

Overweight and obesity in students of a Dental College of Karachi: lifestyle influence and measurement by an appropriate anthropometric index

Mozaffer Rahim Hingorjo,¹ Sadiqa Syed,² Masood Anwar Qureshi³

Department of Physiology, Fatima Jinnah Dental College,¹ Department of Physiology, Bahria Medical and Dental College,²

Department of Physiology, Dow International Medical College, Dow University of Health Sciences,³ Karachi, Pakistan.

Abstract

Objective: To compare body mass index (BMI), waist circumference (WC), and body fat percentage (%BF), as index of overweight and obesity in young adults. We also intended to find an association between lifestyle behaviours and obesity.

Methods: A cross-sectional study was conducted at Fatima Jinnah Dental College, Karachi, during 2007 to 2008, with 192 first year dental students, (18-21years) of high socioeconomic class. All were questioned regarding lifestyle behaviours. Overweight and obesity were estimated by measuring %BF, BMI, and WC. For %BF, skinfold thickness was measured using skinfold calipers. BMI ≥ 23.0 - 24.9 kg/m^2 was taken as overweight and $\geq 25.0 \text{ kg/m}^2$ as obese (Asians criteria proposed by Western Pacific Regional Office of World Health Organization). WC using Asian cutoff values for overweight and obesity were: males $\geq 78\text{cm}$ and $\geq 90\text{cm}$; females $\geq 72\text{cm}$ and $\geq 80\text{cm}$, respectively. Body fat percentage used to define overweight and obesity was: males 22.1-27.0 and >27.1 ; females 27.1-32.0 and >32.1 , respectively. Pearson's correlation was done between the BMI, WC and %BF with statistical significance taken at $P < 0.01$.

Results: BMI (Expressed as mean $\pm$ SD) in males and females was 23.82 ± 3.88 and 20.98 ± 4.12 respectively. WC was $83.63\pm 10.20\text{cm}$ in males and $70.22\pm 9.36\text{cm}$ in females. %BF was 22.32 ± 6.27 in males and 28.73 ± 6.65 in females, with an overall 60.8% females and 44.4% males found to be overweight or obese. Obesity was underpredicted by BMI when compared to skinfold calipers method. The obese were seen to skip breakfast more often [odds ratio (OR):2.39], take frequent snacks (OR:1.58), watch television more (OR:1.58), and were physically less active than their non-obese counterparts.

Conclusion: Body fat percentage using skinfold caliper is a reliable index of obesity. Lack of sleep and skipping of breakfast, are prominent promoters of obesity, in addition to other lifestyle behaviours (JPMA 59:528; 2009).

Introduction

Obesity is fast becoming a global health problem affecting more and more people. In 2001, a writer at the World Health Organization coined a new word, "globesity" by combining the words global and obesity. What was once a problem seen in developed countries only, has now spread around the globe, and is affecting our young population as well, potentially shortening their lifespan.¹ The Centers for Disease Control and Prevention (CDC) defines overweight and obesity as "labels for ranges of weight that are greater than what is generally considered healthy for a given height".² The weight of a person is the result of several interrelated factors; most important among these are genetic, environmental, and behavioural. Studies on twins, raised in separate locales, reveal a strong genetic influence in the development of obesity, however, home environment is another important factor promoting obesity. If the parents are ingesting high calorie foods and avoiding physical activity and exertion, their children tend to adopt the same behaviour leading to increased body fat stores.³

Modern technology has significantly affected daily life, by making both living and working conditions more relaxed. People tend to spend hours sitting in front of their television or computers, burning fewer calories, instead of engaging in healthy physical activity.⁴ This behaviour is similarly adopted by their children, thereby promoting obesity in early life.

Sleep disturbance affects the levels of leptin, an anorexigenic hormone promoting satiety, and ghrelin, producing hunger and increased appetite. Deprivation of sleep leads to a decrease in leptin and an increase in ghrelin levels, thus promoting weight gain and obesity.⁵

The role of calcium in the development of obesity is recently being recognized. Zemel et al⁶ has observed an association with low intake of calcium with obesity, however, further research is needed to examine whether the relationship reported here persists among a broader socioeconomic group.

