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Original Research Article

A comparative study of total body fat percentage, visceral fat percentage and whole body subcutaneous and skeletal fat percentage between patients with depression and normal subjects

Arijit Chakraborty[1], Sujoy P. Bhattacharyya[2]*, Malay K. Ghosal[3]

[1]Department of Physiology, KPC Medical College and Hospital, Jadavpur, Kolkata, India
[2]Department of Physiology, Medical College, Kolkata, India
[3]Department of Psychiatry, Medical College, Kolkata, India

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***Correspondence:**
Dr. Sujoy P. Bhattacharyya,
E-mail: drsujoy130@gmail.com

ABSTRACT

Background: In today's world, depression has been named as the foremost public health problem while obesity has reached epidemic proportions in India in the 21st century. A probable association between depression and obesity has been suspected. The quantification of obesity, can be done by various methods such as body mass index (BMI), bioelectrical impedance analysis (BIA) etc. Among these, BMI and BIA have emerged as well accepted techniques. From impedance measurement values and other data such as a person's height, weight and body types, it is possible to calculate the percentage of body fat, fat-free mass (skeletal muscles), and other body composition values.
Methods: This was an analytical cross-sectional study. Cases comprised of subjects who were diagnosed with depression but were 'drug naive' while the control group comprised of age-matched subjects drawn from the normal population. Measurement of various anthropometric parameters like BMI, total body fat (TBF) %, visceral fat % etc. was carried out among the cases and controls using a portable body fat monitor scan that employed BIA.
Results: BMI, TBF%, visceral fat %, whole body subcutaneous and skeletal fat % were found to be much higher among the cases (subjects with depression) in comparison with the controls (normal subjects), in a statistically significant way.
Conclusions: The study showed that the intrinsic inflammatory potential of obesity coupled with its probable dysregulatory impact on the (hypothalamo-pituitary-adrenal) HPA axis was possibly the underlying cause of the elevated anthropometric parameters noted among the cases.

Keywords: Depression, Obesity, Total body fat percentage

INTRODUCTION

Depression has been named as the world's foremost public health problem, in the recent times. In fact depression as a malady has become so widespread that it is often called the 'common cold' of psychiatric illness. But there is a vast difference between depression and cold. This is because the former if left untreated, can even kill us while the latter is rarely fatal. The suicide rate, studies indicate, has been exponentially increasing in recent years, and includes children and adolescents too. This escalation of death rate has occurred inspite of the numerous antidepressant drugs and tranquilizers which are in use during the past several decades.[1] Recently conducted world mental health surveys indicate that lifetime prevalence of all depressive disorders taken together is over 20%, i.e. 1 in 5 individuals.[2] India is home to an estimated 57 million people (18% of the global estimate) affected by depression.[3]

Like depression, obesity is another serious public health problem in both developed and developing countries. Obesity can be presented as the biggest health problem in the modern industrial world.[4] According to WHO, overweight and obesity were ranked fifth in 2004, amongst the leading risk factors causing death in 2004.[5] Obesity has reached epidemic proportions in India also in the 21st century and about 5% of the country's population are affected with morbid obesity for which urbanization and modernization have been attributed as the main reason.[6,7] Obesity is referred to as a medical condition in which excess body fat has accumulated in the body to the extent that it has an adverse effect on health. Thus obesity has an overall negative impact on the health and longevity of individuals in the society. Based on the pattern of fat distribution, obesity can be classified as: Central obesity or apple shaped obesity (android) and peripheral obesity or pear shaped obesity (gynoid). Central obesity is accumulation of fat in abdominal region mainly; whereas peripheral obesity is accumulation of fat in the lower limbs mainly (hips, thighs, legs). A central distribution of body fat is associated with higher risk of morbidity and mortality than a more peripheral distribution.[8]

Contrary to popular thinking, obesity and depression are not only widely prevalent in the west but are also being increasingly encountered in developing countries like India. The fact that obesity leads to depression and vice-versa is well known and has been substantiated by numerous research studies carried out in different parts of the globe.[9] However, the scenario in the South Asian perspective is often different and quite a few studies done on South Asian population have shown that many depressed subjects were not actually obese. Similarly, the association between total body fat % (TBF%) and body mass index (BMI) though often direct in the western world, is not so among the South Asians.[10] The present study was conducted to compare and analyse the body composition parameters (such as TBF%, visceral fat% etc.) of patients suffering from depression, and attending the Deptt. of Psychiatry, Calcutta Medical College with a suitable control group.

