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ORIGINAL ARTICLE

FACTORS ASSOCIATED WITH TYPE 2 DIABETES MELLITUS AT ADAM MALIK GENERAL HOSPITAL, MEDAN, INDONESIA

Faktor yang Berhubungan dengan Diabetes Melitus Tipe 2 di RSUP Adam Malik, Medan, Indonesia

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ABSTRACT

Background: Diabetes mellitus is third highest cause of death in Indonesia with percentage 6.71%, and 2018 Indonesia was ranked seventh among the 10 countries with most diabetes with prevalence based on blood sugar level test results 8.56%. Adam Malik General Hospital is one of the hospitals with the highest percentage of diabetes in Medan with the cases reported by 1,323 people in 2020. **Purpose:** This study aimed to analyze the factors related to the incidence of diabetes at the Adam Malik General Hospital. **Methods:** This was a cross-sectional analytical design study. The study was conducted at Adam Malik General Hospital between April 22-May 4, 2021. The population of this study included all patients who went to internal medicine, while the sample part of the population (99 respondents) was sampled accidentally. The research instruments used were questionnaires, and data collection used primary and secondary data. Data were analyzed using the chi-square test. **Results:** Three variables were related to the incidence of DM at Adam Malik General Hospital: family history of DM (P =0.00; PR=3.03; 95% CI= <1.37 PR <2.73), physical activity (P =0.00; PR= 3.33; 95% CI= <1.59 PR <6.95), and age (P =0.00; PR= 0.19; 95%CI= <0.52, PR <0.71). **Conclusion:** This study is that there are three factors related to occurrence of diabetes, namely family history, physical activity, and age. It is necessary to carry out regular physical activity every day and conduct health checks, especially for those who have a family history of DM.

ABSTRAK

Latar Belakang: *Diabetes melitus merupakan penyebab kematian ketiga*

tertinggi di Indonesia dengan persentase sebesar 6.71%, dan pada tahun 2018 Indonesia menduduki peringkat ketujuh diantara 10 negara penderita diabetes terbanyak dengan prevalensi berdasarkan hasil pemeriksaan kadar gula darah sebesar 8.56%. RSUP H. Adam Malik merupakan salah satu rumah sakit dengan persentase DM tertinggi di Medan dengan jumlah kasus yang dilaporkan 1,323 orang pada tahun 2020. **Tujuan:** *Penelitian ini bertujuan menganalisis faktor yang berhubungan dengan kejadian DM tipe 2 di RSUP H. Adam Malik Medan Tahun 2021.* **Metode:** *Desain studi analitik dengan cross sectional. Penelitian dilakukan di RSUP Adam Malik selama 22 April-4 Mei 2021. Populasi penelitian ini adalah semua pasien yang berobat jalan ke poli penyakit dalam sedangkan sampel sebagian dari populasi yaitu sebanyak 99 responden, pengambilan sampling dengan Accidental Sampling. Instrumen penelitian menggunakan kuesioner, pengumpulan data menggunakan data primer dan data sekunder. Data di analisis dengan Chi-Square.* **Hasil:** *Terdapat empat variabel yang berhubungan dengan kejadian DM tipe 2 di RSUP H. Adam Malik yaitu riwayat keluarga menderita DM (p=0.00; PR=3.03; 95% CI= <1.37 PR <2.73), riwayat hipertensi (p=0.00; PR= 1.93; 95% CI <1.37 PR <2.73), aktifitas fisik (p=0.00; PR= 3.33; 95% CI= <1.59 PR <6.95), dan umur (p=0.00; PR= 0.19; 95%CI= <0.52 PR <0.71).* **Kesimpulan:** *Penelitian ini terdapat empat faktor yang berhubungan dengan terjadinya DM tipe 2 yaitu riwayat keluarga, hipertensi, aktifitas fisik dan umur. Perlu melakukan aktivitas fisik secara teratur setiap hari, dan melakukan pemeriksaan kesehatan khususnya yang memiliki riwayat keluarga menderita DM dan yang memiliki riwayat hipertensi.*

INTRODUCTION

Diabetes mellitus is a chronic metabolic disease in which the pancreatic organs do not produce enough insulin or the body is ineffective in using insulin. Diabetes is a significant public health issue and one of the four major degenerative diseases that are a priority target for world leaders (1). Diabetes mellitus is one of the fastest-growing health challenges of the 21st century, and people with diabetes died every 8 seconds worldwide in 2017 (2).