Quitting cigarette smoking leads to obesity not only because of better perception of taste and smell of food but also because nicotine increases the metabolic rate, thereby

increasing the calories burnt. Stopping smoking thus decreases this effect.⁷

Accurate assessment of body fat content relies on expensive and clinically impractical procedures, largely replaced by fairly reliable and easily reproducible anthropometric measures such as body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR). Measuring the thickness of the subcutaneous fat layer at specific sites, using skinfold calipers,⁸ more closely resembles the actual value. It is not affected by extremes of fat content or the presence of muscle mass. This method is, however, operator dependent as it would properly estimate body fat if the measurements are taken at appropriate sites using correct methodology. Furthermore, an inferior quality caliper may become unreliable after repeated use. The present study was conducted to examine the extent of overweight and obesity in young population and to investigate various ways for its measurement. We also intended to find an association between lifestyle behaviours with overweight and obesity.

Subjects and Methods

This cross-sectional study was conducted at the department of Physiology, Fatima Jinnah Dental College. A total of 192 first year students of two consecutive years (2007 - 2008), aged 18 to 21 years, participated in this study. Three parameters for determination of socioeconomic status were taken as education, occupation, and income of parents. All the subjects belonged to middle or high socioeconomic class. Written informed consent was taken from each subject and the study was approved by Fatima Jinnah Dental College Research and Ethical Committee. All the subjects were asked to fill out a questionnaire regarding lifestyle behaviours such as: eating habits, sleep duration, smoking, time spent in front of television/computer and level of physical activity. Anthropometric measurements were taken as follows: Weight was measured using digital scale to the nearest 0.1 kg with subjects wearing light clothing, and height was measured without shoes using Detecto stadiometer 3P wall-mount height rod, to the nearest 0.5 cm. Weight and height were taken twice and recorded. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m²). The cutoff value for BMI differs in different regions of the world; therefore the values used in this study correspond to those proposed for adult Asia-Pacific population by the Western Pacific Regional Office⁹ (WPRO) of World Health Organization (WHO) with BMI ≥ 23.0 to 24.9 kg/m^2 taken as overweight and $\geq 25.0 \text{ kg/m}^2$ as obese. Waist circumference (WC) was measured under the clothes, at the narrowest point, midway between the costal margin and the iliac crest, in the horizontal plane with the subject standing. The criteria for overweight and obesity was taken as waist circumference ≥ 78

cm and ≥ 90 cm respectively for males and ≥ 72 cm and ≥ 80 cm for females, these being the cutoff values for adult Asian population.¹⁰ Waist to hip ratio (WHR) was measured by dividing the waist circumference with the hip circumference, the latter taken as the widest point over the buttocks. Waist to height ratio (WHtR) was estimated by dividing the waist circumference with the height. These two indices, however, were not compared with %BF as proper Asian cutoff values were not available for overweight and obesity.

Body fat deposition expressed as percent body fat (%BF) was estimated by first measuring skin fold thickness in three sites (pectoral, abdomen, and thigh for males; triceps, suprailiac, and thigh for females) with the help of Fat-O-Meter skinfold caliper. The pectoral was measured as a diagonal fold, midway between the anterior axillary line and the nipple (males); abdomen was measured as a vertical fold, 2 cm to the right of umbilicus; thigh was taken as a vertical fold, on the anterior midline of the thigh, midway between the proximal border of patella and the inguinal crease (hip); triceps as a vertical fold on the posterior midline of the upper arm, halfway between acromion and olecranon processes, with the arm held freely to the side of the body; and suprailiac was measured as a diagonal fold, in line with the natural angle of the iliac crest taken in the anterior axillary line immediately superior to the iliac crest.

Body density was then calculated using the sum of 3 skinfold measures¹¹ in the following formula:

$$\text{Body Density (male)} = 1.109380 - 0.0008267 (A) + 0.0000016 (A)^2 - 0.000257 (B)$$

$$\text{Body Density (female)} = 1.0994921 - 0.0009929 (A) + 0.0000023 (A)^2 - 0.0001392 (B)$$

[A = sum of 3 skinfolds; B = age in years]

$$\%BF \text{ male} = (495 / \text{body density}) - 450$$

$$\%BF \text{ female} = (496 / \text{body density}) - 451$$

Overweight and obesity were defined as %BF: males 22.1 - 27.0 and > 27.1 ; females 27.1 - 32.0 and > 32.1 , respectively.¹²

Statistical analysis: Pearson's correlation coefficient was used to determine the relation between various anthropometric indices, with statistical significance taken at $P < 0.01$.

