SOCIODEMOGRAPHIC AND LIFESTYLE-RELATED RISK FACTORS FOR TYPE 2 DIABETES MELLITUS: TARGETED TO PREVENTION

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Abstract. The prevalence of diabetes mellitus in Medan City remains high. To ensure diabetic control, it is necessary to identify factors associated with disease occurrence. This study aimed to determine the influence of sociodemographics and lifestyle on the occurrence of type 2 diabetes mellitus. An unmatched case-control study was conducted among 100 individuals with type 2 diabetes mellitus and 100 individuals without diabetes mellitus who were purposively selected from six health facilities in Medan City. Data were collected through interviews using questionnaires, and measurements were performed. Data were analyzed using simple and multiple logistic regression. This study revealed that the majority of individuals with diabetes mellitus were 45 years or older (87%), had an average length of diabetes (Mean±standard deviation (SD)) = 2.73±4.42 years, being female (69%), had low education (52%), had a low income (75%), had a family history of diabetes (36%), had a high-risk waist-hip ratio (83%), had high diastolic blood pressure (70%), being overweight and obese (60%), smoked (23%), lacked physical activity (79%), frequently consumed sweetened foods/drinks (69%) and consumed fewer vegetables and fruits (56%). Multiple logistic regression analysis revealed that a high-risk waist-hip ratio (adjusted odds ratio (aOR) = 2.86, 95% confidence interval (CI): 1.12-7.30), frequent consumption of sweetened foods/drinks aOR = 1.83, 95% CI 1.00-3.39), lack of physical activity (aOR = 1.76, 95% CI 1.12-2.79), and high diastolic blood pressure (aOR = 1.47, 95% CI: 1.04-2.09) were contributing factors for type 2 diabetes mellitus. These results can be targeted for type 2 diabetes prevention and interventions by intensifying community-based health education programs about healthy behaviors.

Keywords: sociodemographic, lifestyle, diabetes mellitus, prevention

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INTRODUCTION

Diabetes mellitus is health problem with an increasing prevalence annually. The disease is common in adults aged 20-79 years and has a serious impact on productivity and quality of life (IDF, 2019). The World Health Organization (WHO) calls it a silent epidemic (Delavari *et al*, 2003). According to the International Diabetes Federation (IDF), 463 million people had diabetes in 2019, and it was predicted that the prevalence will increase to 578 million by 2030 and 700 million by 2045 (IDF, 2019; Saeedi *et al*, 2019). Type 2 diabetes is a more common type of diabetes and impacts socioeconomic status. It was estimated that the costs of health services related to diabetes will be USD 825 billion by 2030 and further increase to USD 845 billion by 2045. Furthermore, the disease can cause serious complications and death. The number of deaths due to diabetes was estimated at approximately 4.2 million in 2019 (IDF, 2019).

Currently, Indonesia has the seventh-ranked highest prevalence of diabetes mellitus worldwide and is predicted to increase to the eighth position in 2045 with a prevalence of 16,6 million cases of diabetes (IDF, 2019; WHO, 2016). Based on basic health research in 2018, the result showed the prevalence of diabetes in Indonesia was 8.5% (MOH RI, 2019), and 69.6% of cases had undiagnosed diabetes (Indonesian Endocrinology Association, 2015). This phenomenon will significantly increase the risk of diabetes complications. However, it was estimated that the prevalence of diabetes will increase to 14.1 million people by 2035 (Indonesian Endocrinology Association, 2015).

North Sumatra ranks thirteenth among diabetes mellitus cases in Indonesia with a prevalence of 2.3% (MOH RI, 2019; MOH RI, 2020). Similarly, the prevalence of diabetes in Medan in 2018 remained high with a death rate of up to 4% (Medan City Health Office, 2019). The occurrence of diabetes mellitus is influenced by many factors, including individual factors, risk behavior,

and environmental factors. Numerous risk factors related to the occurrence of type 2 diabetes mellitus have been studied, including age, ethnicity, family history, low socioeconomic status, obesity, metabolic syndrome, and certain unhealthy lifestyle behaviors (Weisman *et al*, 2018; NCD-RisC, 2016; Astrup and Finer, 2000). Likewise, a greater waist-to-hip ratio as well as lower fruit and vegetable consumption were significantly related to type 2 diabetes mellitus (Chang *et al*, 2013). Another study found that physical inactivity, family history, obesity, and large waist circumference were associated with type 2 diabetes mellitus (Dagdiya *et al*, 2016).

