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The overfat pandemic in India

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Abstract

Up to 76% of the world's population is overfat, a term referring to the accumulation of excess body fat that can impair health and contribute to chronic disease. While most people who are overweight and obese have excess body fat, normal-weight and non-obese individuals can also be overfat, often due to excess abdominal fat. Based on the prevalence of overweight, obesity, and excess abdominal fat, it is estimated that in India 70 to 80% of adults and 41% of children are overfat. The increased consumption of processed foods, especially dietary sugar, which can also offset the benefits of exercise, may play a primary contributory role in the growing overfat pandemic in India.

Keywords: Overfat, Obese, Overweight, Chronic Disease, Insulin Resistance

Introduction

Recently, the global overfat pandemic was estimated to involve between 62 and 76% of the world's total population, with a relatively new term, *overfat,* referring to an accumulation of excess body fat that can impair health [1]. The overfat condition can occur in those who are overweight or obese, and in normal-weight and non-obese individuals, often due to excess abdominal (also called central or visceral) fat. For the first time in human history, the number of obese people globally now exceeds those who are underweight. In India, although the rates of *underfat* continue to diminish, the nutrition transition is responsible for the growing rise in obesity, the prevalence of which has increased nearly two-fold over the past decade [2]. The National Family Health Survey 4 (NFHS-IV) 2015-2016 reported the combined prevalence of overweight and obese (BMI ≥ 25 kg/m^2) having increased from 12.6% to 20.7% in women and from 9.3% to 18.6% in men [2]. About 26% of adolescents are overweight and 15% are obese [3] and at least 20% of children (including adolescents) are overweight or obese [4]. Smaller numbers of people with sarcopenia who accumulate excess body fat can also be overfat, a condition called sarcopenic obesity [5,6], which affects at least 1.3% of elderly Indians [7]. These numbers are derived from the body mass index (BMI), a measure of body weight (in kg) divided by height (in meters) squared.

Considered a surrogate measure of fatness [8,9], BMI is an index for weight and height used to classify obesity, overweight, normal weight, and underweight in adults based on morbidity and mortality statistics from European populations [10,11]. As an indirect measure of body fat, BMI fails to take ethnicity, age, gender, bone structure, fat distribution, and muscle mass into consideration [1,8,9,11-21]. While a BMI ≥ 25-29.9 kg/m^2 is considered to be overweight and a BMI ≥ 30 kg/m^2 is considered obese [10,11], the World Health Organization (WHO) stated that there is inadequate data currently available to establish one clear BMI cut off for all Asian Indians for overweight and obesity [22]. The Indian Consensus group redefined overweight in Indians as 23-24.9 kg/m^2 and obesity as ≥25 kg/m^2 [23].

The use of BMI can misclassify up to 50% or more people with both increased body fat and its associated disease risk factors [24,25]. Hung showed that up to 70% of young adult Taiwanese women with high body fat would be missed by using BMI [26]. In addition, the use of BMI is a particular problem when assessing abdominal obesity, which is considered a better predictor of cardiovascular disease risk than BMI alone [27]. In India, for example, abdominal obesity was found in 70% of men and women age 36 y, many of whom had a BMI <30 kg/m^2, assessed using the waist circumference (WC) cut point for the diagnosis of abdominal obesity in Indian men and women as >90cm and >80cm, respectively [28]. This study

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[28] showed that 80.5% of adults with BMI >23 kg/m^2 were obese or had abdominal obesity. Versus other populations, abdominal obesity in India has been reported even at BMI levels <20 kg/m^2 [29-34]. South Asians from India, Pakistan, Bangladesh, Nepal and Sri Lanka have higher rates of diabetes and premature coronary artery disease than the rest of the world due to dyslipidemia characterized by high serum levels of apolipoprotein B, lipoprotein (a), triglycerides, and low serum levels of high density lipoprotein (HDL) and apolipoprotein A1 [35]. The risk of insulin resistance syndrome is increased in south Asians with abdominal obesity who have settled overseas as well [31].