Results

A total of 192 subjects in the age group of 18 to 21 years were included in the study. The mean age of subjects and the primary data relating to anthropometric measurements is presented in Table. Mean body fat % was $22.32\% \pm 6.27$ in males and $28.73\% \pm 6.65$ in females, the normal upper limit in this age group being 22.0 % and 27.0 % respectively. Due to difference in the predominant area of fat deposition in males

Table: A comparison of anthropometric data of males and females.

	Male (n = 54)	Female (n = 138)
Age (years)	18.96 ± 1.09	18.88 ± 0.92
Weight (kg)	71.03 ± 11.84	52.92 ± 11.08
Height (cm)	172.96 ± 9.98	158.65 ± 5.72
Body mass index (kg/m ²) (BMI)	23.82 ± 3.88 **	20.98 ± 4.12 **
Waist circumference (cm) (WC)	83.63 ± 10.20 **	70.22 ± 9.36 **
Waist-to-hip ratio (WHR)	0.85 ± 0.04	0.77 ± 0.05
Waist-to-height ratio (WHtR)	0.48 ± 0.05 **	0.44 ± 0.06 **
Body fat percentage (%)	22.32 ± 6.27	28.73 ± 6.65

Values are expressed as mean ± standard deviation (SD) and %

* P < 0.05, ** P < 0.01 as compared to body fat percent.

and females, different sites were taken for measurement; however, thigh was a common site and showed increased thickness in females. Skinfold thickness (mean ± SD) expressed in mm in males was 22.02 ± 7.60, 33.77 ± 10.27, and 26.01 ± 9.66 at pectoral, abdomen, and thigh respectively. In females, the values were 22.57 ± 7.37, 20.52 ± 8.90, and 35.85 ± 10.68 for triceps, suprailiac and thigh respectively.

Using %BF as an index of obesity, the subjects were classified into four groups: underweight, normal weight, overweight, and obese. The percentages of males and females in these categories were as follows: Males 3.7%, 51.8%, 25.9%, and 18.5% respectively; Females 5.8%, 33.3%, 27.5%, 33.3% respectively. The overall percentages of males and females who were above normal weight were 44.4% and 60.8%, respectively. A comparison of the different indices of obesity is given in Figure-1. Indices of abdominal obesity (waist circumference) and generalized obesity (BMI) are compared with body fat percent estimated by skinfold thickness. In males, the best indicators of overweight and obesity were waist circumference and BMI respectively. In females, however, fat content estimation by skinfold thickness was a far better indicator revealing the highest number of cases detected, both overweight and obese.

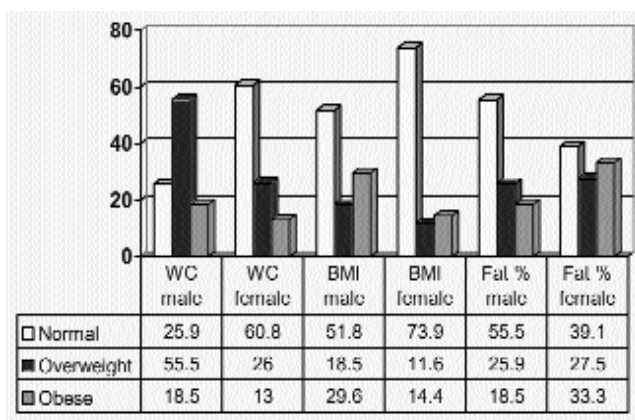


Figure 1: Comparison of waist circumference (WC) and body mass index (BMI) with body fat percent estimated by skinfold thickness, in males and females. Values expressed as percentage (%).

