

Waist to height

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Waist to height ratio (0.5) as a predictor for prediabetes and type 2 diabetes in Indonesia

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Abstract. Obesity has become a big problem for many countries. One of the anthropometric measures of risk factor for type 2 diabetes is waist to height ratio (WtHR). Unfortunately, WtHR is varies depend on the different race of nations in the world. There is no standard size that applied internationally. The aim of this study was to find the WtHR cut-off point to predict prediabetes and type 2 diabetes for Indonesia population. This is a cross sectional study. Based on data from National basic health research of Indonesia, year 2013. Subjects aged 15-65 years, that performed fasting glucose and 2 hours post-prandial, height, weight and waist circumference. Total subjects of 26.213 data were analyzed using Stata version 12. The cut-off point of WtHR is 0.5 for male and females to predict the risk of prediabetes and type 2 diabetes for Indonesian population. There is no difference between male and female. WtHR is the best anthropometric measure compared than BMI and waist circumference themselves. WtHR has an AUC = 0.5613 for prediabetes and 0.6606 for type 2 diabetes. Waist circumference >75cm (male) and >80cm (female) and BMI is 22.89kg/m² as the cut-off point for predicting prediabetes and type 2 diabetes. The WtHR can be used as a screening tool for predicting risk of prediabetes and type 2 diabetes for Indonesia community. It is a simple, practical and cheap method to predict the risk of prediabetes thus more people can be tested the blood glucose as an early diagnosis and prompt treatment.

1. Introduction

Obesity is a metabolic disorder that most commonly affects humans. Currently the world's obese people continues to increase. Research since the 1990s shows an increasing prevalence of obesity in Asia. More than 5% of the Asian population is obese and 20% had excess weight (overweight). In 2012 about 24% of men and 25% of women adult age worldwide are obese, including obesity II (morbidly obese). [1] In Indonesia, prevalence of central obesity at >15 years of age was 18.8%, A total of 47 provinces have central obesity prevalence above national prevalence, namely North Sumatra, Bengkulu, Bangka Belitung, Riau Islands, Jakarta, West Java, East Java, Banten, Bali, East Kalimantan, North Sulawesi, Central Sulawesi, South Sulawesi, Gorontalo, North Maluku, West Papua and Papua. National proportion of obese with BMI >25 kg/m² is 19.7% (men) and 14.8% (women), in 2007 [2].



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Obesity is defined as an excessive accumulation of fat in the body tissues. This hoarding can occur throughout the body or in certain places, for example in the abdominal area which is more commonly referred to as central obesity or abdominal obesity. The distribution of fat in the body is measured by using anthropometry such as Body Mass Index (BMI), waist circumference and the ratio of waist-to-hip (waist to hip ratio). [3-5] Obesity sizes can also be determined by Waist to Height Ratio (WtHR). Parameter of WtHR is varies according to the different types of nations in the world. There is no standard sizes that can be used. [6-7] The WtHR is commonly used as a predictor for cardiometabolic diseases, such as coronary heart disease and diabetes mellitus. The WtHR that is used as a predictor for diabetes mellitus among aboriginals is 0.5, while in the State of Turkey is 0.59. [7] Other research in the world, among others in Taiwan, Iran, Chile and China also suggested the cut-off point of 0.5 to WtHR was a predictor for the risk of cardiometabolic diseases [8].

The relationship between body fat distribution and risk of type 2 diabetes mellitus has been widely studied in various countries including Japan, China, Finland and the United States. [8-10] In 2007, Mihardja found the numbers of impaired glucose tolerance (IGT) or impaired glucose tolerance was 10.2% for people aged >15 years. The prevalence of DM 6.4% (female) and 4.9% (male). The proportion of impaired glucose test (TGT) age of 15-24 years is 5.3%. The prevalence increased sharply at the age of 35-54 years. Determinant factors of patients with IGT and diabetes are age, smoking, obesity, central obesity and hypertension. [11], Research conducted by Pramudya got diabetes prevalence of 5.6% and the undiagnosed diabetes at 4.1% among people aged >15 years using data Riskesda 2007, While the prevalence of IGT or prediabetes reached 10.0% [12].

