

Identifying Type 2 Diabetes Mellitus Risk Factors among Patients at Public Health Care Centre in Indonesia

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) was characterized by insufficient insulin production of body cells to use insulin effectively. Preliminary survey at a Public Health Care Centre (PHCC) in Indonesia indicates a high prevalence of T2DM. This study aimed to identify the risk factors for T2DM in PHCC.

Methods: Quantitative descriptive-analytics research with a case-control design at the PHCC. The sample consisted of 132 respondents, with 66 respondents in control group (non-DM patients) and 66 respondents in case group (DM patients). Data collected using measurements about age, gender, education, dietary habits, smoking, obesity, history of hypertension, stress, activity physique, and family DM history to indicate the incidence of T2DM. Data analysis involved univariate, bivariate (chi-square), and multivariate analysis (logistic regression test).

Results: There was a significant correlation between T2DM and age (p -value=0.000), gender (p -value=0.022), dietary habits (p -value=0.009), obesity (p -value=0.015), physical activity (p -value=0.002), and family history of DM (p -value=0.014). There was no significant correlation between the occurrence of T2DM and education (p -value=0.0254), smoking (p -value=0.0411), history of hypertension (p -value=0.0593), and stress (p -value=0.0320).

Conclusion: Age was a determinant factor with a p -value=0.000 and an odds ratio (OR) of 20.542, indicating aged 45 years are 20.542 likely to develop T2DM.

Keywords: Diabetes mellitus; Risk factors; Age; Insulin

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INTRODUCTION

The term Sustainable Development Goals (SDGs) is used in various activities, especially in the health sector. By 2030, increasing the prevention and treatment of Non-Communicable Diseases (NCDs) will be one of the target achievements of the SDGs program. In Indonesia, the Ministry of Health (Kementerian Kesehatan Republik Indonesia) plays a pivotal role in implementing these goals, particularly focusing on healthcare access, quality services, and disease prevention (1). The high mortality rate and morbidity of NCDs are a concern for national governments and communities around the world (2).

NCDs are the leading cause of death globally, responsible for 74% of all deaths each year. These include cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes. Notably, over 77% of NCD-related deaths occur in low- and middle-income countries. Additionally, each year, 17 million people die from an NCD before the age of 70; 86% of these premature deaths occur in low- and middle-income countries (3).

Type 2 Diabetes Mellitus (DM) as the term "The Great Imitator" because the disease can attack all organs body. Diabetes is a disease that usually has signs of increased blood sugar levels because of damage to pancreatic beta cells. In T2DM sufferers, the insulin hormone is not produced in sufficient quantities and there are body cells that cannot use insulin properly or what is usually called insulin deficiency/resistance. Insulin resistance causes blood sugar levels in the body to rise because it is not secreted.

There are two risk factors for T2DM: modified and unmodified factors. Modified factors consist of obesity, stomach circumference, hypertension, physical activities, dyslipidaemia (fat rate) and smoking habits (4). While unmodified factors consist of race or ethnicity, age, gestational DM and risk of DM from family line. People still do not maintain their diet, smoke, lack of physical activity and so on. In fact, this disease can cause other diseases such as heart, stroke, kidney failure, etc. (5).

According to data from the International Diabetes Federation in 2016, 9% of the 7.53 billion people worldwide suffered from T2DM. Based on data obtained from the World Health Rankings as many as 53.33 per 100,000 people in Indonesia die from T2DM.

Based on a preliminary survey conducted

through interview with nursing in PHCC was stated that T2DM cases registered at the PHCC in Indonesia during 2023 reached 224 cases. 66 participants were active participated in Chronic Disease Management Program (CDMP) at a PHCC in Indonesia. CDMP is a program that aims to improve the quality of life of patients with chronic diseases through a comprehensive approach. The program involves integrated preventive, treatment, and rehabilitation efforts, so that patients can better manage their illness and prevent more serious complications.

METHODS

This research is quantitative research with a case-control design at a PHCC in Indonesia during February-April 2024 to analysis risk factors T2DM. In this research, the data collection technique used involved standard questionnaires and measurements. The dependent variable in this study was the incident T2DM. Meanwhile, the independent variables in this study were age, gender, education, dietary habits, smoking, obesity, history of hypertension, stress, activity physique, and family DM history.

The instruments include questionnaires about age, gender, education, dietary habits, smoking, obesity, history of hypertension, and family DM history, International Physical Activity Questionnaire (IPAQ), and to analyze stress levels use Diabetes Distress Scale (DDS). The questionnaire in this study is valid and reliable with a validity value of 0.910 on the physical activity questionnaire (6) and 0.921 on the Diabetes Distress Scale (DDS) (7).

The population in this study consists of 132 respondents at a PHCC in Indonesia. 66 respondents were in the control group, who patients that come at a PHCC in Indonesia who are not affected by T2DM. Then, 66 respondents were in the case group, who participated in CDMP.

