Comparison of Simple Tools For Measurement Of Obesity With Anthropometric Examination As A Predictor Of Metabolic Syndrome

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Abstract. Visceral fat shows a stronger relationship with the incidence of metabolic syndrome and cardiovascular risk than subcutaneous fat tissue. Visceral fat inhibits the action of adiponectin, so the body produces more fat than what we need. This study aims to compare simple tools for measuring obesity and visceral fat as predictors of metabolic syndrome. This research was a cross-sectional study with a sample of 50 subjects, the type of research was comparative and correlational. The variables in this study were bioelectric impedance analysis (BIA), skinfold thickness (ST), body mass index (BMI), waist circumference (WC), and waist-hip ratio (WHR) results. Data were analyzed with paired t-test and Pearson correlation test. There was a significant difference in body fat examination using BIA with ST (p=0.000). Body fat examination using BIA correlates with BMI, WC, and WHR (p=0.000). On the other hand, body fat examination using ST correlates with BMI and WC (p=0.000) but not with WHR (p=0.151). In conclusion, BIA and ST measurements were different, however, there was a significant correlation between BIA and ST. Body fat examination results of both BIA and ST correlate with other anthropometric examinations, except between ST and WHR.

1 Introduction

Metabolic syndrome is a metabolic disorder that is a risk factor for cardiovascular disease, which consists of central obesity, dyslipidemia hypertension, and abnormal plasma glucose. The above conditions are closely related to a systemic disorder known as insulin resistance. Obesity is associated with insulin resistance, especially with the accumulation of abdominal fat or central obesity [1].

Body mass index and waist circumference are used to assess adiposity, but anthropometric examinations provide less information about the anatomic locations where excess fat is deposited. This is important because several studies have shown that visceral fat tissue shows a strong correlation with the incidence of metabolic syndrome and cardiovascular risk than subcutaneous fat tissue [2].

Based on the National Health and Nutrition Examination Survey (NHANES) in America, between 1999-2006, the prevalence of metabolic syndrome increased from 29.2% to 34.2%. Most occur in women aged 20-39 years [3]. In Bali the prevalence of metabolic syndrome, in rural areas as much as 18.2%, and increases with age. It was also found that the prevalence of central obesity was as much as 35% [1]. About 17% of American adolescents are obese, and about 30-50 percent of obese people have metabolic syndrome., 30-40 percent have hepatic steatosis, and 15-30 percent have type 2 diabetes. This is a serious problem that requires prevention and treatment [4].

There are several simple tests to determine obesity or not, such as skinfold thickness, body mass index, waist circumference, waist-hip ratio, and bioelectric impedance analysis. Skinfold thickness examination error in estimating visceral fat is 3%-11% and the measurement is highly dependent on the skill of the examiner. In addition, because the conversion of skin thickness results to visceral fat is influenced by age, ethnicity, and gender, establishing predictive equations for the individuals who will be tested is very important [5].Examination with BIA is faster and easier, but accuracy decreases when sick, dehydrated, with weight loss, and at a BMI of more than 35. A study of 50 samples of dialysis patients found a significant relationship between BIA and ST examinations [6]. 157 elementary school children in Depok showed a significant relationship between BIA and ST [7]. BIA examination on 85 adult and elderly patients showed a significant relationship with body mass index and waist circumference [8].Researchers want to compare simple tools for measuring obesity and visceral fat as predictors of metabolic syndrome.

2 Material and Methods

This research was a cross-sectional study, and type of research was comparative and correlational, which were described and analyzed the comparison of simple tools for measuring obesity and visceral fat as predictors of metabolic syndrome. This the research was conducted in Banjar Tegeha Village, Banjar District, Buleleng

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Regency. The population in this study were residents of the village of Banjar Tegeha, aged 30-60 years. The sample in this study was taken by simple random sampling. The number of samples were 50 people were taken by calculating Harry King nomogram. Samples were taken from residents of Banjar Tegeha village aged 30-60 years who already met the inclusion criteria. The inclusion criteria in this the study were (a) Men aged 30-60 years and women aged over 30 years and before menopause, (b) willing to participate and sign an informed consent. (c) must be cooperative and reside in the Banjar Tegeha Village Area, Banjar District. While the exclusion criteria in this study was (a) using and having used contraceptive pills or injections and other hormone replacement drugs such as estrogen, blood lipid-lowering drugs such as statins and fibrates, (b) smoking, (c) pregnancy, (d) ascites.