The prevalence of diabetes mellitus in Medan is still high, so effective prevention is necessary. Therefore, identifying risk factors for type 2 diabetes mellitus to determine associated factors is an important component of prevention measures. This study was conducted to determine the influence of sociodemographic factors and lifestyle on the risk of type 2 diabetes mellitus. These findings are useful and can be targeted to prevention interventions.

MATERIALS AND METHODS

This was a retrospective study with an unmatched case-control design. This study was conducted in six health facilities in Medan, including the Medan Barat Health Facility, Medan Amplas Health Facility, Medan Marelan Health Facility, Medan Belawan Health Facility, Medan Sunggal Health Facility, and Hamparan Perak Health Facility, from 9 August 2021 to 18 October 2021. A sample of 200 respondents consisting of 100 individuals with type 2 diabetes mellitus and 100 individuals without diabetes mellitus who fulfill the inclusion criteria and were purposively selected from six health facilities in Medan City. After obtaining a written informed consent and ethical approval from the Medical School, Universitas Sumatera Utara (Reference code number 640/KEP/USU 2021) on 23 July 2021, data were collected by interviewing research participants using structured questionnaires, and measuring weight, height, blood pressure, and blood glucose level. Height was measured using a Microtoise GEA stadiometer (GEA Medical, Jakarta, Indonesia), and body weight was evaluated using a digital scale. Body mass index (BMI) was then calculated by dividing weight (kilogram) by height (meter)^2.

Individuals with a BMI ≥25 kg/m^2 were defined as overweight, individuals with a BMI >25.1 kg/m^2 were defined as obese, and those with BMI <25 kg/m^2 were considered normal weight (MOH RI, 2014). Blood pressure was measured twice using a sphygmomanometer at 5-minute intervals. High blood pressure was defined as an average diastolic blood pressure of 80 mmHg or greater. normal was defined as an average diastolic blood pressure <80 mmHg. Blood glucose was measured in fasting glucose blood using an AutoCheck capillary blood glucose meter (GEA Medical, Jakarta, Indonesia). Normal was defined as a blood sugar level <100 mg/dl while high blood glucose was defined as a blood glucose level of 100 mg/dl or more.

Semi-structured questionnaires in this study consisted of sociodemographic data and lifestyle variables. Sociodemographic data included age, sex, education level, income, body mass index, waist-hip ratio (WHR), family history of diabetes, blood pressure, and blood glucose level. Lifestyle behavior variables include smoking habit, physical activity, frequent consumption of sweetened foods/drinks, and vegetable and fruit consumption.

Data were analyzed using the Statistical Package for Social Science (SPSS) Release 24.0 (IBM, Armonk, NY). Descriptive analysis of the variables is presented either as frequency distributions or proportions. The influence of sociodemographic factors and lifestyle on type 2 diabetes mellitus was analyzed using simple and multiple logistic regression.

RESULTS

The majority of the group with diabetes mellitus were aged 45 years or older (87%) and had an average length of diabetes of 2.73±4.42 years. In addition, these patients were more likely to exhibit the following characteristics: female (69%), low education (52%), low income (75%), overweight and obese (60%), a family history of diabetes (36%), a high-risk waist-hip ratio (83%), high diastolic blood pressure (70.0%), and high blood sugar (80%) (Table 1).

Lifestyle factors were also investigated as shown in Table 2. The majority of cases did not have a smoking habit; only 23% had a smoking habit. The majority of cases reported a lack of physical activity (79%), frequent consumption of sweetened foods/drinks (69%), and reduced vegetable and fruit consumption (56%).

Table 1
Sociodemographic characteristics of respondents

Sociodemographic characteristics	Individuals with diabetes mellitus (cases)	Individuals without diabetes mellitus (control)
Age, *n* (%)		
<45 years	13 (13.0)	21 (21.0)
≥45 years	87 (87.0)	79 (79.0)
Duration of diabetes mellitus in years, Mean±SD	2.73±4.42	N/A
Sex		
Male	31(31.0)	22 (22.0)
Female	69 (69.0)	78 (78.0)
Education level		
High (Senior high school to university)	48 (48.0)	50 (50.0)
Low (Primary school to junior high school)	52 (52.0)	50 (50.0)
Monthly income		
High (IDR ≥3.3 million)	25 (25.0)	32 (32.0)
Low (IDR <3.3 million)	75 (75.0)	68 (68.0)
Body mass index (BMI)		
Normal (BMI 18.1-25.0 kg/m^2)	40 (40.0)	34 (34.0)
Overweight/Obesity (BMI >25.1 kg/m^2)	60 (60.0)	66 (66.0)
Family history with diabetes		
Yes	36 (36.0)	28 (28.0)
No	64 (64.0)	72 (72.0)
Waist-hip ratio		
No risk (Female: ≤0.8; Male: ≤0.95)	17 (17.0)	9 (9.0)
Risk (Female: 0.81; Male: >0.96)	83 (83.0)	91 (91.0)

