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**Original Research Article**

# Analysis of Body Compositions and Energy Expenditure of Sedentary Teaching Employees of SDAU, Gujarat, India

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**A B S T R A C T**

The assessment of body compositions by Bioelectrical Impedance Analysis (BIA) is the best long term marker for assessing the nutritional status whose results represent the collaborative interaction of body composition, energy balance and body function. Total 109 samples out of Assistant professor (69), Associate professor (16) and Professor (24) were selected by proportional stratified random sampling method. The mean age of the respondents ranged from 40.01±1.16 to 56.58±0.68 years. There were significant (P<0.05) differences of PBF (Percent body fat), BMI (Body Mass Index) and fatness among the Assistant professor, Associate professor and Professor. Mean PBF for Assistant professor, Associate professor and Professor was 24.74±0.75, 26.05±0.59 and 28.13±0.95 percent, respectively. The mean BMI showed similar trend as PBF; maximum in Professor (26.12±0.54 kg/m$^2$), minimum in Assistant professor (23.34±0.39 kg/m$^2$) and intermediate in Associate professor (24.52±0.65 kg/m$^2$). The mean of VFA (Visceral Fat Area) and WHR (Waist to Hip Ratio) were found to have highly significant (P<0.01) differences among the categories. It may be concluded that the prevalence of overweight and obesity is gradually increasing among the sedentary teaching employees of the SDAU (Sardarkrushinagar Dantiwada Agricultural University). Therefore, a balanced diet with active lifestyle will be a useful strategy to maintain the health and optimum body weight among the teachers.

**Keywords**

Bioelectrical Impedance Analysis, lifestyle, obesity, VFA and WHR

## Introduction

The process of urbanization the societies pass through a span where both under and over nutrition related problems occur simultaneously. Under nutrition mainly impact on infants, children and women of child bearing age and excessive nutrition creating a variety of chronic health conditions in middle aged and older adults.

Over nutrition or obesity is a growing health problem in the world including India, due to changes in lifestyle. Inadequate nutrition is associated to several chronic diseases that significantly impact morbidity, mortality and quality of life. An ideal nutritional status occurs when the supply of nutrients conforms to the nutritional requirements or

needs. Timely assessment of nutritional status is essential to identify the problems as well as to avoid them. Anthropometry is one of the most basic tools for assessing nutritional status, whether the person is subjected to over nutrition or under nutrition. Anthropometric measurements describe body mass, size, shape, and level of fatness. It helps in adequate assessment of the overall adiposity of an individual (Frisard *et al.,* 2005). Body composition is not only measured to identify deficiencies or surplus of components to know the related health risks but also to formulate suitable interventions. Body composition is one of the most basic tools for assessing nutritional status, whether the person is subjected to over nutrition or under nutrition. The nutritional assessment by body composition is much beneficial as it monitors optimal nutrition along with nutritional management of the person. It is a good indicator for identifying possible health problems like obesity at an early stage and to quantify human body at several levels, depending on clinical concerns.

Bioelectrical Impedance Analysis (BIA) is commonly used cost-effective, non-invasive, reproducible, simple and reliable mode to evaluate nutritional status. It is based on a two compartment body composition model and work with tetra polar multi-frequency (5-50-250 kHz) method. In BIA, a small electrical current travels through the body's water pool and measure the impedance or resistance of the individual and estimates of total body water (TBW), fat-free mass (FFM), and fat mass (Lukaski *et al.,* 1985). It not only determines the obesity related medical condition but also identify malnutrition.

Total Body Water (TBW) is the major component of the body composition. At birth, the body contains 70 to 75 per cent water, but with maturity it decreases to 50 to 60 per cent in lean adults and to less than 40 per cent in obese adults. Water is found exclusively within the FFM, which is approximately 73.2 per cent water in adults. The adult human body contains approximately 57 per cent water (Jequier and Constant, 2010).Similar to TBW, protein is also a functionally important component at the molecular level of body composition which contributes to key body functions like blood clotting, fluid balance, production of hormones and enzymes, vision and cell repair. It is also a chief component of muscle along with water and is distributed in the whole body including vital organs. Protein mass in healthy adults is relatively large, representing 10.6 kg, or 15.1 per cent, of body mass in the reference man (Snyder *et al.,* 1975).

Healthy people maintain a well-balanced body composition but unhealthy persons fail to keep this balance and suffer from obesity, malnutrition, oedema, osteoporosis, etc. The health transition situations due to chronic diseases in India contribute to 53 per cent of deaths and 44 per cent of disability (Reddy *et al.,* 2005) and mainly urban peoples are more prone to this.

Unfortunately, adult and urban population of India is currently experiencing great rise in overweight and obesity. Thus, maintaining healthy body weight and reducing excess body fat is essential to ensure long term health benefits especially when obesity related co-morbidities increases health care costs and results in an economic burden on society.