Although there are various methods to quantify body fat distribution such as underwater weighing, air displacement plethysmography (ADP), dual energy X-ray absorptiometry (DEXA), bioelectrical impedance analysis (BIA), anthropometric measurements (skin fold thickness, body mass index), body imaging (MRI, CT scan) etc, measurement of BMI and bioelectrical impedance analysis (BIA) have been found to be well accepted techniques that are also relatively easy to carry out.

Aim of study was to compare total body fat percentage (TBF%), visceral fat percentage, whole body subcutaneous and skeletal fat percentage between subjects who are newly diagnosed with depression and normal subjects.

METHODS

The present study was undertaken in the departments of Physiology and Psychiatry, Medical College and Hospital, Kolkata (MCHK), from February 2017 to September 2018. It was an analytical cross sectional study conducted on two study groups. The cases (n=31) comprised of patients suffering from depression who were drug naive and the control group (n=35) was made up of normal subjects. The study was approved by the ethics committee of MCHK. The participants in the study belonged to an age group of 18-59 years and had a mixed socio-economic background. The participating subjects were screened for diseases, family history and also history of medication. The cases were diagnosed as having depression using the DSM-5 criteria.

Inclusion criteria

The subjects who fulfilled the selection criteria, gave informed consent and had similar physical activity profile were included in the study (n= 31).

Exclusion criteria

Neurological conditions such as epilepsy, anti-epileptic drug withdrawal, post-head injury, post-stroke, post-meningitis, post-encephalitis, encephalopathy, space occupying lesions (SOL) of brain etc. Patients with any chronic illnesses such as tuberculosis, cancer etc. and subjects with any kind of metallic or electronic implants such as nails, plates, pacemaker etc were excluded.

The study involved the measurement of anthropometric parameters such as height, weight and body composition. Body composition (body fat %) was measured by OMRON Body Fat Monitor with inbuilt weighing scale (OMRON body fat monitor HBF-375 Karada Scan-Omron Healthcare India Private Limited, India). It is a battery operated, automatic electronic machine which comprises of 8 sensors (4 for the feet and 4 for the hands). The device measures body resistance by using a weak current flowing through both the hands and both the feet employing Bioelectrical Impedance Analysis (BIA) or biological resistance method. The amount of current flowing through human body is very small (50 kHz, 500 micro-ampere); which is not stimulatory and is extremely safe for the human body. In order to calculate the body fat percentage and other data from the resistance between both hands and feet, five parameters, viz., (1) resistance value, (2) height, (3) weight, (4) age and (5) gender are required to be fed to the machine. The exact procedure followed while using the device involved the following-the instrument (Omron Body Composition Monitor HBF-375) was checked for its operability. The foot and hand sensors were cleaned with cotton cloth, tap water and made dry. Detailed instructions were given to the subjects about the crucial role of maintaining a firm grip on the 'hand sensors, proper positioning of feet on 'foot sensors' and the position of the arm. The arm position was kept at

90 degrees with the body. A guide sketch of this position was shown to the subject. After selecting the 'guest' profile, age, sex and height were entered on the data acquisition section of the instrument. Next, the subject was instructed to step on the instrument and to grip the hand sensors properly in the desired position. Time was allowed for the measurements to be done according to the visual signals on the LCD screen of the instrument. After the appearance of the result, subject was instructed to step down from the instrument and the data were recorded. Weight was measured by a digital weighing scale that was inbuilt within the Omron Body Composition Monitor HBF-375, to the nearest 0.1 kg (Precision of the instrument being 0.1 kg). Height was measured by the wall-mounted scale to the nearest of 0.1cm. Before measurement, the subject stood on the floor base of the scale with barefoot with his/her heels touching together and to the base of vertical wall-mounted scale, keeping the feet apart at an angle of 45 degrees. Head, scapula and buttocks were kept in contact with the wall as far as possible. Hands were kept hanging by the side. Subject looked straight forward. The head marker was placed down to make a touch with head and the reading was recorded.BMI or Quetelet index (Weight in kilograms/ Height in meters squared) was derived from the measured values of weight and height.

Statistical analysis

The collected data were tabulated and analyzed (significance testing etc) using suitable software packages such as Microsoft Excel, Instat (Graphpad) etc.

RESULTS

The present study was conducted with 31 subjects with depression (cases) and 35 age and sex matched subjects acting as controls. The set of study parameters that were recorded for each subject included anthropometric indices such as height, weight and body composition (body fat %) (Table 1) (Figure 1 and 2).

Table 1: Age-wise distribution of controls and cases.

Age group	Control	Percentage of controls	Cases	Percentage of cases
18-29	19	54.29	15	48.39
30-59	8	22.86	8	25.81
40-49	4	11.43	4	12.9
50-59	4	11.43	4	12.9

Comparison between the BMI of the two study groups (Cases and Controls) is shown in Table 2. It is seen that the difference in BMI among depressed and normal subjects is statistically extremely significant.

