



THE RELATIONSHIP BETWEEN RANDOM BLOOD GLUCOSE AND TOTAL CHOLESTEROL LEVELS AGAINST BODY MASS INDEX IN RESIDENTS OF RW 01 GANG ANWAR, EAST JAKARTA

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Abstract

Obesity is a common and serious condition. The prevalence of obesity worldwide has increased compared to previous years, including the incidence in Indonesia. This research was conducted to observe the value of Body Mass Index (BMI), random blood glucose, and total cholesterol levels in residents in RW 01 Gang Anwar Jatinegara, East Jakarta. This research was conducted to see the relationship between blood glucose and blood cholesterol levels with BMI values for residents in RW 01 Gang Anwar Jatinegara, East Jakarta. Subjects were divided into three groups: normal group (BMI 18.5-22.9 kg/m²), overweight group (BMI 23-24.9 kg/m²), and obese group (BMI more than 25 kg/m²). BMI values, random blood glucose, and total cholesterol levels were analyzed using SPSS. The highest average value of blood glucose levels was found in the overweight group and the highest average value of total cholesterol was in the obese group. Based on the Wilcoxon test, there was a relationship between BMI values with blood glucose and total blood cholesterol ($P < 0.05$). The results showed that there was a relationship between BMI values and random blood glucose and total cholesterol levels in residents of Gang Anwar RT 01 Jatinegara, East Jakarta.

Keywords: *Body mass index, Obesity, Random blood glucose, Total cholesterol.*

Abstrak

Obesitas merupakan keadaan yang umum, serius, dan merugikan. Prevalensi obesitas di seluruh dunia telah meningkat dibandingkan tahun-tahun sebelumnya, termasuk kejadian obesitas di Indonesia. Penelitian ini dilakukan untuk mengamati nilai Indeks Massa Tubuh (IMT), kadar glukosa darah sewaktu dan kolesterol total pada penduduk di RW 01 Gang Anwar Jatinegara, Jakarta Timur. Penelitian ini dilakukan untuk melihat hubungan antara kadar glukosa darah sewaktu dan kolesterol total dengan nilai indeks massa tubuh penduduk di RW 01 Gang Anwar Jatinegara, Jakarta Timur. Subjek dibagi menjadi tiga kelompok yaitu kelompok IMT normal (IMT 18,5-22,9 kg/m²), kelompok IMT *overweight* (IMT 23-24,9 kg/m²), dan kelompok IMT obesitas (IMT lebih dari 25 kg/m²). Teknik pengambilan data dilakukan dengan *purposive sampling*. Data nilai IMT, kadar glukosa darah, dan kolesterol total dianalisis dengan menggunakan *software* statistik SPSS. Didapatkan bahwa nilai rerata tertinggi kadar glukosa darah sewaktu terdapat pada kelompok IMT *overweight* dan nilai rerata tertinggi kolesterol total terdapat kelompok IMT obesitas. Berdasarkan uji Wilcoxon, terdapat hubungan antara nilai IMT dengan glukosa darah sewaktu dan kolesterol total darah ($P < 0,05$). Hasil penelitian menunjukkan bahwa terdapat hubungan antara nilai IMT dengan kadar glukosa darah sewaktu dan kolesterol total pada penduduk Gang Anwar RT 01 Jatinegara, Jakarta Timur.

Kata Kunci: Glukosa darah sewaktu, Indeks massa tubuh, Kolesterol total, Obesitas

INTRODUCTION

Obesity is a condition of abnormal or excessive fat accumulation in the body which can interfere with health. Obesity has now tripled since 1975. According to the World Health Organization (WHO) in 2016, more than 1.9 billion adults are overweight and as many as 650 million of them suffer from obesity (WHO, 2016). Meanwhile in Indonesia, according to the Riset Kesehatan Dasar Indonesia in 2018, as many as 21.8% of the population in Indonesia are obese. Jakarta ranks second highest for the city with the most obesity incidence, which is 29.8% of the total incidence of obesity in Indonesia (Kemenkes, 2018).

Obesity is defined as abnormal or excessive fat accumulation that can interfere with health (WHO, 2016). Obesity describes excess body fat mass. In general, a person is said to be obese by looking at the body mass index (BMI). BMI is calculated by dividing body weight (in kilograms) by the square of body height (in meters squared). The BMI formula is shown in Figure 1.