## Objective

To assess the body composition, energy expenditure and physical active level of the respondents

## Materials and Methods

The teaching employees (e.g., Assistant professor, Associate professor and Professor) workings at SDAU, Gujarat who were willing to participate were selected by the proportional stratified random sampling techniques from the total population as the respondent for this research study. The respondents were divided in three groups according to their designation i.e. Assistant professor, Associate professor and Professor and the number of respondents were selected as 69, 16 and 24 respectively. Both male and female teaching employees were taken for the study purpose.

Bioelectrical Impedance Analysis (BIA) analyzer ioi353 (Jawon medical, Korea) was used for collecting body composition variables (Total body water, total body protein, total body minerals and body fat mass), abdominal analysis (Waist to hip ratio, visceral fat level, visceral fat area and abdominal circumference), body type (Per cent body fat, body mass index), energy expenditure (Basal metabolic rate and total energy expenditure) and age matched to body.

Mean and standard deviations for various parameters were computed. The standard SPSS software 17.0 was used to analyze the data. All the data were tested for significance using the ANOVA among means of various parameters (Sahu, 2010).

## Results and Discussion

### Body composition

The body composition variables i.e. age, height, weight, LBM (Lean Body Mass), MBF (Mean Body Fat), SLM (Soft Lean Mass), mineral, protein, TBW (Total Body water), PBF (Percent of Body Fat), BMI (Body Mass Index), fatness, VFA (Visceral Fat Area), AC (Abdominal Circumference), WHR (Waist Hip Ratio) and AMB (Age Matched of Body) of the respondents are shown in Table-1.

The mean age of Assistant professor, Associate professor and Professor were 40.01±1.16, 48.19±1.56 and 56.58±0.68 years respectively which had highly significant ($P<0.01$) difference among the categories. The mean AMB had also highly significant ($P<0.01$) difference among the categories. The mean of AMB of the Assistant professor, Associate professor and Professor were 41.86±1.26, 49.69±1.47 and 58.58±0.86 years respectively. Comparison of actual age of the respondents with the AMB was found to be slightly higher than actual age in all the categories. As the cadre increased the age of the respondents also increased. Similarly, mean weight of the respondents had significant ($P<0.05$) difference among the categories. The mean weight of the respondents was 68.99±1.24, 71.94±2.23 and 75.08±2.03 kg for Assistant professor, Associate professor and Professor respectively. The mean weight of Associate professor was intermediate (71.94±2.23 kg) which did not differ significantly from other two categories (Assistant professor: 68.99±1.24 and Professor: 75.08±2.03 kg).

The results revealed that the body weight increased gradually with the advancement of age and designation. But there was no significant ($P>0.05$) difference found in mean height of the respondents among the categories. The mean height of the Assistant professor, Associate professor and Professor was 168.17±0.87, 168.38±1.93 and 167.67±1.01 cm respectively.

The mean LBM and SLM of the respondents showed no significant ($P>0.05$) difference among the three categories. The mean LBM

ranged from 48.81±0.81 to 50.84 ±0.73 kg and mean SLM ranged from 45.27±0.76 to 46.78±0.68 kg for the respondents. But the LBM and SLM mean values showed highest in the Assistant professor followed by Associate professor and Professor Categories. The reason behind this is that the mean MBF of the respondents was high in the Professors (20.09±1.08 kg) followed by Associate professors (19.20±0.67 kg) and Assistant professors (17.96±1.15 kg). It may be due to increase in PBF and progression of age which reduces the LBM and SLM contain in the body.

Ho-Pham *et al.,* (2015) supports the current findings. They found that the percentage of body fat increased with advancing age and the rate of increase was greater in women than in men. By the age of 60 or above, PBF in men was 26 per cent (SD 5.9 %) and in women 37 per cent (SD 5.3 %) and a divergent trend showed in lean mass between men and women.

The mean values of major body compositions i.e. mineral, protein and TBW had no significant differences among the three categories. The mean mineral contain in body among the categories ranged from 3.98±0.08 to 4.02±0.09 kg. The mean protein content was 10.13±0.17, 10.34±0.40 and 10.07±0.16 kg for Assistant professor, Associate professor and Professor respectively.

Similar trend showed for the mean TBW was 36.27±0.59, 36.78±1.44 and 36.23±0.61 kg for Assistant professor, Associate professor and Professor respectively. This result revealed that the mineral, protein, and TBF contains of the all respondents were almost in same range. The present research finding was support by Aloia *et al.,* (1996) who found the mean mineral 3.0±0.03 kg, protein 9.6±0.07 kg and water 33.1±0.29 kg in normal black women of New York. They also found that there were declines in protein, mineral and total body water, whereas fat increased linearly with age. Raghuvanshi and Singhal (2013), stated that the mineral, protein and TBW contain of young adult Indian females were 3.35, 8.35 and 27.10 kg respectively. They also found that increase in body fat leads to low total body water level. The current findings showed more mean values for mineral, protein and TBW compare to the above mentioned literature.

