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Determinant of Metabolic Syndrome (Case Study Hypertension and Diabetes Mellitus Type II)

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Abstract

The Study aims to determinants of metabolic syndrome. Metabolic Syndrome (MetS) is a complex metabolic disorder caused by obesity, insulin resistance, diabetes mellitus, and hypertension. The aim of this study is determinants of metabolic syndrome. This is a cross-sectional study, with some samples consisting of 192 respondents. The sample collection technique was a non-probability sampling technique with purposive sampling. The sample used in this study were outpatients at the Health Center in Ternate City, who met the following criteria: outpatients with hypertension and type 2 diabetes mellitus, had metabolic syndrome and underwent examination blood sugar and fat profile laboratory. Data analysis using the Chi-square test and multiple logistic regression. The results obtained were that there was a significant relationship between metabolic syndrome with the length of time suffering from ρ value 0.000 <α (0.05), family history of disease ρ value 0.019 <α (0.05), physical activity ρ value 0.000 <α (0.05), dietary pattern ρ value 0.001 <α (0.05) and age ρ value 0.000 <α (0.05). There was no significant relationship between metabolic syndrome and smoking status ρ value 0.309> α (0.05). Family history of chronic disease, long-suffering from type 2 diabetes mellitus and hypertension, lack of physical activity, and poor diet are determinants of metabolic syndrome.

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Contents

1 Introduction

Metabolic Syndrome (SM) is a complex metabolic disorder caused by obesity, insulin resistance, diabetes mellitus, and hypertension. Diabetes Mellitus Diabetes Mellitus is a degenerative disease that is generally associated with genetic and environmental factors. The prevalence of diabetes mellitus among the world population continues to increase yearly (Masriadi et al., 2017; Masriadi, Irawati, et al., 2020). Hypertension is defined as persistent blood pressure where the systolic pressure is above 140 mmHg and diastolic over 90 mmHg. (Masriadi & Arif, 2018; Masriadi, 2016; Masriadi et al., 2018). One of the major risk factors of hypertension is stroke, heart failure, chronic kidney disease, and visual impairment, and hypertension is often called the silent killer. Hypertension is a condition when a person experiences a rise in blood pressure either slowly (Masriadi & Arifin, 2018; Masriadi, 2019; Musfirah, 2019; Drwis et al., 2020; Masriadi et al., 2020; Masriadi et al., 2021).

The burden of non-communicable diseases (NCDs) has caused a substantial impact on health systems and economies worldwide. NCDs cause a greater increase in morbidities and mortalities, reduced quality of life, and escalated healthcare expenditures to governments, particularly in low- and middle-income countries (LMICs). (Who, 2018; Solomon & Mulugeta, 2019). Coupled with these unprecedented consequences of NCDs, global public health systems are being challenged by the rise of metabolic syndrome (MetS) incidence (Manaf, 2021).

The global epidemic proportions of MetS were estimated to be around 20–25%. When compared across regions, it was estimated that 12–37% of the Asian population were afflicted with MetS, while around 12–26% of the European population suffered from the condition (Ranasinghe et al., 2017). The Joint Interim Statement (JIS) "Harmonized" criteria definition that was later adopted was found to be more suitable to determine the proportions of MetS in Asian populations (Iqbal et al., 2020). While literature to determine MetS in populations was burgeoning rapidly, the exploration of such investigations to occupational groups was limited (Yeh et al., 2018). Research in Indonesia regarding the prevalence of metabolic syndrome varies widely, it was found that out of 100 people, 29% met the WHO criteria and 31% met the ATP III criteria for suffering from metabolic syndrome (Zhang et al., 2019).

The prevalence increases with age, and it was found that the most common component of metabolic syndrome is central obesity. Cases of Metabolic Syndrome (Hypertension and Diabetes Mellitus Type 2) in North Maluku Haze, Indonesia continues to increase, namely 31.2% (2017), 37.9% (2018), and 42.3% (2019), 48.7 (2021) (Christijani, 2019). The cases are almost the same in Ternate City and even higher and continue to increase, namely 27.9% (2017), 30.6% (2018), and 45.5% (2019), 50.5 (2020) (Ternate City Health Office, 2021). Literature has identified a multitude of factors to be associated with MetS. Demographic characteristics such as being a woman or older age were shown to escalate the risk of having MetS, whereas lifestyle behaviours like physical activity, alcohol consumption, smoking, overweight, or obesity were commonly linked to MetS across different geographies and populations (Irawati et al.,2020).

