Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Physiology

Study of Obesity and Fat Distribution in Young Medical Students

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DOI: 10.36347/sjams.2021.v09i06.019 | **Received:** 20.04.2021 | **Accepted:** 28.05.2021 | **Published:** 17.06.2021

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Abstract **Original Research Article**

The Body Mass Index (BMI) and body weight do not give enough information about a person's body composition. Measuring the fat free mass gives us the extra information we need. The body composition can be measured in several ways. Unfortunately none of these techniques is a gold standard. That is why different techniques are combined in a full body composition assessment. This study aims to assess the prevalence of overweight, obesity and the fat distribution in medical students. Two hundred (200) preclinical, 100 male and 100 female age matched students (mean 18.93 ± 0.75 years) were included in the study. BMI, waist hip ratio, body fat, skeletal muscle mass and their bodily distribution were recorded by using an electronic body composition analyzer. The subjects were divided into undernourished (UN=BMI<18.5 kg/m2), normal (N=BMI>18.5–22.9 kg/m2), overweight (OW=BMI>23-27.99 kg/m2) and obese (OB=BMI >28 Kgm2) groups based on BMI cut off values for Asians. The data analyzed showed that 32% of the Male (mean BMI = 25.41 ±1.46 kg/m2) 33% of the Female (mean BMI =25.03 ± 1.44 kg/m2) were over weight and 16% of Males (mean BMI =31.08 ±1.91) 8% Females(mean BMI= 30.73 ± 1.66) were obese. The average total body fat in males was 20.75 ± 6.69% and 28.55 ± 5.86% in females. The total body fat was high in obese males and females 26.67±4.37, 36.73 ±0.46% respectively as compared to other groups. The visceral fat was high in obese males (14.40 ± 2, 27%) and whereas obese females had normal levels at (9.5 ± 1.0%). The subcutaneous fat was more in the lower limbs than in the trunk area in both males and females. The skeletal muscle mass was about 34.5 ± 3.44% in males and 26.98 ± 2.55% in females which was slightly less than the recommended values. The leg area had more muscle mass than other areas. The findings clearly indicate increase in total body fat increases with BMI and WHR.

Key words: Obesity, body fat, visceral fat, body composition, body mass index.

INTRODUCTION

India is battling a full-blown crisis of obesity, one which is anticipated only to worsen in the years to come. The crisis of obesity in India is only expected to get worse, especially among its young people. Together with China, India will be a chief driver of the explosion of childhood obesity by 2030, when 250 million children worldwide will be obese. In India, more than 27 million children will be obese by that year [1]. This is compared to eleven million obese children at present. As such, by 2030, India will surpass the United States as the country with the second highest. Here are some shocking facts for India which should serve as a wake-up call. Some figures presented in the Atlas of Childhood Obesity paint a rather grim picture [2].

In 2016, India had 3.7 per cent obese boys aged 5-9 years, while the figure for girls in the same age bracket was 2.6 per cent. During the same year, there were 1.8 per cent obese boys and 1.1 per cent girls in the age bracket of 10-19 and about 40% of overweight children will stay same during adolescence and 75−80% of obese adolescents become obese adults [3].

"The dramatic rise in the number of children affected by obesity is being driven by emerging economies in Asia, the Middle East and Latin America" said Dr Tim Lobstein, Director of Policy at the WOF and one of the authors of the World Obesity Federation's Report.

Recent statistics indicate that although the prevalence of obesity among children has been lower than adults, the rate of increase in childhood obesity in many countries was greater than the rate of increase in adult obesity. At all levels of income and for all age

groups, the prevalence of obesity was generally higher for women than for men in 2015. Obesity prevalence increased 2.4 fold in both men and women of all ages in between 1980 and 2015. However, this increase was fastest for men aged 25 to 29 in LMICs, from 11.1% (8.5-14.7%) in 1980 to 38.3% (30.7-48.1%) in 2015.