The recognition and prevalence of overfat adults and children in India is important for public health reasons to emphasize the need for treatment and prevention of cardiovascular and metabolic (cardiometabolic) impairment and chronic disease, which can help reduce healthcare costs and improve quality of life. Therefore, the aim of this review is to 1) estimate the prevalence of overfat adults and children in India; 2) increase awareness of excess body fat and its health implications; 3) promote the use of improved terminology—overfat—that clearly states the problem of excess body fat; and 4) promote a simple, effective and inexpensive overfat assessment tool, the waist-to-height ratio, for all to use. This could help public health officials and clinicians better assist patients who can also monitor their own health and make improved health choices.

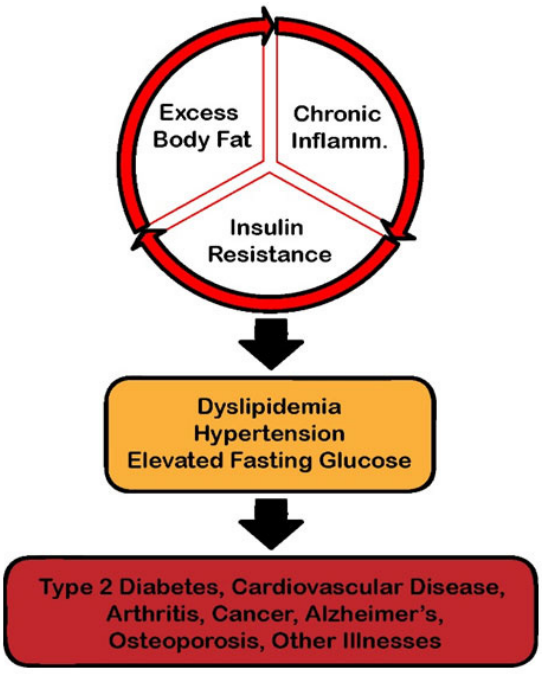

Figure 1. The relationship between overfat, chronic inflammation and insulin resistance leading to cardiometabolic impairment (such as hyperlipidemia, hypertension, elevated fasting glucose) increasing the risk for chronic diseases. Adapted from Maffetone et al., [41].

Review

Body fat and chronic disease

The concept that adipose tissue functions as an endocrine organ through its action on hemostasis and fibrinolysis, and that increased body fat is associated with low-grade chronic inflammation, is well known [36]. Higher levels of body fat can increase the risk for developing a variety of cardiometabolic abnormalities, downstream diseases, and thus morbidity and mortality [24,37]. Even with BMI <25 kg/m^2, abdominal obesity can raise inflammatory proteins and adipokines leading to a state of low-grade chronic inflammation, which, accompanied by a related condition of insulin resistance, can lead to dyslipidemia, elevated fasting glucose, and hypertension, and progress to chronic diseases such as Type 2 diabetes, cardiovascular disease, arthritis, cancer, Alzheimer's, osteoporosis, and other illnesses [27,29,36,38,39]. See **Figure 1**.

Categories of overfat

In addition to being overweight or obese, other conditions of overfat include abdominal obesity, a metabolically-obese normal-weight state, and sarcopenic obesity.

Abdominal obesity

The excess accumulation of visceral fat in the abdominal region is referred to as abdominal obesity, and has potential health risks more pronounced than those due to excess body fat in other regions of the body [40]. About 70% of Indians have abdominal obesity as assessed by WC cut points, and the prevalence of adults with obesity or abdominal obesity at BMI >23 kg/m^2 is 80.5% [28]. While these adults were age 36 y, it is at least a conservative representation of the prevalence of overfat adults in India as further increases in body fat typically occur through middle age. Because abdominal obesity can occur in non-obese individuals, this condition has been referred to as abdominal overfat [41].

