Risk Factors Analysis of Type 2 Diabetes Mellitus in Inpatients at the General Hospital of Muna Regency, Southeast Sulawesi Province, Indonesia

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Abstract. Diabetes mellitus is a chronic disease that occurs when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. This study aimed to analyze risk factors of sports activities, carbohydrate intake, and family history towards type 2 diabetes mellitus incidence in inpatients at the General Hospital of Muna Regency. The study used a case-control study design. The population in this study was all inpatients at the General Hospital of Muna Regency in January to September 2019. The samples in this study amounted to 60 samples, namely 30 cases and 30 controls selected by using a purposive sampling technique. The results showed that sports activities (p-value = 0.038, OR = 3.000), carbohydrate intake (p-value = 0.000, OR = 14.000) and family history (p-value = 0.001, OR = 12.250) were risk factors towards type 2 DM. This study concluded that all variables studied were risk factors for the incidence of type 2 DM in DM patients at the General Hospital of Muna Regency. The government and the community should play an active role to reduce the risk and prevent the occurrence of type 2 diabetes mellitus.

Keywords: Type 2 DM, sports activities, carbohydrate intake, family history

Introduction

Diabetes mellitus (DM) is a group of metabolic disorders characterized by increased blood glucose levels (hyperglycemia) due to damage to insulin secretion, or both. Diabetes is also associated with an increased incidence of macrovascular diseases, such as coronary artery disease (myocardial infarction), cerebrovascular disease (stroke), and peripheral vascular disease. Diabetes can cause complications of the eyes, heart, kidneys, nerves, and amputations so that many experts mention diabetes as the silent killer (Smeltzer, 2013).

Diabetes mellitus is a chronic disease that occurs when the pancreas does not produce enough insulin (a hormone that regulates blood sugar), or when the body cannot effectively use the insulin it produces. Type 2 diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia, which occurs due to abnormalities in insulin secretion, insulin action, or both. The number of cases and the prevalence of diabetes have continued to increase over the last few decades (Ministry of Health of the Republic of Indonesia, 2018).

International Diabetes Federation states that in 2015, around 415 million people worldwide were estimated to suffer from diabetes mellitus. In 2017, diabetes mellitus sufferers increased to 425 million worldwide. The largest number of people with diabetes mellitus is in the Western Pacific region as many as 159 million and Southeast Asia as many as 82 million. China became the country with the most diabetes mellitus sufferers in the world, 114 million sufferers, and followed by India, 72.9 million, and then the United States, 30.1 million, Brazil, 12.5 million, and Mexico, 12 million sufferers. Indonesia is ranked sixth for diabetes mellitus sufferers as many as 10.3 million sufferers (International Diabetes Federation, 2017).

Based on the results of the Basic Health Research in 2018, when compared between 2013 and 2018 the prevalence of diabetes mellitus based on the diagnosis of doctors in the population of all ages in Indonesia was highest in DKI Jakarta Province amounted to 4.1% decreased to 2.6% and the lowest was found in East Nusa Tenggara Province amounted to 0.6% decreased to 0.5%. Whereas in Southeast Sulawesi Province amounted to 1.4% decreased to 0.9% (Ministry of Health of the Republic of Indonesia, 2018). Despite a decrease in prevalence, diabetes mellitus is still a health problem.

Based on data from the Health Office of Southeast Sulawesi Province in 2018 showed that diabetes mellitus was ranked 7th out of the 10 highest diseases in Southeast Sulawesi after ISPA, not Pneumonia as many as 59,739 cases, hypertension as many as 22,517 cases, diarrhea as many as 14,107 cases, suspect of pulmonary TB as many as 4,687 cases, traffic accidents as many as 4,595 cases, influenza as many as 4,295 cases, and diabetes mellitus as many as 3,710 cases (Health Office of Southeast Sulawesi Province, 2019).

Based on data from the Health Office of Muna Regency in 2019 showed that the number of people with diabetes mellitus as many as 402 cases. Factors that cause a high incidence of diabetes mellitus are genetic factors and unhealthy lifestyles such as unhealthy food, lack of physical activity, and stress (Health Office of Muna Regency, 2019).

