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Correlation between body mass index and waist circumference among diabetes mellitus patients in Denpasar, Bali

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ABSTRACT

Background: Obesity is one of the most important modifiable risk factors for type 2 diabetes. There are two types of obesity the general obesity which measured using the body mass index (BMI) and central obesity measured by using waist circumference (WC) or waist/hip ratio. This research aims to investigate the correlation between body mass index and waist circumference among diabetic patients in Indonesian population.

Methods: The study was carried out using the cross-sectional plan, by analyzing the secondary data that was collected from previous research on diabetic patients that was conducted in Medical Faculty of Universitas Udayana, Bali. The research was done in 4 months from October 2015 - January 2016, and the data was categorized based on BMI, WC, gender, age, family history of diabetes and duration of diabetes mellitus.

Results: On a total of 96 sample there were 5 (5.2%) were having general obesity BMI >30 kg/m^2, while 61(63.5%) were having central obesity, where the WC measurement for a male was >102 cm and for a female was >88 cm. From the study, it proves that there was a strong correlation in between BMI and WC ($r = 0.752$, $p < 0.01$). It indicates the correlation was positive and significant.

Conclusions: It is concluded that people who have a higher BMI tend to have a higher waist circumference value and with that, both the BMI and WC strongly correlate. As a suggestion, it is recommended to conduct the study using primary data for future research.

Keywords: body mass index, waist circumference, obesity, diabetes mellitus

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INTRODUCTION

Obesity is defined as an excessive fat accumulation deposited in subcutaneous tissue, around organ, and sometimes distributed into visceral organ. Obesity is caused by an imbalance of energy between consumed calories and expended calories in a long term, influenced by environmental and genetic factors. Increased fat accumulation is a risk factor that causes degenerative diseases such as diabetes mellitus, coronary heart disease, and hypertension.[1]

Body mass index (BMI) and waist circumference (WC) has been shown to be associated with type 2 diabetes. From the clinical perspective, central obesity approximated by WC or waist/hip ratio is known to generate diabetogenic substances and should, therefore, be more informative than general obesity by BMI. Because of their high correlation, from the statistical perspective, BMI and WC are unlikely to yield different answers. To compare associations of diabetes incidence with BMI and WC, the authors conducted a meta-analysis based on published studies from 1966 to 2004 retrieved from PubMed research was conducted.[2]

Obesity plays a central role in the insulin resistance syndrome, which includes hyperinsulinemia, hypertension, hyperlipidemia, type 2 diabetes mellitus, and an increased risk of atherosclerotic cardiovascular disease. The incidence of type 2 diabetes reported in children has increased alarmingly.[3]

Obesity, in particular, abdominal adiposity, is associated with increased risk of diabetes mellitus and also cardiovascular disease. The prevalence of diabetes mellitus is increasing, and already in the United States, the lifetime risk of developing diabetes mellitus is high: 33% for men and 38% for women. Given that patients with diabetes mellitus have at least a 2-fold higher risk of cardiovascular mortality than non-diabetic patients, obesity has become a major clinical and public health problem that threatens to overwhelm already extended healthcare services in many countries.[4]

Obesity also has become a major worldwide epidemic affecting more than 300 million people. It is an important risk factor for diabetes mellitus type 2, a chronic disorder of carbohydrate, fat, and protein metabolism. From the clinical perspective, the visceral adipose tissue is known to generate diabetogenic substances and, as such, may be more informative than total fat for diagnostic evaluation. The standard epidemiologic translation of these important clinical facts uses anthropometric measures. WC and waist/hip ratio have been used as

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measures of central obesity where visceral adipose tissue is stored, and body mass index (kg/m^2) has been used as a measure of general obesity.[5]

Measures of association were transformed to log relative risks per standard deviation which was pooled across all studies, increase in the obesity indicator and pooled using random effects models. The pooled relative risks for incident diabetes were 1.87 (95% confidence interval (CI): 1.67, 2.10) and 1.87 (95% CI: 1.58, 2.20), per standard deviation of BMI and WC respectively, demonstrating that these two obesity indicators have similar associations with diabetes. Although the clinical perspective focusing on central obesity (waist circumference) is appealing, further research is needed to determine the usefulness of waist circumference over body mass index.[2]

Clinical evidence suggests that the association of diabetes with central obesity is stronger than the association with general fat, which is WC and waist/hip ratio have been used as measures of central obesity and body mass index has been used as a measure of general obesity. Central obesity has been associated with decreased glucose tolerance, alterations in glucose-insulin homeostasis reduced metabolic clearance of insulin, and decreased insulin-stimulated glucose disposal. With the rapidly increasing diabetic population, it is of uttermost importance to determine the occurrence of obesity in these diabetic patients and treat it at the earliest by implementing suitable lifestyle measures.[6]

According to the 2005 International Diabetes Federation (IDF) criteria, subsequently revised in 2009, abdominal obesity is identified as the WC of ≥ 80 cm in women and ≥ 94 cm in men. It is responsible for the development of insulin resistance which decreases the levels of the HDL-cholesterol fraction, increases the levels of triglycerides, and leads to the development of arterial hypertension. All of the disorders mentioned above contribute to metabolic syndrome and are related to the development of type 2 diabetes and ischemic heart disease.[7]

Based on this background, a study to finding the correlation in between BMI and WC among diabetic patients in Denpasar was conducted.

METHODS

This study was an analytic study with cross-sectional approach. This study aimed to know the correlation in between BMI and WC among diabetic patients in Denpasar. The data used in this study is a secondary data collected from previous research on diabetic patients that was conducted in Medical Faculty of Universitas Udayana, Bali. This study was done in 4 months from October 2015 - January 2016. 96 diabetic patients who live in the area of Denpasar were included in this study. The data was categorized based on BMI, WC, gender, age, family history of diabetes and duration of diabetes mellitus. The data were analyzed using Pearson's Correlation Test by using the SPSS software package.

