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ORIGINAL ARTICLE

Association between Anthropometric Measurements and Metabolic Syndrome in Office Workers in Trisakti University: A Cross-Sectional Study

Hubungan Antropometri dengan Sindrom Metabolik pada Pekerja Kantor di Universitas Trisakti: Studi Potong Lintang

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ABSTRACT

Background

Metabolic syndrome is a disease with an increasing prevalence and a high health burden. Most individuals with metabolic syndrome have a sedentary lifestyle, such as office workers who rarely undergo health check-ups. Therefore, this study aims to investigate the profile and correlation of anthropometric indices and metabolic syndrome parameters among office workers at Trisakti University.

Methods

Office workers from the Faculty of Medicine, Trisakti University, were recruited for this study, and informed consent was obtained. Subsequently, data on blood pressure, laboratory tests including glucose levels and lipid profiles, as well as anthropometric measurements such as weight, height, body mass index (BMI), waist circumference, and hip circumference were collected. The data were statistically analyzed using univariate analysis and bivariate correlation analysis with Spearman's test, as well as intergroup difference tests using the Kruskal-Wallis test and ANOVA.

Results

The average age of the subjects was 41.46±9.87 years. The data showed that approximately 43.33% had hypertension, with a concentration of data in the profiles of grade I obesity, normotension, normal triglyceride levels, normal blood glucose levels, and normal high-density lipoprotein (HDL) levels. The analysis revealed a significant difference in HDL levels between the normal BMI group and the overweight BMI group (MD: 9.534; 95% CI: 1.68-17.39; p = 0.018). A very weak and non-significant correlation was found between BMI and metabolic syndrome parameters.

Conclusions

Anthropometric indices reflect central obesity as well as the characteristics of metabolic syndrome among employees at the Faculty of Medicine, Trisakti University.

Keywords: Anthropometry; Metabolic syndrome; Office worker.

ABSTRAK

Latar Belakang

Sindrom metabolik merupakan penyakit dengan prevalensi yang terus meningkat dan beban kesehatan yang tinggi. Sebagian besar penderita sindrom metabolik merupakan individu dengan gaya hidup sedenter seperti pekerja kantor yang jarang melakukan pemeriksaan kesehatan. Oleh karena itu, penelitian ini bertujuan untuk menyelidiki profil dan korelasi indeks antropometri dan parameter sindrom metabolik pada pekerja kantor di Universitas Trisakti.

Metode

Subjek penelitian berupa pekerja kantor Fakultas Kedokteran (FK) Universitas Trisakti direkrut dan diperoleh persetujuan informasi untuk studi ini. Kemudian subyek diambil data tekanan darah, pemeriksaan laboratorium berupa kadar glukosa dan profil lipid serta diukur data antropometrinya berupa berat badan, tinggi badan, indeks massa tubuh (IMT), lingkar pinggang dan lingkar pinggul. Data dianalisis secara statistik dengan analisis univariat dan analisis bivariat korelasi menggunakan uji Spearman serta uji perbedaan antarkelompok menggunakan uji Kruskal-Wallis dan ANOVA.

Hasil

Rata-rata usia subjek adalah 41.46±9.87 tahun. Data subjek menunjukkan sekitar 43.33% memiliki hipertensi, pemusatan data pada profil obesitas tingkat I, profil normotensi, profil normal kadar trigliserida, profil normal kadar gula darah, dan profil normal kadar high-density lipoprotein (HDL). Analisis menunjukkan perbedaan bermakna terhadap kadar HDL pada kelompok IMT normal dan IMT berlebih (MD: 9.534; IK 95%: 1.68-17.39; p=0.018). Korelasi sangat lemah yang tidak signifikan didapat antara IMT dan parameter sindrom metabolik.

Kesimpulan

Indeks antropometri menggambarkan obesitas secara umum dan obesitas sentral serta karakteristik sindrom metabolik pada karyawan FK Trisakti.

Kata Kunci: Antropometri; Sindrom metabolik; Pekerja kantor.