Figure 1. Body mass index calculation formula (kg/m²)

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

In adults in Asia Pacific, people who have a BMI value of more than 23 kg/m² are overweight, while a BMI value of more than 25 kg/m² is considered obese (Pan, W.H. & Yeh, W.T. 2008). According to the Direktorat Pencegahan dan Pengendalian Penyakit Tidak Menular (P2PTM), the national classification for mild and severe obesity is a BMI value of more than 25 and more than 27 respectively (Kemenkes, 2018). Table 1 shows BMI values based on the WHO and Asia Pacific.

Table 1. Classification of BMI values based on WHO and Asia Pacific guidelines

Weight Classification	WHO (kg/m ²)	Asia Pacific (kg/m ²)
Underweight	<18.5	<18.5
Normal weight	18.5-24.9	18.5-22.9
Overweight	25-29.9	23-24.9
Obesity	≥30	≥25

Obesity is caused by an imbalance between the amount of energy in and energy out. This is due to the greater amount of incoming energy compared to expended energy over a long period, causing the accumulation of excess calories in the form of fat (adipose tissue). Factors that cause obesity include diet, an inactive lifestyle, an environment that does not support a healthy lifestyle, hormone problems, emotional factors, lack of sleep, and genetics (NHLBI, 2012).

Obesity is marked by an excess of adipose tissue. Adipose tissue is an endocrine tissue that secretes hormones for metabolism regulation in the body. An increase in fat cells (adipocytes) will cause hormonal imbalances that affect the body's metabolism. Adipocytes secrete a variety of biological compounds called adipocytokines or adipokines. In addition, adipose tissue is also a tissue that secretes hormones that play an important role in regulating body weight (Luo, L. & Liu, M. 2016).

Obese sufferers have a risk of developing diabetes up to seven times compared to people with normal weight. This is because obesity causes metabolic changes in the body. These changes cause the release of fat molecules from adipose tissue into the blood, which causes reduced sensitivity of cells to insulin. This results in reduced glucose uptake into adipose tissue. So that obesity can cause hyperglycemia (high blood glucose levels), hyperlipemia (high blood lipid levels), hyperinsulinemia (high blood insulin levels), and insulin resistance (Singla, P., Bardoloi, A., & Parkash, A. A. 2010). These signs that appear due to obesity will increase with increasing body weight and will decrease with weight loss (Chaudhari A., Gujarathi S., & Bhatia G. 2020).

Due to changes in body metabolism due to obesity, obesity is a risk factor for diseases such as coronary heart disease, ischemic stroke, type 2 diabetes mellitus, dyslipidemia, hypertension, sleep apnea, and several types of cancer, so the increase in obesity has become a major health problem (Kim, S.H. & Plutzky, J, 2016). Increased BMI values also increase the risk of developing other diseases such as breast, colon, prostate, endometrial, kidney, and bladder cancer (WHO, 2016). The number of deaths related to high BMI values is due to heart disease (Feingold KR, 2020).

Because the incidence of obesity is common in Indonesia, researchers wanted to observe the value of Body Mass Index (BMI), random blood glucose, and total cholesterol levels in residents in RW 01 Gang Anwar Jatinegara, East Jakarta. The residents who were used as subjects were adult men and women with an age range of 25-45 years who lived in the area. It



is hoped that this research will be able to see the relationship between blood glucose and cholesterol levels on Body Mass Index values in the RW 01 Gang Anwar Jatinegara area, East Jakarta.

METHOD

This research was conducted using the observational method and the approach used in this study was a cross-sectional study. This research was conducted to see the relationship between random blood glucose and total cholesterol levels with body mass index values for residents in RW 01 Gang Anwar Jatinegara, East Jakarta. The subject group consisted of three groups, namely the normal BMI group (BMI value 18.5-22.9 kg/m²), the overweight BMI group (BMI value 23-24.9 kg/m²), and the obese BMI group (BMI over 25 kg/m²). The data collection technique was carried out by purposive sampling.

The research sample was taken from residents of RW 01 Gang Anwar Jatinegara, East Jakarta. Subject inclusion criteria were adult subjects aged around 25-45 years, subjects who were residents of RW 01 Gang Anwar, and subjects who were willing to be sampled for research data. The tools used in the study were Nesco multi-check, strips for glucose, strips for cholesterol, lancing devices, blood lancets, body scales, height meters, and calculators. While the materials used were capillary blood from the subject and alcohol swabs.

