Correlation of Three Anthropometric Parameters with the Percentage of Body Fat and Visceral Fat in the Productive Age Group

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Research Article

Correlation of Three Anthropometric Parameters with the Percentage of Body Fat and Visceral Fat in the Productive Age Group

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Abstract

Currently, obesity is a problem for both developed and developing countries. Obesity nutritional status is associated with body fat levels, central obesity and is associated with various diseases. This study analyzes the correlation between body mass index, waist circumference, and the ratio of waist to hip to body fat percentage and visceral fat based on gender. An observational analytic study with a cross-sectional design, involving sixty-three employees aged 19-60 years in February 2021. Subject characteristics data were collected using a questionnaire, in addition to physical examination to obtain anthropometric data in the form of weight, height, waist circumference, hip circumference. Data on the percentage of body fat and visceral fat were obtained using the Mi body composition digital tool. The Pearson's correlation test was used for analysis and the significance level used was 0.05. A total of 49.2 % of subjects were categorized as obese based on body mass index. In the male group, there was a strong and significant positive correlation between BMI, WC, with the percentage of body fat and visceral fat with p =0.000. However, in female subjects, a significant positive correlation was found between BMI, WC with visceral fat in women with p = 0.000. BMI, WC, and WHR correlated strongly with body fat and visceral fat levels in men. In the female group, BMI and WC were strongly correlated with visceral fat.

Keywords: anthropometric, fat, visceral

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INTRODUCTION

Lifestyle changes and activity restrictions that occur today can increase the incidence of obesity and can become a public health problem in the future. A total of 1.4 billion people aged 20 years and over were reported to be overweight by the WHO in 2008, with a prevalence of obesity of 10% in men and 14% in women of the entire world population. The incidence of obesity is not only increasing in developed countries such as the United States, but there is also an increase in the prevalence of obesity in developing countries such as in Indonesia is at 2.4% and in Saudi Arabia, the prevalence of obesity is estimated at around 5.6%. [1] Based on the 2018 Regional Headquarters data, the prevalence of obesity in Indonesia is 21.8%. [2]The problem of obesity is experienced by several groups of society, including toddlers, school-age children, adolescents, adults, and the elderly. Based on data from the DKI Jakarta health office in 2017, the prevalence of obesity was thirty-five percent. [3]

Someone who is obese tends to have excess body visceral fat. Abdominal circumference is an indicator that can be used to estimate visceral fat. An increase in the percentage of visceral fat is associated with the occurrence of central obesity. [4-6] Another factor that causes obesity is the lack of structured physical activity, both daily activities and structured physical exercise. Physical activity conducted from childhood to old age will affect lifelong health. Obesity in childhood will increase the risk of obesity in adulthood. The cause of obesity is considered 'multicausal' and very multidimensional because it does not only occur in high socioeconomic groups but also often lower middle class. Obesity is influenced by environmental factors compared to genetic factors. The main risk factors that cause obesity are behavioral, namely unhealthy eating patterns coupled with insufficient fiber (fruit and vegetable) consumption, physical inactivity, and smoking. [7]

The nutritional status reflects the state of balance in the form of certain variables, especially related to food intake. Assessment of nutritional status can be done directly or indirectly. Direct assessment includes: anthropometric, clinical, biochemical, and biophysical examinations. Several anthropometric parameters can be used to assess obesity such as body mass index (BMI) can be obtained from weight and height data, which can also use waist circumference (WC), waist-to-hip ratio (WHR), the waist-to-height ratio of the body. In addition, the percentage of body fat can be used as an indicator of obesity. Measurement of body fat percentage requires expensive specialized tools and examiner skills. So that some simple anthropometric indicators BMI, WC, WHR used in society to measure obesity.

The use of BMI parameters to assess obesity status has a weakness, BMI cannot distinguish between body fat mass and lean body mass. A person with a low BMI may have extremely

high-fat mass and vice versa. Population-based studies have found that women have a lower BMI than men, although when measured using other parameters they fall into the obese category. BMI was not originally developed specifically to measure the obesity index in population studies but is widely used because it is easy to perform. [7,8]

In men, BMI cannot be used as an indicator of body fat percentage, so additional anthropometric examinations are needed to measure obesity in men. [9] Several other studies linked to body mass index indicators and other researchers used waist circumference, waist-to-hip ratio to assess the correlation with body fat percentage. [9-11] Based on the pros and cons of using several parameters to predict body fat percentage, this study aims to determine the correlation between body mass index, waist circumference, and waist-hip ratio with the percentage of body fat and visceral fat by gender.