Table 1 (cont)

Sociodemographic characteristics	Individuals with diabetes mellitus (cases)	Individuals without diabetes mellitus (control)
Diastolic blood pressure		
Normal (≤80 mmHg)	30 (30.0)	43 (43.0)
High (>80 mmHg)	70 (70.0)	57 (57.0)
Blood glucose		
Normal (blood glucose ≤100 mg/dl)	20 (20.0)	88 (88.0)
High (blood glucose >100 mg/dl)	80 (80.0)	12 (12.0)

IDR: Indonesian Rupiah; kg/m^2: kilogram per square meter; mg/dl: milligrams per deciliter; mmHg: millimeters of mercury; SD: standard deviation

Table 2
Distribution of respondents based on lifestyle behaviors

Life style behavior	Individuals with diabetes mellitus (cases)	Individuals without diabetes mellitus (control)
Smoking habit, *n* (%)		
Yes	23 (23.0)	18 (18.0)
No	77 (77.0)	79 (79.0)
Regular physical activity, *n* (%)		
Yes	21 (21.0)	35 (35.0)
No	79 (79.0)	65 (65.0)
Frequent consumption of sweetened foods/drinks		
Yes	69 (69.0)	54 (54.0)
No	31 (31.0)	46 (46.0)
Vegetables and fruit consumption		
Daily	44 (44.0)	58 (58.0)
Non daily	56 (56.0)	42 (42.0)

The simple logistic regression revealed that variables, such as age, sex, family history of diabetes, high-risk waist-hip ratio, high diastolic blood pressure, lack of physical activity, and frequent consumption of sweetened foods/drinks, were significant variables with a *p*-value <0.25 (Table 3). These variables were then entered into the multiple logistic regression model using backward methods. The results revealed that a high-risk waist-hip ratio, high diastolic blood pressure, lack of physical activity, and frequent consumption of sweetened foods/drinks were significant variables that affected type 2 diabetes mellitus. The group that had a high-risk waist-hip ratio had a 2.86-fold increased risk of type 2 diabetes mellitus compared to those who did not have a high-risk waist-hip ratio. The group that frequently consumed sweetened foods/drinks had a 1.83-fold increased risk of type 2 diabetes mellitus compared to those who infrequently consumed sweetened foods/drinks. The group that had irregular/lack of physical activity had a 1.76-fold increased risk of type 2

Table 3
Factors associated with type 2 diabetes mellitus using simple logistic regression

Variable	Crude OR (95% CI)	*p*-value
Age	1.78 (0.84, 3.78)	0.14
Sex	1.60 (1.19, 3.0)	0.15
Education level	1.08 (0.62, 1.8)	0.77
Income	0.71 (0.38, 1.31)	0.27
Family history of diabetes	1.45 (0.80, 2.63)	0.22
Body mass index	0.84 (0.62, 1.15)	0.27
Waist-hip ratio	2.07 (1.14, 4.90)	0.09
High diastolic blood pressure	1.51 (1.09, 2.09)	0.01
Smoking habit	1.36 (0.68, 2.72)	0.38
Lack of physical activity	1.96 (1.27, 3.02)	0.02
Frequent consumption of sweetened foods/drinks	1.89 (1.06, 3.38)	0.03
Vegetable and fruit consumption	0.95 (0.53, 1.71)	0.88

CI: confidence interval; OR: odds ratio

diabetes mellitus compared to those who experienced regular physical activity. The group with high diastolic blood pressure had a 1.47-fold increased risk of type 2 diabetes mellitus compared to those who did not have high diastolic blood pressure (Table 4).

DISCUSSION

Univariate analysis showed revealed risk factors, such as a body mass index resulting in overweight and obesity categorization, a high-risk waist-hip ratio, and high diastolic blood pressure, that are highly associated with type 2 diabetes. Similarly, risk behaviors, such as lack of physical activity, frequent consumption of sweetened foods/drinks, and reduced consumption of vegetables and fruits, are also highly associated with type 2 diabetes. Of the multiple logistic regression analysis using the backward logistic regression method, revealed that a high-risk waist-hip ratio, high diastolic blood pressure, lack of physical activity, and frequent consumption of sweetened foods/drinks contribute to the incidence of diabetes in the population in Medan City.

