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Original Article

Waist Stature Ratio: A Measure of Adiposity and Body Fat Composition in Asian Indian

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Abstract

Background: The imbalance between the energy ingested in food and expended can lead to obesity. It is regarded as one of the most prominent but ignored public health issues of today and threatens to inundate the health care resources through increasing clinical consequences and additionally as a financial burden. Hence, the identity of individuals with health dangers using easy, surrogate measures to estimate excess adiposity becoming very important. In this regard, the purpose of this study is to evaluate the incidence of obesity, considering commonly used obesity measures, and also to discern the best obesity predictor among the adult Bengalee females of West Bengal, India. **Research Method:** Participants included 210 healthy adult Bengalee women (mean age 43.06 ± 3.4 years). Following standard procedure, anthropometric measures were taken for height, weight, hip circumference, and waist circumference. Waist-to-hip and waist-to-stature ratios were then computed. A fat monitor was used to calculate body fat percentage. **Results:** Out of all the adiposity measures, Waist Circumference ($r = 0.78$, $P<0.001$), Hip Circumference ($r = 0.74$, $P<0.001$), and Waist Hip Ratio ($r = 0.72$, $P<0.001$), the results showed that Waist Stature Ratio had the largest positive connection ($r = 0.88$, $P<0.001$) with Percent Body fat. **Conclusion:** Therefore, the current study indicated that among Asian Indian middle-aged women, WSR may be the most appropriate marker for PBF.

Keywords: *Public Health; Obesity; Anthropometry; Waist Stature Ratio (WSR); Chronic Diseases*

Introduction

An imbalance between the intake of energy from food and energy expenditure is what defines obesity. Therefore, the excess energy stored in fat cells which eventually leads to weight gain i.e., obesity (Bray, 2004). Currently, the World Health Organization (WHO) and many other national and international organizations have formally classified obesity as a disease (Müller *et al.,* 2017). According to the Obesity Medicine Association, obesity is a multifactorial, relapsing, neurobehavioral condition that is persistent and recurrent. It is caused by abnormal fat mass physical forces and adipose tissue dysfunction, which can have detrimental effects on one's metabolic, biomechanical, and psychosocial well-being (Bays *et al.,* 2020). The World Health Organization (WHO, 2008) depicted obesity as one of the most advanced, conspicuously apparent, and often disregarded public health issues. The word "globesity" was coined to represent the rapidly spreading worldwide epidemic of overweight and obesity. Research (Meldrum *et al.,* 2017; Venkatrao *et al.,* 2021) has shown that obesity prevalence is approaching pandemic levels globally. WHO (WHO, 2020) projected that in 2016, over 650 million adults (13%) and over 1.9 billion adults (39%) globally were obese and overweight, respectively. However, the current trajectory of events (Kelly *et al.,* 2008) suggests that by 2030, almost half of the population in this sector may be overweight or obese.

Many chronic diseases have excess obesity as a major risk factor (Grey *et al.,* 2011), and any disease whose risk is raised by obesity can be classified into one of two pathophysiological groups. The increased mass of fat itself is the fundamental cause of the impairments, which consist of the stigma of obesity and psychosocial issues (bad body picture perception, low self-esteem, depression, and reduced quality of life) and even osteoarthritis. In contrast, the second category included risks associated with metabolic abnormalities brought on by excess fat, such as diabetes mellitus, gallbladder disease, hypertension, cardiovascular disease, problems related to reproductive health (from infertility to subfertility, such as polycystic ovarian syndrome), and certain cancers (Bray, 2004). Besides this, obesity not only threatens to inundate the health care sources by increasing different clinical

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consequences, but it is also an economic burden. It debts for 2% to 7% of total healthcare costs, including some other which consists of decreased quality of life and productiveness loss along with disability-adjusted existence years (DALYs) (Chong *et al.,* 2023) attributed to medical leave (WHO/FAO). Moreover, social risks, unemployment, and a decline in socioeconomic productivity are linked to it (Blüher, 2019). It seems improbable that India's health budget could cover the costs of treating the related consequences of obesity. Thus, to avoid both the early and late consequences of the disease, a nation like India needs to take the necessary measures for an early diagnosis.

