Basic Medical Laboratory Services as an Effort to Detect Metabolic Syndrome in Anduonohu Sub-District, Kendari City

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ABSTRACT

Metabolic syndrome is an accumulation of metabolic disorders that can increase the risk of cardiovascular-related diseases and type 2 diabetes mellitus. Metabolic syndrome is characterized by central obesity, hyperglycemia, hypertriglyceridemia, hypertension and decreased of HDL level. Community basically already knows each parameter separately but still rarely knows about the condition if these parameters occur together as metabolic syndrome. This study aimed to socialize as well as brought laboratory services closer to detect metabolic syndrome. This activity was carried out on 50 residents of the Anduonohu Village, Poasia District, Kendari City. Laboratory services performed include measurement of body mass index (BMI), waist circumference, blood pressure, blood glucose and blood cholesterol. Detection of metabolic syndrome using the definition of the International Diabetes Foundation 2009 by assessing the parameters of central obesity, blood pressure and glucose levels showed that 48% of the participants had metabolic syndrome

Keywords: Metabolic syndrome, central obesity, hyperglycemia, basic medical laboratory service

INTRODUCTION

Metabolic syndrome is a pathological condition that occurs due to the accumulation of several metabolic disorders in the body which together can increase the risk of degenerative diseases such as cardiovascular-related diseases, insulin resistance, diabetes mellitus and neurological complications. Establishment of metabolic syndrome criteria could be done using 3 definitions, among others, based on the 1990 World Health Organization consensus, the National Cholesterol Education Program - Adult Treatment Panel III (NCEP-ATP III) consensus of the International Diabetes Federation 2006. There were 5 criteria for metabolic syndrome including central obesity, hyper triglycerides or increasing of triglyceride levels in the blood, decreasing of high density lipoprotein (HDL) cholesterol levels, increasing of blood pressure and blood glucose levels or hyperglycemia.

Epidemiological studies of the incidence of metabolic syndrome vary by population, which was between 20-45% worldwide. The prevalence of metabolic syndrome in Indonesia in 2019 reached 21.66%. The study in 2020 showed that 46% of Indonesian women from the total subjects experienced metabolic syndrome. The most common components of metabolic syndrome were hypertension (61%) and hyperglycemia (51%).[1]

The incidence of metabolic syndrome is linear with the incidence of obesity and type 2 diabetes mellitus. A report on the prevalence of type 2 diabetes mellitus in the US population by the Centers for Disease Control and Prevention CDC in 2017 stated that 23.8% of the research population did not realize they had diabetes mellitus. So the prevalence of pre-diabetes and metabolic syndrome was even greater, about 3 times greater.[2] Based on the Indonesian Basic Health Research (Riset Kesehatan Dasar) report in 2018 regarding data on the metabolic syndrome component which is diabetes mellitus (DM), the number of people with diabetes mellitus in Indonesia reached 10.9%. This figure increased compared to the number of DM sufferers in 2013, which amounted to 6.9%. Meanwhile, the prevalence of hypertension also

increased from 25.8% in 2013 to 34.1% in 2018.[3,4]

Another characteristic of metabolic syndrome is obesity. Central obesity is a condition of accumulation or hoarding of body fat in the waist and abdominal area. The proportion of central obesity in Indonesia continues to increase from year to year. In 2007, 18.8% of the Indonesian population had central obesity. In 2013, it increased to 26.6% and continued to increase until it reached 31.0% in 2018.[4] Subjects with central obesity will have a two-fold risk of becoming diabetic and hypercholesterolemia.[5] Based on the 2005 IDF criteria revised in 2009, the definition of central obesity is ≥80cm for women and ≥94cm for men. Central obesity is known to be responsible for the development of insulin resistance conditions that will reduce fraction levels, increase triglycerides and trigger hypertension. These conditions contribute to metabolic syndrome, type 2 diabetes mellitus and ischemia.[6]

The shift in lifestyle to physical inactivity and eating patterns that are not in accordance with nutritional proportions are known to be associated with metabolic syndrome criteria. Anduonohu Village is part of the administrative area of Posia sub-district, Kendari City, Southeast Sulawesi. Anduonohu Village has an area of 14.11 km2 with a population of 15,760 people. Diabetes mellitus is one of the top 10 diseases in both Anduonohu and Kendari City. Hypertension, which is part of the metabolic syndrome criteria, is included in the list of diseases with the highest number of patients in Kendari City.[7,8] Metabolic syndrome criteria such as obesity, hypercholesterolemia and hyperglycemia are known by the public as separate conditions. However, conditions that occur together as metabolic syndrome are still rarely known by the public. This research was expected to bring medical laboratory services closer to detect early metabolic syndrome in the community.

