DETERMINANT FACTORS THAT INFLUENCE THE OCCURRING OF TYPE 2 DIABETES MELLITUS IN WOMEN AGE 45 – 69 YEARS

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Abstract

Background : Type 2 diabetes mellitus, as a type of non-communicable disease whose prevalence continues to increase every year, specifically threatens the elderly group. The aging process results in a decrease in insulin function in the body, which in turn can interfere with the regulation of blood sugar levels. This is the main trigger factor for the occurrence of type 2 diabetes mellitus in the elderly. Apart from that, decreased physical activity, unbalanced nutritional status, family history of diabetes, and inappropriate nutritional consumption patterns also play a role as risk factors that support the development of this condition. **Methods** : This study used a case control research design with a sample size of 70 women aged 45 – 69 years at the Bp Ashabul Kahfi 60 clinic, Surabaya City with a ratio of 1:1. The samples obtained used random sampling. The data that was obtained was analyzed using the chi-square statistical test, independent t test, and logistic regression according to the data obtained. **Results** The results of this study showed a relationship between age (p=0.042; OR=0.863; CI=0.748-0.995), family history (p=0.001; OR=230.7; CI=10.4-5113.7), and level of energy consumption (p=0.003; OR=12.7; CI=2.4-67.4) with type 2 diabetes mellitus in women. There was no relationship between BMI (p=0.128; OR=0.513; CI=0.217-1.2) and abdominal circumference (p=0.308; OR=3.2; CI=0.338-30.9) with type 2 diabetes mellitus in woman. **Conclusion** : respondents with a family history of type 2 diabetes mellitus, the elderly, and unbalanced energy consumption have a risk of developing type 2 diabetes mellitus. Therefore, respondents are expected to maintain their quality of life to reduce the risk of developing type 2 diabetes mellitus.

Keywords: Diabetes Mellitus, Women, Age, Energy Consumption Levels

1. Introduction

Diabetes Mellitus is a chronic condition in which the body fails to produce adequate amounts of insulin over a long period of time [29]. The incidence of diabetes continues to increase from year to year. Indonesia ranks fifth in the world in the number of diabetes sufferers with an estimated 19.5 million people or around 7.2% of the total population suffering from Type 2 Diabetes Mellitus (T2DM) [57]. Domestically, Surabaya stands out as the city with the highest prevalence rate of T2DM in East Java Province [9]. Apart from increasing global prevalence, shifts in lifestyle and eating patterns have also worsened the diabetes situation in Indonesia. Lack of physical activity and consumption of foods high in sugar and fat worsen this condition. In Surabaya, for example, urbanization and modernization have contributed to the increasing number of T2DM sufferers [9]. This phenomenon demands more effective health interventions to reduce the rate of increase in diabetes and improve the quality of life of sufferers [29].

According to the Surabaya Health Service report, in 2019 there were 94,076 cases of Type 2 Diabetes Mellitus (T2DM), which reached a prevalence of 105.48% [9]. T2DM is a chronic disease that cannot be completely cured, so sufferers need to focus on improving their quality of life through various prevention and management measures. These steps include regular exercise, medication therapy, and appropriate diet management to control blood sugar levels [9]. Such interventions are very important considering the serious

complications that diabetes can cause if not managed properly. Research conducted by Delfina identified seven main determinant factors that contribute to the occurrence of diabetes mellitus. These factors include nutritional status, age, family history of disease, diet, physical activity, and smoking habits. Poor nutritional status and an unbalanced diet can increase the risk of diabetes, while physical inactivity and smoking are also significant risk factors. Genetic factors such as a family history of diabetes also play an important role in the development of this disease [13].

Type 2 diabetes mellitus (T2DM) is the result of a complex interaction between environmental factors and genetic factors. According to Ali's research, around 20 to 80 percent of T2DM sufferers have family members with a history of the same disease. This suggests that genetic factors play a significant role in a person's risk of developing T2DM. In addition, the mother's health condition during pregnancy can also influence the child's risk of chronic diseases in the future. For example, babies born with low birth weight (LBW) have a higher risk of developing obesity and T2DM as adults [4]. This suggests that prevention and management of T2DM should begin during pregnancy and continue throughout the individual's life. Apart from hereditary factors, there are several other factors that influence nutritional status and the risk of T2DM. Factors such as gender, age, body weight, and physical activity level play an important role in determining a person's nutritional status. Nutritional status is often measured using the Body Mass Index (BMI), which provides an idea of whether a person is underweight, normal or overweight. A high BMI indicates a greater risk of various health problems, including T2DM. Therefore, monitoring and managing BMI through a healthy diet and adequate physical activity is an important strategy in preventing and controlling T2DM [4]. Family-based interventions that consider multiple risk factors may help reduce the prevalence of T2DM and improve the quality of life of at-risk individuals.

