Journal of Epidemiology and Public Health (2021), 06(02): 232-244
Masters Program in Public Health, Universitas Sebelas Maret

Research

Risk Factors of Type 2 Diabetes Mellitus in Elderly

Yulia Afrina Nasution[1)], Zulhaida Lubis[2)], Fazidah Aguslina Siregar[2)]

[1)]Faculty of Medicine, Universitas Muhammadiyah Sumatera Utara
[2)]Faculty of Public Health, Universitas Sumatera Utara

ABSTRACT

Backround: Non-communicable diseases arise in the elderly. The degenerative cycle decreases the resistance of the body, so that it is vulnerable to infectious diseases. Diabetes mellitus (DM) is characterized by chronic hyperglycemia and impaired carbohydrates, lipids, and proteins metabolism caused by complete or partial insufficiency of insulin secretion and/or insulin action. This study aimed to examine the risk factors of type 2 DM among elderly at Muhammadiyah General Hospital, North Sumatera.

Subjects dan Method: This was a case control study carried out at Muhammadiyah Hospital, North Sumatera, in 2018. A total of 148 elderly patients was selected for this study, consisting of 74 patients with type 2 DM and 74 patients without type 2 DM. The dependent variable was the incidence of type 2 DM. The independent variables were family DM history, smoking habit, physical activity, carbohydrate diet, fiber diet, body mass index (BMI), abdominal circumference, and hypertension. The data were collected by questionnaire and analyzed using multivariate analysis.

Results: The risk of type 2 DM increased with family history of DM (OR= 4.62; 95%CI: 1.89 to 11.27; p<0.001) lack of physical activity (OR= 3.13; 95%CI= 1.30 to 7.55 p=0.001), smoking habit (OR= 2.67; 95% CI= 1.10 to 6.44 p= 0.005), central obesity (OR= 2.85; CI= 1.11 to 7.33 p= 0.001),high consume of carbohydrate (OR= 2.90; 95% CI= 1.13 to 7.40; p= 0.01), and lack of fiber intake (OR= 4.83; CI= 2.02 to 11.58 p<0.001). The association between type 2 DM and BMI, blood pressure, and carbohydrate, was not statistically significant

Conclusion: Type 2 DM risk increased with DM family history, lack of physical activity, smoking habit, abd central obesity, and lack of fiber intake.

Keywords: type 2 diabetes mellitus, elderly

Correspondence:
Yulia Afrina Nasution. Faculty of Public Health, Universitas Sumatera Utara, Medan, North Sumatera. Email: yuliadokter@gmail.com. Mobile: 081370888764.

Cite this as:
Nasution YA, Lubis Z, Siregar FA (2021). Risk Factors of Type 2 Diabetes Mellitus in Elderly. J Epidemiol Public Health. 06(02): 232-244. https://doi.org/10.26911/jepublichealth.2021.06.02.10.

BACKGROUND

Diabetes is one of the four priority non-communicable diseases and a leading cause of blindness, heart attacks, strokes, kidney failure and leg amputations. About 80% of complications due to diabetes can be prevented or delayed with optimal treatment management, so that people with diabetes can live long and healthy lives (WHO, 2016).

Data from the 2015 International Diabetes Federation (IDF) global study states that 415 million people worldwide have diabetes or about 1 in 11 adults suffer from diabetes. By 2040 it is estimated that 642 million people or 1 in 10 adults will suffer from diabetes (IDF Atlas, 2015).

WHO (2016) stated that the prevalence of people with diabetes in Indonesia showed a tendency to increase from 5.7% (2007) to 6.9% (2013). The prevalence of

being overweight (obese) or overweight increased from 12.5% in 2007 to 15.4% in 2013, Obesity is one of the biggest risk factors for diabetes (WHO, 2016).

The 2013 Basic Health Research (Riskesdas) data shows that the prevalence of DM in Indonesia for those aged over 15 years is 6.9%. The prevalence of DM in Indonesia has increased from 1.1% (2007) to 2.1% (2013). The highest prevalence of DM that has been diagnosed by a doctor is in DI Yogyakarta (2.6%), DKI Jakarta (2.5%), North Sulawesi (2.4%), and East Kalimantan (2.3%) (Kemenkes RI, 2013).

The prevalence of DM in the elderly tends to increase, this is because DM in the elderly is multifactorial which is influenced by intrinsic and extrinsic factors. Age turned out to be one of the independent factors in its influence on changes in the body's tolerance for glucose. Of these, it is said that 50% are patients aged > 60 years (Gustaviani, 2006).

Seeing that DM will have an impact on human resources and a large increase in health costs, it is very necessary to control type 2 DM, type 2 DM can be prevented, delayed or eliminated by controlling risk factors.