In light of this, effective diagnostic instruments to pinpoint those who are excessively obese have become crucial (Rakić *et al.,* 2019). As a result, there is growing interest in concentrating on low-cost, easily measured anthropometric markers like height, weight, and circumferences (Han *et al.,* 2006). Several anthropometric measures have already been used to measure central and total adiposity, including Body mass index (BMI), waist circumference (WC), hip circumference (HC), waist-to-hip ratio (WHR), and waist stature ratio (WSR) (Bergman *et al.,* 2011). Researchers (Janssen *et al.,* 2004; Brambilla *et al.,* 2013) noted that anthropometric measures for central obesity are marginally better predictors of elevated levels of health risk factors in populations of all ages than overall obesity as measured by BMI. WC and WHR (Sahakyan *et al.,* 2015) were used as proxies for central/visceral obesity whilst WSR is a proxy for visceral adipose tissue (Ashwell *et al.,* 1996; Roriz *et al.,* 2014). An ample number of studies (Hsieh *et al.,* 1995; Shao *et al.,* 2010; Ashwell and Gibson, 2016; Vasquez *et al.,* 2019; Ashwell and Hsieh, 2005) have been conducted to compare the effectiveness of the WSR versus BMI and other indices in identifying individuals who are at risk of obesity and the exceptional metabolic syndrome that goes along with it. These studies have established that the WSR has several advantages over BMI, or even WC and WHR, when it comes to identifying health risks in women and men, across various ethnic groups, and at all ages. Even though several previous meta-analyses (Vazquez *et al.,* 2007; de Koning *et al.,* 2007; Czernichow *et al.,* 2011) failed to demonstrate a significant advantage of abdominal obesity indices over BMI or among the aforementioned indices that measure abdominal obesity. Hence, the crucial question is which anthropometric measure is the most straightforward and accurate in suggesting "early health risk" of an individual as prevention of obesity and related non-communicable illnesses may not be feasible until obesity is accurately evaluated.

Objectives

Within this context, the current study aimed to assess the prevalence of obesity taking into account all regularly used obesity indicators and to identify the most reliable obesity predictor among adult Bengalee females in West Bengal, India.

Research Methodology

The present study consisted of 210 adult Hindu caste Bengalee females residing Bally, Howrah, West Bengal. Informed consent was obtained from each participant prior to the study and as well Institutional ethical clearance has been obtained (Ref No. CUIEC/02/15/2022-23). Measurements such as Height, Weight, HC, WC were taken from each participant using the standard protocol (Weiner and Lourie, 1981). BMI [WT (kg) / HT (m2)], WHR [WC (cm) / HC (cm)], and WSR [WC (cm) / HT (cm)] were calculated using the standard formulae (Fauziana *et al*., 2016; Choi *et al*., 2018; Morais *et al*., 2018). PBF was assessed by an OMRON body scanner with a scale following the instruction manual.

Results

Table 1 represents the general distribution of the age, anthropometric measurements, and body composition characteristics. Based on the BMI cut-off value (table 2), the frequency of being overweight and obese was estimated to be 25.23% and 10%, respectively. Examination of the prevalence of obesity based on percent body fat (PBF), WC, WHR, and WSR as presented in Table 3 revealed that the frequency of obesity is higher according to WSR (46.19%) compared to PBF (42.38%) followed by WC (34.28%) and WHR (31.90%). In terms of predicting Percent Body Fat (PBF), Table 4's multiple regression analysis of central obesity measures showed that WSR had the strongest positive correlation ($r = 0.88$, $p<0.001$) with PBF when compared to other measures of adiposity, such as WC ($r = 0.78$, $p<0.001$), HC ($r = 0.74$, $p<0.001$), WHR ($r = 0.72$, $p<0.001$), and Conicity Index (CI) ($r = 0.42$, $p<0.001$).