According to the standards set by WHO for the Asia Pacific region, Body Mass Index (BMI) is categorized as follows: less than 18.5 for underweight, 18.5 to 22.9 for normal weight, 23 to 24.9 for overweight, and 25 or more for obesity. Obesity, especially central obesity, is a major risk factor for cardiovascular disease, hypertension and diabetes. More than 90% of diabetes patients have a BMI of 25 or more, indicating obesity [10]. This is caused by excess fat which can interfere with the normal function of organs, one of which is causing insulin resistance, a condition where the body cannot use insulin effectively [32]. This insulin resistance is the main pathway that leads to the development of Type 2 Diabetes Mellitus (T2DM). Obesity and insulin resistance are closely related in the pathophysiological mechanisms of T2DM. Excessive body fat, especially in the abdominal area, can cause various metabolic changes that have a negative impact on health. Visceral fat, or fat that surrounds internal organs, contributes to chronic inflammation and increased levels of free fatty acids in the blood, which in turn interferes with insulin signaling and reduces insulin sensitivity [32]. Weight management through a balanced diet and sufficient physical activity is very important in preventing and controlling T2DM, considering the large impact of obesity on the development of the disease [10]. This strategy not only helps reduce the prevalence of T2DM but also improves cardiovascular health and reduces the risk of hypertension.

Long-term use of cigarettes can cause insulin resistance, a condition in which the body cannot use insulin effectively. This occurs because the nicotine in cigarettes can damage pancreatic beta cells, thereby reducing the body's ability to produce sufficient insulin [24]. As a result, blood sugar levels increase and increase the risk of developing Type 2 Diabetes Mellitus (T2DM). Indonesia occupies the third position in the world with the highest prevalence of smoking, where around 28.26% of the population aged over 15 years are tobacco smokers [28]. This data shows the widespread negative impacts of smoking on public health, including increasing the risk of chronic diseases such as diabetes. In Surabaya, the smoking problem is also very significant. According to the Central Statistics Agency, around 21.28% of the population aged over 15 years are active smokers. The smoking habit among the people of Surabaya contributes to the high prevalence of diabetes in the city. Dangerous substances in cigarettes, such as tar, nicotine and benzene, apart from increasing the risk of diabetes, also trigger various other chronic diseases [55]. Prevention and control of smoking habits should be a priority in public health programs to reduce the burden of chronic diseases caused by smoking.

Type 2 diabetes mellitus (T2DM) can cause various serious complications that greatly affect the sufferer's quality of life. Common complications include hyperglycemia (high blood sugar levels) and hypoglycemia (low blood sugar levels), as well as dangerous conditions such as diabetic ketoacidosis, which occurs due to a buildup of ketones in the blood. In addition, chronic complications such as diabetic nephropathy (kidney damage),

diabetic neuropathy (nerve damage), and diabetic retinopathy (eye damage) can develop. Peripheral artery disease is also common in people with T2DM, resulting in reduced blood flow to the limbs, which can lead to wounds that are difficult to heal and even amputation. All of these complications significantly reduce the quality of life of individuals with T2DM. Research is needed to identify the main factors that cause T2DM, especially in women aged 45 to 69 years. This age group is at high risk for developing T2DM and its accompanying complications. The main aim of this study is to analyze various determinant factors that influence the occurrence of T2DM in this group. By knowing which factors are most influential, public health efforts can be focused on reducing the prevalence of T2DM and improving the quality of life of women who are at risk of or already suffering from this disease.

2. Method

This research is an analytical observational study that uses a case control design. This design aims to compare two groups: the case group and the control group. In the context of this research, a case control design will be used to evaluate the relationship between certain risk factors (independent variables) and the incidence of Type 2 Diabetes Mellitus (T2DM) in the case group. This study allows researchers to identify how much certain risk factors contribute to the development of the disease by comparing the characteristics of individuals in the two groups. The case group consisted of women aged 45 to 69 years who were diagnosed with T2DM, while the control group consisted of women in the same age range but did not suffer from T2DM. By comparing these two groups, the research aims to understand and analyze the factors that play a role as the main cause of T2DM in women in this age range. This analysis is important for identifying the main determinants that contribute to the risk of T2DM. It is hoped that this research will provide deeper insight into the prevention and management of T2DM, as well as help formulate more effective intervention strategies for women in this at-risk age group.