Multiple studies revealed that increased body mass index related to the increased incidence rates of type 2 diabetes mellitus, which are three and ten times higher in individuals with BMI ranging from 25 to 30 kg/m^2 and greater than 30 kg/m^2, respectively (Bonora *et al*, 2004). In this study, BMI was not significantly associated with the occurrence of diabetes, but the waist-hip ratio (WHR) is a

Table 4
Factors associated with type 2 diabetes mellitus using multiple logistic regression

Variable	Crude OR (95% CI)	Adjusted OR (95% CI)
Waist-hip ratio	2.17 (1.14, 4.90)	2.86 (1.12, 7.30)
High diastolic blood pressure	1.51 (1.09, 2.09)	1.47 (1.04, 2.09)
Lack of physical activity	1.96 (1.27, 3.02)	1.76 (1.12, 2.79)
Frequent consumption of sweetened foods/drinks	1.89 (1.06, 3.38)	1.83 (1.00, 3.39)

CI: confidence interval; OR: odds ratio

strong predictor in describing the risk of developing type 2 diabetes. WHR is more reflective of the accumulation of intra-abdominal fat than BMI (Bray *et al*, 2008) and is a marker of central obesity (Qiao and Nyamdorj, 2010). Central obesity is caused by impaired glucose tolerance and the development of type 2 diabetes (Cheng *et al*, 2010). An increased WHR is often associated with insulin resistance, impaired glucose tolerance, hypertriglyceridemia, hypercholesterolemia, and hyperuricemia. Numerous studies have revealed the relationship between waist circumference and type 2 diabetes mellitus risk in many European populations (Nyamdorj *et al*, 2010; Melidonis *et al*, 2006; Pi-Sunyer, 2004).

High consumption of sweetened beverages as well as diets low in fruits and vegetables are associated with higher type 2 diabetes mellitus (Zheng *et al*, 2018). Excessive consumption of sweetened foods/drinks can increase the risk of diabetes mellitus because it causes an increase in blood sugar levels (hyperglycemia) due to alterations in carbohydrate metabolism. In addition, high consumption of sweetened foods/drinks could cause an imbalance of food intake that has an impact on the occurrence of obesity, which is a trigger for diabetes mellitus (Linder, 2006). This study revealed that high consumption of sweetened foods/drinks was associated with the occurrence of type 2 diabetes mellitus with an OR of 1.83. These findings were supported by Kahlhöfer *et al* (2016), who reported a significant association between high consumption of sweetened food/drinks and glucose blood levels.

Physical activity is one of the pillars of diabetes mellitus management that serves to improve insulin sensitivity, maintain body fit, and reduce weight gain that prevent the progression of diabetes mellitus (Tjokroprawiro and Murtiwi, 2014). Therefore, decreased or lack of physical activity contributes to a high risk for type 2 diabetes mellitus. In this study, a lack of physical activity was associated with the occurrence of type 2 diabetes mellitus; specifically, 79% of diabetic patients did not experience regular physical activity. These findings were supported by a study by Nakanishi and co-workers in Japan that found that physical activity in daily life is inversely associated with the risk of developing type 2 diabetes (Nakanishi *et al*, 2004).

Diabetes and hypertension frequently occur together. Hyperglycemia is often accompanied by metabolic syndrome, including hypertension, which

trigger and exacerbate cardiovascular complications (Cheung and Li, 2012). In the United States, hypertension occurs approximately 50-80% of patients with type 2 diabetes (Landsberg and Molitch, 2004). In this study, high diastolic blood pressure contributed to the incidence of type 2 diabetes mellitus. These findings were similar to those of a study in the United States, which found that type 2 diabetes mellitus was 2.5 times more common among subjects with hypertension compared with subjects with normal blood pressure (Gress *et al*, 2000).

In summary, this study showed that sociodemographic factors (high-risk waist-hip ratio, high diastolic blood pressure) and lifestyle factors (the frequent consumption of sweetened foods and drinks, and lack of physical activity) contributed to the risk of type 2 diabetes mellitus. These findings are useful and can be incorporated into prevention interventions.

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CONFLICT OF INTEREST DISCLOSURE

The author declares no conflict of interest.

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