Hyperglycemia due to diabetes can affect almost the entire human body system, from the skin to the heart, which results in complications (3). Complications of diabetes mellitus are very complex, and people with diabetes are at a high risk of developing various dangerous health problems. Continuously elevated and uncontrolled blood glucose levels can lead to health complications such as heart and cardiovascular diseases, eyes, kidneys, nerves, and teeth. Moreover, patients with diabetes are also at a high risk of infection (4).

The International Diabetes Federation (IDF) stated that from 2000 to 2019, the number of cases of diabetes has continuously increased; in 2000, as many as 151 million to 463 million DM sufferers in 2019, the number of cases of diabetes is predicted to increase again in 2030, with as many as 578 million people, and in 2045, it is predicted to be 700 million people. The highest number of people with diabetes is in the Western Pacific region, and 159 million in Southeast Asia at 82 million; the global prevalence of diabetes in Southeast Asia in 2017 was 8.52%. It is predicted to increase by 2045–11.10%. 79.00% of adults with diabetes live in low- and low-income countries. Diabetes in Indonesia currently ranks sixth with 10.30 million patients. If this is not handled correctly, it is predicted that by 2030, the incidence of diabetes in Indonesia will increase sharply to 21.30 million people. The proportion of people with type 2 diabetes is increasing in various countries; every one in five people over 65 years has diabetes (2). It is estimated that approximately 463 million adults aged 20–79 years have diabetes, and it is predicted that by 2045, this number will increase by 700 million (5).

In Indonesia, diabetes was the third leading cause of death (6.71%), followed by stroke (21.17%) and heart disease (12.91%) (6). The data showed that 90.00% of all diabetes cases had type 2 diabetes. In general, type 2 diabetes occurs in adults; however, it has also been found in children

and adolescents in recent years. Diet and lack of physical activity can make children overweight or obese (7).

North Sumatra Province is one of the provinces with the highest prevalence of diabetes in Indonesia. In 2018, North Sumatra was ranked 13th in Indonesia, with a prevalence of diabetes of 1.86% based on doctor diagnoses in all age groups (7). The proportion of people with type 2 diabetes increases every year in the Adam Malik General Hospital Medan; in 2010, the number of DM sufferers was 1,087 people undergoing outpatient treatment, and the number of DM sufferers increased in the following year to 2,079 in 2011 and 2,352 in 2012 (8). As a comparison, the number of DM patients at Pirngadi Hospital Medan was 780 in 2016, 893 in 2017, and 270 in 2018 there were 270 people (9).

Based on a preliminary survey conducted at Adam Malik General Hospital Medan, it is known that the number of DM sufferers who were treated on the road in 2016 was 2,090 people. In 2017 people with diabetes were treated on the road as many as 2,000 people. In 2018, patients were treated by the road as many as 1,786 people; in 2019, patients were treated by the road as many as 1,310 people; and in 2020, people with diabetes were treated by the road as many as 1,323 people, whereas in January (181 people), February (173 people), March (155 people), April (84 people), May (77 people), June (84 people), July (93 people), August (82 people), September (109 people), October (76 people), November (118 people), and December (91 people).

Based on the background description, it is necessary to study the factors related to the incidence of type 2 diabetes in the Adam Malik General Hospital Medan in 2021.

METHODS

This cross-sectional study was conducted at Adam Malik General Hospital, Medan, Indonesia. The population in this study included all patients who visited the Outpatient Installation of Internal Medicine poly of Adam Malik General Hospital Medan and were recorded on the medical record at Adam Malik General Hospital. At the same time, the sample was part of the population and was recorded on the medical record at Adam Malik General Hospital.