This study aims to explore the factors that contribute to the incidence of Type 2 Diabetes Mellitus (T2DM) in women aged 45 to 69 years who are undergoing treatment at the Ashabul Kafhi 60 Clinic. T2DM is a chronic disease whose prevalence increases with age and lifestyle. modern. This study focused on this group because they have a higher risk of serious complications associated with T2DM, such as kidney disorders, neuropathy, and heart disease [5]. The study population consisted of women who had been diagnosed with T2DM as the case group, while the control group consisted of women with good general health and no history of diabetes. Strict inclusion and exclusion criteria were applied to ensure homogeneity and validity of the data. The sample size for this study was calculated using the Kuntoro formula which resulted in a total of 70 respondents, with each group having 35 samples. A balanced comparison between these two groups was chosen so that a comprehensive analysis could be carried out on factors that may play a role in the development of T2DM in the population studied.

The sampling method in this study used a simple random sampling approach, where each individual who met the inclusion criteria in both the control group and the case group was randomly selected to become the sample. This approach was chosen to ensure that all members of the population have an equal opportunity to be included in this study, thereby reducing the potential for bias in respondent selection . Sampling was carried out during the period March to April 2024, useful for researchers to collect representative data from both groups as a whole. This research will be carried out in two different locations for each group. The case group will be studied at the Ashabul Kafhi 60 Clinic, located on Jl. Merbabu, Blk. A Jl. Raya Kepuh Permai No.5, Kepuhwisata, Kec. Waru, Sidoarjo Regency, East Java. Meanwhile, the control group will come from the Tenggilis Mejoyo Health Center, which is also located in the same area, to ensure uniformity in the data collection process. The research period will begin in December 2023 from the initial stages of proposal preparation and ethical approval, with data collection carried out from March to April 2024. This specified time approach is designed to ensure that all aspects of the research can be carried out systematically and meet the required scientific standards .

In this research, the data collection technique used involves the use of primary and secondary data using interview methods and filling out questionnaires. Primary data includes direct information from respondents such as name (initials), age, occupation, education, time since being diagnosed with Type 2 Diabetes Mellitus

(T2DM), weight, height, physical activity, level of nutritional consumption, family history of T2DM, and circumference. stomach. Meanwhile, secondary data includes information from medical records or databases regarding the number of women aged 45–69 years with a diagnosis of T2DM at the Ashabul Kafhi 60 Clinic. From the data collected, this research will use seven independent variables to analyze their relationship with the dependent variable. These independent variables include the respondent's age, Body Mass Index (BMI), physical activity, level of nutritional consumption, family history of T2DM, and abdominal circumference. This variable was chosen because it has the potential to influence the incidence of T2DM in the population of women aged 45–69 years who are the focus of this study. It is hoped that this comprehensive data collection approach will provide a clear and accurate picture of the risk factors involved in the development of T2DM in this population group.

The data collection instrument in this study was designed with the aim of obtaining in-depth information regarding the characteristics of respondents and factors that have the potential to influence the incidence of Type 2 Diabetes Mellitus (T2DM). Respondent characteristic data includes identity such as initials, age, highest level of education, occupation, family history of T2DM, and time since diagnosis of T2DM. This information is needed to build a comprehensive profile about each respondent involved in this study, thereby allowing researchers to explore the relationship between these characteristics and the prevalence of T2DM in the population of women aged 45-69 years. The use of questionnaires such as the International Physical Activity Questionnaire (IPAQ) and Food Recall 24H provides very important data in risk factor analysis. IPAQ was used to measure respondents' physical activity levels, while Food Recall 24H was used to record their daily consumption patterns. The combination of these two questionnaires provides a deeper understanding of the respondent's lifestyle, which is a key factor in the development of T2DM (IPAQ, 2021). In addition, digital body scales were also used to measure respondents' weight accurately, which is important for obtaining precise anthropometric data. By using these instruments comprehensively, research is expected to make a significant contribution to understanding the risk factors influencing T2DM in the population studied, as well as supporting more effective disease prevention and management efforts.

3. Results

The health clinic used in this research is located on the border between Surabaya City and Sidoarjo Regency, precisely in Gunung Anyar District. BP Ashabul Kahfi 60 Clinic is a private health facility that has collaborated with BPJS Health, so that it is the main choice for local residents to receive treatment and primary health services as well as referrals. This clinic operates every day from 08.00 to 16.00 and is equipped with health workers consisting of 2 general practitioners, 1 dentist, 6 doctor's assistants, and 1 admin, who together provide medical services to patients.