METHOD

This research is an analytic observational study with a cross-sectional design, conducted in February 2021. This study included sixty-three research subjects. Inclusion criteria for men and females aged 19-60 years, willingness to participate in the study, and signed informed consent. The exclusion criteria were consuming alcohol, having a history of malignancy, kidney failure, history of hospitalization in the last 1 month, and consuming cholesterol-lowering drugs. Physical examination in the form of height, weight, waist circumference (WC), hip circumference (HC), and body fat percentage. The number of research samples was calculated using an infinite-finite population formula, with the prevalence used being 35%, the accuracy level used was 0.05. Based on the calculation of the formula, the number of subjects required is 63 subjects. A consecutive nonrandom sampling method was used in collecting the subjects of this study.

Subjects were asked to wear minimal clothing and not use footwear during anthropometric measurements, bodyweight measurement using digital scales with an accuracy of 0.1 kg. WC and HC were measured using the nearest 0.1 cm tape measure. The Mi body composition digital tool (accuracy = 0.1%) is used to obtain body fat percentage data, which is statistically accurate by means of a series complex algorithm and advanced Bioelectrical Impedance Analysis (BIA). At the time of measurement of height, the subject was asked to stand upright and the position of the heels, buttocks, and shoulder blades against the wall. HC was measured for maximal gluteal protrusion, WC was measured in a standing position at the midpoint between the lowest rib and the iliac crest and at the end of a normal expiration, using a tape measure.

Before measuring the percentage of body fat and visceral fat, the subjects were asked to clean their feet first. The examiner inputs data on the subject's gender, age, and height before the subject stands on the instrument. Trained personnel performed measurements. BMI calculation using the W/H^2 formula. BMI in subjects was grouped into not obese (BMI<25), obese (≥25). According to WHO criteria waist circumference, grouped normal <90 cm normal, obese ≥ 90 cm for men, and normal < 80 cm, obese ≥80 cm for females. Waist Hip Ratio Criteria According to WHO the cut-off point waist-hip waist ratio for Asians is normal if WHR < 0.9 for men and WHR < 0.8 for women. Data analysis was conducted by using Statistical Package for Social Sciences version 25. The descriptive data were reported in mean, standard deviation, frequency, and percentage. The correlation between anthropometric measures was examined using Pearson's correlation test at significance level ≤ 0.05. The ethical approval of this research was obtained from the Research Ethics Commission of the Faculty of Medicine, Universitas Trisakti No172/KER/FK/XII/2020.

RESULTS

Data table 1 shows the mean patient aged 42.14 ± 8.78 years. A total of 26 (41.3%) subjects were male and thirty-seven subjects (58.7%) were female. The mean height was 164.54 and 157.05 cm for men and females, while the average body weight of the subjects was 67.7 kg and 64.34 kg for men and females. Based on the body mass index value of the research subjects, the average BMI of the female is higher 26.18 than that of men 24.97. The average percentage of body fat in females is higher (36.13±7.16) than in men (24.22±8.27). The ethnic group of the research subject is dominated by the Javanese ethnic group.

Table 1. Demographic and anthropometric characteristics of research subjects (N=63)

Characteristics	Total	Male	Female
Number of subjects	63	26	37
Tribes			
Betawi	3		
Javanese	40		
Sundanese	13		
Minang	4		
Nias	2		
Dayak	1		
Age (year)	42.14 ± 8.78	43.27 ± 9.93	41.35 ± 7.93
Height (cm)	160.14 ± 7.06	164.54 ± 6.63	157.05 ± 5.63
Weight (kg)	65.72 ± 12.44	67.70 ± 15.50	64.34 ± 10.22
Waist circumference (cm)	88.63 ± 10.65	90.16 ± 12.63	87.59 ± 9.05
Body mass index (kg/m^2)	25.68 ± 4.83	24.97 ± 5.07	26.18 ± 4.66
Waist to hip ratio	0.87 ± 0.07	0.92 ± 0.07	0.84 ± 0.05
Percentage body fat	31.9 ± 9.61	24.22 ± 8.27	36.13 ± 7.16
Visceral fat	8.46 ± 3.75	9.81 ± 4.44	7.51 ± 2.87

All values are means ± SD

The results of this study showed that 46.2% of male subjects were included in the obese category based on BMI and WHC criteria, more men were included in the non-obese category. Meanwhile, based on the WC value, 57.7% of male subjects were included in the obese criteria. More female subjects were found to be obese based on the criteria for BMI, WC, and WHR with values of 51.4%, 75.7%, and 70.3%. Based on the BMI category, 31 (49.2%) research subjects were included in the obese category (Table 2).