Table 1: Age and Anthropometric Variables

Variables	Mean	SD (±)
Age (in year)	43.06	3.42
Height (cm)	152.09	6.45
Weight (kg)	58.5	14.54
HC (cm)	97.36	5.89
WC (cm)	84	8.61
BMI	25.45	13.48
WHR	0.86	0.8
WSR	0.54	0.07
PBF (%)	31.17	6.74

Table 2: Obesity and overweight based on BMI categories (WHO, 2004)

BMI	Total	Frequency (%)
Non-obese	136	64.76
Overweight	53	25.23
Obese	21	10

Table 3: Obesity based on PBF, WC, WHR and WSR

Variables	Total Overweight	Frequency (%)	Normal	Frequency (%)
PBF	89	42.38	121	57.61
WC	72	34.28	138	65.71
WHR	67	31.90	143	68.09
WSR	97	46.19	113	53.80

Table 4: Stepwise Multiple Regression Analysis of Central Obesity Measures in Predicting Percent Body Fat

Model[a]	r	adj R^2	F	*p*
1.	0.889	0.781	779.92	< 0.001
2.	0.909	0.830	1025.1	< 0.001
3.	0.912	0.832	879.41	< 0.001
4.	0.912	0.832	541.46	< 0.001

a Model 1, WSR; Model 2, WSR and CI; Model 3, WSR, CI and WC; Model 4, WSR, WC, HC, WHR, and CI.

Discussion

Obesity is a deadly disease of the 21st century and is a prime causative element for lots of different other disorders (Ramachandran and Snehalatha, 2010). Several health effects, higher prevalence, and the financial burden they impose make the prevention of obesity a primary public health priority. Therefore, effective interventions are needed to identify people with excess adiposity (Rakić *et al.,* 2019). The latest examination (Chong *et al.,* 2023) pronounced overall obesity elevated in females from all socio-demographic statuses. Different anthropometric measures like height, weight, and circumferences have already been used for assessing overall and central adiposity (Bergman *et al.,* 2011). However, because different ethnic groups have varying body proportions, it is still important to determine which anthropometric measure is the best and most reliable for preventing obesity and related disorders. Therefore, the goal of the current study was to ascertain the prevalence of obesity while taking into account widely used obesity measurements and to identify the most effective obesity predictors. The present discourse demonstrated various obesity indicators (BMI, WC, HC, WSR, WHR, and PBF) to measure excess body fat (Tables 2 and 3).

Additionally, a higher predisposition to be overweight and obese (35.23%) was noted among the population under study, despite the majority of participants (64.76%) having normal BMIs according to BMI classification (Table 2). This is even higher (17.45%) than another study conducted in the Bengalee population (Bhadra *et al.,* 2005), may be because of the higher mean age of the studied population. As it has been shown in past research with increasing age Bengalee women put on weight and develop obesity (Sengupta *et al.,* 2013). After Jammu & Kashmir and Uttar Pradesh, they have the third-highest rate of obesity in India (Zargar *et al.,* 2000). When contrasting the current data with those from other

Indian populations, it becomes clear that the high prevalence of overweight and obesity is in line with findings from previous Indian studies (Gopinath *et al.,* 1994; Visweswara *et al.,* 1995; Gopalan, 1998). However, there aren't many studies on how percent body fat (PBF) relates to other anthropometric indices, ratios, and/or measurements.

Therefore, the present study attempted to predict the best measures to discern PBF through stepwise multiple logistic regression (Table 4), and vindicated WSR was the best predictor for PBF among the aged Bengalee caste Hindu Population. Stated differently, WSR may serve as the exclusive, ideal, or most effective anthropometric index to screen individuals who are at risk of obesity, especially those who have decreased other anthropometric parameters and are at increasing health risks which aligns with the findings of a few earlier research (Shao *et al.,* 2010; Kim *et al.,* 2016). Moreover, both obesity and malnutrition need to be understood through the specific obesity measures that effectively indicate ethnic specific disparity (O'Connell and Smith, 2016).

Conclusion

Waist Stature Ratio (WSR) can be an excellent, easy and reliable clinical predictor for obesity (PBF) in adult females of West Bengal.

Conflict of Interest

No conflict of interest

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