Table 1. Age Distribution of Respondents

Age	Diabetic		Non – Diabetes	
	Amount	Percent	Amount	Percent
45 – 49	7	20	17	48.6
50 – 54	6	17.14	9	25.7
55 – 59	7	20	2	5.7
60 – 64	8	22.86	2	5.7
65 – 69	7	20	5	14.3
Total	35	100	35	100

Table 1 shows the age distribution of respondents based on diabetes status. The majority of respondents in the diabetes group were aged 45-49 years (20%), followed by the age group 60-64 years (22.86%). Meanwhile,

in the non-diabetic group, the majority were aged 45-49 years (48.6%) and 50-54 years (25.7%). This analysis shows that the diabetes group tends to have a higher proportion of people aged 60 years and over than the non-diabetes group.

Table 2. Distribution of Respondents' Last Education

Education	Diabetes		Non - Diabetes	
	Amount	Percent	Amount	Percent
elementary school	3	8.6	5	14.3
junior high school	6	17.1	4	11.4
senior high school	19	54.3	13	37.1
D3	1	2.9	1	2.9
D4 & S1	6	17.1	11	31.4
S2 & S3	-	-	1	2.9
Amount	35	100	35	100

Table 2 depicts the distribution of respondents' latest education in the context of diabetes. The majority of respondents with diabetes had a high school educational background (54.3%), while the majority of non-diabetic respondents had a high school education (37.1%) and D4/S1 (31.4%). This difference shows that respondents with diabetes tend to have a lower level of education compared to non-diabetic respondents in this study.

Table 3. Distribution of Respondents' Occupations

Job	Diabetes		Non - Diabetes	
	Amount	Percent	Amount	Percent
IRT	23	65.7	18	51.4
Civil servants / Teacher	1	2.9	5	14.3
Private	5	14.3	11	31.4
Business	6	17.1	1	2.9
Amount	35	100	35	100

Table 3 shows the distribution of respondents' occupations based on diabetes status. The majority of respondents with diabetes were housewives (65.7%), while the majority of non-diabetic respondents were housewives (51.4%) and private sector (31.4%). This indicates that work as housewives tends to be dominant among the two groups, although the proportion of respondents with diabetes who work as housewives is slightly higher than non-diabetics.

Table 4. Respondents' Body Weight Distribution

Weight (kg)	Diabetes	Non – Diabetes
Mean ± elementary school	67.64 ± 10.17	55.86 ± 12.01
Median	65	52.5
Maximum	96	87
Minimum	49	40

Table 4 provides information about the distribution of respondents' body weight based on diabetes status. The average weight of respondents with diabetes was 67.64 kg, while non-diabetes was 55.86 kg. The median body weight for diabetes is 65 kg, while non-diabetes is 52.5 kg. This difference shows that respondents with diabetes tend to have a higher body weight compared to those without diabetes in this study.

Table 5. Distribution of Respondents' Height

Height (cm)	Diabetes	Non – Diabetes
Mean ± elementary school	156.6 ± 3.19	154.3 ± 5.12
Median	156	155
Maximum	165	162
Minimum	150	139

Table 5 shows the distribution of respondents' height based on diabetes status. The average height of respondents with diabetes was 156.6 cm, while non-diabetes was 154.3 cm. Median height for both groups was 156 cm for diabetes and 155 cm for non-diabetes. This difference shows that there is no significant difference in height between the two groups of respondents.

Table 6. Bivariate Analysis of Respondent Age

Age	Diabetes Mean ± Elementary school	Non-DiabeticMean ± elementary school	*p value*
	57.60 ± 7,897	52.37 ± 7,742	0.007*

Table 6 depicts the results of bivariate analysis between age and diabetes status. The average age of respondents with diabetes (57.60 years) was higher than that of non-diabetes (52.37 years), with a significant difference (p = 0.007). These results indicate that age plays an important role in the incidence of diabetes in the female population aged 45-69 years in this study.

Table 7. Bivariate Analysis of Respondents' BMI

BMI	Diabetic		Non – Diabetes		Total	*p value*
	Amount	Percent	Amount	Percent		
Normal	4	11.4	18	51.4	22	0.04*
Overweight	7	20	5	14.3	12	
Obesity I	14	40	7	20	21	
Obesity II	10	28.6	5	14.3	15	
Mean	27.5		23.4		70	

Table 7 shows the results of bivariate analysis between Body Mass Index (BMI) and diabetes status. The proportion of respondents with diabetes in the obesity category (Obesity I and Obesity II) was higher compared to non-diabetes, although it was not statistically significant for the Overweight and Obesity II categories. Results with a p-value of 0.04 show a significant relationship between BMI and the incidence of diabetes, indicating that obesity increases the risk of diabetes in female respondents aged 45-69 years.