Several studies have shown that genetic factors are a strong component of the prevalence of DM in the elderly, although the specific genes associated with this condition are not yet clear. If a family member with DM has a history of type 2 DM, then other family members will be exposed to DM. DM generally occurs in the elderly with certain racial groups, the possibility of elderly with identical twins having one sibling can get DM >80%. Elderly people with type 2 diabetes who are identical twins, siblings who are not diabetic have evidence that their glucose metabolism is abnormal (Meneilly and Tessier, 2001).

Risk factors for non-communicable diseases, including type 2 DM, are divided into two, the first is risk factors that cannot be changed, such as gender, age and genetic factors. The second is a factor that can be changed, such as smoking habits (Bustan, 2010).

Previous studies have shown that demographics, behavioral and lifestyle factors, as well as clinical or mental conditions affect the incidence of type 2 DM (Irawan, 2010).

Research conducted by Herawati in 2012 in Samosir district showed that the modifiable risk factors that affect the incidence of type 2 diabetes are BMI 23, lack of physical activity, carbohydrate diet ≥ 70% and fiber diet 20 grams, and the most influential is BMI 23 (Herawati, 2012).

Another study conducted by Nadyah in 2013 at the Endocrine Polyclinic section/ SMF FK-UNSRAT Manado showed that the risk factors that influence the incidence of type 2 DM at the Endocrine and Metabolic Polyclinic were BMI >23, hypertension >140/90 mmHg, family history, age >40 years, and dyslipidemia (Nadyah, et al, 2013).

General Hospital (RSU) Muhammadiyah North Sumatra is one of the hospitals located in urban areas and is a referral hospital for the Social Security Administering Agency (BPJS), based on the 2013 Riskesdas that residents who live in urban areas have a greater risk of the incidence of DM. Based on interviews with medical record officers, it was found that patient visits were due to increased DM. Based on data found in 2015 there were 132 cases of DM, in 2016 the number of cases was 212 cases and the number of cases in 2017 has not decreased by 237 cases. Based on the above, it is necessary to conduct research related to risk factors for type 2 DM in

elderly patients at Muhammadiyah General Hospital, North Sumatra.

SUBJECTS AND METHOD

1. Study Design

This research is an analytical observational research design with a case control study (case control) which examines the relationship between certain effects (diseases or health conditions) with certain risk factors.

2. Population and Sampel

The population of this study were patients with type 2 diabetes who were diagnosed with type 2 diabetes by doctors at the Muhammadiyah General Hospital in North Sumatra. The sample for the case was 74 people and for the control 74 people with a ratio of 1:1. so the total sample size is 148 respondents.

3. Research variabel

The independent variables consisted of family history of DM, smoking habits, physical activity, BMI, central obesity, blood pressure, carbohydrate intake, and fiber intake. The dependent variable (dependent variable) is the incidence of type 2 DM in the elderly.

4. Operational Definition of Variabels

Elderly patients are patients who are registered and have medical records at the RSU. Muhammadiyah North Sumatra, aged 60 years, age is calculated from the date of birth listed on the identity card.

The incidence of DM in the elderly is the condition of an elderly patient who is a new patient diagnosed with diabetes by a doctor at the Muhammadiyah North Sumatera General Hospital with a fasting blood glucose level result of 126mg/dl and or a blood glucose 2 hours after eating ≥200 mg/dl and or a blood glucose while 200 mg/dl with clinical symptoms of DM.

Family history of DM is a history of DM disease in parents (father, mother or both) and whether there is a biological family who suffers from DM

Smoking habit is a patient's habit of consuming cigarettes calculated by the number of cigarettes smoked every day. Smoking habits were grouped into two groups, namely not smoking or <12 cigarettes/ day and smoking or >12 cigarettes/day (Eason, 2005).

Physical activity is any body movement with the aim of increasing and releasing energy and energy, carried out more than 3 times a week with a duration of more than 30 minutes (Perkeni, 2015).

Body mass index (BMI) is a condition that describes a person's nutritional status as measured by BMI by comparing weight (kg) with the square of height (m2) of elderly patients at Muhammadiyah General Hospital, North Sumatra.

Central obesity is dangerous accumulation of body fat in the abdomen, determined by measuring the circumference of the abdomen in elderly patients at Muhammadiyah General Hospital, North Sumatra from the measurement results in centimeters.

Hypertension is the result of measuring brachial artery blood pressure in the upper arm of elderly patients at Muhammadiyah General Hospital, North Sumatra. Grouped into 2 categories, namely hypertension if systolic 140 mmHg or diastolic 90 mmHg. Non-hypertensive category if systolic <140 mmHg or diastolic <90 mmHg.

Carbohydrate intake is the number of types of carbohydrates consumed by respondents in 1 day, calculating the amount of carbohydrates consumed by respondents by conducting interviews and then calculating carbohydrates based on age and gender.