Table 2: Prevalence of obesity based on BMI, WC, WHR in participant

Variable	N	Not obese	Obese
BMI			
Men	26	14 (53.8%)	12 (46.2%)
Female	37	18 (48.6%)	19 (51.4%)
WC			
Men	26	11 (42.3%)	15 (57.7%)
Female	37	9 (24.3%)	28 (75.7%)
WHC			
Men	26	14 (53.8%)	12 (46.2%)
Female	37	11 (29.7%)	26 (70.3%)

Based on Table 3, in male subjects, there was a strong and significant positive relationship between BMI, WC with the percentage of body fat and visceral fat with p = 0.000. Meanwhile, the correlation between WHR with the percentage of body fat and visceral fat was found to have a significant correlation with p values = 0.003 and p = 0.013, with a statistically moderate correlation strength. However, in female subjects, a very weak and not significant correlation was found between BMI, WC, and body fat percentage. Furthermore, a significant positive correlation was found between BMI, WC, and visceral fat in women with p = 0.000 and p = 0.000. Positive correlation with weak correlation strength and not significant obtained WHR and percentage of body fat and visceral fat in women.

Table 3: Pearson's correlation coefficient BMI, WC, and WHR with the percentage of body fat and visceral fat

Variables	% Body Fat		Visceral fat	
	r	p	r	p
Men				
BMI	0.683	0.000*	0.778	0.000*
WC	0.705	0.000*	0.819	0.000*
WHR	0.567	0.003*	0.480	0.013*
Female				
BMI	0.069	0.686	0.761	0.000*
WC	0.005	0.974	0.788	0.000*
WHR	0.039	0.819	0.289	0.082

P< 0.05

DISCUSSION

In this study, the prevalence of obesity based on BMI was 49.2%. Where this figure is higher than the prevalence rate reported by the Khabazkhoob study [12] the study obtained an obesity prevalence rate of 31%. Likewise in Omar's study [13], the prevalence rate of obesity was 32.2%. This is due to differences in the age of research subjects and different research locations. The subject of this research is mostly Javanese ethnicity. Indonesia is a country with various ethnic groups. Differences in ethnicity will affect consumption patterns and macronutrient intake. Ethnic differences affect the type of food consumed and the way it is processed. Diversity and the cultural uniqueness of an ethnic group certain society is a form of ideas, feelings, actions, and works that participate from the physical characteristics of food (menus, patterns, and basic ingredients of food). Connection culture of food or food marked by the type of menu, how to process and serve by tribe nation. The level of food consumption (carbohydrates, protein, and fat) in terms of quality and quantity will affect a person's level of health. If the quantity of consumption exceeds the body's needs, it will cause a state of excess nutrition and even obesity. [14,15]

In this study, the percentage of body fat in men was lower than in women. Women's body fat is used for hormonal function and the need for childbirth, so women have a higher percentage of body fat. At puberty, you will begin to see

differences in body fat based on gender. Compared to women, men had lower fat mass but had greater total body mass, arm muscle mass, and bone mineral mass. Women have more essential adipose tissue and fat distribution in the periphery (hips), thighs, accumulation occurs in the lower body segment (gynecoid). Distribution of upper body fat (android) tends to occur in men. A condition in which there is an accumulation of excess fat in the body is known as obesity. Obesity conditions, especially central obesity, which is characterized by fat accumulation in the abdomen, are a risk factor for various degenerative diseases such as stroke, heart disease, diabetes mellitus, and others. Degenerative/non-infectious diseases are currently the biggest cause of death for the world's population. An increased risk of bone and joint damage also occurs in someone with obesity, this can increase the risk of falls or accidents. A person with obesity tends to have excess visceral body fat. Visceral fat is body fat that collects in the midsection and covers the internal organs. Excess visceral fat is closely related to several diseases such as an increased risk of cardiovascular disease, metabolic syndrome (hypertension, dyslipidemia, and type II diabetes), and insulin resistance. [6,10-13]

In our results, the average waist circumference of men is greater than that of women. WC is one of the alternative parameters for markers of body fat mass, especially subcutaneous and abdominal fat. WC can be used to assess central obesity. The study by Koscinski concluded that WC was negatively related to the hormone estradiol in females, but positively related to the hormone testosterone in men so WC in females was lower than men. The value of WC is greater in men causes a higher WHR in men than women [14] A study in Belgium concluded that there was a strong positive correlation between BMI and waist circumference. To identify an elevated risk of disease related to body weight, the use of WC is better than using the BMI classification, especially in women. The use of BMI cannot identify cardiovascular risk in men. The risk of diabetes mellitus in women was not identified by using WC. [11]

In this study, a strong and significant positive correlation was found between BMI, WC, and WHR with the percentage of body fat in men. Different results were obtained for the female sex, a very weak and not significant correlation between BMI and WC and body fat percentage was obtained. The same results were also obtained in another study It was concluded that there is a relationship between BMI and body fat. BMI can be used as a good determining parameter to assess whether a person is obese or not. BMI is an effortless way to do with a direct calculation method using height and weight. Obesity can be caused by several factors including hormones, genetics, and the environment. These things are generally more common in women. However, the biggest determinant of body fat percentage and an indication of BMI is a lifestyle (diet, physical activity) which does not depend on gender. everyone has the same risk for obesity, and BMI is one of several methods for indication of obesity. [20,21]