Subjects were measured for height and weight using a scale accompanied by a measurement of height. The measurement results were recorded to calculate the Body Mass Index (BMI) for each subject. BMI results in kg/m² units were recorded and used to determine the subject's BMI group.

Blood glucose and cholesterol levels were measured using a Nesco multi-check. Capillary blood was obtained using a lancet needle inserted into the subject's fingertip. Then the blood is attached to the glucose and cholesterol test strips. Wait a few seconds to see the results. Results of blood glucose and cholesterol levels in units of mg/dL were recorded.

Data on BMI values, blood glucose levels, and blood cholesterol were analyzed using the Kolmogorov-Smirnoff normality test to determine whether the data were normally distributed or not. If the data is normally distributed, then a parametric correlation test is performed to determine the degree of relationship between the two variables. If the data is not normally distributed then proceed with a non-parametric examination. Data analysis using SPSS 26th version for statistical testing.

RESULT AND DISCUSSION

The following are the results of a study on BMI, blood glucose, and blood cholesterol examination conducted at RW 01 Gang Anwar. Subjects were divided into three groups based on the calculation of their BMI values, namely the normal BMI group (BMI value 18.5-22.9 kg/m²), the overweight BMI group (BMI value 23-24.9 kg/m²), and the BMI group obesity (BMI more than 25 kg/m²). The results of the study regarding the number of subjects according to the BMI group for normal and abnormal values of random blood glucose and total cholesterol are shown in Table 2. The description of the lowest, highest, and mean values for random blood glucose levels and total cholesterol in all BMI groups are shown in Tables 3 and 4.

Table 2. Results of BMI values, random blood glucose, and total blood cholesterol of the study subjects

Subject Group	Number of Subjects	Random Blood Glucose Value (mg/dL)		Total Cholesterol Value (mg/dL)	
		Normal (70-200 mg/dL)	Abnormal (> 200 mg/dL)	Normal (< 200 mg/dL)	Abnormal (> 200 mg/dL)



Normal BMI (18.5 - 22.9 kg/m ²)	9 persons	9 persons	-	9 persons	-
BMI overweight (23 - 24.9 kg/m ²)	18 persons	15 persons	3 persons	8 persons	10 persons
Obese BMI (> 25 kg/m ²)	29 persons	27 persons	2 persons	5 persons	24 persons

Table 3. Description of random blood glucose levels in research subjects

Random Blood Glucose Level (mg/dL)	Normal BMI (18.5 - 22.9 kg/m ²)	Overweight BMI (23 - 24.9 kg/m ²)	Obese BMI (> 25 kg/m ²)
The lowest value	84	73	89
The highest value	154	305	322
Average value	102,11	141.17	121.52
Standard deviation	21.56	71,18	54.04

Table 4. Description of total cholesterol levels in research subjects

Total Cholesterol Level (mg/dL)	Normal BMI (18.5 - 22.9 kg/m ²)	Overweight BMI (23 - 24.9 kg/m ²)	Obese BMI (> 25 kg/m ²)
The lowest value	107	156	167
The highest value	195	276	318
Average value	150.44	207,72	228.79
Standard deviation	28.96	34,19	35,40

Values of random blood glucose and blood cholesterol levels of the subject group were then analyzed using SPSS. The normality test performed on the data indicated that the data were not normally distributed ($p < 0.05$) so a non-parametric test was performed. The non-parametric test performed was the Wilcoxon test. Based on the Wilcoxon test, there was a relationship between BMI values with random blood glucose and total blood cholesterol ($P < 0.05$). This shows that there is a relationship between BMI values with random blood glucose and total blood cholesterol.

Based on the description of the blood glucose levels at any time, it was found that the BMI group with the lowest glucose value was the overweight BMI group (73 mg/dL) and the highest glucose value was the obese BMI group (322 mg/dL). The highest mean blood glucose value was in the overweight BMI group (141.17 mg/dL). As for the value of total cholesterol levels, the lowest value was in the normal BMI group (107 mg/dL) and the highest value was in the obese BMI group (318 mg/dL). The highest total cholesterol means value was in the obese BMI group (228.79 mg/dL).

Obesity is considered a health problem in developed and developing countries. Obesity is defined as the excessive accumulation of fat tissue which can interfere with the health and well-being of sufferers.¹⁰ This disease has been identified as the main cause of insulin resistance and hyperglycemia associated with diabetes (Martyn, J.A, et al, 2008). In addition, hypercholesterolemia is also often associated with obesity and hypertriglyceridemia (Aguilar, D., & Fernandez, M. L, 2014).