Fiber intake is the amount of fiber consumed by the respondent in one day, calculating the amount of fiber (vegetables,

fruit and nuts) consumed by conducting interviews.

5. Study Instruments

Data collection on the variables of family DM history, smoking habits and physical activity were carried out using a questionnaire. Data collection on carbohydrate intake and fiber intake was carried out using food recall with interviews and for data on Body Mass Index (BMI), central obesity and hypertension using medical records.

6. Data analysis

Data analysis was performed using univariate analysis, bivariate analysis, and multivariate analysis with multiple logistics regression.

RESULTS

1. Univariate analysis

The number of respondents in this study were 74 cases and 74 controls.

Table 1. Frequency Distribution by Age at Muhammadiyah General Hospital, North Sumatera

Characteristics of Respondents	Case	%	Control	%
Age				
60-69 years	30	40.5	35	47.3
≥ 70 years	44	59.5	39	52.7
Gender				
Male	29	39.2	29	39.2
Female	45	60.8	45	60.2
Education				
Low	45	60.8	31	41.9
High	29	39.2	43	58.1
Occupation				
Not working	43	58.1	55	74.9
Working	31	41.9	19	25.7

The results showed that the most patients suffering from type 2 DM were aged 70 years, namely 44 people (59.5%) while those aged 60-69 years were 30 people (40.5%). Patients who suffered the most DM were female as many as 45 patients (60.8%), while the male sex was 29 patients (39.2%).

The number of respondents who had low education in the case group were 45 respondents (60.8%), while in the control group who had low education were 31 respondents (41.9%). The number of respondents who do not have a job in the case group is 43 people (58.1%), while in the control group who does not work as many as 55 respondents (74.9%).

The risk factors studied in this study consisted of education, occupation, family history of DM, smoking habits, physical activity, BMI, central obesity, blood pressure, carbohydrates and fiber. After conducting interviews with patients with Type 2 DM in elderly patients with 74 cases and 74 controls, then performing a univariate analysis, the results of the frequency distribution of these variables can be seen in Table 3.

Table 2. Frequency distribution of family history of DM, smoking habits, physical activity, BMI, central obesity, blood pressure, carbohydrate intake and fiber intake

Risk Factor	Case	%	Control	%
History of DM in family				
Yes	51	68.9	26	35.1
No	23	31.1	48	64.9
Smoking Habbit				
Yes	45	60.8	18	24.3
No	29	39.2	56	75.7
Physical Activity				
<3x in a week	43	58.1	26	45.1
≥3x in a week	31	41.9	48	64.9
BMI				
Obesity	35	47.3	28	37.8
Not obesity	39	52.7	46	62.2
Central Obesity				
Yes	50	67.6	26	35.1
No	24	32.4	48	64.9
Blood Pressure				
Hipertention	50	67.6	46	62.2
Not Hipertention	24	32.4	28	37.8
Carbohydrate Intake				
>60% carbohydrate	52	70.3	24	32.4
≤60% carbohydrate	22	29.7	50	67.6
Fiber Intake				
<20 g/day	53	71.6	23	31.1
≥20 g/day	21	28.4	51	68.9

Table 3. Average smoking habits, BMI, central obesity, carbohydrate intake and fiber intake

Variable	Category	Average	SD	Minimal	Maximum
Smoking habit	Male	12	5.1	0	24
	Female	3.14	5.1	0	18
BMI	Male	23.7	3.03	20	31.4
	Female	23.6	3.7	18.7	32.1
Central obesity	Male	94	11.4	78	120
	Female	83	9.4	68	111
Carbohydrate intake (gram)	Male	350.2	61.8	209	490
	Female	279.8	25.03	221	381
Fiber intake (gram)	Male	19.6	5.6	9	30
	Female	17.8	5.9	8	30

Table 3 showed that carbohydrate intake (gram) for male (Mean= 350.2; SD= 61.8) and for female (Mean= 279.8; SD= 25.03).

The Smoking habit in male group was (Mean= 12; SD; 5.1) and female group was (Mean= 3.14; SD= 5.1). The BMI in male group was (Mean= 23.7; SD= 3.03) and female group was (Mean= 23.6; SD= 3.7).

The abdominal circumference in the male group was (Mean= 94; SD= 11.4) and women group was (Mean= 83; SD= 9.4). Meanwhile, fiber intake (gram) in the male

group was (Mean= 19.6; SD= 5.6) and female group was (Mean= 17.8; SD= 5.9).

2. Bivariate Analysis

Bivariate analysis was conducted to determine the relationship between the independent variables, namely education, occupation, family history of DM, smoking habits, physical activity, BMI, abdominal circumference, blood pressure, carbohydrates and fiber with the dependent variable being type 2 diabetes. determine the variables that enter into the multivariate model. This bivariate statistical test used the chi-square test.