The data collection technique in this study was to test and measure obesity and visceral fat using the following tools: (1) Bioelectric impedance analysis: Using Omron Fat Loss Monitor (HBF-306), (2) Skinfold thickness using a skinfold caliper measured in 4 body points (*biceps, triceps, subscapularis, suprailiaca*) 4 times in a row and unit in mm, and is calculated using the Durnin/Womersley method, (3) Waist circumference: Measured in standing position. Clothing or measurement barriers are removed. Place the measuring tape on the top edge of the *crista iliaca dextra*. Then the tape measure is looped around the abdominal wall at the level of the *crista iliaca*. Make sure that the measuring tape is not pressing too tightly against the skin. Waist circumference units in cm, (4) waist hip ratio: the stomach must relax, and the waist measurement is above the navel. Then, to measure the hips, the largest hip circumference is determined, and then the comparison between waist and hip is calculated, (5) Body Mass Index: BW/height2 where BW is body weight in kilograms and height in meters. Body weight was measured using the Omron Body Scale Digital. Data analysis using paired t-test and Pearson correlation test. The data is processed using the SPSS 20.0 program

3 Result and Discussions

3.1 Description of Data

3.1.1 Gender

The number of male samples was 16 people and female samples were 34 people.

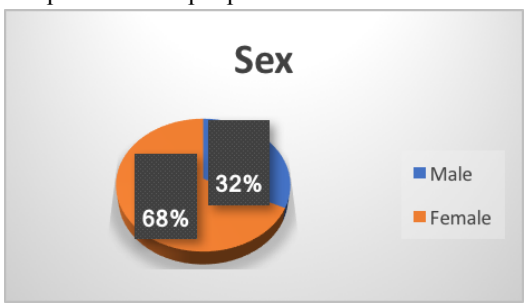

Figure 1. Gender Description

3.1.2 Body Mass Index

The number of samples with normal BMI was 21 people, overweight BMI was 13 people, and obese BMI was 16 people.

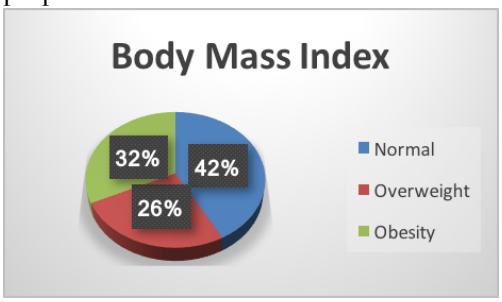

Figure 2. BMI Description

3.1.3 Body Weight

Mean is 69.65, the median is 66.75, the mode is 55, the standard deviation is 14.73

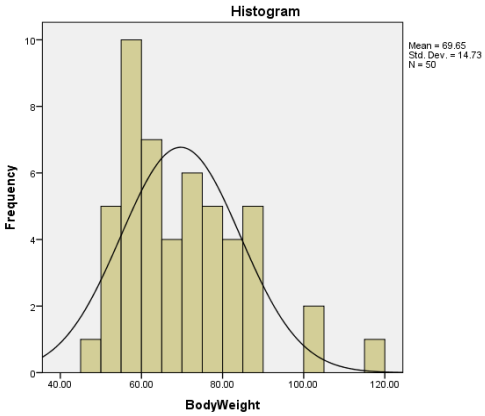

Figure 3. Body Weight Description

3.1.4 Height

Mean is 160.16, the median is 159.25, the mode is 165, the standard deviation is 8.79

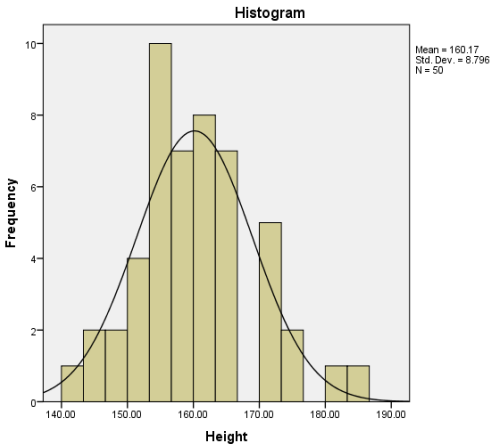

Figure 4. Height Description

3.1.5 Waist to Hip Ratio

The number of samples with low risk is 35 people, and the number of samples with high risk is 15 people.

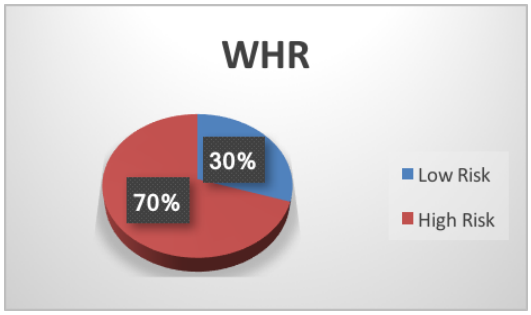

Figure 5. WHR Description

3.1.6 Waist Circumference

The number of samples with a low risk of metabolic syndrome was 24 people, and 26 people with a high risk of metabolic syndrome.