Medical record data of diabetes mellitus in inpatients at the General Hospital of Muna Regency in 2016 as many as 60 cases, in 2017 as many as 69 cases, in 2018 as many as 80 cases and in January to September 2019 there were 51 cases. Based on a preliminary study conducted at the General Hospital of Muna Regency was obtained information that there were some patients had a family history of suffering from diabetes mellitus, but almost all patients suffered from diabetes mellitus due to lifestyle namely unhealthy food intake and lack of activities and sports (General Hospital of Muna Regency, 2019).

The increased type 2 diabetes mellitus sufferers are caused by an increase in obesity, lack of physical activity, less consumption of fibrous foods, smoking, and consumption of high-fat foods. Among adults with type 2 diabetes mellitus, more than 80% are overweight or obese. It showed that obesity is a major problem in populations with degenerative diseases that can be reduced in number by improving lifestyles. For example, the main risk factors for diabetes mellitus can be modified by changing risk behaviors such as smoking, less active physical activity, and unhealthy eating patterns (Vidyanto, 2019).

Based on these problems, the authors conducted a study about risk factor analysis of type 2 diabetes mellitus in inpatients at the General Hospital of Muna Regency.

Materials and Methods

Type of the study was an observational analytic by case-control design to analyze risk factors of type 2 diabetes mellitus in inpatients at the General Hospital of Muna Regency, Southeast Sulawesi Province, Indonesia. The population in this study was all inpatients at the General Hospital of Muna Regency in January to September 2019 as many as 51 patients. The samples in this study amounted to 60 people consisted of 30 cases and 30 controls. The sampling used non-probability sampling techniques by purposive sampling. Data analysis used computerized and SPSS version 20. To determine the relationship between two variables used chi-square test in accordance with the significance of p-value = 0.05 and to determine the strength of the relationship using the odds ratio (OR) test.

Results and Discussion

The characteristics of respondents in this study were age, sex, level of education, and occupational. Table 1 showed that out of a total of 60 respondents (100%), the most respondents aged 51-60 years old as many as 22 respondents (36.7%) while the fewest respondents aged 71-80 years old as many as 4 respondents (6.7%). Based on the results of the

study conducted by Trisnawati et al., showed that age variable ≥50 years old can increase type 2 diabetes mellitus incidence because aging causes decreased insulin sensitivity and decreased body function for glucose metabolism (Trisnawati *et al*., 2013).

Based on sex, the number of male respondents is the same as the number of female respondents namely 30 respondents (50%). However, if seen based on the incidence (cases), female respondents suffer more from diabetes mellitus, namely 16 people (53.3%). Based on the level of education, most respondents have elementary school education as many as 25%, while the fewest respondents had no education (never school) as many as 2 respondents (3.3%). Based on occupational, most respondents were self-employed and civil servants/pensionary, namely 18 respondents (30%), while the fewest were employee namely 1 respondent (1.7%). The characteristics of respondents can be seen in table 1.

Table 1. Distribution of respondents by characteristics

Variable	Samples				Total	
	Cases		Controls			
	n	%	n	%	n	%
Age (years old)						
30 - 40	2	6.7	4	13.3	6	10.0
41 - 50	8	26.7	5	16.7	13	21.7
51 - 60	10	33.3	12	40.0	22	36.7
61 - 70	10	33.3	5	16.7	15	25.0
71 - 80	0	0	4	13.3	4	6.7
Total	**30**	**100**	**30**	**100**	**60**	**100**
Sex						
Male	14	46.7	16	53.3	30	50
Female	16	53.3	14	46.7	30	50
Total	**30**	**100**	**30**	**100**	**60**	**100**
Level of education						
Never school	1	3.3	1	3.3	2	3.3
Elementary school	9	30.0	6	20.0	15	25.0
Junior high school	3	10.0	1	3.3	4	6.7
Senior high school	11	36.7	15	50.0	26	43.3
College/university	6	20.0	7	23.3	13	21.7
Total	**30**	**100**	**30**	**100**	**60**	**100**
Occupational						
Civil servants/pensionary	6	20.0	12	40.0	18	30.0
Employee	0	0	1	3.3	1	1.7
Self-employed	12	40.0	6	20.0	18	30.0
Farmers/ Fishermans	4	13.3	5	16.7	9	15.0
Housewives	8	26.7	6	20.0	14	23.3
Total	**30**	**100**	**30**	**100**	**60**	**100**