Hypertension and Type 2 Diabetes Mellitus are considered the dominant factors for metabolic syndrome. In addition to these two determinants, unhealthy lifestyles such as smoking, unhealthy eating patterns, and lack of physical activity also have the potential to cause metabolic syndrome. The shift in lifestyle behaviour from cities to villages is marked by an increase in cases of degenerative diseases so that prevention efforts continue to be improved (Fidler, 2002; Marmot, 2005). They no longer want to process traditional food into

daily food because it is considered that the processing process takes a long time while they are already busy with their activities. Based on this background, researchers are interested in analyzing the causes of the increasing cases of metabolic syndrome.

2 Materials and Methods

The research design used was observational with a cross-sectional study design. The number samples consisted of 128 respondents with type 2 diabetes mellitus and 64 respondents with hypertension. The sample collection technique was a non-probability sampling technique with purposive sampling. The sample used in this study were outpatients at the Siko Public Health Center in Ternate City who met the following criteria: outpatients with hypertension and type 2 diabetes mellitus, had metabolic syndrome and underwent examination blood sugar and fat profile laboratory. Data analysis using the chi-square and multiple logistic regression test.

3 Results and Discussions

This research was carried out at the Health Public Center, Ternate City, North Maluku. The results of the study can be seen in Table 1. Table 1 shows that there is a significant relationship between the length of suffering from chronic disease, family history, physical activity, diet, and age (ρ value 0.000) with metabolic syndrome (hypertension and type 2 diabetes) while the smoking variable (ρ value 0.309) does not have a significant association with Metabolic Syndrome (Hypertension and type 2 DM). Multiple logistic regression analysis (multiple logistic regression) predictive models includes the selection of modelling candidates to determine the variables that make a major contribution to the incidence of metabolic syndrome (hypertension and type 2 diabetes).

Table 1
Determinants of metabolic syndrome

Variable	Metabolic syndrome				*P-value*
	Positive		Negative		
	Frequency	%	Frequency	%	
Long Suffering					
>6 Years	55	67.1	27	32.9	.001
1-5 Years	9	19.6	37	80.4	
Family History					
Yes	58	54.7	48	45.2	.001
Not	6	27.3	16	72.7	
Physical Activity					
Light	25	67.6	12	32.4	.001
Medium	28	58.3	20	41.7	
Weight	11	25.6	32	74.4	
Dietary habit					
Bad	44	63.8	25	36.2	.001
Good	20	33.9	39	66.1	
Smoking Status					
Not Smoker	53	48.2	57	51.8	.309
Smoker	11	61.1	7	38.9	
Age					

30-45	1	4. 2	23	95.8	.001
46-60	34	54.8	28	45.2	
>60	29	69.0	13	31.0	

Table 2 shows that the long-suffering variable ρ value 0.001, family history of chronic disease ρ value 0.105, physical activity ρ value 0.999 and diet ρ value 0.000, age ρ value 0.43 The results of the analysis show that there are 3 variables (long-suffering, diet, and age) with a value the significance is smaller than <0.25 so that the variables of the length of suffering, diet and age have a partial influence on the metabolic syndrome. Meanwhile, there are two variables (family history of chronic disease and physical activity) with a significant ρ value > 0.25 so that H0 is accepted, thus the variables of family history of chronic disease and physical activity have no significant effect on metabolic syndrome

Table 2
Multiple Logistic Regression Modelling

	B	Wald	Sig.	Exp(B)	95% CI	
					Lower	Upper
Long Suffering	-1.764	10.263	.001	.166	.055	.498
Family History of Chronic Disease	1.007	2.621	.105	2.736	.809	9.255
Physical Activity	.000	.000	.999	1.000	.492	2.033
Dietary habit	-1.657	12.451	.000	.191	.076	.479
Age	-.917	4.111	.043	.400		
Constant	8.155	11.636	.001	3.482E3		

The results of the analysis of the relationship between long-suffering from type 2 DM, long-suffering from hypertension, family history of chronic disease, physical activity, diet, smoking, and age. The criteria for metabolic syndrome in the study used the NCEP ATP III category where there must be at least 3 out of 5 criteria met to be able to determine someone positive for metabolic syndrome. The results showed that 67,1% of respondents suffered from metabolic syndrome.

Hypertension and type 2 DM with the age of 40-60 years had the highest percentage of metabolic syndrome. It shows that the age of 40-60 years is significantly associated with metabolic syndrome risk factors. In the study that most metabolic syndromes occurred at the age of 60-69 years, where most of the respondents at that age were no longer working or retired. This is in line with previous research which states that the prevalence of metabolic syndrome tends to increase with age. Then metabolic syndrome is more common in women. This study shows that female respondents are more at risk of suffering from metabolic syndrome than men (North Maluku Provincial Health Office, 2021).

The results showed a high percentage of metabolic syndrome in married respondents. Stated that marital status, at the time of retirement, overweight and obesity were significantly related to metabolic syndrome risk factors with an ρ value of 0.002. The type of work may be related to metabolic syndrome (Pal & Bhadada, 2020; Huang et al., 2020). A person's job can affect their level of physical activity, the incidence of metabolic syndrome in this study is more common in housewives (IRT).