Metabolically obese normal weight

A 2010 study titled, "Are Normal-weight Americans, Over-fat?" strikingly suggests that the 5th percentile for body fat percent that is representative of the leanest individuals corresponds to a body fat level as high as 28% for women and 17% for men [42]. This reflects the concept of metabolically obese normal weight (MONW) individuals as originally described by Ruderman et al. (1998), suggesting that such individuals, especially in a BMI range of 20-27 kg/m^2 who may have gained 2-10kg of adipose mass throughout adult life, could account for higher prevalence of Type 2 diabetes and cardiovascular disease [43]. These individuals often exhibit insulin resistance, hyperinsulinemia, and hypertriglyceridemia due to adipocyte hypertrophy mediated by abdominal overfat [43]. A novel criterion, the TyG Index [fasting triglycerides (mg/dl−1) × fasting

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glucose (mg/dl – 1)/2)] was recently reported to reflect the metabolic phenotype of MONW to predict disease risk [44]. A 2015 meta-analysis on the prevalence of MONW by Wang et al. (2015) reported that about 20% of the world's population is MONW [45]. A similar condition to MONW called normal weight obesity (NWO) has been described as normal weight and high body fat with cardiometabolic abnormalities [46]. Both MONW and NWO are subsets of overfat [41].

Sarcopenic obesity

Defined as a progressive loss of type 2 fast-twitch muscle fibers and strength with aging, sarcopenia can coincide with an accumulation of excess fat within existing muscle [5]. The combination of higher body fat and sarcopenia is termed sarcopenic obesity [6]. However, the condition occurs in those who may not be obese, and hence may be more appropriately called sarcopenic overfat [41]. A multi-continent study estimated the prevalence of sarcopenia in India at 17.5% with 1.3% Indians being affected by sarcopenic overfat [7]. We did not include the incidence of sarcopenic overfat in our estimations of overfat adults as it was not possible to separate those who were sarcopenic overfat from the data of other studies we used.

Overfat adults and children in India

Although sufficient data on precise body fat percentages in the Indian population are lacking, other studies allow for estimations of overfat adults and children:

- The National Family Health Survey 4 (NFHS-IV) 2015-2016 of Indian adults showed the prevalence of overweight and obesity (BMI ≥ 25 kg/m^2) for women to be about 22% and for men 19%, totaling 41% [2]. While this percentage is similar to the global burden of disease study [47], data were based on BMI with higher cutoffs. Even combining the prevalence of MONW adults at 20% [45], brining the estimated overfat adult rate in India to over 60%, these numbers may still underestimate overfat rates in adults due to high BMI cutoffs. The prevalence of abdominal overfat may be more useful.
- The prevalence of Indian adults with abdominal overfat is 70%. However, the prevalence of adults with obesity or abdominal obesity at BMI >23 kg/m^2 is 80.5% [28]. While a cutoff of BMI >23 kg/m^2 can still underestimate the overfat population as discussed above, we have used these figures to estimate a range of overfat prevalence in Indian adults to be between 70 and 80%.
- While the incidence of overweight and obesity in children has been estimated as high as 36% in affluent urban children in the Indian subcontinent [48], we relied on a review by Ranjani et al. of 52 studies conducted in 16 of 28 Indian states that showed the combined prevalence of overweight and obesity in children 1-18 y to be 19.3% [4]. In developed countries, primarily in mixed populations of the US and UK, overfat estimates in children were 22% higher than the overweight and obese estimations [1,41]. We therefore estimated the prevalence of overfat children in India to be 41% **Figure 2**.

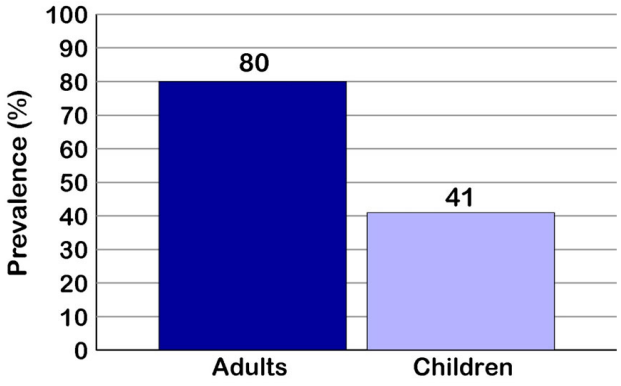

Figure 2. Prevalence of overfat adults and children in India.