The reasons behind this trend are manifold. Research indicates that economic growth correlates with fewer cases of stunting and wasting, both conditions linked to undernourishment, but also with higher obesity rates. Greater availability of processed produce and fast food contributing to increased consumption of so-called 'westernised' diets, a transition in employment from manual labour to white collar work, and lesser levels of physical activity are other factors [4]. However, the country has worked in the direction of existing policies to reduce physical inactivity and efforts are underway to reduce the norm of unhealthy diet that lead to rise in non-communicable diseases.

The effects, meanwhile, are widespread and far-reaching. Obesity negatively affects productivity and educational performance, impairing economic growth. For the individual, meanwhile, obesity has numerous deleterious health effects, upping the risk of numerous noncommunicable diseases (NCDs) such as heart disease--India's most common cause of death and one which is already increasing in prevalence. Already, children in India are witnessing higher risk of conditions such as diabetes and high cholesterol. More than ten percent of children in India are prediabetic.

To counteract the trend, India has launched numerous campaigns in recent months. The Eat Right India movement promotes the value to health and importance of a nutritious, adequate and balanced diet. The Food Safety and Standards Authority of India (FSSAI) is moving towards eliminating trans fats from the country's food supply by 2022–one year ahead of the World Health Organization's targets for the same.

Obesity costs the global economy US$2 trillion per annum, while under nutrition and micronutrient deficiencies account for an additional US$2.1 trillion. October 11th marks World Obesity Day, an opportunity for India to promote awareness of its crisis of obesity, the condition's risks to health, wellbeing, and lifestyle, and how best to prevent them. India must take note of the current trends and statistics and work towards alleviating the nation's burden of overweight and obesity–of vital necessity to public health and the health of the country overall. India, which is still dealing with the problem of malnourishment which threatens to thwart the ambitious nutrition targets set for 2022, is also fighting the obesity menace and is not too far away when it comes to catching up with developed countries on this.

The National Health Portal of India defines obesity as a condition where a person has accumulated abnormal or excessive body fat that causes negative effects on health. For an individual, obesity is usually the result of an imbalance between calories consumed and calories expended. An increased consumption of high calorie foods, without an equal increase in physical activity leads to an increase in weight. Decreased levels of physical activity will also result in an energy imbalance and lead to weight gain.

Body composition (BC) estimations are strongly recommended in nutrition, metabolic and obesity research. It has an advantage over body mass index (BMI) in quantifying the distribution of its components in the body. The present study was designed to assess the percentage of overweight/obesity in medical students group. The risk groups that are associated with excess body fat. Location of fat in the body is also important and could be a better indicator of a risk factor. Fat which accumulates around the waist may be more dangerous in long-term [5].

MATERIAL AND METHODS

This cross sectional study was conducted by the Faculty of Physiology Department in a Medical College in Andhra Pradesh. After detailing the purpose and methodology of the study, all eligible subjects were requested to participate in the study. Ethical clearance was obtained from the Institutional Ethical Committee. Study was conducted on 200 subjects, 100 males and 100 females, using a pre-tested questionnaire, measuring their body mass index and body fat composition using Omron Body fat analyser. Students excluded from the study were those suffering from Hypothyroidism, Diabetes, psychological disorders and those on medications steroids and sedatives. Assessment of Obesity was carried out by using the body mass index (BMI) formula--

Where BMI = Weight (kg) / Height (m^2)

Normal range for BMI: 18.5-24.9 kg/m^2

(According to World Health Organization) (6)

The weight of subjects was measured by using a calibrated weighing machine. The weight was recorded to the nearest kilogram (kg). For recording the height of subjects, a vertical measuring rod was fixed to wall and subjects were asked to remove shoes and stand on flat floor in front of measuring rod with the feet parallel and heels, buttock, shoulders and back of head touching vertical rod. The head was held completely erect with lower border of orbit in the same horizontal plane as the external auditory meatus. The arms were kept hanging by the sides in natural manner. The horizontal bar of the measuring rod was lowered to touch the head. The height was recorded to the nearest centimeter (cm).

Body mass index (BMI) was calculated by using the Quettlet's formula:

BMI = Weight (Kg)/Height $(m)^2$

A non-stretchable tape was used to measure waist circumference (WC) in centimeters. It was measured at a level mid-way between the lower rib margin and the iliac crest at the end of expiration in a standing position.