In this research, Accidental Sampling was performed, which is a technique for determining samples based on coincidence; respondents who accidentally/accidentally met with researchers can be used as samples (10). The size of the sample in this study was taken, where the population in this study is unknown; thus, the formula used was:

$$n = \frac{Z^2 \, a \, p \, q}{d^2} = \frac{Z^2 \, p \, (1-p)}{d^2}$$

Information:
n: Minimum number of samples required
p: proportion of diabetes mellitus (6.90% according to Indonesian Society of Endocrinology)
q: 1-p (proportion of DM)
α: degree of trust
d: Limit of error or absolute precession

$$n = \frac{1.96^2 \, 0.069 \, x \, (1-0.069)}{(0.05)^2}$$
$$n = \frac{3.8416 \, x \, 0.064239}{0.0025}$$
$$n = \frac{0.2467805}{0.0025}$$
$$n = 98.7$$
$$n = 99$$

So the size of the sample obtained in this study was 99 respondents.

The independent variables in this study were family history of DM, smoking, physical activity, age, occupation, education level, and sex, while the dependent variable was the incidence of diabetes.

The respondents' physical activity was carried out within 24 hours, such as household activities and activities related to transportation, work, sports, and other activities. The physical activity carried out by a person within 24 hours is expressed in PAL (Physical Activity Level) with the formula $PAL = \sum PAR$ x W/ 24 hours. Categorical physical activities are Lightweight (PAL=1.40-1.69), Medium (PAL=1.70-1.99), and Weight (PAL=2.00-2.40).

The family history of the respondents has or not of family suffering from diabetes, both parents, siblings, and children. For categorical bivariate analysis used, are have a history of DM and are without a history of DM.

The habits of respondents who had smoked at least for the last three months were calculated based on the number of daily cigarettes. According to the WHO (11), smokers are classified into three categories:
1. Light Smoker: 1-10 cigarettes/day
2. Moderate Smoker: 11-20 cigarettes/day
3. Heavy Smoker: >20 cigarettes/ day

For categorical bivariate analysis used are smoking and no smoking.

Data collection was performed using primary and secondary data. Primary data were obtained through direct interviews with questionnaire guidelines, namely variability in physical activity, family history, age, education level, and occupation status. Secondary data obtained from the medical records at Adam Malik General Hospital Medan were then recorded following the variables to be studied, namely hypertension.

The data analysis method that has been collected will be processed using a computer following the stages of data editing, coding, data entry, and data cleaning, and then analyzed univariately and bivariate to determine the factors related to the incidence of diabetes, which will be presented in the form of tables, diagrams, and narratives. Univariate analysis was used to examine every variable's characteristics and frequency distribution, such as family history of diabetes, history of hypertension, physical activity, age, sex, level of education, and occupation. Bivariate analysis was used to examine the relationship between variables of family history of diabetes, history of hypertension, physical activity, age, sex, education level, and occupation with the incidence of type 2 diabetes mellitus; if the results of the statistical analysis of the chi-square test had a significance value of $p<0.05$ were then declared related. This study was reviewed and approved by the Ethics Committee of the Faculty of Medicine, University of Sumatra Utara (Approval Number:195/KEP/USU/2021).

RESULTS

The proportion of respondents with type 2 diabetes mellitus was (52.53%), and 47.47 % %did not suffer from type 2 diabetes mellitus as many as (47.47%). Ninety-nine respondents participated in this research and completed the questionnaire, with more than half (52.53%) male and (47.47%) female. As shown in Table 1, most respondents were aged ≥ 40 years (82.83%). Regarding occupation, most patients were active workers (78.79%). The majority of respondents had higher education (77.78%), low physical status (69.70%), and no smoking (77.78%). As shown in Table 1, not all variables were related to the incidence of type 2 diabetes mellitus at Adam Malik General Hospital Medan in 2021.