Respondents whose sports activities have a high risk (rarely and never exercise) amounted to 28 respondents (46.7%) and those with low risk (routinely exercise) amounted to 32 respondents (53.3%). If seen from diabetes mellitus incidence, the high-risk sports activities (rarely and never exercise) were in the case group as many as 18 respondents and the low-risk sports activities were in the control group as many as 20 respondents. Based on the results of interviews, they rarely exercise because they did not have enough time to exercise due to being busy with their work (self-employed and civil servants), and housewives were busy taking care of their children and homes. Those with the low-risk sports activities, routinely do sports at

least ≥3 times a week with sports-type such as jogging, walking, swimming, and cycling. Risk factor analysis of sports activities with type 2 diabetes mellitus incidence in inpatients at the General Hospital of Muna Regency can be seen in table 2.

Sports activities are a form of organized and planned activities that are beneficial to the physical health that is carried out repeatedly by a person. Exercise causes insulin to increase so that blood sugar levels will decrease. In people who rarely exercise, food substances (nutrients in food) that enter the body are not burned (processed) but piled up in the body as fat and sugar. If insulin is insufficient to convert glucose into energy, then diabetes mellitus will occur (Asif, 2014).

Table 2. Risk factor analysis of sports activities with type 2 diabetes mellitus incidence

Sports activities	Cases		Controls		Total		p-value	Odds ratio (OR)	95% Confidence interval (CI)	
	n	%	n	%	n	%			Lower	Upper
High risk	18	60.0	10	33.3	28	46.7	0.038	3.000	1.046	8.603
Low risk	12	40.0	20	66.7	32	53.3				
Total	**30**	**100**	**30**	**100**	**60**	**100**				

The results showed that sports activities are a risk factor for type 2 diabetes mellitus incidence in inpatients at the General Hospital of Muna Regency. Respondents who rarely and never do sports activities have a risk of suffering from type 2 diabetes mellitus namely 3.000 or 3 times greater than respondents who routinely do sports. It was evidenced by Confidence Interval (CI) of 95% and obtained Odds Ratio (OR) namely 3.000.

Exercise in people with diabetes mellitus can increase the use of blood glucose by active muscles so that physical exercise can directly reduce body fat levels, control blood glucose levels, improve insulin sensitivity, and reduce stress. Highly recommended exercise is aerobic, which can delay or even prevent type 2 diabetes mellitus incidence because it can increase insulin sensitivity directly (Vidyanto, 2019).

Respondents in the case group (diabetes mellitus patients) who had high-risk carbohydrate intake were 28 respondents (93.3%), and in the control group were 15 respondents (50%). Risk factor analysis of carbohydrate intake with type 2 diabetes mellitus incidence in inpatients at the General Hospital of Muna Regency can be seen in table 3.

Table 3. Risk factor analysis of carbohydrate intake with type 2 diabetes mellitus incidence

Carbohydrate intake	Cases		Controls		Total		p-value	Odds ratio (OR)	95% Confidence interval (CI)	
	n	%	n	%	n	%			Lower	Upper
High risk	28	93.3	15	50	43	71.7	0.000	14.000	2.818	62.562
Low risk	2	6.7	15	50	17	28.3				
Total	**30**	**100**	30	**100**	**60**	**100**				

Unhealthy dietary habits that contain high calories come from simple carbohydrates and fats but low in fiber are risky dietary habits that can cause type 2 diabetes mellitus. Excessive food intake is the first known risk factor for causing diabetes mellitus. The risk of diabetes mellitus increases when a person consumes excess carbohydrates because more glucose enters the body. In this regard, energy consumption that exceeds the body's needs causes more glucose in the body. In patients with type 2 diabetes mellitus, the body's tissue is unable to store and

use glucose, so blood glucose levels will rise. High blood glucose levels are influenced by high energy intake from food (Kusnadi *et al.*, 2017).

Based on the results of the study showed that carbohydrate intake is a risk factor for type 2 diabetes mellitus incidence in inpatients at the General Hospital of Muna Regency. Respondents with excess carbohydrate intake have a risk of suffering from type 2 diabetes mellitus namely 14.000 or 14 times greater than people who consume enough carbohydrates. It was evidenced by Confidence Interval (CI) of 95% and obtained Odds Ratio (OR) namely 14.000.