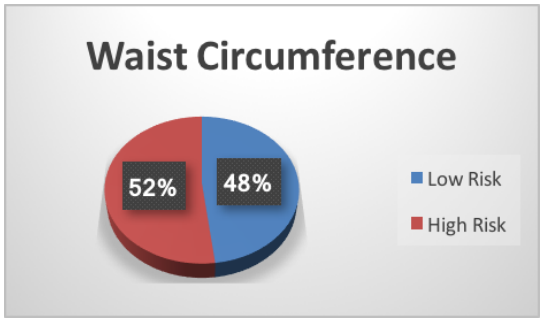

Figure 6. WC Description

3.1.7 Body Fat by BIA examination

Normal was 22 people, high body fat, very high body fat 14 people.

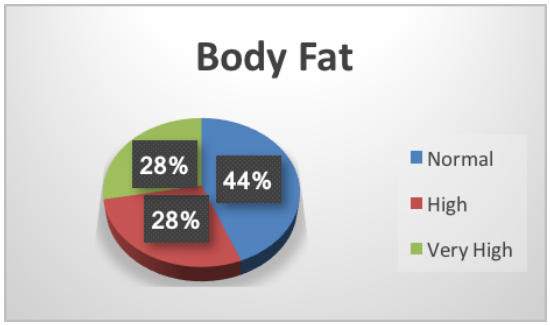

Figure 7. Body Fat by BIA examination

3.1.8 Body fat by skinfold examination

Thin 1 person, normal 14 people, overweight 9 peoples, obesity 26 peoples.

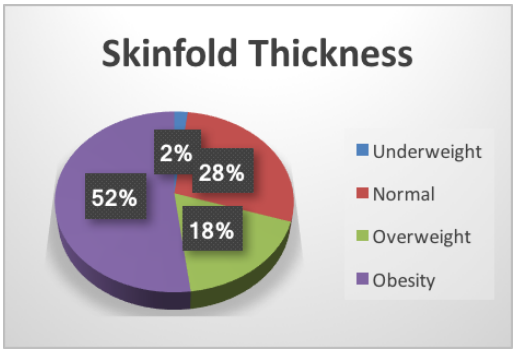

Figure 8. Skinfold Thickness Examination

3.2 Results

3.2.1 Comparison of the results of an examination of body fat using bioelectric impedance analysis and skinfold thickness

Based on the paired T-test, there were differences in the

Table 1. Results of comparison examination of body fat using bioelectric impedance analysis and skinfold thickness

	Paired Differences		**Sig, (2-tailed)**
	Mean	**Std Deviation**	
BIA Skinfold	-.94920	2.70901	.017

results of the examination between bioelectric impedance analysis and skinfold thickness. The average body fat examination results using bioelectric impedance analysis was 30.58% while using skinfold thickness (caliper) was 31.53%. The results obtained were significantly different ($p = 0.017$). These results can be seen in Table 1.

3.2.2 Relationship of body fat examination using bioelectric impedance analysis with skinfold thickness results

Table 2. Relationship of body fat examination using bioelectric impedance analysis with skinfold thickness

		BIA	**Skinfold**
BIA	Pearson Correlation	1	0.554
	Sig. (2-tailed)		0.000
	N	50	50
Skinfold	Pearson Correlation	0.554	1
	Sig. (2-tailed)	0.000	
	N	50	50

Based on the results of the Pearson correlation test, there was a significant relationship between the examination of body fat using bioelectric impedance analysis and the

examination of body fat using a skinfold caliper. It was found a significance of 0.000 ($p < 0.01$), these results can be seen in Table 2.

3.2.3 The relationship of body fat examination using bioelectric impedance analysis (BIA) with the waist circumference, body mass index, and waist-hip ratio

Table 3. The relationship of body fat examination using bioelectric impedance analysis (BIA) with the waist circumference, body mass index, and waist-hip ratio

		BMI	WC	WHR	BIA
BMI	Pearson Correlation	1	.789**	.450**	.920**
	Sig. (2-tailed)		.000	.001	.000
WC	Pearson Correlation	.789**	1	.804**	.877**
	Sig. (2-tailed)	.000		.000	.000
WHR	Pearson Correlation	.450**	.804**	1	.639**
	Sig. (2-tailed)	.001	.000		.000
BIA	Pearson Correlation	.920**	.877**	.639**	1
	Sig. (2-tailed)	.000	.000	.000	

Based on the results of the Pearson correlation test, there was a very significant correlation between BIA and waist circumference ($p = 0.000$), a significant correlation between BIA and waist-hip ratio ($p = 0.000$), and a significant correlation between BIA and BMI ($p = 0.000$). These results can be seen in Table 3.