Table 4. Risk Factors Associated with the Incidence of Type 2 DM in Elderly Patients at RSU Muhammadiyah North Sumatra

Risk Factor	Case		Control		OR	95% CI	p
	n	%	n	%			
Family History of DM							
Yes	51	68.9	26	35.1	4.09	2.06 to 8.13	0.001
No	23	31.1	48	64.9			
Smoking Habit							
Yes	45	60.8	18	24.3	4.83	2.38 to 9.79	0.001
No	29	39.2	56	75.7			
Physical Activity							
<3x in a week	43	58.1	26	45.1	2.56	1.32 to 4.98	0.005
≥3x in a week	31	41.9	48	64.9			
BMI							
Obesity	35	47.3	28	37.8	1.47	0.77 to 0.84	0.245
Not obesity	39	52.7	46	62.2			
Central Obesity					3.85	1.95 to 7.60	0.001
Yes	50	67.6	26	35.1			
No	24	32.4	48	64.9			
Blood Pressure					1.27	0.65 to 2.49	0.491
Hipertention	50	67.6	46	62.2			
Not hipertention	24	32.4	28	37.8			
Carbohydrate Intake					4.92	2.45 to 9.88	0.001
>60% carbohydrate	52	70.3	24	32.4			
≤60% carbohydrate	22	29.7	50	67.6			
Fiber Intake					5.60	2.76 to	0.001
<20 g/day	53	71.6	23	31.1		11.33	
≥20 g/day	21	28.4	51	68.9			

3. Multivariate Analysis

Multivariate analysis is an analysis to determine the effect of independent variables, namely family history of DM, smoking habits, physical activity, central obesity, carbohydrate intake and fiber intake with the dependent variable being type 2 diabetes.

The results of logistic regression showed that the most dominant variable influencing the incidence of type 2 DM in elderly patients at Muhammadiyah General Hospital North Sumatra was fiber intake variable with a value (OR= 5.60; CI= 2.76 to 11.33 p<0.001), meaning that people with fiber intake <20 g/day is more at risk of suffering from type 2 DM 5.60 times compared to people whose fiber intake is 20 g/day.

Table 5. Effect of Family History of DM, Smoking Habits, Physical Activity, Central Obesity, and Fiber with the Incidence of Type 2 DM in Elderly Patients at RSU Muhammadiyah North Sumatra

Variable	OR	95%CI		p
		Lower limit	Upper limit	
Family history of DM (yes)	4.62	1.89	11.27	<0.001
Physical activity (less)	3.13	1.30	7.55	0.001
Smoking habit (active)	2.67	1.10	6.44	0.005
Central obesity (yes)	2.85	1.11	7.34	0.001
Carbohydrate Intake (>60%)	2.90	1.13	7.40	0.001
Fiber intake (< 20 g/day)	4.83	2.02	11.58	<0.001

DISCUSSION

1. Family history of DM and type 2 DM in elderly

Multivariate results showed that there was an influence of family history of DM with the incidence of type 2 DM in elderly patients (OR= 4.62; 95% CI= 1.89 to 11.27; p= 0.001) means that people who have a family history of type 2 DM are more at risk of suffering from Type 2 DM compared to people with no family history of type 2 DM.

This is in line with Amalia (2014) which states that there is a relationship between a family history of DM and the incidence of DM (OR= 6.48 (95% CI=2.08 to 20.21; p=0.001) means that people who have a history of DM have a risk of 6.48 times greater than people who do not have a history of DM. This study is also in line with Sirait et al. (2015) which stated that there was a relationship between a parent's DM history and the incidence of Type 2 DM in adults in Bogor.

A study conducted by Scott et al. (2013) stated that there was a significant relationship between a family history of DM and the incidence of diabetes mellitus (p<0.001). A family history of DM is associated with metabolic abnormalities and is a strong risk factor for the development of type 2 diabetes.

A person with a family history of type 2 DM can increase the risk of the disease. The lifetime risk of treatment for type 2 diabetes is estimated at 40%, if one parent has type 2 diabetes. Although most studies have reported this effect is not sex-specific, there are some exceptions in this regard. For example, Mooy et al reported positive effects only in men, and Sugimori and coworkers only in women. Effects of family history were seen across age groups. For example, when Costa, et al. studied 205 non-diabetic people who were related to people with type 2 diabetes, compared with the general population and in each age group type 2 diabetes was more common among people with a family history of diabetes (Colagiuri et al, 2009).

The risk of a child getting type 2 diabetes is 15% if one parent has diabetes and a 75% chance if both have diabetes. In general, if a person suffers from DM, his siblings have a risk of DM as much as 10% (Kemenkes RI, 2008).