METHOD

This activity was held in the Anduonohu sub-district resident housing complex in September 2021. The activity was attended by men and women residents aged 25-70 years. Detection of risk factors is carried out through several examinations including anthropometric examinations for measuring height, height and waist circumference; blood pressure checks and basic laboratory tests by measuring blood glucose and blood cholesterol levels.

Body weight was measured using a digital scale with units of kilogram (kg). Height was measured using a microtois with units of centimeters (cm). Waist circumference was measured using a non-elastic tape with centimeters (cm). Body mass index (BMI) values were calculated using the formula kilogram of body weight divided by the square of height in meters

$$BMI = \frac{weight\,(kg)}{height\,(m)^2}$$

Systolic and diastolic blood pressure were measured using a digital tensimeter with units of millimeters of mercury (mmHg). Blood pressure categories were categorized using mean arterial pressure (MAP).[9]

$$MAP = Distolic + \left(\frac{sistolic - diastolic}{3}\right)$$

Blood glucose and total cholesterol were measured using a Nesco® point of care (POCT) device in milligrams per deciliter (mg/dl). Metabolic syndrome in this activity refers to the definition set by the IDF consortium revised 2009, namely a person is called having metabolic syndrome if they have central obesity, which is ≥90 cm for men and ≥80cm for women followed by 2 or more other criteria including hypertriglyceridemia, decreased HDL levels, increased blood pressure and or increased fasting blood glucose levels. In this activity, the affordable criteria are an increase in blood pressure, namely systolic ≥130mmHg or diastolic ≥85 mmHg and an increase in fasting blood glucose levels, namely ≥100 mg/dl.[10]

RESULT AND DISCUSSION

The results of the participant's examination were documented on the results sheet on the leaflet which is also an educational media that was handed over to all participants (Figure 1). Leaflet has been registered for intellectual property rights.

A total of 50 participants have participated in this activity. This services was carried out in 2 acttivity namely socialization and detection of risk factors for metabolic syndrome on September 2021 in Posia sub-district, Anduonohu District, Kendari City. Socialization of metabolic syndrome was carried out through presentations, interactive discussions and using leaflet media. The process of this community service activity has been published on online and electronic media as a health promotion effort.[11–13]

Figure 1. Participants' Examination Results as Well as The Metabolic Syndrome Education Leaflet

In this activity, participants were given education about the condition of metabolic syndrome, such as the definition and minimum criteria for diagnosis. Participants were also given an understanding of the complications that can occur in metabolic syndrome conditions. In addition, participants were given education for lifestyle improvement efforts if they were found to have entered the criteria for metabolic syndrome as a form of monitoring so as to reduce the occurrence of complications.

Figure 2. Educate Participants about Metabolic Syndrome

The average age of participants in this activity was 49.26 years old, dominated by female residents Table 1).

Table 1. Characteristic of participant

Charasteristic (n=50)	Value (average±standarddeviation)
Sex	
Female	40
Male	10
Age (years)	49,26 ± 11,7
Sistolik (mmHg)	138,68 ± 23,37
Diastolik (mmHg)	83,84 ± 12,38
Height (cm)	153,72 ± 7,56
Weight (kg)	68,07 ± 10,61
Body Mass Index (BMI)	28,88 ± 4,64
Waist circumference (cm)	93,14 ± 6,83
Fasting Blood Glucose (mg/dl)	122,66 ± 41,50
Total Cholesterol (mg/dl)	268,79 ± 52,25

Based on the national classification, the mean BMI of 28.88 falls into the category of severe obesity or level II obesity. Unlike the WHO classification, the national classification does not have an overweight category but only thin, normal, and fat (obesity) (14) (Table 1). The national classification divides the fat category into mild and severe degrees. The category of mild obesity (obesity I) if the BMI value is at a value of 25.1-27 while severe obesity (obesity II) if the BMI value is> 28. A person is said to have a normal

body weight to height index if they have a BMI value between 18.5 - 25. While BMI values that are less than this figure are included in the thin category.

Figure 3. Documentation by TVRI Sultra on The Process of Basic Laboratory Services to Participants[13]

Only 6% (n=3) had normal BMI. As many as 40% (n=20) of the participants in this activity experienced level II obesity while 26% (n=18) experienced level I obesity and 18% (n=9) were overweight (Figure 4). WHO data states that in 2016 as many as 13% of the world's population is obese. The obesity rate in adults in Indonesia in 2018 reached 21.8%. Obesity occurs when the amount of energy intake is greater than the amount of energy expended. As a result, excess food intake will be stored as triglycerides in adipose tissue in the body.
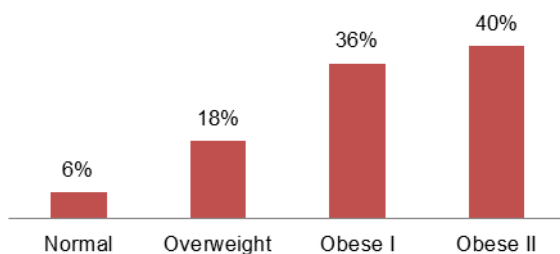