In this study, the cut off values of random blood glucose and blood cholesterol were divided into normal and abnormal values. In Indonesia, based on the Direktorat Pencegahan dan Pengendalian Penyakit Tidak Menular (P2PTM), the normal value of random blood glucose is less than 200 mg/dL and the abnormal value is more than 200 mg/dL. As for cholesterol levels, normal levels are below 200 mg/dL and high cholesterol levels are said to be more than 200 mg/dL (Kemenkes, 2018).

Based on the results of the study, the total number of research subjects was 56 people. A total of 9 of them are in the normal BMI group (16.07%), 18 people are in the overweight BMI group (32.14%), and 29 people are in the obese BMI group (51.79%). Random blood glucose values in the normal BMI group showed that all people (100%) had normal glucose



levels. In the overweight BMI group, 15 people (83.3%) had normal blood glucose levels and 3 people (16.7%) had abnormal glucose levels. Meanwhile, in the obese BMI group, 27 people (93%) had normal blood glucose levels and 2 people (7%) had abnormal glucose levels.

The total cholesterol value in the normal BMI group also shows that everyone (100%) has a normal total cholesterol value. In the overweight BMI group, 8 people (44.4%) had normal total cholesterol levels and 10 people (55.6%) had abnormal total cholesterol levels. Meanwhile, in the obese BMI group, 5 people (17.2%) had normal total cholesterol levels and 24 people (82.8%) had abnormal total cholesterol levels.

Based on the results of the study, the highest random blood glucose and total cholesterol levels were found in the obese BMI group. The highest average value of blood glucose levels was found in the overweight BMI group and the highest average value of total cholesterol was in the obese BMI group. In addition, there is a relationship between BMI values with random blood glucose levels and total blood cholesterol as evidenced by the Wilcoxon test ($P < 0.05$). This is to the statement that states that there is a correlation between an increase in body mass index value and the risk of diabetes which is characterized by hyperglycemia (Gupta & Bansal, 2020). In addition, there is a correlation between high body mass index values and hypercholesterolemia (Gostynski, M., *et al*, 2004)

Weight gain occurs when the number of calories that enter the body is more than the calories that are expended. The pathophysiology of obesity is based on changes in adipocytes that store fat.¹⁵ As a result of excess energy input in obese conditions, adipocytes can grow to their maximum size and then begin to divide. If an individual's BMI value reaches 30 kg/m^2 , the adipocytes in that individual will increase in size. Whereas in severe clinical obesity, apart from increasing in size, the total number of adipocytes also increases (Klein S & Romijn JA, 2016)

Abundant fat stores are needed for survival when there is a nutritional deficiency such as starvation. When the abundance of fat stores occurs for a prolonged period, excess fat storage will occur, which will lead to obesity. This excess fat storage will eventually lead to the excess release of fatty acids. Excess fatty acids can cause damage to insulin receptors and inhibit lipogenesis. The consequence of insulin receptor dysfunction causes hyperglycemia which is compensated by hepatic gluconeogenesis which ultimately increases glucose production in the liver. Free fatty acids can also reduce insulin-stimulated muscle glucose use, causing hyperglycemia (Redinger, 2007).

Overweight and obesity conditions increase the risk of hypercholesterolemia because obesity affects lipoprotein metabolism including cholesterol and triglycerides. Triglycerides are formed in the liver from free fatty acids and glycerol. If the body forms too many triglycerides, it will cause an increase in other lipoproteins such as cholesterol. When a person is overweight or obese, the amount of adipose tissue in the body will increase, meaning that more free fatty acids will enter the liver. The effect of insulin resistance also increases the amount of free fatty acids in the liver (Jung U & Choi M-S, 2014)

CONCLUSION

Conclusion

Obesity is a condition characterized by excess body fat mass. In general, a person is said to be obese by looking at the body mass index (BMI). The main factor of obesity is an imbalance between the amount of incoming and outgoing energy in the body which causes an increase in the amount of adipose tissue. Increased adipose tissue can interfere with glucose and lipid metabolism which leads to hyperglycemia and hypercholesterolemia. The results showed that there was a relationship between BMI values and transient blood glucose levels and total cholesterol in residents of Gang Anwar RT 01 Jatinegara, East Jakarta.



Suggestion

Conducted further research on the effect of obesity on the process of glucose and lipid metabolism in adult subjects. Research can be done on a larger number of subjects to represent the population in Jakarta.

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