There were significant ($P<0.05$) differences of PBF, BMI and fatness among the Assistant professor, Associate professor and Professor. Mean PBF for Assistant professor, Associate professor and Professor were 24.74±0.75, 26.05±0.59 and 28.13±0.95 per cent respectively.

Like PBF the similar trend showed for BMI, maximum in Professor (26.12±0.54 kg/m$^2$), minimum in Assistant professor (23.34±0.39 kg/m$^2$) and intermediate in Associate professor (24.52±0.65 kg/m$^2$).

The mean of BMI and fatness was found to be more according to enhancement of designation from Assistant professor to Professor. Akindele *et al.,* (2016) found that, there was a strong and positive statistical relationship between body fat percentage and BMI. The mean BMI of professional women (20-50 years) from Rajasthan ranged between 27.8-28.9 kg/m$^2$ (Jain and Singh, 2003). BMI of 20-40 years old underweight, normal and overweight Indian men was 17.4, 21.4 and 28.0 kg/m$^2$ and for women 17.2, 20.8 and 27.1 kg/m$^2$ respectively (Kuriyan *et al.,* 2006).

A lower BMI of the subjects was observed in the present study when compared to reported values in literature.

**Table.1** Body composition parameter of the respondents according to the categories (Mean ± SEm)

| Variables | Assistant professor (n=69) | Associate professor (n=16) | Professor (n=24) | Calculated F value |
|---|---|---|---|---|
| | Mean ± SEm | Mean ± SEm | Mean ± SEm | |
| Age (year) | 40.01±1.16$^{c}$ | 48.19±1.56$^{b}$ | 56.58±0.68$^{a}$ | 37.871$^{**}$ |
| AMB (year) | 41.86±1.26$^{c}$ | 49.69±1.47$^{b}$ | 58.58±0.86$^{a}$ | 32.770$^{**}$ |
| Height (cm) | 168.17±0.87 | 168.38±1.93 | 167.67±1.01 | 0.065$^{NS}$ |
| Weight (kg) | 68.99±1.24$^{b}$ | 71.94±2.23$^{ab}$ | 75.08±2.03$^{a}$ | 3.387$^{*}$ |
| LBM (kg) | 50.39±0.82 | 51.09±1.99 | 50.33±0.84 | 0.083$^{NS}$ |
| MBF (kg) | 19.20±0.67 | 17.96±1.15 | 20.09±1.08 | 0.747$^{NS}$ |
| SLM (kg) | 46.35±0.76 | 47.18±1.83 | 46.30±0.77 | 0.133$^{NS}$ |
| Mineral (kg) | 3.98±0.08 | 3.98±0.17 | 4.02±0.09 | 0.049$^{NS}$ |
| Protein (kg) | 10.13±0.17 | 10.34±0.40 | 10.07±0.16 | 0.225$^{NS}$ |
| TBW (kg) | 36.27±0.59 | 36.78±1.44 | 36.23±0.61 | 0.081$^{NS}$ |
| PBF (%) | 24.74±0.75$^{b}$ | 26.05±0.59$^{b}$ | 28.13±0.95$^{a}$ | 3.007$^{*}$ |
| BMI (kg/m$^{2}$) | 23.34±0.39$^{b}$ | 24.52±0.65$^{b}$ | 26.12±0.54$^{a}$ | 3.109$^{*}$ |
| Fatness (%) | 8.36±1.88$^{a}$ | 10.17±2.92$^{a}$ | 13.87±2.44$^{a}$ | 3.444$^{*}$ |
| VFA (cm$^{2}$) | 113.78±5.56$^{b}$ | 130.75±5.19$^{b}$ | 157.71±8.03$^{a}$ | 9.865$^{**}$ |
| AC (cm) | 89.47±1.20 | 89.93±1.64 | 92.28±1.34 | 0.896$^{NS}$ |
| WHR | 0.90±0.01$^{b}$ | 0.95±0.08$^{a}$ | 0.98±0.01$^{a}$ | 12.205$^{**}$ |

$^{*}$Significant at 0.05 level $^{**}$Significant at 0.01 level $^{NS}$ Non-significant
Means bearing common superscripts within the row do not differ significantly (P>0.05)

