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Waist Circumference and Metabolic Syndrome: A Review

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Author's contribution

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Review Article

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ABSTRACT

It is known that there is an increasing in prevalence of metabolic syndrome worldwide. The most investigated component of metabolic syndrome is waist circumference. The World Health Organization reported that waist circumference is the easiest and most efficient anthropometric index to be used in many studies. Waist circumference gives information on the general and abdominal obesities. Many different studies on waist circumference have been exhibited that it is a significant component of metabolic syndrome which is in relation to various diseases and risk factors for various ethnicities. It has been shown that waist circumference is a better predictor than body mass index in metabolic syndrome detection. The purpose of present review is to converse waist circumference variations in metabolic syndrome.

Keywords: Waist circumference; metabolic syndrome.

1. INTRODUCTION

It is known that there is an increasing in prevalence of metabolic syndrome worldwide. This increase may associate with the elevation of obesity and sedentary lifestyles [1]. The most investigated component of metabolic syndrome is waist circumference. The World Health

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Organization (WHO) has reported that waist circumference (WC) is the easiest and most efficient anthropometric index to be used in many studies [2]. It estimates fatness and fat location. Many studies have exhibited that waist circumference is associated with body mass index (BMI) and body fat percentage [3-8]. Some investigations have shown that the localization of abdominal fat is more significant than the total amount of body fat in the prognoses of type 2 diabetes. They have indicated that the predictive effect of the waist circumference was same as effect of the waist circumference and the body mass index [9]. Marjani et al. [10-11] have shown that the waist circumference has a weaker correlation with the body mass index compared with the body fat percent in diabetic patients. It has been indicated that body mass index and waist circumference have positive correlation with the number of metabolic syndrome factors among postmenopausal women [12]. The Lobo's study exhibited that there is a relationship between the elevation of weight and obesity, and the elevation of prevalence of metabolic syndrome among postmenopausal women [13]. It is indicated that waist circumference is in correlation with the amount of visceral adipose tissue [14]. It has revealed that alteration in waist circumference was a better predictor of alteration in the visceral adipose tissue [15]. Waist circumference gives information on the general and abdominal obesities (abdominal subcutaneous fat and the visceral adipose tissue) [16]. An elevated waist circumference is associated with increased risk factors. It may correlate with accumulation of visceral fat [17]. Studies have shown that there is a correlation between the abdominal visceral adipose tissue deposition and an elevation in the portal free fatty acid level [14,18]. Many studies have indicated that the modification of waist circumference guidelines were suggested for the different ethnic groups [19-20]. Several studies have been shown that different ethnic groups indicate various prevalence of elevated waist circumference. Ford et al. exhibited that Hispanics and blacks showed higher waist circumferences than whites [21]. Bacha et al. [22] reported that black and white adolescents had different visceral fat levels. Study on waist circumference according to ATP III criteria showed that the prevalence of metabolic syndrome altered by race. It has been also reported that waist circumferences showed no differences between white and Filipino women. But Filipino women indicate higher prevalence of metabolic syndrome than white women which had the same waist circumference [23]. Bacha and Okosun et al. [22,24] have been shown that there are correlation between waist circumference elevation and increased rates of high blood pressure, high insulin and high triglyceride levels in different ethnic groups. Elevated waist circumference in Hispanics and blacks people showed correlation with elevated rates of diabetes and high triglycerides and high prevalence of hypertension, respectively [24-25]. Study of Bacha et al. [22] on waist circumference have been exhibited that it is a significant component of metabolic syndrome which is in relation with various diseases and risk factors for various ethnicities. It has been shown that waist circumference is a better predictor than BMI in metabolic syndrome detection. The purpose of present review is to converse waist circumference variations in metabolic syndrome.

2. DIFFERENT DEFENITIONS OF METABOLIC SYNDROME

There are many different defining criteria for metabolic syndrome. Some of these defining criteria are the same. The definition of metabolic syndrome according to different criteria as is explained below:

- A) In 1999, the World Health Organization (WHO) criteria [26] requires the presence of any one of diabetes mellitus, impaired glucose tolerance, impaired fasting glucose or insulin resistance, and two of the following criteria:

1. Blood pressure: $\geq 140/90$ mmHg
 2. Dyslipidemia: triglycerides (TG): ≥ 1.695 mmol/L and high-density lipoprotein cholesterol (HDL-C) ≤ 0.9 mmol/L (male), ≤ 1.0 mmol/L (female)
 3. Central obesity: waist: hip ratio > 0.90 (male); > 0.85 (female) or body mass index > 30 kg/m²
 4. Microalbuminuria: urinary albumin excretion ratio ≥ 20 μ g/min or albumin: creatinine ratio ≥ 30 mg/g
- B) In 1999, the European Group for the Study of Insulin Resistance (EGIR) requires insulin resistance defined as the top 25% of the fasting insulin values among nondiabetic individuals and two or more of the following [26]:
1. Central obesity: waist circumference ≥ 94 cm (male), ≥ 80 cm (female)
 2. Dyslipidemia: TG ≥ 2.0 mmol/L and/or HDL-C < 1.0 mmol/L or treated for dyslipidemia
 3. Hypertension: blood pressure $\geq 140/90$ mmHg or antihypertensive medication
 4. Fasting plasma glucose ≥ 6.1 mmol/L
- C) In 2001, the US National Cholesterol Education Program Adult Treatment Panel III (NCEP) requires at least three of the following [27]:
1. Central obesity: waist circumference ≥ 102 cm or 40 inches (male), ≥ 88 cm or 36 inches (female)
 2. Dyslipidemia: TG ≥ 1.7 mmol/L (150 mg/dl)
 3. Dyslipidemia: HDL-C < 40 mg/dL (male), < 50 mg/dL (female)
 4. Blood pressure $\geq 130/85$ mmHg
 5. Fasting plasma glucose ≥ 6.1 mmol/L (110 mg/dl)
- D) In 2004, the AHA/NHLBI creates another set of guidelines or simply updates the NCEP ATP III definition (American Heart Association/Updated NCEP) [28-29].
1. Elevated waist circumference: Men: greater than 40 inches (102 cm), Women: greater than 35 inches (88 cm)
 2. Elevated triglycerides: Equal to or greater than 150 mg/dL (1.7 mmol/L)
 3. Reduced HDL ("good") cholesterol: Men: Less than 40 mg/dL (1.03 mmol/L), Women: Less than 50 mg/dL (1.29 mmol/L)
 4. Elevated blood pressure: Equal to or greater than 130/85 mm Hg or use of medication for hypertension
 5. Elevated fasting glucose: Equal to or greater than 100 mg/dL (5.6 mmol/L) or use of medication for hyperglycemia.
- E) In 2006, the International Diabetes Federation (IDF) consensus worldwide definition of the metabolic syndrome. Central obesity defined as waist circumference with ethnicity-specific values and any two of the following [30]:
1. Raised triglycerides: > 150 mg/dL (1.7 mmol/L), or specific treatment for this lipid abnormality
 2. Reduced HDL cholesterol: < 40 mg/dL (1.03 mmol/L) in males, < 50 mg/dL (1.29 mmol/L) in females, or specific treatment for this lipid abnormality

3. Raised blood pressure (BP): systolic BP > 130 or diastolic BP >85 mm Hg, or treatment of previously diagnosed hypertension
4. Raised fasting plasma glucose (FPG): >100 mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes. If FPG is >5.6 mmol/L or 100 mg/dL, an oral glucose tolerance test is strongly recommended. If BMI is >30 kg/m², central obesity can be assumed and waist circumference does not need to be measured.

3. DISCUSSION

Waist circumference is associated with elevated visceral adipose tissue. There is collaboration between insulin resistance, glucose intolerance, and abnormal lipid profiles and elevated visceral adipose tissue [31]. There is an association between visceral fat metabolism and elevation in circulation of free fatty acid, reduce liver uptake of insulin and elevate insulin circulation. This may eventually cause glucose intolerance [32]. Therefore, waist circumference (central adiposity) is more special than body mass index in identification of some risk factors for cardiovascular disease such as metabolic syndrome. In several epidemiologic studies, significance of waist circumference in prognoses of high blood pressure, dyslipidemia, hyperglycemia, diabetes, Coronary Heart Disease and mortality have been indicated [33-40]. Some other studies have shown that waist circumference is significant in prognoses of diabetes, Coronary Heart Disease and rate of death, without dependence on blood pressure, blood glucose and lipoproteins [33,36]. The association between waist circumference and cause of disease may be influenced by gender, age and different ethnic groups [41]. Investigators have paid attention to obesity and its relation with cardiovascular disease [42]. It has been shown that obesity in different disease is not screened as a usual practice which is a significant component of cardiovascular disease estimation [43]. Many studies have exhibited that waist circumference has used as a risk factor for cardiovascular disease [44,45]. Studies of the Hoorn and Katzmarzyk et al. have indicated that metabolic syndrome presence elevated in general cardiovascular risk, but there were very small differences in prognoses of the prevalence of coronary artery disease and death rate when it use different definitions of metabolic syndrome [46,47]. High waist circumference as an index for visceral obesity is the most important component for metabolic syndrome [14, 44,45]. It has been reported that metabolic syndrome itself gives a higher risk for cardiovascular disease when compared to every single components of metabolic syndrome [48,49]. Alexander et al. showed that after modifying every single components of metabolic syndrome like high blood pressure, insulin resistance, and low HDL-cholesterol, metabolic syndrome did not prognosis as a risk factor for coronary artery disease [50]. In studies on Iranian population indicated that BMI and WC have the similar power to foretell metabolic syndrome and in another study showed significance of waist circumference in risk stratification of metabolic syndrome in adult people [51-55].

4. CONCLUSION

Waist circumference shows an important indicator body fat distribution. It is in relation to elevated risk factors for cardio-metabolic disease. Determination of waist circumference may occasionally give some useful information for the diagnosis of cardio-metabolic risk factors, like dyslipidemia and hyperglycemia. Choice of suitable waist circumference values may be complicated. Waist circumference is depended on gender, age, different ethnic groups and body mass index. This is important that clinician may pay attention to waist circumference measurement by different defining criteria for metabolic syndrome in the future.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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