Most people, are diagnosed as diabetes in health centre or medical practitioners just by chance, most of them do not realize suffering of diabetes, it is called undiagnosed diabetes. Undiagnosed diabetes is very alarming, because diabetes is a chronic disease that affects the long complications and attacks all organs, for example neurogenic, blood vessels, kidneys, eyes, brain, skin, etc. Patient often comes to the doctor is already in a state of more complications. The prevalence of undiagnosed diabetes in Indonesia reached 4.1% of total 5.6% of people with diabetes. [12] Research conducted in Beijing in 2013 found that the proportion of undiagnosed diabetes approximately 5.1% and there is a significant relationship with the WtHR. The higher WtHR, the higher risk of developing type 2 DM. [13] So, the WtHR is a good predictor for predicting type 2 diabetes. [14-18] Most of studies showed that the central obesity and waist circumference were used to predict cardiometabolic diseases in general, but not specifically for the risk of type 2 diabetes, especially the risk of prediabetes. Waist circumference size has the disadvantage of high stature especially for entities that are not in accordance with waistlines [19-23].

2. Prediabetes

Prediabetes is defined as a situation where the results of the fasting blood sugar (fasting plasma glucose) is 100-125 mg/dL or value 2 hours postprandial blood glucose 140-199 mg/dL. Meanwhile, according to the value of A1C = 5.7%-6.4% for prediabetes. The prediabetes condition, has a value high enough glucose levels, but can not be categorized as diabetes. If the risk factors persist in someone who already have prediabetes condition, they will suffer from diabetes later. Approximately 5-10% of people with prediabetes condition will develop into diabetes, and vice versa can also return to normal. By the year of 2030, the prevalence of prediabetes will increase, and estimated about 470 million people will suffer from prediabetes. [21] The prevalence of prediabetes was 7.3% and 12.1% diabetes, prediabetes risk associated with obesity or overweight, hypercholesterolemia and hypertension [22].

3. Waist to Height Ratio (WtHR)

Body mass index (BMI) is not able to distinguish between mass due to body fat mass or because of physical muscle. Likewise, BMI does not take into account the distribution of body fat. Therefore, it has been suggested to measure waist circumference, the ratio of waist and hip (WHR) or the waist to height ratio that is expected as a better measure than BMI to identify people with risk factors for disease in people suffering overweight or obese. [1] Waist circumference >102 cm in men and >88 cm in women

as a risk factor for metabolic syndrome, abdominal obesity according to the definition used by the National Institutes of Health (USA) ATP (Adult Treatment Panel) III.

The low waist circumference in male is <94cm, moderate = 94-102cm, and very high >102cm, women with low waist circumference is <80 cm, moderate = 80-88 cm, and very high > 88cm. Waist circumference is a very good measure to determine the content of visceral fat in the abdomen. However unclear the effect of the height of the waist circumference and visceral fat in the abdomen. Some studies suggest no effect, while other studies say no impact. Height however will not improve prediction of waist circumference were associated with risk of incident diabetes in later life. [23] However, the height may increase the ability of waist circumference in predicting the incidence of diabetes in the woman's native to Mexico and Spain, [24], the presence of diabetes prevalence differences between ethnic groups / populations may relate, among various other factors related to the degree of obesity. Until now there has been no single indicator that is superior and consistent in predicting the incidence of diabetes in the future someday. Differences in the prevalence of diabetes in different ethnic populations are especially dependent on how to measure obesity. Height will be a confounding factor in the ability of waist circumference in predicting the incidence of diabetes mellitus caused by difference height between ethnic and population.

Therefore height, body fat distribution, and or intra-abdominal fat plays an important role as a measure of obesity in predicting the incidence of diabetes mellitus in various ethnic / population in the future. Research suggests that waist circumference is better than BMI and the WtHR is better in predicting the incidence of diabetes among women [24].

4. Research Methodology

This was cross-sectional study using the data based from National basic health research of Indonesia, year 2013. Subjects aged 15-65 years old that perform blood sugar (fasting and 2 hours post-prandial), height, weight and waist circumference. There is only 26,213 subjects data could be analysed. A numbers of 9,028 subjects were excluded because they did not have full filled data.