**Table.2** Energy expenditure on BMR, TEE, PAL and other physical activity of the respondents according to the categories (Mean ± SEm)

| Energy expenditure | Assistant professor (n=69) | Associate professor (n=16) | Professor (n=24) | Calculated F value |
|---|---|---|---|---|
| | Mean ± SEm | Mean ± SEm | Mean ± SEm | |
| BMR (kcal) | 1345.99±15.50$^{a}$ | 1302.94±41.96$^{a}$ | 1228.21±19.19$^{b}$ | 7.532$^{**}$ |
| TEE (kcal) | 2073.19±50.00$^{a}$ | 2006.50±64.64$^{a}$ | 1873.88±37.22$^{b}$ | 8.471$^{**}$ |
| PAL | 1.54± 0.00 | 1.54±0.00 | 1.53±0.01 | 0.193$^{NS}$ |
| Physical activity (MET min/week) | 2207.55±126.83$^{a}$ | 1374.09±243.95$^{b}$ | 1350.75±179.48$^{b}$ | 8.965$^{**}$ |

$^{*}$ Significant at 0.05 level $^{**}$ Significant at 0.01 level $^{NS}$ Non-significant
Means bearing common superscripts within the row do not differ significantly (P>0.05)

The mean of VFA and WHR was found to have highly significant (P<0.01) differences among the categories. The mean VFA of the Assistant professor, Associate professor and Professor were 113.78±5.56, 130.75±5.19 and 157.71±8.03 cm$^{2}$ respectively. There

was no significant (P>0.05) difference found in VFA between Assistance professor and Associate professor Categories. Likewise, the mean WHR was found to be low in Assistant professor (0.90±0.01), high in Professor (0.98±0.01) and intermediate in Associate professor (0.95±0.08). There was no significant (P>0.05) difference found in Associate professor and Professor Categories. These results signified that WHR and VFA increased according to the designations of the respondents. It may due to less physical activity, high food intake and increase of age. The high mean values of VFA and WHR identified at risk for many metabolic diseases among the Professor category followed by Associate professor and Assistance professor. But the mean AC showed no significant (P>0.05) differences among the categories. The mean AC of the Assistant professor, Associate professor and Professor were 89.47±1.20, 89.93±1.64 and 92.28±1.34 cm respectively.

The study conducted by Inamdar *et al.,* (2016) supports present study, the women were more at risk by waist circumference but by WHR measures the males are more at risk of metabolic disorders. It may be due to the less number of female respondents as compare to male respondents in this current study, so the mean AC had no significant difference among the categories but WHR had high significant differences. Again Kaur *et al.,* (2012) also supported current findings, a significant (P<0.05) increase in visceral fat rating of the subjects was observed with the advancement of age. But they also indicated that the subjects were at low risk of degenerative diseases which also supports to current findings.

## Energy expenditure

The values of energy expenditure by BMR, TEE, PAL and physical activity of the respondents are represented in Table-2. The mean values of the BMR, TEE and physical activity of the respondents had significant (P<0.01) difference among the categories. The mean BMR and TEE of Assistant professor, Associate professor and Professor were 1345.99±15.50, 1302.94±41 and 1228.21±19.19 kcal; and 2073.19±50.00, 2006.50±64.64 and 1873.88±37.22 kcal respectively, which did not differ significantly (P>0.05) between the Assistance professor and Associate professor categories in both BMR and TEE. The mean physical activity was observed to be 2207.55±126.83, 1374.09±243.95 and 1350.75±179.48 MET min/week in Assistant professor, Associate professor and Professor Categories respectively. No significant (P>0.05) difference was found in Associate professor and Professor Categories. According to the Kaur *et al.,* (2012), the mean BMR of the subjects on the basis of their age i.e. 21 - 30, 31 - 40, 41 -50 and 51 – 60 years was 1357, 1361, 1391 and 1357 kcal and the corresponding total daily energy expenditure (TDEE) values were 2290, 2446, 22480 and 2392 kcal respectively. This study was contradicted the current research work. The BMR and TEE was decreased by increased in age of the respondents.

The calculated PAL mean values had no significant (P<0.05) difference with the categories because all the respondents were sedentarily active according to their PAL range. The mean PAL of Assistant professor, Associate professor and Professor were 1.54±0.00, 1.54±0.00 and 1.53±0.01 respectively. The result found that the BMR, TEE and physical activity decreased by increasing the carder of the respondents. Physical activity MET calculated through the IPAQ questionnaire showed the significant differences among the categories while PAL values was found to be same for

all categories. The older age groups had more active life style which could be attributed to better awareness regarding importance of active life style as the age progresses. None of the subjects in the three categories had moderate and vigorously active life style. PAL values in- creased with increasing activity grade (Larsson *et al.*, 2004). Lifestyle changes that increase the level of physical activity may be advantageous in blunting age-related increase in total and central body fatness.

According to the body composition variables of the teaching employees like weight, percentage of body fat, WHR and VFA were gradually increased by advancement of age and designation. The prevalence of overweight and obesity is gradually increased among the sedentary teaching employees of the SDAU. Light exercise, balanced diet with active lifestyle will be useful strategy to maintain optimum body composition among the teachers.

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