INTRODUCTION

The prevalence of metabolic syndrome is increasing globally. Metabolic syndrome has been shown to increase the occurrence of degenerative diseases, such as cardiovascular disease. The prevalence of metabolic syndrome varies between populations with different ethnicities. It is estimated that 12-37% of the Asian population and 12-26% of the European population suffer from metabolic syndrome.[1] Hypertension is a major contributor to the prevalence of metabolic syndrome, and abdominal adiposity is more strongly associated with metabolic syndrome than overall adiposity.[2] Overweight people have a 5.54 times greater risk of developing metabolic syndrome compared to those with a normal body mass index, while obesity has a 7.44 times greater risk of developing metabolic syndrome compared to those with a normal BMI.[3]

The diagnosis of metabolic syndrome requires invasive laboratory measurements to determine plasma lipid profiles and glycemic status. These measurements are relatively expensive. The beneficial effects of weight loss on various components of metabolic syndrome have been shown to reduce cardiovascular mortality. Therefore, the use of several anthropometric indices to assess central obesity as a non-invasive method can help to estimate the risk of developing metabolic syndrome.[4]

Anthropometric indices, such as waist circumference, which reflects abdominal adiposity, are commonly used in metabolic syndrome screening. The selection of waist circumference as a tool to determine metabolic syndrome is based on its association with cardio-metabolic risk in the United States and Western European populations.[5] The use of waist circumference alone for metabolic syndrome screening may have limitations because individuals with the same waist circumference do not necessarily share the same health risks, which can also depend on their height. For example,

in Japanese people, short men show higher health risks compared to tall men with similar waist circumference.[6] In addition, subcutaneous adipose tissue mass has been shown to contribute independently and synergistically to cardiovascular disease pathology, along with visceral fat.[7] Thus, a simple waist circumference measurement to indicate visceral adiposity does not reflect all predictions of cardiovascular disease risk associated with anthropometric factors. The waist-to-height ratio (WHRR) is measured by comparing the results of waist circumference measurements and height. The value determined for a large WHRR is >0.5, while for a small WHRR, the value determined is <0.5. Ashwell (2009) reported that 0.5 is the limit used as an indication of the risk of health problems associated with body fat levels.[8].

METHODS

This study is an observational analytical study with a cross-sectional method with a population of men and women aged 20-60 years who are employees of the Faculty of Medicine, Trisakti University. The sample consisted of 60 people taken using a random sampling technique. Data collection was carried out at the Trisakti Medical Faculty campus in February 2024. The inclusion criteria were men and women aged > 20 years when the study was conducted and were willing to be included in the study and the exclusion criteria were respondents diagnosed with the following diseases: diabetes mellitus, cancer, kidney disease, liver disease, gastrointestinal diseases that require a special diet, physical or mental disabilities, pregnant women and taking steroid drugs. The selected subjects were asked to fast for at least 10 hours before their blood was taken. Then the subjects' blood pressure data were taken, laboratory tests in the form of glucose levels and lipid profiles, and their anthropometric data were measured in the form of weight, height, waist circumference, and hip circumference. From the anthropometric data, the body mass index, the ratio of waist circumference and height, and the ratio of waist circumference and hip circumference were then calculated. From the data obtained, sample characteristics data in the form of general obesity status and central obesity, blood pressure characteristics, and characteristics of fasting blood glucose lab results and lipid profiles, in this case, triglyceride levels and HDL levels. The statistical test to be performed is univariate analysis to describe the characteristics of each variable against gender, age, anthropometric index, and metabolic syndrome component parameters. Bivariate analysis is used to determine whether or not there is a relationship between the independent and dependent variables, namely anthropometric indices with metabolic syndrome components (blood pressure, blood sugar levels, cholesterol levels, HDL levels, triglyceride levels). The normalization test is performed using the Shapiro-Wilk test on each dataset to determine whether the data is normally distributed or not. The Kruskal-Wallis and ANOVA tests are performed to test the differences between BMI groups against metabolic syndrome parameters. The correlation test between the independent and dependent variables uses the Spearman correlation test with a significance level of p <0.05.

RESULTS

Univariate Analysis

Characteristics

In this study, there were 60 research subjects with 17 male subjects and 43 female subjects. The mean age of all research subjects was 41.46 ± 9.87 years with a mean age of men 39.79 ± 8.85 years and a mean age of women 45.82 ± 11.20 years. The research subjects had a median BMI of 27.19 (16.1-46.93) kg/m2, mean RLPLP 0.86 ± 0.07, mean RLPTB 0.58 ± 0.07, median blood sugar level 92.5 (71-298) mg/dL, median triglyceride level 106 (57-651) mg/dL, and mean HDL level 55.87 ± 12.81. Complete demographics of the research subjects can be seen in Table 1.

Table 1. Demographics of research subjects and results of metabolic syndrome parameter measurements.