Diagnosis of prediabetes and diabetes was used by ADA (American Diabetes Association) year 2016. Diabetes has a value of fasting blood glucose (fasting glucose) >125 mg/dL or 2 hours post prandial >=200 mg/dL. While the diagnosis of prediabetes if the fasting glucose test results ranged from 100-125 mg/dL, 2 hours post prandial glucose 140-199 mg/dL. Data were analyzed using by Stata version 12.

5. Results

Table 1. Frequency of diabetes status according to fasting blood glucose and 2 hours post-prandial blood glucose

Diabetes status	n	%
Normal	11,233	42.85
Prediabetes	11,787	44.97
Diabetes	3,193	12.18
Total	26,213	100.00

Table 2. Comparison of Area under Curve (AUC) based WtHR, Waist Circumference and BMI for predicting Prediabetes and Type 2 Diabetes

Predictor	Status	Cut point	Male			Cut point	Female		
			Sensitivity	Specificity	AUC		Sensitivity	Specificity	AUC
WtHR	- Prediabetes	0.46	53.99	53.38	0.5605	0.51	54.77	54.00	0.5607
	- Diabetes	0.48	63.04	62.00	0.6688	0.53	61.90	61.90	0.6477
	Overall (male and female)								
	- Prediabetes	0.49	54.23	54.01	0.5613				
	- Diabetes	0.51	62.39	62.00	0.6605				
WC	- Prediabetes	>=75	53.78	51.91	0.5491	>=75	53.78	51.91	0.5543
	- Diabetes	>=77	60.93	60.34	0.6490	>=80	61.05	59.84	0.6381
BMI	- Prediabetes	22.31	54.00	53.04	0.5442				
	- Diabetes	22.89	59.16	58.63	0.6165				

*WtHR= waist to height ratio, WC= waist circumference, BMI= body mass index

6. Discussion

The results show the magnitude of the prevalence of type 2 diabetes mellitus at the age of 15-65 years is 12.18%, while the prevalence of prediabetes amounted to 44.97%. This figure is very alarming, when compared with the prevalence of diabetes in 2007 was 5.6%. (Pramono, et al), which means there is an increase of 100% more. Even that is quite surprising is the number of prediabetes is so large, even exceeding the number of people who have normal blood sugar levels. It is said that the tendency of people with prediabetes will become diabetic patient by 5-10%, if not done in risk factor modification. The high prevalence of DM also related to the others factors such as smoking, obesity (abdominal circumference, height) and physical activity [25-28].

Cut-off point WtHR= 0.5 does not show the difference between men and women, this means that the size of WtHR can be used in general, do not need to consider the gender. As one measure of the predictor of the risk of prediabetes and diabetes incidence, WtHR has an AUC = 0.5613 for prediabetes, meaning that at the point of intersection of 0.5 WtHR able to distinguish by 56.13% at risk for prediabetes. Meanwhile, the AUC = 0.6606 means WtHR at the cut-off point of 0.5 is able to distinguish the 66.06% risk for diabetes. There are no significant differences according to gender prediction. [6,16] WtHR size is better than the body mass index (BMI), which only has a AUC = 0.5442 (54.42%) for prediabetes and 0.6165 (61.65%) for type 2 diabetes [3,7,9,14].

The size of waist circumference as a predictor of diabetes for Indonesians was smaller than the Europeans. We found that the waist circumference >75cm (male) and >80cm (female) as the cutoff point for predicting diabetes and prediabetes type 2. [17,28,29] As well as the size of BMI, is obtained at the cutoff point = 22.89, it is definitely smaller at the obesity index for Indonesia population (>25kg/m²).

The WtHR can be used as a screening tool for predicting risk of prediabetes and diabetes in the community. It is a simply, practical and cheap method to predict the risk of prediabetes thus more people can be tested the blood glucose as an early diagnosis and prompt treatment to reduce the prevalence of type DM.

7. Conclusion

- The prevalence of prediabetes and diabetes respectively 44.97% and 12.8%.
- The cuStoff point of WtHR was 0.5 for males and females to predict the risk of type 2 diabetes and prediabetes fairly for Indonesian population.
- WtHR size is the best anthropometric measure compared than BMI and abdominal circumference itself.
- By simply reducing WtHR <=0.5 will decrease the risk of type 2 diabetes and prediabetes.

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