Assessment of overfat

With the increasing prevalence of such adverse consequences of being overfat, there is an important need to easily, accurately, and inexpensively assess this condition. The assessment of body fat percentage via dual energy X-ray absorptiometry (DXA) is considered one of the most accurate methods. The DXA derived abdominal fat mass was comparable with WC in predicting blood lipid profiles and inflammation (through C-reactive protein) [49], with WC having the strongest associations with health risk indicators such as serum glucose and blood lipids, even more than BMI [50]. Unfortunately, DXA and other high-tech body fat assessments are costly and not accessible to many people. For most people, a valuable clinical tool is the waist-to-height ratio (WHtR). Especially in South Asian adults, WC and WHtR are the most accurate indices to predict diabetes and hypertension which are important risk factors for cardiovascular disease [51]. The WHtR is an easy, accurate, and inexpensive method to assess the overfat condition, cardiometabolic impairments, and chronic disease risk [12]. A ratio <0.5 appears to be the optimal healthy cut point in both sexes and among different ethnicities and age groups including children, with the simple notion that one's waist should be less than half their height [52]. See **Figure 3**.

Lifestyle effects on body fat

Both diet and physical activity are widely known to affect body fat content, with recent lifestyle alterations paralleling the rising overfat pandemic, most likely playing a causal role [1,41]. Westernization has led to a nutrition and lifestyle transformation in India, and compared to their European counterparts, Indians are more insulin resistant at any given BMI and more likely to develop associated co-morbidities [53], and therefore are at higher risk for being overfat. The economic and nutrition transition in India over the past two decades have resulted in reduced physical activity and increased consumption of

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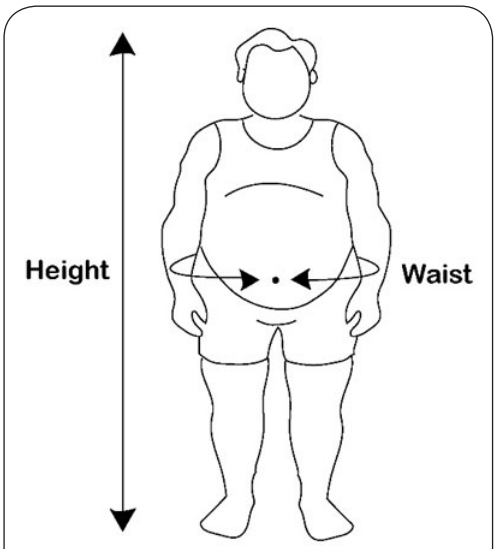

Figure 3. Measuring waist-to-height ratio. Adapted from Maffetone et al., [41].

sugar, trans fats, and processed/junk foods, contributing to the increased prevalence of abdominal overfat on an otherwise thin frame [54]. For example, a study of 532 rural-urban migrants settled in slums of northern India have a higher prevalence of obesity (10.6% in males and 40.2% in females) as defined by body fat percentage [32]. This problem could be due to a shift in diet (high fiber to low fiber) and physical activity (farmers to roadside vendors) patterns. Childhood obesity in India was found to be more prevalent in private versus government schools due to higher socio-economic status, accessibility and affordability to junk foods, and to motorized transportation [55].

While physical activity has many well-known benefits and should continue to be encouraged, the simultaneous increase in overfat rates in almost all countries appear driven mainly by changes in the global food system, which produces more processed, affordable, and effectively marketed junk food than ever before [56]. The mean kcal intake of most South Asian countries has increased from 2066 kcal/day in 1969-1971 to 2660 kcal/day in 2015, with the consumption of processed wheat and sugar increasing in India [57]. It is long known that the normal action of insulin converts ~40% or more of consumed carbohydrates into stored fat [58], with consumption of processed carbohydrates such as added sugars potentially overproducing insulin even in young healthy people [59].