Figure 4. Classification of BMI Values of Activity Participants Based On National Categories

Obesity is a condition caused by multiple factors. Genetics, food consumption patterns and physical activity as environmental factors and the consumption of several types of drugs can trigger obesity. Obesity classification can not only be determined through BMI values but can also use waist circumference values. The reference value

of waist circumference or abdominal circumference will differ depending on the ethnic population in the world. The criteria published by the International Diabetes Foundation (IDF) for South Asia are men >90cm and women >80cm. The mean waist circumference in this study was 93.14 cm (Table 1).
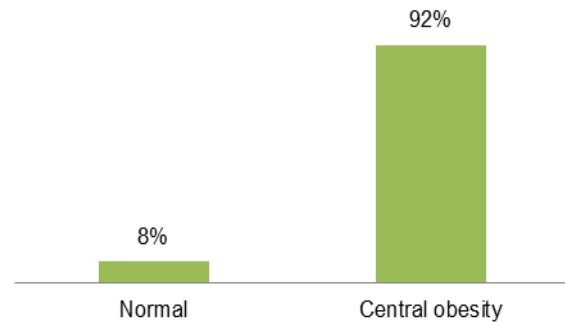

Figure 5. Classification of Participants' Central Obesity

The proportion of central obesity in Indonesia at the age of >15 years is 31% (4). In this research, 92% (n=46) of the total participants had central obesity (Figure 5). Central obesity is characterized by the accumulation of lipid stores in the abdominal region and the number is independent of the body mass index value.

Figure 6. Documentation by TVRI Sultra During Anthropometric Measurements of Participants by The Committee Team [13]

Adipose tissue in the mesenteric region of the abdomen is known to have higher lipogenic activity than in the subcutaneous region. The high metabolic activity in this region coupled with high calorie food consumption and lack of physical activity will cause higher lipid uptake compared to other body regions.[15]
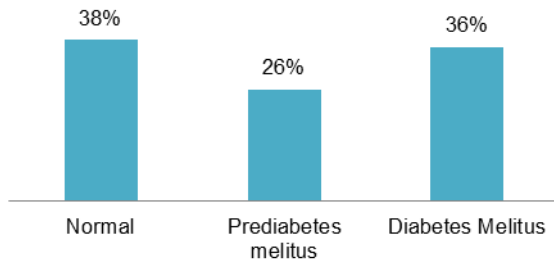
Figure 7. Classification of Fasting Blood Glucose Levels of Participants

Hyperinsulinemia and hyperleptinemia are known to cause impaired insulin signaling in various tissues such as hepatic, skeletal muscle, adipose, and brain in obesity. The resulting peripheral insulin resistance will lead to impaired systemic glucose hemostasis that can develop into type 2 diabetes mellitus.[16] Based on this social service, more than 50% of participants experienced impaired glucose hemostasis. As many as 26% (n=13) of participants experienced pre-diabetes mellitus and 36% (n=18) had fasting blood glucose levels in the diabetes mellitus category based on Perkumpulan Endokrinologi Indonesia Perkeni 2021.[17]
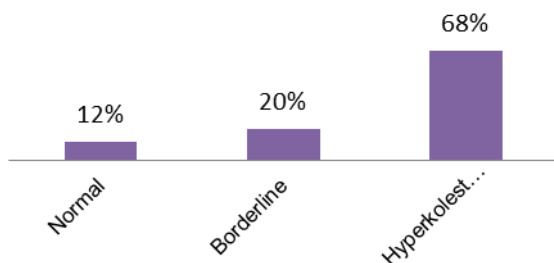

Figure 8. Classification of Cholesterol Levels of Participants

Total lipid stores in the body are known to correlate with a person's BMI. The average cholesterol level of the 50 participants was 268.79 mg/dl (Table 1). About 20% (n=10) of the participants had cholesterol levels at the borderline while 68% (n=34) had hypercholesterolemia (Figure 8). Grouping lipid levels based on dyslipidemia management guidelines in Indonesia.[18] Cohort studies have shown that cholesterol levels are found to be higher in individuals with hypertension.[19]
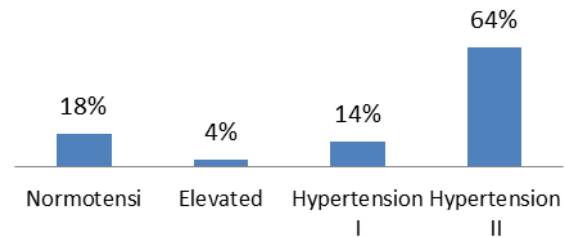