RESULT

The characteristic of diabetic patients who lives in the area of Denpasar was showed in table 1. Most of the diabetic patients were males, which is 50 patients or 52.1%. However, the female diabetic patient were 46 patients (47.9%). Most of the diabetic patients had a family history of diabetes mellitus (65.6%). Most of them were suffering from diabetes mellitus for 1 to 5 years (55.2%) Whereby, the number of patients that has suffered from diabetes mellitus

Table 1 Characteristic of diabetic patients who live in the area of Denpasar

Characteristic	Frequency (n=96)	Percentage (%)
Gender		
Male	50	52.1
Female	46	47.9
Age (year)		
30-40	5	5.2
41-50	33	34.4
51-60	40	41.7
60-70	18	18.8
BMI		
<18.5 kg/m^2	6	6.3
18.5-24.9 kg/m^2	52	54.1
25-29.9 kg/m^2	33	34.4
30-39.9 kg/m^2	5	5.2
>40 kg/m^2	0	0
WC		
<70 cm	5	5.2
70.1-79.9 cm	8	8.3
80-99.9 cm	65	67.7
>100 cm	18	18.75
Family History		
Yes	63	65.6
No	33	34.4
Duration of Diabetes Mellitus (year)		
1-5	53	55.2
6-10	32	33.3
11-15	10	10.4
>15	1	1.0

Table 2 **The Correlation of Obesity based on BMI and Waist Circumference according to Gender**

	Waist Circumference	BMI	r
Male	28	2	0.58; P <0.01
Female	33	3	0.67; P <0.01
Total	61	5	0.752; P<0.01

for more than 15 years was only 1.0%. Most of the diabetic patients had BMI ranging from normal to grade 1 overweight (34.4%). The data also showed that most of the patients have WC ranged from 80-99.9 cm (67.7%)

According to the data obtained, diabetes mellitus patients that have general obesity (BMI >30 kg/m^2) were 5 patients (5.2%) and with central obesity (WC: female >88cm; male > 102 cm) were 61 patients (64.6%). In this study, WC was found to be significantly correlated with BMI (r = 0.752, P < 0.05) (table 2).

DISCUSSION

The correlation between BMI and WC in patients with diagnosed diabetes mellitus in this study were compared, which was done using the Pearson correlation. The components were distinguished of diabetes mellitus patients according to subject sex. It is determined that the correlation between BMI and WC occurred in each of the studied subgroups. It was determined that in the subgroup of a female with diabetes mellitus, the correlation between BMI and WC (r = 0.67, P < 0.01) was more pronounced than in the subgroup of the male. The correlation is the lowest (r = 0.58) in the subgroup of a male with diagnosed diabetes mellitus. It is probably due to the small size of the subgroup (n = 28). In this study, WC was found to be significantly correlated with BMI (r = 0.752, P < 0.05). The results showed that between BMI and WC has a very strong correlation. In whereby means the hypothesis is accepted where the increase in BMI increases WC.

Based on the survey conducted the association of body mass index and WC, with incident diabetes was confirmed in the study by the significant correlation. When comparing the associations in the subset of studies with both body mass index and WC, the association of female was slightly stronger when compared with male. Nevertheless, none of these differences was statistically non-significant. A recent meta-analysis of the association of body mass index and incident diabetes found similar results, although this study differed in some analytical aspects in estimating study level relative risk, study selection, and target population. Because this study is focused on reporting the measure of central obesity and general obesity, there are fewer studies included in the analyses.

Another study has supported the use of WC as a measure of obesity to predict health risk. Among their arguments are that WC has been shown to be a good or better predictor than body mass index of the metabolic syndrome, diabetes, cardiovascular disease, and all-cause mortality, it provides information about health risk in addition to body mass index, and it is conceptually easy to measure, although it does require some training and standardization.[8]

However, others have noted that substitution of BMI by WC as an indicator of risk for diabetes may be an oversimplification. Some counterarguments are that WC is strongly correlated to body mass index. WC does not differentiate between subcutaneous fat and visceral fat; it has not been shown that a consistent association exists between WC with visceral fat after adjustment for age and BMI and body fat distribution is different across racial, sex, and age strata.

Other indicators have been suggested to describe fat distribution associated with abdominal obesity. For example, the subscapular or triceps skinfold ratio has been used to describe central versus peripheral obesity. The waist/hip ratio and the waist/thigh ratio have been used to identify upper versus lower body obesity. Also, other indices, such as waist/height ratio, and abdominal to mid-thigh girth, have been developed by a variety of criteria. However, ratios are more difficult to interpret biologically.[5] From this study, it is proven that the number of people obese by WC is greater in number compared to the patients that are obese by BMI. It indicates that it is also established that obesity could be one of the fundamental risk factors that cause diabetes mellitus since the number of people with obese is higher than the number of people who are not among the diabetic patients.

LIMITATION

This study has a limitation that is the measurements of the patients were not done by the researcher; it was secondary data from previous research. As a suggestion, it recommended conducting the study using primary data for future research.

CONCLUSION

Based on the results of this research it is confirmed that there is a strong linear correlation between WC and BMI values. It was concluded that people who have a higher BMI tend to have a higher waist circumference value and with that, both the

BMI and WC strongly correlate. The presence of overweight in men and even normal body weight in women corresponds to an increased volume of visceral tissue in the abdomen. In by mean even if they have a normal BMI value but if their WC is more than the normal values than they are considered to have abdominal or central obesity. Introduction of primary prophylaxis in those people to limit the development of diabetes mellitus diseases should be considered.

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