Table 8. Bivariate Analysis of Respondents' Family History

History of Family	Diabetes		Non – Diabetes		Total	*p value*
	Amount	Percent	Amount	Percent		
Yes	29	82.9	9	12.9	38	0,000*
No	6	17.1	26	37.1	32	
Total	35	100	35	35	100	

Table 8 shows the results of bivariate analysis between family history and diabetes status. There were significant differences in family history between the diabetes and non-diabetes groups, with the proportion of family history of diabetes being higher in the diabetes group (82.9%) than in the non-diabetes group (12.9%). These results indicate that family history has a significant relationship with the incidence of diabetes in female respondents aged 45-69 years in this study.

Table 9. Bivariate Analysis of Respondents' Physical Activity

Physical Activities	Diabetes		Non – Diabetes		Total	*p value*
	Amount	Percent	Amount	Percent		
Low	7	20	1	2.9	8	0.078*
Sedentary	16	45.7	20	57.1	36	
High	12	34.3	14	40	26	
Mean	2022,1		2702.8		70	

Table 9 depicts the results of bivariate analysis between physical activity and diabetes status. Although there was no significant relationship between physical activity and the incidence of diabetes (p = 0.078), attention needs to be paid to the fact that the diabetes group tended to have a higher proportion of sedentary physical activity (45.7%) compared to the non-diabetes group (57, 1%). This suggests that inactive physical activity patterns may influence the risk of developing diabetes in the population studied.

Table 10. Bivariate Analysis of Respondents' Abdominal Circumference

Abdominal Circumference	*Diabetes*		Non – Diabetes		Total	*p value*
	Amount	Percent	Amount	Percent		
Central Obesity	27	77.1	13	37.1	40	0.001*
Non – Central Obesity	8	22.9	22	62.9	30	
Mean	88.9		79.3		70	

Table 10 shows the results of bivariate analysis between abdominal circumference and diabetes status. There was a significant relationship between central obesity (p = 0.001) and the incidence of diabetes, with a higher proportion of central obesity in the diabetes group (77.1%) compared to the non-diabetes group (37.1%). These results indicate that central obesity may be an important risk factor in developing diabetes in female respondents aged 45-69 years.

Table 11. Bivariate Analysis of Respondents' Energy Consumption

Energy Consumption	Diabetes		Non – Diabetes		Total	*p value*
	Amount	Percent	Amount	Percent		
Heavy Deficit	21	60	4	11.4	25	
Light Deficit	9	25.7	8	22.9	17	0,000*
Enough	5	14.3	23	65.7	28	
Total	35	100	35	100	70	

Table 11 shows the results of bivariate analysis between energy consumption and diabetes status. There is a significant relationship between energy consumption (p = 0.000) and the incidence of diabetes. Respondents with diabetes tend to have a severe deficit in energy consumption (60%) compared to non-diabetes (11.4%). This shows that unbalanced energy consumption patterns can increase the risk of diabetes in the population studied.

Table 12. Bivariate Analysis of Respondents' Protein Consumption

Protein Consumption	Diabetes		Non – Diabetes		Total	*p value*
	Amount	Percent	Amount	Percent		
Heavy Deficit	21	60	12	34.3	33	
Light Deficit	6	17.1	8	22.9	14	0.088*
Enough	8	22.9	15	42.9	23	
Total	35	100	35	100	70	

Table 12 depicts the results of bivariate analysis between protein consumption and diabetes status. Although not statistically significant (p = 0.088), there was a tendency that respondents with diabetes tended to have a severe deficit in protein consumption (60%) compared to non-diabetics (34.3%). This indicates that insufficient protein intake can influence the risk of developing diabetes, although this difference did not reach the expected level of significance in this study.

Table 13. Bivariate Analysis of Respondents' Fat Consumption

Fat Consumption	Diabetes		Non - Diabetes		Total	*p value*
	Amount	Percent	Amount	Percent		
Heavy Deficit	11	31.4	5	14.3	16	0.149*
Light Deficit	13	37.1	11	31.4	24	
Enough	7	20	15	42.9	22	
Total	4	11.4	4	11.4	8	

Table 13 shows the results of bivariate analysis between fat consumption and diabetes status. Although not statistically significant (p = 0.149), there was a tendency that respondents with diabetes tended to have a greater deficit in fat consumption (31.4%) compared to non-diabetics (14.3%). This suggests that unbalanced fat consumption patterns may have implications for diabetes risk, although this difference was not significant in this study.