The data was analyzed by SPSS program through three stages of data analysis. Univariate use to know the risk factors for T2DM in the form of age, gender, education, diet, smoking, obesity, history of hypertension, stress, physical activity and family history of DM. Second, bivariate analysis was used the chi-square test to determine the relationship between independent and dependent variables. Third, multivariate analysis was used a multiple logistic regression test to find out which risk factors had the most influence on the incidence of T2DM at a PHCC in Indonesia.

RESULTS

Respondent Characteristics

Characteristics of respondents in the case group commonly were aged 19-44 years, in the control group commonly respondent was aged ≥ 60 years,

both in the case and control groups dominant is woman, has a high school education, has a good diet, does not smoke, is not obese, has a history of hypertension, does not experience stress, has moderate physical activity and has a family history of DM. **Table 1** describe the relationship between variables.

Table 1: Correlations between risk factors and the incidence of T2DM in PHCC (N=132)

Variables	Case (T2DM)		Control		Total		p-value
	n	%	n	%	n	%	
Age							
19 - 44 years	-	-	38	57.6	38	28.8	0.000
45 - 59 years	19	28.8	20	30.3	39	29.5	
≥ 60 Years	47	71.2	8	12.1	55	41.7	
Gender							
Man	13	19.7	26	39.4	39	29.5	0.022
Woman	53	80.3	40	60.6	93	70.5	
Education							
Elementary school	32	57.6	21	31.8	53	40.2	0.254
Junior high school	12	12.1	16	24.2	28	21.2	
High school	18	24.2	22	33.3	40	30.3	
College	4	6.1	7	10.6	11	8.3	
Dietary habits							
Bad	27	40.9	23	34.8	70	53.0	0.009
Good	39	59.1	43	65.2	62	47.0	
Smoke							
Do not smoke	53	80.3	48	72.7	101	76.5	0.411
Smoke	13	19.7	18	27.3	31	23.5	
Obesity							
Yes	28	42.4	14	21.2	42	31.8	0.015
No	38	57.6	52	78.8	90	68.2	
History of hypertension							
Yes	42	63.6	38	57.6	80	60.6	0.593
No	24	36.4	28	42.4	52	39.4	
Stress							
Yes	46	69.7	52	78.8	98	74.2	0.320
No	20	30.3	14	21.2	34	25.8	
Activity physique							
Light	36	54.5	24	36.4	60	45.5	0.002
Moderate	30	45.5	32	48.5	62	47.0	
Heavy	-	-	10	15.2	10	7.6	
Yes	44	66.7	29	43.9	73	55.3	0.014
No	22	33.3	37	56.1	59	44.7	
Total	66	100	66	100	132	100	

In the age variable, based on the results of data analysis using Chi-Square, a p -value of 0.000 which means that there was a significant relationship between age and the incidence of T2DM at a PHCC in Indonesia. In the gender variable p -value of 0.022 which means that there was a significant relationship between gender and the incidence of T2DM at a PHCC in Indonesia. Women have a higher risk of developing abdominal obesity, which is one of the key factors

in insulin resistance.

In the education variable has been a p -value of 0.254 which means that there was no significant relationship between education and the incidence of T2DM at a PHCC in Indonesia. In the dietary variable has been p -value of 0.009 which means that there was a significant relationship between diet and the incidence of T2DM at a PHCC in Indonesia.

In the smoking variable has been a p -value of 0.411 which means that there was no significant relationship between smoking and the incidence of T2DM at a PHCC in Indonesia. Smoking was not significantly associated because the majority of respondents were non-smokers. Furthermore, most of the smokers were light to moderate smokers, so the smoking variable did not influence the incidence of T2DM. In the obesity variable, based on the results of data analysis using Chi-Square, a p -value of 0.015 which means that there is a significant relationship between obesity and the incidence of T2DM at a PHCC in Indonesia.

In the hypertension history variable has been a p -value of 0.590 which means that there was no significant relationship between the history of hypertension and the incidence T2DM at a PHCC in Indonesia. A history and the incidence of T2DM at a PHCC in Indonesia. A history of hypertension did not have a significant effect because it was influenced by data from the control group, the majority of whom also had a history of hypertension. In the stress level variable has been p -value of 0.320 which means that there was no significant relationship between stress and the incidence of T2DM at a PHCC in Indonesia. In the study, some respondents stated that they did not experience stress. They mentioned not overthinking about T2DM. The respondents said

they focused more on efforts to recover rather than dwelling on the problems they were facing.

In the physical activity variable has been p -value of 0.002 which means that there was a significant relationship between physical activity and the incidence of T2DM at a PHCC in Indonesia. The researchers assume that physical activity played a significant role because some respondents lacked daily activities, often having ample free time that was not used for physical exercise. In the variable of family DM history has been p -value of 0.014 which means that there is a significant relationship between family DM history and the incidence of T2DM at a PHCC in Indonesia.