Some of the healthy lifestyle behaviours that help in maintaining normal weight of a person include: taking three meals/day, taking one or no snack/day, taking fruits and vegetables daily, taking calcium or milk supplements daily, watching television / computer for < 2 hrs, having a good night's sleep of > 6 hrs and doing moderate physical activity. It was observed that 39.4 % individuals who were overweight or obese skipped breakfast regularly, in comparison to 25.2 % normal weight persons. Most of the subjects, (85% normal weight and 90% overweight and obese), took non-nutritious snacks in the form of French fries, burger, fried food, and pizzas, and only few were taking fruits, vegetables, or other nutritious item, as a form of snack. Figure-2 represents a

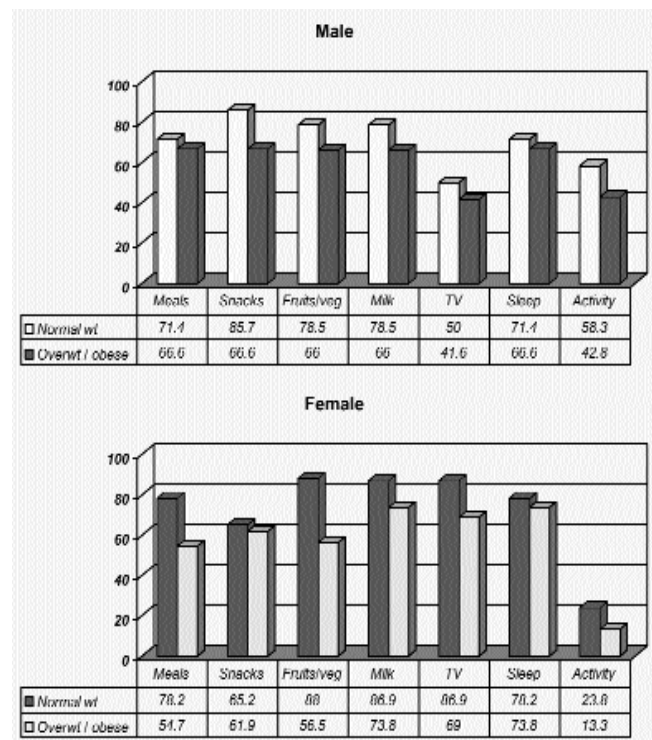


Figure 2: A comparison between subjects having normal weight with individuals who are either overweight or obese, in relation to lifestyle behaviors considered good for health. Meals: taking 3 meals/day; Snacks: taking one or less snack/day; Fruits & vegetables: taking daily; Milk / yogurt: taking daily; TV / computer: watching for < 2 hrs; Sleep: > 6 hrs; Activity: moderate. Values are expressed as percentage (%).

comparison between subjects having normal weight with individuals who are either overweight or obese, in relation to the above mentioned healthy lifestyle behaviours.

Discussion

In this study we investigated the presence of overweight and obesity in young adults coming from middle to high socioeconomic classes, correlating them with their dietary habits, physical activity, and other lifestyle behaviours.

Surprisingly, a large number of subjects (60.8% females and 44.4% males), were found to be either overweight or obese in the study population. A previous study done in Pakistan observed 13.8% females and 12.4% males, in a similar age group, to be overweight or obese.¹³ Another study involving children and adolescents of high socioeconomic class of Karachi, found overweight and obesity to be 19.35% and 6%, respectively.¹⁴ In our study, it was further observed that obesity was under-predicted by BMI (using Asia-Pacific population cutoff values), when it was compared to body fat percentage obtained by skinfold calipers method. This may be due to two reasons: Firstly, BMI is not considered a good measure of obesity in Asians as they have different body stature, with relatively low BMI and a central obesity, thus needing separate cutoff values.¹⁵ Secondly, the BMI is different for males and females, reflecting in part the level of physical activity, therefore using a single value for both sexes may underestimate one half of the population.¹⁶ A proper adjustment in BMI cutoff value is important, as it is still widely used in population surveys for planning the prevention and treatment of obesity and its related problems.¹⁷ Furthermore, BMI is a measure of body weight, and therefore doesn't make allowances for increased weight due to muscular development. Waist circumference, on the other hand, is a good index of central obesity and especially evaluates overweight subjects. However, this technique is again unsuitable for individuals who are excessively overweight.¹⁸ Waist circumference is ideally measured at the narrowest point, midway between the costal margin and the iliac crest. In excessively overweight subjects, especially those with upper abdominal obesity, it is difficult to identify this narrowest point. The umbilical level is used instead, which gives a falsely high measure of waist circumference. This may be the reason for the variable result of our study, obtained using waist circumference as an index of obesity. It may also be due to the fact that the cutoff values for the study population are still not well defined for either sex. A combination of BMI and waist circumference may therefore be able to give a more reliable result.