2. Smoking habit and type 2 DM in elderly

The results of the multivariate analysis conducted showed that there was an influence between smoking habits and the incidence of type 2 diabetes in elderly patients. The results (OR= 2.67; 95% CI= 1.10 to 6.44; p= 0.005) means that people who have a smoking habit are more at risk of suffering from type 2 DM 2.67 times compared to people who do not have a

smoking habit. The average results of smoking habits based sex in the male group were 12 cigarettes while in female group as many as 3.14 cigarettes.

This is in line with Fatmawati (2010) which states that there is a relationship between smoking and the incidence of type 2 DM, but a study by Amalia (2015) states that there is no relationship between smoking and the incidence of type 2 diabetes.

Case control study in California by Casanno cited by WHO in DM patients who smoked 12 cigarettes per day had 3 times the risk of developing diabetic ulcers compared to DM patients who did not smoke. Smoking habits as a result of the nicotine contained in cigarettes will cause endothelial damage and then platelet adhesion and aggregation will occur which then leaks so that lipoprotein lipase will slow down the clearance of blood lipids and facilitate the onset of atherosclerosis. Atherosclerosis results in vascular insufficiency so that blood flow to the dorsalis pedis, popliteal, and tibial arteries will also decrease.

3. Physical activity and type 2 DM in elderly

The results of multivariate analysis showed that there was an effect of physical activity on the incidence of type 2 DM in elderly. Elderly with physical activity <3 times a week are more at risk of suffering from type 2 DM 3.13 times compared to elderly with physical activity >3 times a week.

This is in line with Fatmawati (2010) which states that there is a relationship between physical activity and the incidence of type 2 DM. or can reduce the risk of developing type 2 diabetes.

Lack of exercise will make excess energy from caloric intake not channeled and cause the rest of the energy to be stored in the body in the form of fat. This fat deposit will trigger obesity which causes insulin resistance and will further trigger type 2 diabetes in adolescents and children which is in line with the obesity epidemic in this age group (Aman, 2013).

According to Chaveau and Kaufman physical exercise/exercise in diabetes can cause an increase in the use of blood glucose by active muscles so that physical exercise can directly cause a decrease in body fat levels, control blood glucose levels, improve insulin sensitivity, reduce stress, prevent the occurrence of type 2 diabetes in children. patients with impaired glucose tolerance (Kemenkes 2008).

Aerobic exercise such as walking or swimming can help you lose weight, improve heart health, and is a good control of blood sugar. Research has shown that strengthening exercise can improve insulin sensitivity, improve glucose tolerance, help with weight loss, and reduce the risk of heart disease. In fact, in people with diabetes, strengthening exercise combined with aerobics is more beneficial (Seibel, John., 2009).

4. BMI and type 2 DM in elderly

The results of the bivariate analysis carried out showed that there was no effect between BMI and the incidence of type 2 diabetes. This study is not in line with Fatmawati (2010) which states that there is a relationship between obesity based on BMI and the incidence of type 2 diabetes mellitus (p = 0.003).

A study by Trisnawati showed that the variable that had a strong relationship with the incidence of Type 2 DM was Body Mass Index (OR= 0.14; 95%CI=0.04 to 0.52; p= 0.006). People who are obese are 7.14 times more likely to suffer from Type 2 DM compared to people who are not obese (Trisnawati, 2013).

A study Corbin et al. (2016) showed that there was a relationship between BMI

and type 2 DM (OR= 1.27; 95% CI= 1.18 to 1.36; p= 0.019). Obese people were 1.27 times more likely to suffer from type 2 diabetes than people who were not obese.

5. Central obesity and type 2 DM in elderly

Multivariate results showed that there was an effect of abdominal circumference with the incidence of type 2 DM in elderly. Elderly with central obesity are 2.85 times more likely to suffer from type 2 diabetes than those without central obesity.

This is in line with Sepriana (2012), which was conducted at the Jatinegara Health Center elderly poly, which showed that there was a significant relationship between obesity and DM. Riskesdas 2007 data analysis conducted by Irawan found that people with central obesity had a 2.63 times risk of suffering from type 2 DM compared to normal people (Irawan, 2010).

Research conducted by Freemantle et al. (2008) showed that there was a strong relationship between central obesity and the incidence of type 2 diabetes (OR= 2.14; 95% CI= 1.70 to 2.71; p< 0.001). Elderly with central obesity are more at risk of suffering from type 2 diabetes, which is 2.14 times compared to those without central obesity. Waist circumference is one of the main risk factors for type 2 diabetes, so reducing waist circumference can reduce the risk of type 2 diabetes.

Obesity, especially abdominal/ central obesity is significantly associated with dysmetabolic syndrome (dyslipidemia, hyperglycemia, hypertension), which is based on insulin resistance. Abdominal obesity can be identified by measuring the circumference of the abdomen. In men, it is said to be abdominal/central obesity if the abdominal circumference measurement is > 120cm (Asia > 90 cm) and in women > 82 cm (Asia > 80 cm). This type of obesity is a risk factor that greatly influences the incidence of cardiovascular disease and diabetes (Kemenkes RI, 2008).