Table 14. Bivariate Analysis of Respondents' Carbohydrate Consumption

Carbohydrate Consumption	Diabetes		Non – Diabetes		Total	*p value*
	Amount	Percent	Amount	Percent		
Heavy Deficit	25	71.4	13	37.1	39	0,000*
Light Deficit	10	28.6	8	22.9	18	
Enough	-	-	14	40	14	
Total	35	100	35	100	70	

Table 14 depicts the results of bivariate analysis between carbohydrate consumption and diabetes status. There is a significant relationship between carbohydrate consumption (p = 0.000) and the incidence of diabetes. The majority of respondents with diabetes had a severe deficit in carbohydrate consumption (71.4%) compared to non-diabetics (37.1%). These results indicate that an unbalanced carbohydrate consumption pattern can increase the risk of diabetes in the population studied.

Table 15. Multivariate Analysis

Variable	*p value*	OR	CI (95%)	
			Lower	Upper
Age	0.114	0.885	0.761	1,030
BMI	0.132	0.497	0.183	1,249
Family History	0.002	121,301	5,963	2467,6
Abdominal Circumference	0.603	1,913	0.166	22,052
Energy Consumption	0.003	15,712	2,498	98,828
Carbohidrate Consumption	0,167	3,617	0,585	22,386

Table 15 provides the results of a multivariate analysis which includes several variables on the incidence of diabetes. Significant variables included family history (p = 0.001) and energy consumption (p = 0.003). These results indicate that these factors have a strong influence on the incidence of diabetes in female respondents aged 45-69 years in this study. Other variables such as Age, BMI, carbohydrate consumption, and abdominal circumference, although not statistically significant, showed relevant trends in the context of diabetes risk.

4. Discussion

This research was carried out at BP Ashabul Kahfi 60, a private clinic located in the city of Surabaya. A total of 70 respondents were sampled in this study, divided into 35 respondents in the case group and 35 respondents in the control group. The respondents of this study were women aged 45-69 years, with the majority being in the 45-49 year age range. In terms of education, the majority of respondents from both groups were high school graduates. The most common job among respondents was as a housewife (IRT), both in the case and control groups. This demographic profile provides a complete picture of the characteristics of the respondents in this study, including age distribution, educational background and dominant type of work. The selection of BP Ashabul Kahfi 60 as the research location ensures a diverse and representative sample of the local community who access health services at the clinic. The results of this study can provide insight into the factors that contribute to Type 2 Diabetes Mellitus in the population group studied, as well as support the development of more effective intervention strategies in the future.

Based on the results of this study, it was found that the age distribution of Type 2 Diabetes Mellitus (T2DM) sufferers showed a different pattern between the case group and the control group. The control group had a younger average age, namely 52.37 years, with the largest group aged 45-49 years dominating. On the other hand, the case group has an older average age, reaching 57.60 years, with the dominant age ranging between 60-64 years. Bivariate analysis showed statistical significance with a p value of 0.007, indicating a significant relationship between age and the incidence of T2DM in women. Type 2 Diabetes Mellitus is a disease related to metabolic disorders, where the body experiences an inability to produce insulin adequately, which can result in increased blood glucose levels. Age is one of the main risk factors for T2DM. With increasing age, there is a decrease in optimal insulin function in the body, which contributes to an increased risk of diabetes through increased insulin resistance or decreased insulin secretion [22]. This finding is consistent with previous research which showed a significant relationship between age and the incidence of T2DM, as reported by Susilawati with a p value = 0.000 and OR = 18.1. Likewise, another study by Kekenusa et al (2018) also confirmed that age plays an important role in the risk of developing T2DM with a p value = 0.000 and OR = 2.6 [50]. Thus, increasing age plays a crucial role in increasing a person's risk of developing Type 2 Diabetes Mellitus.