Table 2 shows the risk of type 2 diabetes based on age; the overall risk of diabetes caused by age was 0.19 (95%CI=0.52-0.71). Based on statistical tests, the Prevalence Ratio (PR) of type 2 diabetes mellitus between the ages of < 40 and ≥ 40 years was 0.19. It indicates that age is not a risk factor. Table 2 displays the risk of type 2 DM unfounded on physical activity; the overall risk of diabetes due to physical activity was 3.33 (95% CI=1.59-6.95). The Prevalence Ratio (PR) of diabetes between respondents who actively engage in physical activities and those who do not do less physical activity is 3.33 (95% CI=1.59-6.95), meaning that respondents whose physical activity is less active have a risk of developing DM 3.33 times compared to respondents who actively engage in physical movements. Therefore, physical movement is considered a risk factor.

Table 2 displays the risk of type 2 DM based on a history of family suffering DM. The overall risk of diabetes due to a family suffering from diabetes was 3.03 (95% CI=2.00- 4.61). The Prevalence Ratio (PR) of type 2 diabetes mellitus between respondents with a family history of diabetes and respondents who had no family history of DM was 3.03 (95% CI=2.00- 4.61), meaning that respondents with a family history of DM had a 3.03 times risk of developing diabetes mellitus compared to respondents who had no family history of DM. Therefore, a family history of diabetes mellitus is a risk factor.

Table 1
Characteristics of Respondents Type 2 Diabetes Mellitus

Variable	Type 2 Diabetes Mellitus Patients				Total	*p*-value
	Yes	%	No	%		
Age (years)						
< 40	2	11.76	15	88.24	17 (17.17%)	0.00*
≥ 40	50	60.98	32	39.02	82 (82.83%)	
Gender						
Male	27	51.92	25	48.08	52 (52.53%)	
Female	25	53.19	22	46.81	47 (47.47%)	

Table 1
Continued

Variable	Type 2 Diabetes Mellitus Patients				Total	*p*-value
	Yes	%	No	%		
Occupation						
Actively working	39	50.00	39	50.00	78 (78.79%)	0.00*
Not working	13	61.90	8	38.10	21 (21.21%)	
Level of Education						
Higher education	43	55.84	34	44.16	77 (77.78%)	
Low education	9	40.90	13	59.10	22 (22.22%)	
Family suffering from diabetes						
Yes	35	87.50	5	12.50	40 (40.40%)	
No	17	28.81	42	71.19	59 (59.60%)	
Current smoker						
Yes	13	59.10	9	40.90	22 (22.22%)	
No	39	50.60	38	49.40	77 (77.78%)	

*) Statistically significant; chi-square test

Table 2
Final Risk of Type 2 Diabetes Mellitus in Relation to Age, Physical activity, Family suffering from Diabetes, and Hypertension

Variable	Type 2 Diabetes Mellitus Patients				PR (95% CI)
	Yes	%	No	%	
Age (years)					
< 40	2	11.76	15	88.23	0.19 (0.52-071)
≥ 40	50	60.98	32	39.02	
Physical activity					
Physically active	6	20.00	24	80.00	3.33 (1.59-6.95)
Physically low	46	66.67	23	33.33	
Family suffering from diabetes					
Yes	35	87.50	5	12.50	3.03 (2.00- 4.61)
No	17	28.81	42	71.19	

DISCUSSION

Based on the yield of the research, it was discovered that respondents with diabetes were 29 years old (one respondent) and 39 years old (one respondent), while the oldest diabetes sufferers were 82 years old (one respondent). Age is one of the factors that most often affects a person suffering from diabetes mellitus; the risk factor will be significantly higher when he is 45 years old. It happens at that age that usually do not do much physical activity, obesity will occur, and muscle mass will decrease, resulting in pancreatic dysfunction. Pancreatic dysfunction increases blood sugar levels because insulin is not produced (12). Physiological changes in humans experience a drastic decline at the age of over 40 years. Diabetes often appears after a person enters the vulnerable age range, that is, after the age of 45

years. The results of the study stated that 3.95 respondents suffering from type 2 DM obtained an age range of 60-64 years 1.53 years respondents 8.00%), while were aged≥ 65 years 2,420 respondents (6.30%) (13). The results of this research are same with Dafriani (14) , which researched as many as 90 people at the Gambok Health Center Polyclinic, Sijunjung Regency, with the results of the chi-square test obtained a p-value <0.05 means there is an age connection with the incidence of type 2 diabetes at the Gambok Health Center Polyclinic. High obesity rates reduce life expectancy and affect the high prevalence of diabetes. There is a link between diabetes and brain weakness in adults (and older adults), as well as insulin resistance and certain vitamin deficiencies (15).

