes.

The results of this study contradict the research conducted by Maddatu, Anderson-baucum, & Evans-molina (2018), who suggested a relationship between smoking and an increased risk of developing diabetes. A similar research conducted by Campagna et al (2019) revealed that there was a harmful relationship between diabetes and smoking. This study also suggested that making a habit out of smoking was a risk factor, causing mortality in patients with diabetes and cardiovascular morbidity.

This current study revealed results that differed from several previous studies, which stated that there is a relationship between smoking and DM. This study indicated that most of the respondents who had diabetes claimed that they did not smoke. The results of the statistical tests carried out indicated that there was no relationship between smoking and DM.

The Relationship between Body Mass Index and the Occurrence of Diabetes

Respondents in overweight and obese BMI categories (i.e., those with high blood fat levels, high diastolic blood pressure, and large waist circumferences) were at risk of having metabolic syndromes. BMI can be employed to measure one's vigilance against the possibility of contracting NCDs, e.g., coronary heart disease, type 2 diabetes, and stroke (Subardjo, Agustia, Ramadhan, & Betaditya, 2018).

Obesity is closely linked to the number of fat cells. Fat cells can experience resistance to the antilipolytic effect of insulin, which affects the process of increasing lipolysis and Free Fatty Acid (FFA). Increased FFA will stimulate the process of gluconeogenesis and can lead to insulin resistance in the liver and the muscles. This impacts insulin secretion (Schwartz et al., 2016).

The results of this study revealed that none of the BMI categories (underweight, normal, overweight, and obese) had a relationship with the incidence of diabetes in urban areas. These findings are supported by the research conducted in Korea by Noh et al. (2018), who suggested that many diabetics who were surveyed had a normal BMI (493 respondents, 50.90%), so the researchers concluded that there was no relationship between BMI and the initial onset of type 2 diabetes (Noh et al., 2018).

These findings are in complete contrast with the study conducted by Aravinda (2019), who suggested that patients diagnosed with diabetes were significantly overweight, with $p=0.01$, $p<\alpha$. Other studies have also revealed similar findings: Other risk factors of diabetes, such as the loss of beta-cell mass, also need to be considered. Risk factors also include someone being overweight and having dyslipidemia (Olesen et al., 2020). Increased vagal input related to diet-induced obesity can contribute to extensive innervation by increasing β -cell mass and altering insulin sensitivity (Khemka & Banerjee, 2017).

These current findings differed from several studies that have been conducted previously. This was because the majority of respondents studied in this population had normal weights, so the results of the statistical analysis tests indicated that there was no relationship between BMI and DM.

Research Limitation

The characteristics of the respondents analyzed for this study from the IFLS 5 data were incomplete. This study analyzed the link between the smoking status variable and the incidence of DM, however, it did not account for the length of time the respondent smoked. This could affect the relationship between smoking and DM since DM is a chronic disease.

CONCLUSION

Most of the respondents in this study who suffered from diabetes were >35 years of age, attained a high level of education, and did not smoke. The majority of the respondents who did not have diabetes were ≤ 35 years of age, had a low level of education, and did not smoke. There was a relationship between age and the education level with the incidence of diabetes in Indonesia (based on the IFLS 5 data). The smoking status variable and BMI had no relationship with the incidence of diabetes in Indonesia. Importantly, it is expected that the results of this study will enhance the awareness levels of people (especially those >35 years of age who are more at risk) who have diabetes and help those who have attained a low level of education to maintain a healthy lifestyle and improve their knowledge of diabetes. People need to be supported with additional knowledge about balanced nutrition and by emphasizing on the importance of a clean and healthy living behavior as early as possible. The government of Indonesia has provided a forum for community empowerment in the form of Integrated Service

Post or Pos Pelayanan Terpadu (Posbindu), which can be maximized as a medium for disseminating information related to DM.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest

AUTHOR CONTRIBUTION

All authors actively participated in this article and assumed responsibilities at various stages in the process of completing this study. This included preparing the initial draft, concept writing, research design selection, analysis, and revision of the article. AZS was tasked with preparing, writing the concepts, and revising the article. RNF was responsible for analyzing the data. EA helped by providing comments and suggestions to improve this article.

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