WC based cut-offs:

Normal weight <80 cm,
Over weight 80 to 87.99 cm and
Obese >88 cm for women was considered.

The same tape was used to measure the hip circumference which was measured as the maximal circumference over the buttocks at the level of greater trochanter. The Waist-to-hip Ratio (WHR) was calculated and cut-offs of Normal weight <0.80, Overweight 0.80 to 0.84 and Obese >0.85 was considered for women.

Waist hip ratio looks at the proportion of fat stored on the body around the waist and hip. It is a simple but useful measure of fat distribution. The Waist Hip Ratio is calculated by dividing the waist measurement by hip measurement, since the hips are the widest part of the buttocks.

The formula is:
WHR= waist circumference / hip circumference
Central obesity was defined according to the WHO criteria [6]
WC ≥ 94 cm for men and
≥ 80 cm for women or waist-to-hip ratio (WHR) ≥ 0.90 in men and
≥ 0.85 in women and a WHTR of > 0.50

The numbers in the table below count for adults. Certain ethnic groups like Hindus or African Americans are extremely sensitive for accumulation of fat in the belly. These groups are more sensitive to develop diabetes or coronary diseases [7].

Table-1: Relation between waist circumference and the risk of coronary disease

GENDER	LOW RISK	HIGH RISK	HIGH RISK
MALES	< 94 CM	94 – 99 CM	> 100 CM
FEMALES	< 80CM	80 - 89	> 90 CM

Body fat, skeletal muscle mass and their bodily distribution were recorded by using Body Composition Monitor – BF511 (HBF-511T-E/HBF-511B-E) (Karada Scan, Omron, Japan) that works on the principle of bioelectrical impedance.

Bioelectrical Impedance Analysis (BIA)

This indirect method for measuring body composition is based on the conduction of an alternating electrical current applied to the human body. BIA determines the electrical impedance, or the opposition to the flow of an electric current through body tissues. This instrument precisely measures the following body composition parameters and immediately interprets the results:

- Body Fat (in %)
- Visceral Fat (up to 30 levels)
- Body Mass Index (BMI)
- Skeletal Muscle (in %)

A well trained faculty recorded the body composition variables of all subjects.
The subjects were divided into the following categories:

- Undernourished - (UN=BMI<18.5 kg/m^2),
- Normal - (N=BMI>18.5–22.9 kg/m^2)
- Overweight - (OV= 23 – 27.99kg/m2)
- Obese - (OB=BMI>28 kg/m^2) groups based on BMI cut off values for Asians[6].

RESULTS

Table-2: BMI of female students

BMI(Kg/m2)	CRITERIA	BMI(MEAN±SD)	PERCENTAGE
<18.5	UNDERWEIGHT	16.23 ± 1.57	8.30%
18.5 - 22.99	NORMAL	20.79 ± 1.52	50.00%
23 - 27.99	OVERWEIGHT	25.03 ± 1.44	33.33%
> 28	OBESE	30.73 ± 1.66	8.33%

Table-3: BMI of male students

BMI (Kg/m2)	CRITERIA	BMI (MEAN±SD)	PERCENTAGE
<18.5	UNDERWEIGHT	17.73 ± 0.76	13%
18.5 -22.99	NORMAL	19.83 ± 1.28	38%
23-27.99	OVERWEIGHT	25.41 ± 1.46	12%
>28	OBESE	31.08 ± 1.91	16%

Table-4: Body fat of males and females

BMI (MEAN±SD)	MALE (BODY FAT%)	FEMALE (BODY FAT%)
< 18.5%	14.52 ± 2.97	18.07 ± 3.64
18.5 -22.99	16.99 ± 4.68	26.38 ±3.97
23 -27.99	24.04 ± 2.08	32.38 ± 3.27
>28	26.67 ± 4.37	36.73 ± 0.46