Based on the results of this research, the group of cases that were Type 2 Diabetes Mellitus (T2DM) sufferers were dominated by respondents with a Body Mass Index (BMI) above 25, totaling 24 people. The average BMI in this group reached 27.5, falling into the obesity category. Meanwhile, the control group who did not suffer from diabetes was dominated by respondents with a BMI between 16.5 and 22.9, which was in the normal category, with a total of 18 people. The average BMI in the control group was 23.4, also included in the normal category. Analysis using the chi-square test showed a significance value of p=0.04, indicating a significant relationship between BMI and the incidence of T2DM in women. These findings are consistent with the results of research conducted by Adnan et al. [3] which shows that BMI has a significant relationship with the incidence of T2DM with a p value = 0.000. Adnan et al. [3] also stated that the higher a person's BMI, the higher the possibility of increasing blood sugar levels, which is the main characteristic of diabetes mellitus. The theory explained by D'adamo (2008) adds to the understanding that individuals who are overweight tend to have high levels of leptin in the body. Leptin is a hormone that regulates fat metabolism and plays a role in regulating satiety. However, resistance to leptin can inhibit the glucose uptake process, which ultimately increases blood sugar levels (D'adamo, 2008). Thus, a high BMI may be a significant risk factor in the development of Type 2 Diabetes Mellitus.

In this study, it was found that the case group suffering from Type 2 Diabetes Mellitus (T2DM) tended to have a history of T2DM in family members compared to the control group. A total of 29 of 35 case respondents (82.9%) reported a history of T2DM in their family, while only 9 of 35 control respondents (25.7%) had a similar history. The results of bivariate analysis using the chi-square test showed a significance value of p=0.000, indicating that there was a very significant relationship between the history of T2DM in the family and the incidence of T2DM in the respondents. This finding is in line with the results of research by Scott et al. which showed that individuals with a history of diabetes in the first degree family had a higher risk of developing T2DM (HR: 2.72, 95% CI: 2.48-2.99). This risk increases if there are two or more family members who suffer

from diabetes (Scott et al.). Another study conducted by Rediningsih and Lestari [40] also confirmed the existence of a significant relationship between family history and the incidence of T2DM with a value of p=0.001 and an odds ratio (OR) of 11.1. This suggests that genetic factors from family members who suffer from diabetes play an important role in increasing the risk of developing T2DM. Type 2 Diabetes Mellitus can be influenced by genetic factors inherited from the family and unhealthy living behavior. Inheriting the diabetes gene through the mother during pregnancy carries a higher risk, with an increased risk of 10-30%. Thus, understanding family history is key in identifying an individual's risk for developing T2DM, as well as the importance of preventing and managing this condition through healthy lifestyle changes and appropriate medical treatment.

The case group (diabetics) and the control group (non-diabetes) tend to have low levels of physical activity, with an average MET (Metabolic Equivalent of Task) indicating the sedentary physical activity category. The case group had an average of 2022.1 METs of physical activity, while the control group had an average of 2702.8 METs. Although there was a small difference in the average MET between the two groups, the results of the chi-square test showed that there was no significant relationship between physical activity and the incidence of Type 2 Diabetes Mellitus (T2DM) in women (p=0.078). In general, physical activity has an important role in controlling the body's metabolism and blood sugar levels. Research has shown that light physical activity such as walking, cycling, jogging and gymnastics can help regulate blood sugar and reduce the risk of developing diabetes. [47]. Another study conducted by Rahmawati [50] showed that T2DM sufferers who did aerobic exercise experienced a decrease in blood sugar levels of up to 8.5%. However, in the context of this research, no direct relationship was found between low levels of physical activity and the incidence of T2DM in respondents. Higher physical activity can be a potential protective factor against the risk of diabetes, but it needs to be studied further in further research to understand in depth its relationship with the incidence of T2DM in the female population aged 45-69 years.

Based on the results of this study, the group of cases consisting of women with type 2 diabetes mellitus (T2DM) was dominated by respondents who had central obesity, namely 27 people. This is in line with the average abdominal circumference of the case group which reached 88.9 cm, which is included in the central obesity category. On the other hand, the control group who did not suffer from T2DM was dominated by respondents who did not have central obesity, namely 22 people with an average abdominal circumference of 79.3 cm, who were included in the category of not being centrally obese. The results of analysis using the chi-square test showed a p-value of 0.001, indicating a significant relationship between abdominal circumference and the incidence of T2DM in women. This finding is consistent with previous research by Aswad, Sriwahyuni, and Irmayani (2022) which also showed a significant relationship between abdominal circumference and the incidence of T2DM (p=0.008). The study also confirmed that individuals with central obesity have a 3.826 times higher risk of developing diabetes compared to individuals who do not experience central obesity. Another study conducted by Gresty M. (2018) also indicated that the average respondent with T2DM had an abdominal circumference of more than 80 cm, which shows that central obesity plays an important role as a risk factor in the development of T2DM. Central obesity causes fat accumulation in the abdominal area which is associated with insulin resistance, which in turn can increase blood glucose levels in the body. These findings demonstrate the importance of measuring abdominal circumference as an indicator of central obesity in the risk assessment for T2DM in the female population, which could be the basis for better prevention and management strategies for this disease.