In central obesity, insulin resistance occurs in the liver which results in an increase in FFA/Free Fatty Acid (free fatty acids) and the oxidation of FFA causes impaired glucose metabolism both oxidatively and non-oxidatively so that it interferes with the use of glucose by peripheral tissues. The increase in FFA in obese people generally occurs because the process of lipolysis of adipose tissue is more frequent than normal. An increase in the amount of visceral (abdominal) fat has a positive correlation with hyperinsulin and a negative correlation with insulin sensitivity.

6. Blood Pressure and type 2 DM in elderly

The results of bivariate analysis showed that there was no effect between blood pressure and the incidence of type 2 diabetes in elderly patients. This is in line with Amalia (2014) which states that there is no relationship between hypertension and the incidence of type 2 DM (p = 0.931).

About 60% of the elderly will experience hypertension after the age of 75 years. Tight blood pressure control in DM patients is associated with the prevention of uncontrolled hypertension and several other diseases, such as diabetes mellitus, stroke, myocardial infarction, and peripheral vascular disease. this can be achieved by keeping the blood pressure at less than 150/85 mmHg (not too tight control) or less than 180/105 mmHg (tight control). Strict control is carried out for patients who have a high risk of having complications from other diseases, such as diabetic retinopathy, reduced vision, or severe DM (Farid, 2007).

Diabetes and hypertension are 2 diseases that always coexist, the combination of the two diseases results in an increased risk of cardiovascular events that

can be life-threatening. Recent guidelines agree that the need for early blood pressure reduction of <130/80 mmHg in diabetic patients. Given that diabetes is a cardiovascular risk factor, it is necessary to consider the selection of antihypertensive therapy in order to reduce the occurrence of cardiovascular complications due to diabetes (Mancia, G., 2005).

7. Carbohydrate intake and type 2 DM in elderly

The results of the multivariate analysis that have been carried out show that there is an influence between carbohydrate intake > 60% with the incidence of type 2 diabetes in elderly. Elderly who eat carbohydrates >60% more risk of suffering from type 2 diabetes 2.90 compared to people whose carbohydrate intake is 60%. This is in line with Amanina (2015) which states that there is a relationship between carbohydrate intake and the incidence of type 2 diabetes.

Progressive changes in carbohydrate metabolism in the elderly include changes in glucose-influenced insulin release and insulin-mediated inhibition of glucose release. The magnitude of the decrease in insulin secretion was more apparent in the response to oral glucose administration than intravenous administration. These changes in carbohydrate metabolism include loss of the first phase of insulin release (Henderina, 2010).

Currently what is needed is the distribution of carbohydrate intake, education is needed regarding discipline of carbohydrate intake and meal times to avoid severe fluctuations in blood sugar levels. Diets for weight loss are especially recommended in adolescents, and the elderly should be prescribed with caution, as malnutrition is more of a problem than obesity. In chronic conditions, there is no need to restrict the diet plan. Consistent daily food, adequate carbohydrate intake is more important to avoid nutritional deficiencies (Joslin Diabetes Center, 2013).

Carbohydrate diets are very effective in lowering glucose levels in the body. In research conducted by Yancy et al. It shows that there is a relationship between dietary carbohydrates and a decrease in glucose in the body ($p<0.001$). Because carbohydrate diets are very effective in lowering blood glucose, diabetic patients who are undergoing treatment must be under medical supervision to be able to adjust the patient's medication (Yancy et al., 2005).

In 2008, Balagopal and colleagues evaluated lifestyle interventions for 703 residents consisting of adults and adolescents aged 10-92 years in Tamilnadu Village, India. These interventions aim to prevent or reduce the risk of developing DM and its complications. One of the education given is about diet. Improvement of obesity and diet is one of the outcomes of the intervention because the study found that the prevalence of DM and pre-DM in the village has increased (Balagopal et al, 2008).

According to Joslin from the Medical Center Institute, in the management of DM there are 3 (three) J's that DM sufferers must know and implement, namely the amount of food, the type of food, and the meal schedule.

8. Fiber Intake and type 2 DM in elderly

The results of multivariate analysis showed that there was an effect of fiber intake with the incidence of type 2 diabetes in elderly. Elderly whose fiber intake is <20 g/day are at risk of suffering from type 2 DM 4.83 times compared to those whose fiber intake is 20 g / day. Based on the results of logistic regression, the most dominant factor influencing the incidence of type 2 diabetes in elderly patients is fiber intake <20 g/day.