Long-term changes in kidney function can result in further damage to existing nephrons. Sclerotic lesions form more and more so that it can lead to the obliteration of the glomerulus resulting in a further decline in renal function, and creating a vicious cycle that develops slowly that ends in terminal kidney disease (Hopps et al., 2010; Ritchie & Connell, 2007). If the patient has metabolic syndrome and cannot be treated appropriately, it will lead to terminal CKD within 5-10 years.

It is best illustrated by the fact that hypertension is a major component of metabolic syndrome (MS), a cluster of CV risk factors that include abdominal obesity, glucose intolerance or diabetes type 2, and dyslipidemia characterized by increased triglycerides and reduced HDL-cholesterol (Harrison et al., 2007; Gradman et al., 2010). The duration of hypertension is a risk factor for metabolic syndrome disease, long-term

uncontrolled hypertension can build complexity. In this study, it was also found that the duration of hypertension increased the risk of developing metabolic syndrome (Sigit et al., 2020; Trtica Majnaric et al., 2019).

The metabolic syndrome (hypertension and type 2 diabetes) with a family history of chronic disease so it can be said that there is a significant relationship between the metabolic syndrome (hypertension and type 2 diabetes mellitus) and a family history of chronic disease. This states that family history is one of the parameters incorporated in several genetic substances including peristome proliferators, CD3C adiponectin, Badrenergic receptors, insulin substrate receptors, Bdihydroxylated dehydrogenases, and adipocytokines.

That those with a family history of DM had a significant relationship with MetS and DM, and those with a family history of HTN had a positive relationship with HTN. Subjects with a family history of DM in the PBF quartile were associated with higher cardiometabolic events, and the combination of family history containing a family history of DM had a significant relationship with the risk of cardiometabolic disorders such as MetS, DM, and cardiovascular disease (Chaudhari & Patil, 2019)

Murningtyas et al (2020), show that there is a significant relationship with an OR value of 3.778, meaning that samples with a genetic history have a risk of 3.778 times the incidence of metabolic syndrome compared to samples without a genetic history. Most of the samples in this study had people or families who had diabetes mellitus, hypertension, and obesity. A history of diabetes mellitus in one or both parents not only has an impact on glucose disturbances but also has an impact on cardiometabolic such as central obesity, low HDL levels, and high blood pressure which are components of the metabolic syndrome. A history of hypertension in parents or siblings also has an impact on obesity, hypertension, and decreased HDL levels which are components of the metabolic syndrome (Chen et al., 2018).

It can be said that there is a significant relationship between metabolic syndrome (type 2 diabetes hypertension) and physical activity. Physical activity variables were categorized into 3, namely, light, moderate and heavy physical activity. Most of the respondents had relatively light physical activity. This is possible because more respondents are elderly so they are not too able to do strenuous sports/physical activities and spend more time resting or staying at home.

Listyandini et al (2020), state that there is a significant relationship between physical activity variables and metabolic syndrome. A sedentary lifestyle contributes to the obesity epidemic, physical exercise has many benefits for one's body. In people who do regular exercise insulin sensitivity will increase and the ability to regulate increases. But stopping physical activity can reduce insulin sensitivity, the muscles of a person who is trained have a better blood supply because blood glucose is obtained effectively. The liver becomes more efficient in producing glycogen and glucose in the blood. This study shows that the risk of metabolic syndrome increases with age and food intake, especially excessive carbohydrate intake is associated with the risk of metabolic syndrome, and low physical activity is associated with the risk of metabolic syndrome (Murningtyas et al., 2020)

It is known that the proportion of people who eat less fruit and vegetables aged 10 years or older is 93.6 percent. Some food intakes that are determinants of metabolic syndrome are saturated fatty acids, unsaturated fatty acids, fibre, and carbohydrates, and eating patterns with unbalanced and excessive menus such as foods high in protein, high in fat, and high in carbohydrates, especially pure carbohydrates accompanied by low fibre intake. affects lipoprotein levels, triglycerides, and cholesterol levels in the blood which results in increased cases of metabolic syndrome (Herman et al., 2022; Saraswatiet al., 2021).

Reduction of caloric intake and weight loss can significantly improve aspects of metabolic syndrome. These improvements can be made by reducing saturated fat intake to reduce insulin resistance, reducing salt intake to lower blood pressure, and reducing carbohydrate intake with a high glycemic index to lower blood glucose and triglyceride levels.