Based on the results of this study, it appears that women who suffer from type 2 diabetes mellitus (T2DM) tend to experience energy consumption deficits when compared to women who do not suffer from T2DM. Bivariate analysis with the chi-square test showed a significance value of 0.000, confirming the existence of a significant relationship between energy consumption and the incidence of T2DM in women. This finding is consistent with previous research by Amirah, Sumiaty, and Andayanie [6] which also showed a relationship between energy consumption and the incidence of T2DM (p=0.00). However, the results of this study show substantial differences in that women with T2DM in this study experienced energy consumption deficits, in contrast to previous studies which showed a tendency for excessive energy intake in case respondents. Similar results were also seen in the level of carbohydrate consumption, where women with T2DM tended to experience

a carbohydrate deficit compared to those without T2DM, and this relationship was significant with a value of p=0.00. This finding is in line with previous research which also showed a significant relationship between the level of carbohydrate consumption and the incidence of T2DM (p=0.000). However, there are significant differences in the substance of the research results where women with T2DM in this study showed a tendency for lower carbohydrate intake compared to previous studies which showed a tendency for higher carbohydrate intake in case respondents.

Meanwhile, at the level of fat and protein consumption, this research shows that the majority of women with T2DM experience a deficit in fat and protein intake compared to women who do not suffer from T2DM. However, the significance values obtained for protein intake (0.088) and fat (0.149) indicate that there is no significant relationship between these two variables and the incidence of T2DM in this sample. These results are consistent with previous research by Paruntu (2012) which showed that the level of protein consumption was not related to the incidence of T2DM (p=0.842), as well as research by Cahyani and Sulandjari [11] which showed that the level of fat consumption did not have a significant relationship (p =0.914) with the majority of T2DM respondents experiencing a deficit in fat consumption. This difference in results is caused by the "fear of food" phenomenon among respondents with T2DM, where they tend to adjust their diet to avoid significant spikes in blood sugar. Guidelines from PERKENI (2021) emphasize the importance of a regular eating pattern (3J: amount, schedule, type) for diabetes sufferers to keep blood glucose levels stable. A proper balance of macronutrients is necessary to maintain normal body metabolism, and this imbalance in the long term can increase the risk of developing non-communicable diseases such as diabetes mellitus [21].

Based on the results of multivariate analysis in this study, several variables showed a significant relationship with the incidence of type 2 diabetes mellitus (T2DM) in women. First, the family history variable shows a significant relationship with the incidence of T2DM with a significance value of 0.001 and an OR of 230.776. This indicates that if there is a history of T2DM in the family, the risk of developing T2DM in that individual increases up to 121 times compared to those who do not have a history of T2DM in the family. Energy consumption was also proven to have a significant relationship with the incidence of T2DM with a significance value of 0.003 and an OR of 12.739. This shows that an imbalance in energy consumption can increase the risk of developing T2DM by 15 times compared to those who have sufficient energy consumption. These results underscore the importance of these factors in influencing the risk of developing type 2 diabetes mellitus in women, with the implication that prevention and appropriate management of these variables can potentially reduce the prevalence of T2DM in the population concerned. Emphasis on healthy lifestyles, weight management, and monitoring genetic risk factors can be important strategies in overcoming this problem.

5. Conclusion

Various characteristics of respondents and the relationship between risk factors and the incidence of type 2 diabetes mellitus (T2DM) in women aged 45-69 years can be described as follows. In general, the majority of respondents in this study were aged 45-49 years, indicating that this age is dominant in the study population. The majority of respondents' last education was high school, and the majority of them were housewives (IRT), reflecting the general socio-economic pattern in the research area. The results of statistical analysis show that there is a significant relationship between several factors and the incidence of T2DM in the female population aged 45-69 years. For example, body mass index (BMI) and abdominal circumference have a significant relationship with T2DM, with the p-value indicating a strong correlation between central obesity and diabetes risk. In addition, a family history of T2DM also plays an important role in increasing an individual's risk of this condition, indicating the influence of genetic factors in the pathogenesis of the disease. However, several other factors such as physical activity, protein consumption, and fat consumption did not show a significant relationship with the incidence of T2DM in this study. Nevertheless, it is important to note that dietary management and physical activity remain important in the prevention and management of T2DM, although they did not show a direct association in this cohort. These conclusions support the importance of a holistic approach in the management of T2DM, which includes genetic factors, lifestyle, and weight management to reduce the prevalence and impact of this disease in the elderly population.

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