Figure 9. Classification of Participants Blood Pressure

The results of blood pressure measurements showed that 4% (n=2) of participants had increased blood pressure, 14% (n=7) had grade I hypertension and 64% (n=32) had grade II hypertension (Figure 9). Hypertension is called a silent killer because it can occur without signs and symptoms. WHO data states that 1.28 billion adult individuals have hypertension.[20] More than 600,000 Indonesians have hypertension.[4] Hypertension in a person can increase the risk of diseases related to cardiovascular, brain, kidney and other diseases.[20] One hypothesis regarding the pathophysiology of hypertension in metabolic syndrome is through hyperinsulinemia. Hyperinsulinemia is thought to affect the mechanism of sodium ion reabsorption in the kidneys which leads to hypertension.[21]

The definition of metabolic syndrome varies depending on the organization issuing the criteria. There were 3 definitions of metabolic syndrome that are popularly used, including the WHO 1999 classification, the National Cholesterol Education Program (NCEP) - Adult Treatment Panel (ATP) III and the International Diabetes Federation (IDF) criteria (10,14,22). In this research, the criteria for metabolic syndrome refered to the IDF criteria because the waist circumference criteria used are in accordance with the normal values for the Asian population, namely men > 90cm and women > 80.

Based on the IDF criteria, the definition of metabolic syndrome is if an individual is centrally obese while experiencing 2 or more other criteria including triglyceride levels ≥150 mg/dl, HDL levels <50 mg/dl for women and <40mg/dl for men, systolic blood pressure ≥130mmHg and diastolic ≥ 85 mmHg and fasting blood glucose levels ≥100 mg/dl.[10]
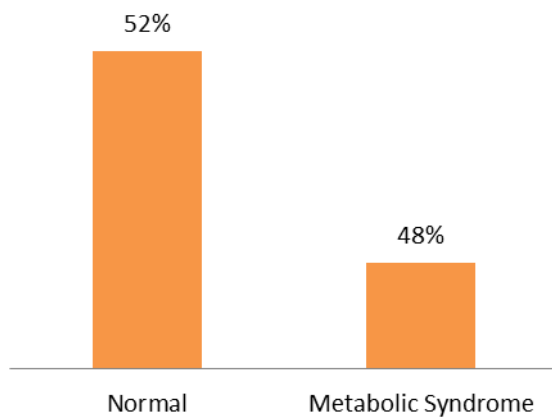
Figure 10. Proportion of Metabolic Syndrome in Participants

As many as 48% (n=24) of the total participants were found experienced metabolic syndrome in this social service (Figure 10). The condition of metabolic syndrome in the community of Anduonihu Village, Kendari City in this activity is higher than the metabolic syndrome rate in a similar community service activity conducted in the community of Tambang sub-district, Kampar district, Riau Province, where only 16.39% of the 61 participants were identified as suspected metabolic syndrome.[23] Medical examination in the form of measuring metabolic syndrome parameters in this activity are one of the promotive and preventive efforts to increase awareness for the implementation of a healthy lifestyle.

Considering that the detection of metabolic syndrome in this activity only assesses 3 affordable criteria, namely central obesity, hyperglycemia and hypertension, this figure is likely to be greater if the other 2 criteria are examined.

A prospective cohort study in Indonesia found that in general the incidence of metabolic syndrome was 56 cases per 10,000 population during the 6 years of the study. Women have a 4.78 times greater risk of developing metabolic syndrome than men.[24] Increasing age is also known to increase the risk of metabolic syndrome up to 4 times. Individuals with obesity even have a 7.5 times greater risk of developing metabolic syndrome. Another determinant of metabolic syndrome is eating habits. Individuals who often consume fried snacks increase the risk to 1.21 times.[25]

Individuals with metabolic syndrome are at 2 times greater risk of cardiovascular-related disease and up to 5 times greater risk of developing type 2 diabetes mellitus. Cardiovascular complications also occur more in people with diabetes mellitus who have metabolic syndrome than those who do not have metabolic syndrome. The improvement of metabolic syndrome is done by focusing on each component of abnormal criteria.[10]

Metabolic syndrome is a chronic but preventable pathological condition. Prevention activities can be carried out early, for example in adolescence, to increase awareness so as to improve a healthy lifestyle as early as possible.[26] Community service activities like this can not only be carried out at adolescence or productive age but can also be carried out at the age of the elderly group participants. This is expected as an effort to improve the standard of living and life expectancy of the elderly age group.[27]

CONCLUSION

This activity has been successfully carried out in accordance with the target number of participants. The achievement of this activity is that as many as 50 participants know the status picture of their respective metabolic syndrome conditions. Based on IDF criteria, 48% of participants had metabolic syndrome with assessment of central obesity parameters, blood pressure and hyperglycemia.

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