Variable	Male (n=17)	Female (n=43)	All (n=60)
Age (year)	39.79±8.85	45.82±11.20	41.46±9.87
BMI (kg/m^2)	25.72 (18.11-38.64)	27.79 (16.1-46.93)	27.19 (16.1-46.93)
WBC/WC	0.90±0.07	0.84±0.06	0.86±0.07
WBC/HB	0.56±0.08	0.59±0.07	0.58±0.07
Blood Glucose Level (mg/dL)	102 (82-165)	91 (71-298)	92.5 (71-298)
Triglyceride levels (mg/dL)	122 (81-493)	102 (57-651)	106 (57-651)
HDL levels (mg/dL)	48.71±8.31	58.70±13.24	55.87±12.81

Note: HDL, *high-density lipoprotein*; BMI, body mass index; WBC/WC, waist/hip ratio; WBC/HB, waist/height ratio.

A total of 26 research subjects had high blood pressure, and 34 research subjects had normal blood pressure. In the central obesity parameter, a total of 41 research subjects had large WBC/HB and 19 research subjects had normal WBC/HB, while there were 30 research subjects that had large WBC/WC and 30 research subjects had normal WBC/WC. Table 2 shows the characteristics of research subjects based on blood pressure, WBC/HB, and WBC/WC.

Table 2. Subject characteristics based on blood pressure, WBC/HB, and WBC/WC.

Variable	High blood pressure (systolic≥140 mmHg/diastolic≥ 90 mmHg)	Normal blood pressure (systolic <140 mmHg/diastolic <90 mmHg)	WBC/HB Large (>0,5)	WBC/HB normal (≤0,5)	WBC/WC Large (>0,5)	WBC/WC normal (≤0,5)
Male (n(%))	6 (10)	11 (18.33)	3 (5)	14 (23.3)	9 (15)	8 (13.3)
Female (n(%))	20 (33.33)	23 (38.33)	38 (63.3)	5(8.3)	21(35)	22(36.7)
Total (n(%))	26 (43.33)	34 (56.66)	41(68.3)	19(31.6)	30(50)	30(50)

Note: WBC/HB: waist circumference/height ratio; RLP/LP: waist circumference/hip circumference ratio.

Bivariate Analysis

Table 3 shows the distribution of blood pressure measurement results against BMI, WBC/WC, and WBC/HB. The distribution of research subjects with hypertension did not show significant differences between the normal, overweight, and obese BMI groups; normal and obese WBC/WC; and normal and obese WBC/HB. When viewed from the research subjects with hypertension from the obesity group to the other groups, there were more hypertensive subjects in the obesity group based on WBC/WC and WBC/HB than BMI.

Table 3. Distribution of blood pressure measurement results against BMI, WBC/WC, and WBC/HB using Chi-Square

Variable		Blood pressure Normotensi	Hypertension	p
BMI	Normal	10	7	0.949*
	Berlebih	13	11	
	Obesity	11	8	
WBC/WC	Normal	17	11	0.609*
	Obesity	17	15	
WBC/HB	Normal	6	2	0.446*
	Obesity	28	24	

***** Chi-square statistical test

Note: BMI: body mass index; WBC/WC: waist/hip ratio; WBC/HB: waist/height ratio.

Table 4 shows the median results of blood sugar, triglyceride, and HDL measurements in the normal, overweight, and obese BMI groups, normal and obese BMI/LP, and normal and obese BMI/TB. In each BMI group, there was no significant difference between the normal, overweight, and obese BMI groups. However, the higher BMI group had higher blood sugar and triglyceride levels and lower HDL levels. When viewed from BMI to blood pressure, the normal, overweight, and obese BMI groups did not have a significant difference in blood pressure (p = 0.956). In statistical testing with the ANOVA test for HDL levels with normal data distribution (table 5), the results showed that the normal BMI group had higher HDL levels than the overweight BMI group (mean difference [MD]: 9.534; 95% confidence interval [CI]: 1.68-17.39; p = 0.018) with a significant difference. When viewed from the WBC/WC and WBC/HB, statistical testing did not show any significant differences between the groups with normal and obese WBC/WC and WBC/HB.

Table 4. Results of the Kruskal-Wallis Test Measurement of blood sugar, triglyceride, and HDL levels in various BMI, WBC/WC, and WBC/HB groups.