Table 3 shows the comparison of the TBF% between the cases and controls. Again, the difference in TBF% among depressed and normal subjects is seen to be statistically extremely significant.

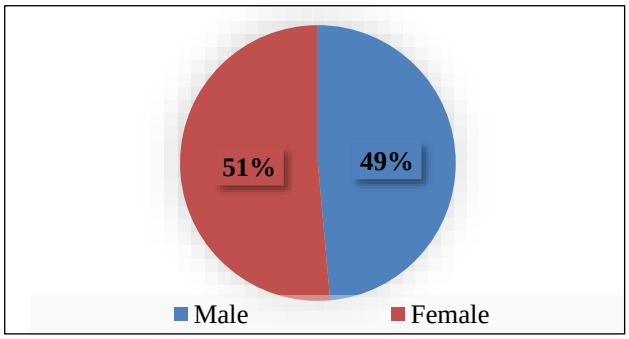

Figure 1: Sex distribution among controls.

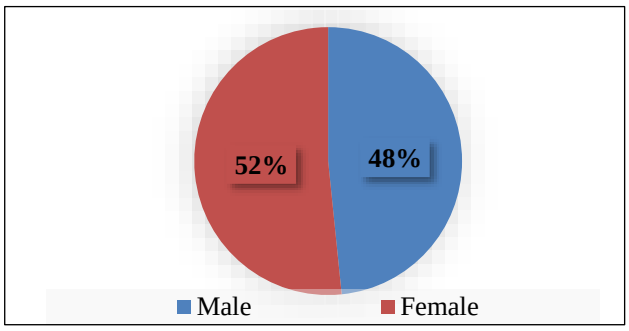

Figure 2: Sex distribution among cases.

Table 2: Comparison of BMI between controls and cases.

	BMI (Mean±SD)	% difference of the mean	p value
Control	22.6±3.79	-35.18	<0.0001
Cases	30.55±4.53		

Table 3: Comparison of TBF% between controls and cases.

	TBF% (Mean±SD)	% difference of the mean	p value
Control	24.41±7.79	-35.68	<0.0001
Cases	33.12±5.3		

Table 4: Comparison of visceral fat % between controls and cases.

	Visceral fat% (Mean±SD)	% difference of the mean	p value
Control	5.73±3.22	-138.92	<0.0001
Cases	13.69±5.07		

Comparison of the visceral fat % between the two study groups is shown Table 4. The difference was found to be statistically extremely significant.

Table 5 shows the comparison of whole body subcutaneous fat % between the cases and controls. The

difference turned out to be statistically extremely significant.

Table 5: Comparison of whole body subcutaneous fat % between controls and cases.

	Whole body subcutaneous fat% (Mean±SD)	% difference of mean	p value
Control	18.83±7.53	-39.46	<0.0001
Cases	26.26±7.19		

Table 6: Comparison of whole body skeletal fat % between controls and cases.

	Whole body skeletal fat% (Mean±SD)	% difference of mean	p value
Control	30.42±5.19	11.27	0.0027
Cases	26.87±3.85		

Comparison of the whole body skeletal fat % of the two study groups is shown in Table 6. Again, the difference turned out to be statistically very significant.

Figure 3 shows the distribution of mean subcutaneous fat % in various regions of the body, among the two study groups. The difference in subcutaneous fat% of trunk (p<0.0001), arms (p=0.0058), and legs (p= 0.0006) among depressed and normal subjects is statistically extremely significant.

Distribution of the mean skeletal fat % in various regions of the body, among the two study groups, is shown in Figure 4. It is seen that the difference in skeletal fat% between depressed and normal subjects with regard to trunk (p<0.0001) is statistically extremely significant while that for arms (p=0.01) is just significant and that for legs (p= 0.0006) is not significant.

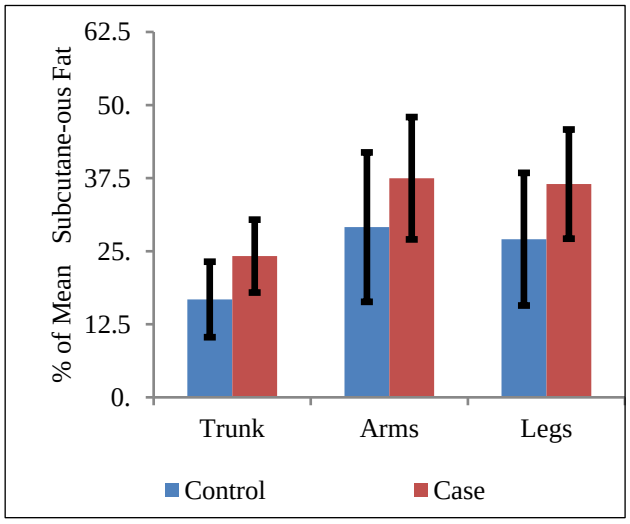

Figure 3: Distribution of mean subcutaneous fat% of trunk, arms and legs among controls and cases.