Multivariate analysis showed that age was the risk factor that had the most influence on the incidence of T2DM at a PHCC in Indonesia. The result is explained in **Table 2**.

In **Table 2**, the results were obtained that the age sub-variable was the most dominant sub-variable related to the incidence of T2DM at a PHCC in Indonesia because it had the smallest p -value (p -value=0.000), and the results of the analysis obtained the largest odds ratio (OR) value of 20.542. The results of the odds ratio explained that age has a greater chance than other variables by 20.542 times to be able to cause the incidence of T2DM at a PHCC in Indonesia.

Table 2: Final modelling of multivariate analysis

Sub Variable	B	S. E	p -value	Exp (B)/OR	95% CI for EXP (B)	
					Lower	Upper
Age	3.022	0.534	0.000	20.542	7.208	58.547
Gender	1.522	0.630	0.016	4.583	1.332	15.763
Obesity	-1.317	0.633	0.038	0.268	0.077	0.927
Constant	2.574	1.241	0.038	13.115		

DISCUSSION

There is a relationship between age and the incidence of T2DM because generally humans experience a dramatic physiological decline at age after 40 years. At the age of 40, there is a decrease in pancreatic endocrine function so that it cannot produce insulin optimally (8). Age has an influence because the body's function is not optimal in the elderly (9). In addition, at age ≥ 45 adipocyte hormones change which have an impact on plasma insulin levels (10). Researchers assume that age has a significant impact on body health because bodily functions tend to be less optimal in older adults. As people age, particularly at ≥ 45 years, changes in adipocyte hormones can affect

insulin levels in the blood plasma. These hormonal changes can potentially reduce insulin sensitivity and impair glucose metabolism, which in turn increases the risk of developing conditions such as type 2 diabetes. Therefore, age and the physiological changes that occur with aging are considered significant risk factors for glucose metabolism disorders.

In this research, age was the most dominant risk factor with p -value 0.000 and OR 20.542 where age has a chance that is 20.542 times greater than other variables. Around 50% of T2DM is experienced by the age group 45 and over (11). Individuals over the age of 45 are at a higher risk of developing diabetes mellitus and glucose intolerance due to

degenerative changes, including a decline in the body's ability to effectively metabolize glucose (12).

Apart from the age factor, gender is also related to the incidence of T2DM with a *p*-value 0.016. This study is similar with (13) which states that gender differences also arise from psychosociocultural processes such as differences in behaviour, lifestyle and attitudes towards prevention and treatment also influence the susceptibility and development of T2DM in women. In the previous study conducted explained that gender is a risk factor for type 2 diabetes with an odds ratio (OR) of 3.5 (14). Diabetes is more common in women because they tend to engage in less physical activity, especially after marriage, when a wife is often busy with family responsibilities and exercises less compared to men (14).

T2DM occurs more often in women because they tend to have lower insulin sensitivity than men. In women, diabetes is harder to control due to lower insulin sensitivity, requiring more insulin to maintain optimal blood sugar levels (15). Researchers assume in this study both the case group and the control group of respondents were dominated by women. This is also a consideration why gender is a risk factor for the occurrence of T2DM at a PHCC in Indonesia.

Obesity can also trigger high fat levels in blood. In Indonesia, a person is categorized as obese if he has an abdominal circumference of > 90 cm in men and > 80 cm in women (16). The role of obesity in the development of diabetes since people suffering from obesity have high levels of leptin and a very large number of fat cells. Obesity also triggers chronic inflammation and metabolic disorders, further increasing the risk of developing diabetes mellitus (17).

Overweight adults have more large fat cells in the body, and large fat cells do not respond to insulin. This explains that obesity affects the incidence of T2DM (18). In this study, researchers assumed that obesity can be a risk factor for T2DM because people who are overweight, of course, in their body there is a lot of fat which will later be broken down into glucose. Obesity was related to the incidence of T2DM at a PHCC in Indonesia.

CONCLUSION

Research conducted at a PHCC in Indonesia regarding risk factors for T2DM showed that there was a relationship between age, gender diet, obesity, physical activity, history of DM and the

occurrence of T2DM while education, smoking, history of hypertension had no relationship with T2DM. The suggestion from this study is to increase massive health promotion efforts in the community to increase knowledge about T2DM. The limitations of this study are related to the sampling process (e.g., gender imbalance among respondents) and the lack of control over confounding variables.

ETHICAL MATTERS

Ethical clearance and approval were obtained from the Health Research Ethics Committee of The University of Muhammadiyah Purwokerto No. KEPK/UMP/34/I/24.

CONFLICT OF INTEREST

The authors declare there is no conflict of interest.

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AUTHOR CONTRIBUTIONS

FL: Writing the manuscript.

NI: Reviewed and improved the manuscript.

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