This study is in line with Amanina (2015), which states that there is a relationship between fiber intake and the incidence of type 2 diabetes. The mechanism of fiber in reducing blood glucose levels in patients with type 2 diabetes is strongly influenced by the absorption of carbohydrates in the intestine. The lower the carbohydrates absorbed by the body, the lower the glucose levels, in this case fiber can reduce the efficiency of carbohydrate absorption which can cause a decreased insulin response. If the insulin response decreases, the work of the pancreas will be lighter so that it can improve the function of the pancreas in producing insulin (Astawan and Tutik, 2012).

A study conducted on risk factors for the incidence of type 2 diabetes mellitus in elderly patients at Muhammadiyah General Hospital, North Sumatra, it can be concluded that there is an influence of family history of DM, smoking habits, physical activity, central obesity, carbohydrate intake and fiber intake with the incidence of type 2 diabetes in elderly patients. at the Muhammadiyah General Hospital in North Sumatra.

The effect of fiber intake in reducing blood glucose levels occurs in the stomach, both soluble and insoluble fiber have the ability to fill the stomach, slow gastric emptying and change gastric peristaltic movements. So that it can cause a longer feeling of fullness and delay the delivery of nutrients to the small intestine. Furthermore, in the small intestine, the type of water-soluble fiber can increase the viscosity of the contents in the small intestine which can result in a decrease in amylase enzyme activity and can slow down glucose absorption. Then it can indirectly reduce the rate of diffusion on the mucosal surface of the small intestine so that it results in a decrease in blood glucose levels (Budiyanto, 2002).

AUTHOR CONTRIBUTION

Yulia Afrina Nasution, Zulhaida Lubis, and Fazidah Aguslina Siregar together formulate problem formulations, collect data, and analyze research results.

FUNDING AND SPONSORSHIP

This research is self-funded.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

REFERENCES

Amalia FR (2014). Faktor risiko kejadian diabetes melitus pada lansia di puskesmas Kecamatan Mampang Prapatan Jakarta Selatan Tahun 2014 (Risk Factors for the Incidence of Diabetes Mellitus in the Elderly at the Health Center in Mampang Prapatan District, South Jakarta in 2014). FKM UI. Jakarta.

Aman (2013). Tren spritualitas milenium ketiga cetakan pertama. Tanggerang: Ruhama.

Amanina A (2015). Hubungan asupan karbohidrat dan serat dengan kejadian diabetes melitus tipe II wilayah kerja Puskesmas Purwosari (Relationship between carbohydrate and fiber intake with the incidence of type II diabetes mellitus in the Purwosari Public Health). Thesis. Faculty of Public Health Universitas Muhammadiyah Semarang.

Astawan M, Tutik W (2012). Diit sehat dengan makanan berserat (Healthy Diet With Fiber Food). Edisi 5. Solo: Tiga Serangkai.

Balagopal P (2008). A community-based diabetes prevention and management education program in a rural village in

India. Diabetes Care. Retrieved from http://www.perkeni.org/?page=buletin.detail&id=134, in July 2014.

Budiyanto (2002). Gizi dan kesehatan (nutrition and health). Malang: Bayu Media dan UMM Press.

Bustan MN (2010). Epidemiologi penyakit tidak menular (epidemiology of non-communicable diseases), Cetakan Kedua. Jakarta: Rineka Cipta.

Colagiuri R, Colagiuri S, Yach D, Pramming S (2009). The answer to diabetes prevention: science, surgery, service delivery, or social policy?. Am J Publich Health. 96(9): 1562-1569. https://dx.doi.org/10.2105%2FAJPH.2005.067587.

Corbin LJ, Richmond RC, Wade KH, Burgess S, Bowden J, Smith GD, Timpson NJ (2016). BMI as a modifiable risk factor of type 2 diabetes: refining and understandinng causal estimates using Mendelian Randomazion. Diabetes. 65(10): 3002–3007. https://dx.doi.org/10.2337%2Fdb16-0418.

Eason SL, Petersen NJ, Suarez-Almazor M, Davis B, Collins TC (2005). Diabetes mellitus, smoking and the risk for asymptomatic peripheral arterial disease: whom should we screen. J Am Board Fam Pract. 18(5): 355-61. https://doi.org/10.3122/jabfm.18.5.355.

Farid (2007). Hipertensi pada lansia, kontrol ketat cegah komplikasi (Hypertension in the elderly, tight control to prevent complications). Accessed from http://www.majalah-farmacia.com/rubrik/one_news.asp?IDNews=491.

Fatmawati A (2010). Faktor risiko kejadian diabetes melitus tipe 2 pasi en rawat jalan (studi kasus di rumah sakit umum daerah sunan kalijaga demak (risk factors for the incidence of type 2 diabetes mellitus in outpatients (case study at the Sunan Kalijaga regional general hospital, Demak)). Tesis Universitas Negeri Semarang).