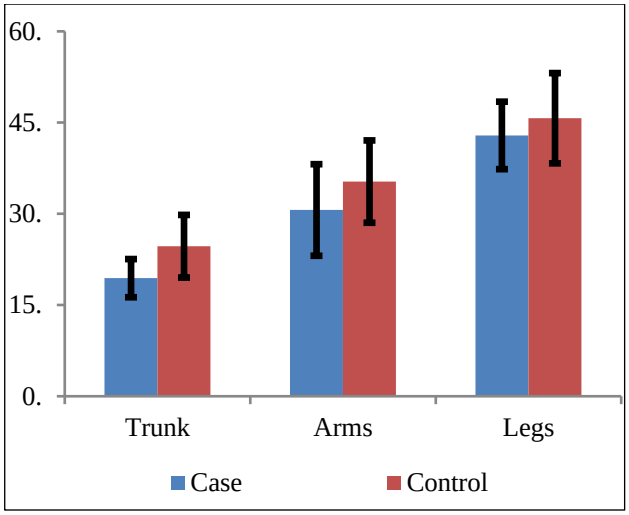

Figure 4: Distribution of mean skeletal fat% of trunk, arms and legs among controls and cases.

DISCUSSION

In the present study, the TBF%, visceral fat% and whole body subcutaneous and skeletal fat% was estimated among depressed subjects and the same was compared with age and sex matched normal subjects. In our study, most of the depressed patients belonged to the age group of 18-29 years. It is probably due to the increased awareness and activity in this particular age group that leads to a large number of disease reporting at hospitals. Sex wise distribution of both cases and controls are almost equivalent in our study. Our study had the following salient findings: i) The mean value of BMI among depressed subjects was more than that among controls in a statistically extremely significant way (p<0.0001); ii) The mean value of TBF% among depressed subjects was more than that among controls in a statistically extremely significant way (p<0.0001); iii) The mean value of visceral fat% among depressed subjects was more than that among controls in a statistically extremely significant way (p<0.0001); iv) The mean value of whole body subcutaneous fat% among depressed subjects was more than that among controls in a statistically extremely significant way (p<0.0001); v) The mean value of whole body skeletal fat% among depressed subjects was more than that among controls in a statistically extremely significant way (p<0.0001).

Comparable findings were reported by various other researchers. Wit et al in 2009, Faith MS in 2002, and Scott et al in 2008, in their studies, showed that due to the high prevalence of both depression and obesity, a potential association between depression and obesity has been presumed and repeatedly been examined. Such an association has been confirmed at the cross-sectional level.[11-13]

On the contrary, a small number of studies have documented that depressed subjects were not always obese.[14,15]

Obesity is an inflammatory state, as weight gain is known to activate inflammatory pathways. Inflammation is also associated with depression.[16] Since inflammation plays a role in both obesity and depression, it may be the mediator of the association. The groundbreaking discovery of leptin in 1994 ignited the field of obesity research by providing the first direct evidence for a hormonal system primarily involved in body weight regulation. It appears that leptin controls feeding not just by providing physiological satiety signal, but also by mediating "synaptic plasticity" as well as modulating the perception of reward associated with feeding.[17] Moreover, the hypothalamic-pituitary-adrenal axis (HPA axis) might play a role in both depression and obesity. It has been shown that obesity might involve HPA axis dysregulation. HPA axis regulation is also known to be associated with depression.[18] Being overweight and the perception of being obese increases psychological distress and depression.[19] Bjorntorp showed that depression induces abdominal obesity through long term activation of the HPA axis.[20]

Finally, the important limitations of our study included (1) a relatively small sample size and (2) Bioelectrical Impedance Analysis (BIA) is not the best method to calculate TBF%, visceral fat%, whole body subcutaneous and skeletal fat%. Dual-energy X-ray Absorptiometry (DXA) is now considered the "Gold Standard" for TBF%, visceral fat%, whole body subcutaneous and skeletal fat%.

CONCLUSION

We thus conclude that BMI, TBF%, visceral fat %, whole body subcutaneous fat % and whole body skeletal fat % were more among the cases (depressed subjects) in comparison to the controls (normal subjects), in a statistically significant way. The intrinsic inflammatory potential of obesity coupled with its dysregulatory impact on the HPA axis, possibly underlie these findings.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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