Table-5: Distribution of fat in males and females

GENDER	S.C FAT	U.B FAT	TRUNKAL	L.L FAT	V. FAT	TOTALFAT
MALE	14.32 ± 5.54	22.53 ± 8.15	12.54 ± 5.63	21.45 ± 8.05	6.58 ± 4.55	20.75 ± 6.69
MALE	24.86 ± 5.82	40.41 ± 8.51	20.85 ± 5.80	37.70 ± 7.54	5.87 ± 6.87	28.55 ± 5.86

Table-6: Anthrometric indices of males and females

GENDER	AGE	WEIGHT KG	HEIGHT CM	BMI KG/M2	W.C	H.C	W/H
M	19.23 ± 0.84	67.3 ± 15.48	170.16 ± 6.38	23.17 ± 4.72	33.48 ± 4.92	37.77 ± 4.72	0.89 ± 0.08
F	18.64 ± 0.76	61.81 ± 12.49	163.16 ± 6.02	22.66 ± 3.86	33.49 ± 3.81	38.56 ± 3.61	0.87 ± 0.08

DISCUSSION

In 2014, WHO declared that the worldwide prevalence of overweight and obesity affected about 1.9 billion adults aged 18 years or older. Obesity related studies on medical students are rare but some studies show that obesity is a problem even in this population. For example, a Japanese study has reported an increasing trend in obesity from 1979-1991 [8]. Another report from Greece has shown that 4% men and 23% women had BMI >25 kg/m2. The study also revealed that 33% male and 22% female subjects had central obesity [9]. Similarly, a study from Sicily has shown that 13% male and 13.6% female subjects were obese. In the present study 13% male are obese and female obesity is 8.33% with BMI over 30.73. A recent study from Malaysia has recorded 30% ow/ob subjects among their medical students with a BMI over 23 kg/m2 [10].

In the present study the data analyzed showed that 32% of males are over weight and 13% are obese. The females are 33.33% over weight and 8.33% are obese. These findings are similar to the study conducted by Zaytoun et al and Yasir Mehamood et al [11].

The total body fat was high at 31.08 ± 1.91.%, 25.41± 1.46 % and 36.73 ± 0.5%, 32.38 ± 3.27 % in overweight, obese males and females respectively as compared to other groups. The results show that as the body mass index increases, the percentage of body fat also increases in male group and female group. One research in Kuwait people revealed that the body fat percentages of males and females are 23.3% and 37.7% respectively. Females were greater than that for males, and males have a significantly higher proportion of obesity than women. This result is consistent with the findings of other studies in other countries. The findings are similar to our study. Body fat percentages differ among countries depending on genetic factors, eating patterns, regular exercise, and other life-style habits.

Although overall obesity confers a significant threat to the health of individuals, the distribution of body fat is also of great importance in determining this threat [12]. Central obesity has been recognised as an independent risk factor for cardio-metabolic diseases and a better predictor of cardiovascular risk than overall obesity [13, 14, 15]. In the present study females are found to have higher WHR (≥ 0.85).

The skeletal muscle mass was about 32.5 ± 0.3% in over weight/obese males and 24.4 ± 0.2% in over weight obese females which was slightly less than the recommended values. The leg area had more muscle mass than other areas. The subcutaneous fat was more in the arms and legs than in the trunk area in both males and females. Thus the study findings are consistent with those of other studies. In the present study BMI and WC were positively correlated, which was reported in the studies conducted by Schreiner et al compared with BMI, WC and WHR are good indicators for body fatness in adults at the population level and provide additional information about central fat distribution.

In the present study the visceral fat was high in the obese males (14.40 ± 2, 27%) and whereas obese females had normal levels at (9.5 ± 1.0%). The overweight obese males will develop more health risks as observed with higher visceral fat suggesting very strongly that the young subjects follow poor health behavior and life style practices [11]. It is very crucial to promote healthy foods, introduction of extra-curricular activities at institutional level, avoiding fast foods are likely to have a major effect in reducing obesity among these young medical students. This would also enable them to maintain normal weights, avoid immediate and long-term complications associated with overweight and obesity [16].

To counteract the trend, India has launched numerous campaigns in recent months. The Eat Right India movement promotes the value to health and importance of a nutritious, adequate and balanced diet.