Wang et al. (2019), state that respondents who are less in terms servings of vegetables and fruits mostly experience metabolic syndrome. Likewise, respondents who do not eat vegetables and fruits every day, most of them have metabolic syndrome (Sembiring et al., 2022). This is related to the nutrients and non-nutritional substances contained in vegetables and fruits. The content of natural phytochemical compounds in vegetables and fruit, for example, acts as an anticancer, antimicrobial, antioxidant, anti-inflammatory, and antithrombotic substance (Listyandini et al., 2020).

The results of the analysis of the relationship between metabolic syndrome (hypertension and type 2 diabetes) with smoking status showed a p-value of 0.309 > (0.05) so it can be said that there is no significant

relationship. Based on the distribution of data by gender, most respondents are female, and none of the respondents smokes. States that there is no relationship between smoking and the incidence of metabolic syndrome, the content in cigarettes can cause a reduction in sensitivity and increase insulin resistance.

The risk of metabolic syndrome increases with age. Changes in body composition in old age have decreased muscle mass causing a decrease in the basal metabolic rate, namely a decrease in energy-burning power up to 10% every 10 years so that fewer calories are burned and cause an increase in body fat, a decrease in activity so that the risk of disease increases. All of these conditions are factors that trigger the occurrence of metabolic syndrome.

Bingo ballet et al (2018), stated that the results of multivariable logistic regression analysis showed that age 47-57 years aged 58 years and having FBS > 130mg/dl was found to have a significant relationship ρ value of 0.039 with MetS. That it can be said that there is no significant relationship with metabolic syndrome. This is because the number of respondents aged <60 years (35.9%) suffer from metabolic syndrome, supported by a poor diet (37.5%) and a family history of chronic diseases so that in adulthood the respondents have experienced metabolic syndrome (Wang et al., 2019).

The results of the multivariate test showed that the variables of length of stay, diet, and age had a partial influence on the metabolic syndrome, while the variables of family history of chronic disease and physical activity had no significant effect on the metabolic syndrome. Family history of chronic disease is also very risky OR 2,736 and physical activity is also very risky OR 1 time for metabolic syndrome.

In addition, with the increasing severity of hypertension, the prevalence of type 2 DM also increases. Diabetes and blood pressure are closely related diseases. There is a high incidence rate of these two diseases in the same patient. When this happens they are called “Comorbidities” there is a gradual increase in type 2 diabetics from normal BP (37.2%) to pre-HT (42.7%) in each category, From-HT jumps to (61.4%) in HT stage 1 and slightly increased to (63.5) in HT stage 2 these data confirm the fact that DM and HT are comorbidities.

More than 60% of subjects with a family history of MetS, had an abnormal lipid profile (high total cholesterol, high LDL levels, low HDL levels, high triglyceride levels), and subjects with a family history of MetS indicated higher insulin resistance. Central to this is a related family history of cardiovascular disease, diabetes, and hypertension in all study participants in Ghana. Mets are also a contributor in individuals with a family history of premature cardiovascular disease). Individuals who have a family history of diabetes mellitus have significantly greater waist circumference, waist circumference ratio, body mass index, and fasting blood glucose levels compared to individuals who do not have a family history of Diabetes Mellitus.

Tammelin et al. (2003), stated that obesity is usually documented as being associated with a poorer health-related quality of life (HRQOL) relationship, not only in the physical but also in the mental domain, this study shows that a higher number of MetS components accompanied by lower physical health scores were found in women but not in men. Physical activity may not be the most influential factor in Mets, or Mets may be influenced by many factors including diet, age, and genetics (Biadgo et al., 2018; Efendi et al., 2022; Amir & Munir, 2021).

The absence of a relationship between the level of physical activity can be caused because most of the subjects are in a low level of physical activity, and only a few subjects have a high level of physical activity, whereas according to Ekelund high physical activity plays an important role in the risk factors for SM. One study reported that adolescents' energy expenditure was lower when they watched television than when they rested.

States that physical activity tends to decrease in old age as a result of increasing obesity rates. As you get older, blood pressure tends to increase and increases again with overweight or obesity. Obesity, especially central obesity, is an independent predictor of an increased risk of DM, hypertension, ischemic heart disease, and dyslipidemia. From the results of this analysis, it is known that central obesity has a 2.5-fold risk for the occurrence of DM. Diabetes mellitus is a disease that has received worldwide attention because its incidence continues to increase

4 Conclusion

Family history of chronic disease, long-suffering from type 2 diabetes mellitus and hypertension, lack of physical activity, and poor diet are determinants of metabolic syndrome. It is necessary to eat and do aerobic

physical activity both in terms of frequency and duration with a duration of 40-60 minutes/item in preventing Metabolic Syndrome

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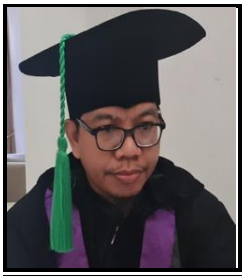
Biography of Authors



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