The increased consumption of sugar alone among adults and children worldwide may be a primary contributor to the overfat pandemic [60–64]. Reducing carbohydrates to improve health was recently demonstrated in a prospective cohort study of high-, middle- and low-income countries, including India, that showed high carbohydrate intake was associated with higher risk of total mortality [65]. The consumption of sugar-sweetened beverages (SSBs) in particular is strongly associated with chronic illness [66]. In the US, for example, SSBs are the largest source of added sugar and the top source of energy intake [67]. In India, at least 50% of children consume SSBs >4 times/week [68]. The SSB consumption in India has increased from 2 liters per capita per year in 2000 to more than 11 liters per capita per year in 2013, with its sales increasing by 13% per year since 1998 [68,69]. Such a progressive rise could increase the incidence of Type 2 diabetes mellitus from 319 to 336 per 100,000/year before the year 2023 [68-70]. See **Figure 4**.

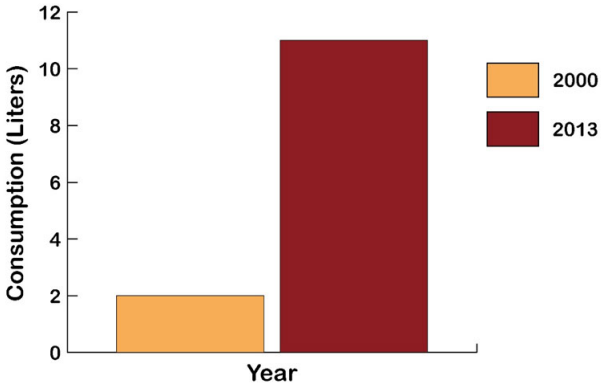

Figure 4. Change in annual sugar sweetened beverage consumption in India between 2000 and 2013. Adapted from Basu et al. 2014 [69].

Increased intake of dietary sugar can also offset exercise benefits leading to elevated body fat [71,72]. In athletes, higher body fat levels can hamper performance (exceptions include those relying on increased body weight such as sumo wrestlers, linemen, etc.) and impair health. A study of 186 female athletes from different sporting disciplines reported that out of 150 athletes with normal BMI, 6.7% still had obese body fat levels of ≥33% [73]. Metabolic syndrome is also observed in 16.8% of 900 physically active police [74], with a similar study of 256 police officers in south India showing 71.5% were overfat with waist circumferences ≥90cm in men and ≥ 80cm in women [75].

The importance of our review is that it is the first estimation of overfat adults and children in India that we are aware of, and it emphasizes the important relationship between excess body fat and poor health. In addition, we show for the first time that normal weight overfat levels in India are significantly higher in comparison to that of developed countries (see **Figure 5**). Precise estimations of overfat are difficult because of limited data on accurate body fat percentages. We therefore relied on published rates of overweight, obesity, abdominal obesity and waist circumference as discussed above.

Conclusion

Based on the levels of overweight, obesity, and those with

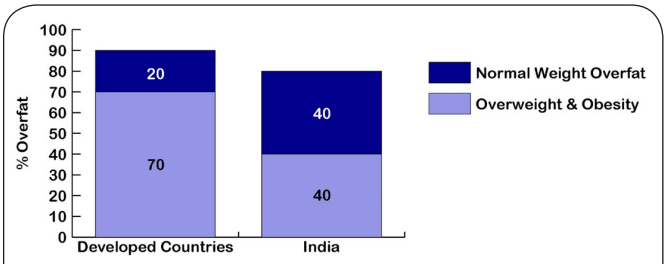

Figure 5. Difference between highest rates of normal-weight overfat adults in developed countries and India [41,53].

excess abdominal fat, it is estimated that in India 70 to 80% of adults and 41% of children are overfat. The waist-to-height ratio is a simple and accurate measure of overfat risk, and of cardiometabolic impairments and chronic disease risk, for all Indian people, with the recommendation that the waist be less than half one's height. The increased consumption of processed foods, especially added dietary sugars, can offset the benefits of exercise and contribute to the growing overfat pandemic in India.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

Authors' contributions	PM	MK
Research concept and design	✓	--
Collection and/or assembly of data	✓	✓
Data analysis and interpretation	✓	✓
Writing the article	✓	✓
Critical revision of the article	✓	✓
Final approval of article	✓	✓
Statistical analysis	✓	✓

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