Statistical results show no relationship between age and the occurrence of diabetes.

However, this study found that the proportion of people with diabetes with type 2 mellitus in the female sex is more commonly found compared to the male sex. The outcome of this research is supported by other researchers who explain that the results of the analysis of respondents' characteristics based on sex are dominated by female respondents, totalling 58 (60.40%) respondents, while male respondents with 38 (39.60%) respondents (16). This is in accordance with the research by Komariah and Rahayu (17), which showed that the female sex category tended to have normal fasting blood sugar levels in as many as 47 patients (58.00%). In this study, the results of statistical tests showed a p-value of 0.33; therefore, it can be concluded that there is no relationship between sex and fasting blood sugar levels in patients with type 2 diabetes mellitus at the Proklamasi Clinic, Depok, West Java. The same in the research by Musdalifah and Nugroho (18), which states that there is no meaningful relationship between the sexes with the occurrence of type 2 diabetes mellitus in 111 respondents who researched with the yield of chi-square test value obtained a p value= 0.29 in the working area Palaran Health Center, Samarinda City in 2019.

Unfounded on the information in this research, it is known that respondents with higher education categories (high school graduates and bachelor/academic) suffered from diabetes more than category respondents with low category education (not going to school, finishing elementary school, and finishing junior high school), which is the opposite of the theory, which should be the category of higher education, has more knowledge to prevent diabetes mellitus. High cases of DM in respondents in the higher education category occur because the respondents who were highly educated have a family history of diabetes afflicted, namely 32 patients (41.63%) more than low educated respondents: 8 patients (36.42%), then seen from the age of highly educated respondents aged ≥40 years, namely 65 patients (79.31%) more than respondents in the category of low education (<40 years) were 17 patients (20.79%). However, the results of this study contradict the findings by Pahlawati and Nugroho (19), which state that chi-square analysis states that there is a connection between education level and the incidence of diabetes mellitus (p-value (0.00). People with low education had a 4.89 times chance of plunging DM compared to people who did not have diabetes, with an odds ratio (OR value of 4.89 (CI 95% 1.82 –13.11).

There is no significant connection between work and the occurrence of diabetes mellitus disease in Puskesmas I Wangon with the number of respondents studied; namely, 106 respondents and the chi-square test result obtained a p-value = 0.55 (20). The outcome of this research agrees with other people's research which states that there is no connection between employment status with an incident of diabetes mellitus, the statement in the studies was that there was no meaningful connection between employment status and the incidence of DM at the Cilacap Community Health Center Prolanis using 69 respondents consisting of the non-working category of 76.80% (53 people) and the working category of 23.20% (16 people), and the chi-square test yield obtained p-value =0.19 (21). Nevertheless, this study is contrary to the results of other researchers, namely, factor work affects significant risks of the occurrence of DM, work with physical activities that lightness will lead to a lack of burning energy by the body so that excess power in the body would store fat in the body, resulting in obesity, which is a risk factor for diabetes mellitus (22).

One of the factors causing diabetes mellitus was family offspring. People will be more at risk of contracting diabetes if the person has a history of motherhood, and it is more likely to contract DM more quickly if they have a diabetic lineage from both parents. A person who has one or more family members suffering from diabetes mellitus, whether parents, siblings, children, and such others, has a 2 to 6 times further risk of suffering DM than a person who does not have a family history of diabetes American Diabetes Association (2018) (23). It is similar to the findings by Wardiah and Emilia (24), who stated that a family history of DM has a 15.09% chance of developing diabetes, is at risk of glucose intolerance, and has a 30.01% inability to metabolize carbohydrates.