Variable		Blood sugar levels	p	Triglyceride levels	p	HDL levels	p
IMT	Normal	90 (82-149)		106 (57-493)		63 (39-89)	
	Berlebih	95 (71-298)	0.801	101.5 (73-651)	0.751	51 (31-78)	0.051*
	Obesitas	93 (80-136)		114 (67-206)		55 (40-81)	
WBC/WC	Normal	92.5 (77-149)		111 (67-233)		55 (38-78)	
	Obesitas	92 (71-298)	0.906	100 (57-651)	0.366	55.5 (31-89)	0.836*
WBC/HB	Normal	89.5 (82-106)		100 (61-164)		66 (45-79)	
	Obesitas	93.5 (71-298)	0.191	108 (57-651)	0.618	55 (31-89)	0.066*

***** Kruskal-Wallis statistical test

Note: HDL: high-density lipoprotein; BMI: body mass index; WBC/HB: waist/height ratio; WBC/WC: waist/hip ratio.

Tabel 5. Hasil uji ANOVA kadar HDL pada berbagai kelompok IMT.

BMI	Normal	Over	Obesity
Normal		MD: 9.534; IK 95%: 1.68-17.39; p=0.018	MD: 7.697; IK 95%: -0.58-15.97; p=0.068
Over	MD: -9.534; IK 95%; -17.39 - -1.68; p=0.068		MD: -1.838; IK 95%: -9.45 – 5.77; p=0.63
Obesity	MD: -7.697; IK 95%: -15.97 – 0.58; p=0.068	MD: 1.838; IK 95%: -5.77 – 9.45; p=0.63	

Note: CI: confidence interval; BMI:body mass index; MD:mean difference.

The correlation was positive and very weak in BMI against blood pressure (r=0.005), blood sugar levels (r=0.001), and triglyceride levels (r=0.085). The correlation of BMI against HDL levels was found to be a weak negative correlation (r=-0.227). Not much different, a very weak positive correlation was found between WBC/WC with blood pressure (r=0.076) and HDL levels (r=0.045). A very weak negative correlation was found in WBC/WC against blood sugar levels (r=-0.015) and triglycerides (r=-0.018). A very weak positive correlation was also found in WBC/HB with blood pressure (r=0.145), blood sugar levels (r=0.170), and triglyceride levels (r=0.065). A weak negative correlation was found between WBC/HB with HDL levels (r=-0.239, p=0.065). However, the correlation did not show significant results between BMI, WBC/WC, and WBC/HB with metabolic syndrome parameters, including blood pressure, blood sugar levels, triglyceride levels, and HDL levels (Table 6).

Table 6. Spearman correlation results of BMI, WBC/WC, and WBC/HB on blood sugar levels, triglyceride levels, and HDL levels.

Correlation test	Blood pressure	Blood sugar levels	Triglyceride levels	HDL Levels
Body mass index (BMI)	r=0.005; p=0.969	r=0.001; p=0.993	r=0.085; p=0.518	r=-0.227; p=0.082
WBC/WC	r=0.076; p=0.562	r=-0.015; p=0.907	r=-0.118; p=0.370	r=0.045; p=0.731
WBC/HB	r=0.145; p=0.269	r=0.17; p=0.194	r=0.065; p=0.621	r=-0.239; p=0.065

***** Spearman correlation statistical test

HDL: high-density lipoprotein; BMI: body mass index; WBC/HB: waist circumference/height ratio; WBC/WC: waist circumference/hip circumference ratio

DISCUSSION

The components of metabolic syndrome include a large waist circumference, hypertriglyceridemia, low high-density lipoprotein (HDL) cholesterol, hypertension, and hyperglycemia.[9,10] The diagnosis of metabolic syndrome can be made when 3 of the 5 components are met. Because of this, obesity is one of the prominent components in patients with metabolic syndrome.10 Thus, individuals with obesity are of particular concern for the incidence of metabolic syndrome.[9-11]

Body Mass Index (BMI) is a popular diagnostic tool used to classify obesity because it is easy and inexpensive, only measuring weight and height, although BMI cannot accurately measure body composition.[12,13] Normal BMI has a lower risk of metabolic syndrome, which ultimately reduces the risk of morbidity and mortality due to metabolic syndrome.[12,14]

From this study, the results obtained were 17 people (28.3%) who were in the normal body mass index category, 26 people (43.3%) who were overweight, and 19 people (31.7%) who were obese. In addition, the centralization of BMI data was in grade I obesity. These findings imply that the BMI of office workers at Trisakti Medical Faculty is obese and at risk of developing metabolic syndrome.