The etiology of obesity is multifactorial, with genetic factors playing a prominent role in the pathogenesis. The two main reversible factors include the extent of physical activity done by the individual, with a more relaxed attitude towards life, and the amount of high calorie food consumed over a period of time. A certain amount of physical activity is essential to maintain body fitness, both in terms of musculoskeletal as well as cardiovascular systems. Decrease in physical activity due to increased dependence on transportation, even for short distances, is one of the causative factors for the development of overweight. Our study demonstrated that watching television or computer usage for more than 2 hours was related to obesity - odds

ratio (OR) being 1.58, as has been observed in other studies.¹⁹ This is partly explained by the food and beverage consumption during television viewing.²⁰ Children sitting too much in front of the television, eat more carbohydrates, more fats and less protein.

Eating behaviours that promote build up of fat are skipping breakfast, eating unhealthy food, and an increased frequency of snacks consumed during the day. It was observed that subjects, who regularly skipped breakfast, were more at risk of obesity, as compared to those consuming breakfast regularly (OR = 2.39). A similar study done on US adult population estimates the risk of obesity being 4.5 times in subjects skipping breakfast.²¹ One reason suggested for this, is an overall increase in the amount of food consumed due to hunger, during the day, by those who skipped breakfast, thus contributing to their weight gain. A study done by Schlundt et al on humans recorded overeating by the subjects after meal skipping.²² Another observation regarding obese subjects was that they were more frequent snackers than their non-obese counterparts (OR = 1.58). This is in accordance with what a cross sectional study found in Sweden, where they also observed that sweet and fatty foods more commonly contributed to increased energy intake.²³ The human body remains fit when it receives large meals well separated. Taking a meal leads to insulin secretion, a hormone designed to store glucose as glycogen and excess energy as fat. In between meals, when insulin secretion falls, the stored energy is metabolized. This response is, however, blunted by taking frequent snacks that promote frequent insulin release and eventually may become the forerunner of insulin resistance and metabolic syndrome.²⁴

The overall consumption of milk was slightly more in the non-obese subjects. According to Zemel et al,⁶ low dietary calcium increases levels of parathyroid hormone and 1,25(OH)₂D, the active form of vitamin D, which then increase calcium within the adipocytes. Intracellular calcium in adipocytes stimulates storage of fat and prevents lipolysis. A high calcium diet, conversely, promotes lipid oxidation and thermogenesis. The weight reducing effect of dairy products is more than that of using calcium supplements, as dairy products contain additional bioactive compounds that act synergistically with calcium to reduce obesity.

Results from our study suggest that sleep deprivation may also be associated with weight gain. Obesity was observed more in subjects getting less than 6 hours of sleep, especially in the male subjects. A study of different phases of sleep in relation to obesity revealed shorter sleep duration and reduced REM sleep in obese subjects as compared to normal weight controls.²⁵ Several studies have demonstrated that, sleep deprivation results in an altered endocrine and metabolic function of the body. Circulating plasma levels of anorexogenic hormone leptin fall, whereas grehlin, a hormone

involved in increasing the appetite, rise. The overall effect is weight gain.

In conclusion, important factors promoting obesity is a change in lifestyle towards lack of physical activity and giving more time to the computer and television. Lack of sleep, skipping breakfast and eating frequent low quality snacks add insult to injury. Awareness has to be created among the general population regarding obesity, especially targeting our young adults, in whom the process of weight gain is in its early stages and would be more easily reversible. Measurement of body fat by skinfold calipers is an easily reproducible and cost effective way to calculate body fat, in comparison to waist circumference and BMI, given the current cutoff values used for our population. It can be adopted by the health professionals as it gives a reliable and objective evidence of obesity to the patient and aids in the counseling process involved in weight reduction.

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