Hereditary factors directly affect beta cells and overhaul their inability to identify and transmit insulin steroid stimuli. Almost half of the respondents had a history of diabetes, namely 20 people (45.50%), and the respondents also had DM. The respondents' background supports it: respondents based on education mostly had low education, namely 27 people (61.40%), so they were not informed about the factors that cause diabetes mellitus, one of which is a family history of the disease. In this study, respondents with a family history of diabetes were at a higher risk than those with no family history of diabetes. It aligns with previous studies showing that diabetes

increases two to six times if parents or siblings experience this disease (25).

Another research stated that there is no significant relationship between smoking habits and the incidence of diabetes mellitus at Puskesmas I Wangon by examining 106 respondents and obtained the results of the chi-square statistical test p-value 0.31 (p=0.31; OR=0.66; 95%CI; 0.30-1.47) (20). Smoking is a known trigger factor in Coronary Heart Disease (CHD) (26). Nevertheless, over the years of collecting research data, longer/chronic smoking has been associated with a higher risk of insulin resistance. In patients with diabetes mellitus, smoking behaviour can worsen their health condition of DM patients.

Smoking directly interferes with glucose metabolism; the mechanism is not fully understood, but cigarette oxidative stress is thought to increase adrenaline and norepinephrine levels. The release of this hormone affects the sympathetic nervous system and increases the rates of gluconeogenesis and glycogenolysis (27).

DM sufferers who still smoke are at greater risk of complications such as kidney disease, retinopathy, eye pain, and blood circulation problems that end in amputation. These complications are directly proportional to the number of cigarettes smoked per day. Smoking is one of the goals that must be achieved to manage the lifestyle of patients with DM. Doing physical activity could reduce the risk of contracting diabetes mellitus, and physical activity is also proven to help people with diabetes reduce the consumption of treatment with insulin and non-insulin hormones (28).

In the study, it was found that the physical activity of most respondents was in the light category, namely 34 (61.80%) respondents. It is because the activities carried out are sedentary and do not use much energy. In people who rarely engage in sports, the food consumed is not burned but stored in fat and sugar. If the amount of insulin in the body cannot convert glucose into energy, there is an increase in blood sugar, resulting in diabetes mellitus. It is necessary to provide public awareness and motivation to increase physical activity (29).

Physical activity or exercise can create sensitivity to hormone receptors. Insulin is getting higher so that the glucose contained in the blood allows it to be overhauled into energy through metabolic processes. One of the many benefits of physical activity is that it can lower blood sugar levels in patients with diabetes, discourage obesity, and prevent more severe health problems such as lipid disorders and hypertension (30). Some physical activities, such as jogging, which are done regularly for 30-40 minutes, can increase glucose intake into cells by 7-20 times compared to not doing the activity. Blood sugar levels in individuals with diabetes can be either hypoglycemic or hyperglycemic. Hypoglycemia occurs when the body cannot compensate for the high demand for glucose in excessive physical activity. In contrast, hyperglycemia occurs when blood sugar levels exceed the body's capacity to store it, coupled with low physical activity or less.

CONCLUSION

The research indicates an association between physical activity, age, and family suffering from diabetes and the incidence of type 2 diabetes, and there is no relationship between education level, sex, occupation, smoking habits, and the incidence of diabetes mellitus.

However, the magnitude of the effect could not be estimated for the population because this study used non-random sampling. Confident intervals were applied only to the study sample. Future studies should use larger sample sizes and more detailed questionnaires and add other variables such as diet, stress levels, and comorbidities of other diseases.

CONFLICT OF INTEREST

The authors state that there were no competing interests in this study, and we confirmed the correctness of the results.

AUTHOR CONTRIBUTIONS

MN: compiles proposals, collects data, designs research, and conducts statistical tests. CUW: The revision of this research starts from the abstract and ends with the results of the research. FAS: Assist in compiling proposals until the completion of this research and revising the research results.

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