3.2.4 Correlation between skinfold thickness examination with waist circumference, body mass index, and waist-hip ratio

Table 4. Relationship of skinfold thickness examination with waist circumference, body mass index, and waist-hip ratio

		BMI	WC	WHR	ST
BMI	Pearson Correlation	1	.789**	.450**	.711**
	Sig. (2-tailed)		.000	.001	.000
WC	Pearson Correlation	.789**	1	.804**	.525**
	Sig. (2-tailed)	.000		.000	.000
WHR	Pearson Correlation	.450**	.804**	1	.206
	Sig. (2-tailed)	.001	.000		.151
ST	Pearson Correlation	.711**	.525**	.206	1
	Sig. (2-tailed)	.000	.000	.151	

Based on the Pearson correlation test, there was a significant relationship between skinfold thickness examination and BMI ($p = 0.000$), a significant relationship between skinfold thickness and waist circumference ($p = 0.000$), and an insignificant relationship between skinfold thickness and the ratio hips ($p=0.151$), these results can be seen in Table 4.

3.3 Discussion

Differences in the results between the examination of body fat using bioelectric impedance analysis and skinfold thickness. Based on the paired t-test, there were differences in the results of the examination between bioelectric impedance analysis and skinfold thickness. The average body fat examination results using bioelectric impedance analysis was 30.58% while using a skinfold caliper was 31.53%. The results obtained were significantly different ($p = 0.017$). This difference was in accordance with the theory that the ST examination error in estimating visceral fat is 3%-11% and the measurement was highly dependent on the examiner. In addition, because of the conversion of skin thickness results of visceral fat were influenced by age, gender and ethnicity established predictive equations for the individuals to be tested is very important [5]. Examination with BIA was faster and easier, but accuracy decreases when you were sick, dehydrated, weight loss and at a BMI of more than 35. From With this theory, it could be concluded that skinfold thickness examination needs accuracy and was highly dependent on the skill of the examiner. This causes the the difference in results between BIA examination and skinfold thickness.

Relationship of body fat examination using bioelectric impedance analysis with skinfold thickness results. Based on the Pearson correlation test, there was a significant correlation between the examination of body fat using bioelectric impedance analysis and the examination of body fat using a skinfold caliper. Obtained a significance of 0.000 ($p < 0.01$). The results of this study were in line with research conducted by Gracia [6], on 50 samples of dialysis patients, which found a significant relationship between BIA and ST examinations. This study was also strengthened by Arini [7], on 157 elementary school children in Depok showed a significant relationship between BIA and ST examinations.

The relationship between examination using bioelectric impedance analysis (BIA) with the examination of waist circumference, body mass index, and waist-hip ratio. Based on the Pearson correlation test, there was a relationship between BIA and waist circumference ($p = 0.000$), a relationship between BIA and waist-hip ratio ($p = 0.000$), and a significant relationship between BIA and BMI ($p = 0.000$). This study is in line with that conducted by Menezes (2012) who found a very significant relationship between BIA examination with BMI and waist circumference. In particular, visceral fat was more likely to play a role in insulin resistance and metabolic syndrome. From the results of this study, it could be explained that the BIA examination has the same results as BMI, waist

circumference, and WHR. This was very important in identifying obesity. So that the examination becomes more objective.

The relationship between skinfold thickness examination and waist circumference, waist-hip ratio and BMI. Based on the Pearson correlation test, there was a very significant relationship between skinfold thickness examination and BMI (p = 0.000), a very a significant relationship between skinfold thickness and waist circumference (p = 0.000), and an insignificant relationship between skinfold thickness and the ratio hips (p=0.151). Obesity was an important risk factor for diabetes, dyslipidemia, hypertension, and heart disease [2]. BMI and waist circumference was commonly used to assess adiposity, but anthropometric examinations provide less information about the anatomic locations where excess fat is deposited. This was very important because several studies had shown that visceral fat tissue showed a stronger relationship with the incidence of metabolic syndrome and cardiovascular risk than subcutaneous fat tissue. From the results of this study, it could be explained that the ST examination had the same results as other anthropometric examinations in identifying obese patients with body fat indicators as a risk factor for metabolic syndrome. Although there was no significant relationship between ST examination and WHR, most of the anthropometric examinations such as waist circumference and BMI were associated with ST.

4 Conclusion

There were differences in the results of body fat examination by using bioelectric impedance analysis with skinfold thickness. However, there was a correlation between body fat examination using bioelectric impedance analysis with skinfold thickness. Body fat examination using bioelectric impedance analysis correlates with body mass index, waist-hip ratio, and waist circumference. On the other hand, body fat examination using a skinfold caliper correlates with body mass index and waist circumference but not with waist-hip ratio.

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