Excess carbohydrate intake triggers obesity and insulin resistance. Carbohydrate intake is broken down into simple forms, namely glucose, and then be absorbed in the intestine. Glucose will enter the blood circulation. Therefore, excess carbohydrate intake increases glucose levels in the blood. A metabolic study found that diets high in carbohydrates (>55% of total calorie requirements) increase triglyceride levels and postprandial glucose levels. The results of the study of Halton et al. found that people on low carbohydrate diets experienced an increase in insulin sensitivity (Werdani & Triyanti, 2014).

In the case group, there were 14 respondents (46.7%) were at high risk or had a family history of diabetes mellitus from mother, father, siblings, or grandparents and there were 16 respondents (53.3%) were at low risk or there was no a family history of suffering from diabetes mellitus. In the control group, from 30 respondents there were 2 respondents (6.7%) had a family history of diabetes mellitus and 28 respondents (93.3%) did not have a family history of diabetes mellitus. Risk factor analysis of family history with type 2 diabetes mellitus incidence in inpatients at the General Hospital of Muna Regency can be seen in table 4.

Table 4. Risk factor analysis of family history with type 2 diabetes mellitus incidence

Family history	Cases		Controls		Total		p-value	Odds ratio (OR)	95% Confidence interval (CI)	
	n	%	n	%	n	%			Lower	Upper
High risk	14	46.7	2	6.7	16	26.7	0.000	12.250	2.464	60.910
Low risk	16	53.3	28	93.3	44	73.3				
Total	**30**	**100**	**30**	**100**	**60**	**100**				

Family history of diabetes mellitus can be an important cause of diabetes mellitus because strong familial patterns cause damage to pancreatic beta cells that produce insulin, causing abnormalities in insulin secretion and insulin action (Werdani & Triyanti, 2014). Someone who has a family history suffering from diabetes mellitus will have a risk of suffering from diabetes mellitus about 6% when compared to families who do not have a hereditary diabetes mellitus about 1% (Wardiah, 2018).

The results of the study conducted in patients of type 2 diabetes mellitus treated at the General Hospital of Muna Regency showed that family history was a risk factor for type 2 diabetes mellitus. The results of the statistical test obtained Odds Ratio (OR) namely 12.250. It showed that people who had a family history of suffering from diabetes mellitus have a risk of 12.250 times suffering from type 2 diabetes mellitus compared with people who did not have a family history of suffering from diabetes mellitus.

In the first offspring of patients with type 2 diabetes mellitus more related to hepatic insulin resistance that can be known from the occurrence of impaired blood glucose (impaired fasting blood glucose) caused by effects on glucose metabolism and inherited in offspring (Wagner *et al.*, 2013). A parent's genetic inheritance to offspring is then expressed including several genes that have mutations.

There are mutations in type 2 diabetes mellitus that can increase gene expression on the island of Langerhans and have an impact on the disruption of insulin secretion, reduced plasma insulin, impaired insulin secretion by glucose stimulation, and reduce insulin sensitivity thereby increasing the risk of developing type 2 diabetes mellitus. Type 2 diabetes mellitus is an interaction between genetic and environmental factors. Genetic factors will manifest into type 2 diabetes mellitus if supported by environmental conditions that can trigger this disease (Paramita, & Lestari, 2019).

Conclusion

Based on the results of the study, it can be concluded that sports activities, carbohydrate intake, and family history were risk factors for the incidence of type 2 diabetes mellitus in inpatients at the General Hospital of Muna Regency. The suggestions or recommendations that can be given are:

- Community health center as a basic health services place, it is better to prioritize promotive and preventive efforts by implementing the Healthy Living Community Movement (Gerakan Masyarakat Hidup Sehat, GERMAS in Indonesia) that has been announced by the government such as physical activity and sports every day.
- The Hospital should give nutritional counseling for people with type 2 diabetes mellitus in accordance with the food that should be consumed by patients so that blood sugar can be controlled and for the general public to manage dietary habits, especially carbohydrate intake to control blood sugar levels.
- For people who have families suffering from type 2 diabetes mellitus in order to always implement a healthy lifestyle and do things that can reduce the risk of type 2 diabetes mellitus.

Conflict of interests

The authors declare that there was no conflict of interest regarding the publication of this paper.

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