A study by Ranasinghe C in Sri Lanka concluded that in the adult population BMI is highly correlated with body fat percentage. Age and gender had a significant effect, and this relationship was curved even at BMI values < 30 kg/m^2. Age and gender are factors that need to be considered when estimating obesity/body fat percentage in a population. The relationship between BMI and body fat percentage increases with age. With age, there will be an increase in body fat, this is made possible by several conditions such as absence/lack of physical activity, lack of protein intake resulting in protein malnutrition, muscle atrophy occurs, especially in the elderly group. [20-22] Another study concluded that BMI, WC, and the ratio of waist circumference to height (WHtR) were significantly more correlated with each other than the correlation of these parameters with the percentage of body fat in all age groups and sex. In men, body fat percentage correlates more significantly with WC than with BMI, while in women body fat percentage is more significantly with BMI than with WC. [23]

In male subjects, the increase in BMI, WC, and WHR values was in line with the increase in visceral fat. In contrast to women, only the increase in BMI and WC was strongly correlated with visceral fat and was statistically significant. In contrast to other studies, the study of Swainson MG et al concluded that of the five anthropometric variables (BMI, WC, WHR, WhtR, and waist circumference/height 0.5 (WHT.5R), WhtR was the best variable/parameter to measure fat percentage, and visceral mass, as well as adipose tissue. This WHtR can be used as a proxy measure suitable for both sexes, in both males and females. [24] The results of a study in China found that in patients with the comorbid disease, abdominal fat accumulation or ectopic fat can be predicted by measuring WC and WHtR. Central obesity (fat accumulation in the abdomen) is a significant risk factor for metabolic disease compared to indicators of obesity in general. Body fat and lean mass were indistinguishable by measurement of BMI, whereas WC was more reflective of visceral obesity than BMI. [25,26]

A study in Ghana concluded that body fat has a strong correlation with waist circumference, whereas BMI has only a weak correlation with body fat. Indicators of measuring body fat can be shown as waist circumference and hip circumference. Waist circumference indicates fat accumulation in the abdomen (midsection), associated with an increased risk of several diseases. WC can be used as a reliable indicator to assess visceral fat. [27] The limitations of this study are several factors such as psychological conditions, food recall, genetic factors, vitamin D receptor polymorphisms, and hormonal status.

CONCLUSIONS

BMI, WC, and WHR correlated strongly with body fat and visceral fat levels in men. In the female group, BMI and WC were strongly correlated with visceral fat.

Conflicts of Interest

The authors do not have any conflict of interest to declare.

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IFSC code: YESB0000569 **Swift Code:** YESBINBB **MICR:** 326532002

Bank Address: NH-12, Patan Road Jhalawar, Rajasthan-326001, India

Option 2: WESTERN UNION Money Transfer (WUMT) Details is below:

Receiver First Name: Karan Raj Receiver Last Name: Gautam
Phone: +91-9571225094
Address: S/O-Pyare Lal Gautam, R/O-Bohra, Teh-Khanpur, District- Jhalawar, State-Rajasthan, India, **PIN-** 326038 **Country: I**NDIA

Option 3: PayPal –
Email: dhakarvinita@gmail.com **Link: https://www.paypal.com/invoice/p/#7GX76HV5KBTCV8V6**

In case we do not hear from you within the stipulated time, we may postpone the publication until the next issue.

We value your support of our journal and Thank you for considering this journal as a venue for your work. If you have any questions, please do not hesitate to contact us.

Regards:

Ram C Dhakar, Editor

Journal of Drug Delivery and Therapeutics(JDDT)

Website: jddtonline.info

editor.jddt@gmail.com, +91-9783920207

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Editor, Journal of Drug Delivery and Therapeutics
Website: jddtonline.info
+91-9783920207 Email: editor.jddt@gmail.com

2 Attachments • Scanned by Gmail

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Meiyanti Meiyanti Feb 26, 2022, 7:25 PM

Dear Editor and team, Regarding this, I send you these files: - Copyright Transfer Agreement (CTA transfer-proof for handling and process

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Meiyanti Mar 1, 2022, 11:04 AM

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Dear Editor and team. I have not received the final proof of my paper, Please provide information a

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Meiyanti Meiyanti <meiyanti@trisakti.ac.id> Mar 2, 2022, 2:31 PM

to Editor

Dear Editor JDDT and teams,
thank you for the information.
We inform you that there are no changes needed.

Warm regards,
Meiyanti
meiyanti@trisakti.ac.id

M ReplyForward