Freemantle N, Holmes J, Hockey A, Kumar S (2008). How strong is the association between abdominal obesity and the incidence of type 2 diabetes?. Int J Clin Pract. 62(9): 1391–1396. https://dx.doi.org/10.1111%2Fj.1742-1241.2008.01805.x.

Gustaviani R (2006). Diagnosis dan klasifikasi diabetes melitus (diagnosis and classification of diabetes mellitus). Buku Ajar Ilmu Penyakit Dalam. IV ed. Jakarta: balai penerbit FKUI.

Henderina (2010). DM in elderly. Accessed from http://www.scribd.com/doc/72-458847/dm-pada-lansia.

Herawati (2012). Pengaruh faktor risiko yang bisa dimodifikasi terhadap diabetes mellitus tipe 2 di rumah sakit umum Hadrianus. Sinaga, Pangurusan Kabupaten Samosir. Tesis. FKM USU, Medan

IDF Atlas (2015). Unite for Diabetes. Idf diabetes atlas sixth edition. Diakses pada tanggal 18 Juli 2016 dari https://www.idf.org/sites/default/files/Atlas-poster-2015_EN.pdf

Irawan D (2010). Prevalensi dan faktor risiko kejadian diabetes melitus tipe 2 i daerah urban indonesia (Analisa data sekunder riskesdas 2007). Thesis Universitas Indonesia.

joslin diabetes center (2013). stay healthy with diabetes, Harvard medical school.

Kemenkes RI (2008). Ditjen PP & PL: Petunjuk teknis pengukuran faktor risiko diabetes melitus (technical guidelines for measuring diabetes mellitus risk factors). Jakarta.

Kemenkes RI 2013. Riset Kesehatan Dasar; RISKESDAS. Jakarta: Balitbang Kemenkes RI.

Mancia (2005). The association of hypertension and diabetes: prevalence, cardiovascular risk and protection by blood pressure reduction. 42: 17-25. Accessed from https://link.springer.-com/article/10.1007%2Fs00592-005-0177-z.

Meneilly GS, Tessier D (2001). Diabetes in elderly adults. J Gerontol A Biol Sci Med Sci. 56(1): M5-13. https://doi.-org/10.1093/gerona/56.1.m5.

Nadyah A. dkk., 2013. Gambaran faktor resiko pasien diabetes tipe II di Poliklinik Endokrin Bagian (Overview of risk factors for type II diabetes patients at the Endocrine Polyclinic Section)/SMF FK UNSRAT RSU Dr. R.D. Kandou Manado periode Mei 2011 Oktober 2011. Jurnal e-Biomedik (eBM). 1(1): 45-9.

Perkeni (2015). konsensus pengelolaan dan pencegahan diabetes melitus tipe 2 di indonesia (consensus on the management and prevention of type 2 diabetes mellitus in Indonesia). Jakarta.

Seibel, John. 2009. Strength training and diabetes. Retrieved from: http://diabetes.webmd.com/strength-training-diabetes.

Sepriana, Rosalia. 2012. Prevalensi dan determinan diabetes mellitus di Poli Lansia Puskesmas Kecamatan Jatinegara Jakarta Timur. Skripsi. FKM UI. Depok.

Sirait AM, Sulistiowati E, Sihombing M, Kusuma A, Idayani S (2015). Insiden dan faktor risiko diabetes melitus pada orang dewasa di Kota Bogor (Incidence and risk factors of diabetes mellitus in adults in Bogor). Buletin Penelitian Sistem Kesehatan. 18(2): 151–160. http://ejournal.litbang.kemkes.go.id/index.php/hsr/article/download/4315/3993.

Scott RA, Langenberg C, Sharp SJ, Franks PW, Rolandsson O, Drogan D, van der Schouw YT, et al. (2013). The link between family history and risk of risk of type 2 diabetes is not explained by antrhropometric, Lifestyle or Genetic Risk Factors: The EPIC-InterAct Study. Diabetologia. 56(1): 60-9. https://doi.org/10.1007/s00125-012-2715-x.

Trisnawati S, Widarsa T, Suastika K (2013). Faktor risiko diabetes mellitus tipe 2 pasien rawat jalan di Puskesmas Wilayah Kecamatan Denpasar Selatan. Public Health and Preventive Medicine Archive. 1(1). https://media.-neliti.com/media/publications/21527-ID-faktor-risiko-diabetes-mellitus-tipe-2-pasien-rawat-jalan-di-puskes-mas-wilayah-k.pdf

WHO (2016). Diabetes fakta dan angka (Diabetes facts and figures). Retrieved from http://www.searo.who.int/indonesia/topics/8-whd2016-diabetes-facts-and-numbers-indonesian.pdf.

Yancy WS (2005). A low-carbohydrate, katogenic diet to treat type 2 diabetes. Nutr Metab (Lond). 2005; 2: 34. https://dx.doi.org/10.1186%2F1743-7075-2-34.