The Food Safety and Standards Authority of India (FSSAI) is moving towards eliminating trans fats from the country's food supply by 2022, one year ahead of the World Health Organization's target for the same. October 11th marks the World Obesity Day, an opportunity for India to promote awareness of its crisis of obesity, the condition that risks health, well-being and lifestyle and how best to prevent them. India must take note of the current trends and statistics and work towards alleviating the nation's burden of overweight and obesity which is of vital necessity to public health and the health of the country overall.

CONCLUSIONS

In this study, it is found that significant increase in body fat and visceral fat was observed in both genders with increase in BMI and WHR.

REFERENCES

1. 250 million children worldwide forecast to be obese by 2030. Available from https://www.telegraph.co.uk/ global-health/science-and-disease/250m-children-worldwide-forecast-obese-2030-china-drives-epidemic/
2. Second only to China, India will have 27 million obese children by 2030. Available from https://www.news18.com/news/india/second-only-to-china-india-will-have-27-million-obese-children-by-2030-says-global-report-2333949.html
3. Report of the commission on ending childhood obesity. World Health Organization Geneva (2016). WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004, 363:157.
4. Consultation, W. E. (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet (London, England), 363(9403), 157-163. Available from http://dx.doi.org/10.1016/S0140-6736(03)15268-3
5. Anjana, R. M., Deepa, M., Pradeepa, R., Mahanta, J., Narain, K., Das, H. K., ... & Yajnik, C. S. (2017). Prevalence of diabetes and prediabetes in 15 states of India: results from the ICMR–INDIAB population-based cross-sectional study. The lancet Diabetes & endocrinology, 5(8), 585-596.
6. WHO Expert Consultation. (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004, 363:157.
7. World Health Organisation. (2011). Waist circumference and waist-hip ratio report of a WHO expert consultation, Geneva. 2011. ISBN 978 92 4 150149 1
8. Ohe K, Hachiy Y, Takahashi Y, Oda S. (1992). The significance of obesity in UOEH medical students--multiple regression analysis of the annual physical checkup data in 1991. J UOEH, 14(4): 279-288.
9. Bertsias G, Mammas I, Linardakis M, Kafatos A. (2003) Overweight and obesity in relation to cardiovascular disease risk factors among medical students in Crete, Greece. BMC Public Health, 3:3.
10. Muralidhara, D. V., & Pui, C. (2015). An evaluation of overweight/obesity and body fat status in medical students. Integr Obes Diabetes, 1(1), 7-10. 1: doi: 10.15761/IOD.1000103.
11. Yasir Mehmood, Farhan Khashim Al-Swailmi, Shehab Ahmed Al-Enazi. (2016). Frequency of obesity and comorbidities in medical students. Pak J Med Sci., 32(6): 1528–1532.
12. Bhaskaran K, Douglas I, Forbes H, Dos-Santos-Silva I, Leon DA, Smeeth L. (2014). Body mass index and risk of 22 specific cancers: a population-based cohort study of 5.24 million UK adults, Lancet., 384:755–765.
13. Flegal KM, Kit BK, Orpana H, Graubard BI. (2013). Association of all-cause mortality with overweight and obesity using standard body mass index categories: a systematic review and meta-analysis, JAMA., 309:71–82.
14. National Heart, Lung and Blood Institute. (2013). US Department of Health and Human Services. Managing overweight and obesity in adults: systematic evidence review from the Obesity Expert Panel, 2013. Available from http://www.nhlbi.nih.gov/sites/www.nhlbi.nih.gov/files/obesity-evidence-review.pdf.
15. Ashwell, M., & Gibson, S. (2009). Waist to height ratio is a simple and effective obesity screening tool for cardiovascular risk factors: analysis of data from the British National Diet and Nutrition Survey of adults aged 19–64 years. Obesity facts, 2(2), 97-103.
16. Al Rashdan I, Al Nesef Y. (2010). Prevalence of overweight, obesity, and metabolic syndrome among adult Kuwaitis: results from community-based national survey. Angiology. 61(1):42–48.