The amount of fat in the abdomen indicates several metabolic changes, including insulin resistance and increased production of free fatty acids, compared to the amount of subcutaneous fat on the legs and arms.[15] Metabolic changes provide an overview of the examination of diseases related to differences in body fat distribution. 15,16 More sensitive measures to assess central obesity are the waist-to-height ratio (WBC/HB) and the waist-to-hip ratio (WBC/WC).[15,17-19] The WBC/HB value limit is 0.5 and can be used in all genders and all races for both children and adults. [20] From this study, more than half of the respondents were in the large WBC/HB category, namely 41 people (68.3%). The remaining 19 people (31.72%) were in the normal category. More female respondents were in the large WBC/HB criteria, namely 38 people (63.3%). Another parameter that is considered sensitive to assess central obesity is the ratio between waist circumference and hip circumference (WBC/WC). Based on WHO criteria, WBC/WC is categorized as central obesity for men is >0.90 and women >0.85.[20] The results of the study obtained balanced values between the two, namely 50% for large WBC/WC and 50% for the normal WBC/WC category, where more female respondents were categorized as central obesity, namely 21 people (35%).

Hypertension is a component that is also included in metabolic syndrome. According to WHO, blood pressure (BP) is categorized as high if systolic BP> 140 mmHg and/or diastolic BP> 90 mmHg. Sigit et al (2020) stated that Indonesian women suffer more from metabolic syndrome than men.[2] This is following the results of the current study, namely that hypertension in women (33.3%) is more than in men, which is only 10%. Overall, 34 people (56.7%) were in the normal BP category, and the remaining 26 people (43.3%) were in the high BP category. These findings also show that quite

a lot of research subjects with hypertension are also components and risk factors for metabolic syndrome. The statistical results showed no significant difference in hypertension parameters against anthropometric measurements (BMI, WBC/WC, and WBC/HB). This happened because the concentration of the subject's blood pressure data was at normotension. From these findings, it can be concluded that the office worker research subjects had just experienced obesity and had not progressed to metabolic syndrome, such as hypertension. Studies have shown that central obesity is the beginning of the onset of metabolic syndrome by contributing to insulin resistance in individuals.[21]

Insulin resistance is one of the parameters in metabolic syndrome. The occurrence of insulin resistance, such as in cases of diabetes mellitus and metabolic syndrome, will result in abnormal fasting blood glucose levels. According to the WHO, abnormal fasting blood glucose levels are when the results are above 100 mg/dL. The fasting blood glucose levels of the study subjects showed that 10 people (16.7%) were included in the abnormal level category for fasting blood glucose. The remaining 50 people (83.3%) were in the normal blood sugar category. The fasting blood glucose levels in the findings were still within normal limits, with a few study subjects having abnormal levels. However, this does not rule out the possibility of insulin resistance that begins to occur in individuals with obesity.[22]

Triglyceride levels are one of the components that meet the criteria for metabolic syndrome. Based on the criteria from the World Health Organization (WHO) and the International Diabetes Federation (IDF) for triglyceride levels are 150 mg/dl.[15] The results of the examination showed that 13 subjects (21.7%) were included in the high triglyceride level category. The remaining 47 subjects were included in the normal triglyceride level category.

HDL cholesterol levels have the effect of reducing the risk of atherosclerosis of blood vessels, including one of the criteria for metabolic syndrome. Based on WHO criteria, the limit value of HDL levels is different for men and women. HDL is categorized as metabolic syndrome for men if the level is <40 mg/dl. While for women, if the HDL level is <50 mg/dl.[12] The results of the study showed that most of them were in the high HDL category, namely 57 people (95%). The remaining 3 people were in the low HDL category. The normal BMI group had higher HDL levels than the excessive BMI group with a significant difference (MD: 9,534; 95% CI: 1.68-17.39; p = 0.018). These results indicate that HDL levels are likely to be the first change in the increase in BMI in individuals.[12]

CONCLUSION

From the research, data on the characteristics of anthropometric indices were obtained that describe general obesity and central obesity, as well as the characteristics of the components of metabolic syndrome in FK Trisakti employees. To assess the relationship between the anthropometric index and the components of metabolic syndrome, it is necessary to continue with appropriate statistical tests as mentioned above.

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AUTHORS CONTRIBUTION

Study conception, design: AT, DN, CS, MS; data collection: AT, DN, CS, KM, LP, analysis, interpretation of results, manuscript preparation: AT, DN, CS, MS, KM, LP; All authors reviewed the results and approved the final version of the manuscript.

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CONFLICT OF INTEREST

In this study, no conflict of interest was found.

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