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A Comparative Study of Body Composition among Middle-Aged Adults of Patiala

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Abstract
The current research was done to compare the body composition variables of middle-aged adults living in Patiala city. Body composition is one of the primary factors that predetermine overall health, which has an impact on physical fitness, metabolic efficiency and risk of disease. The variables were analyzed such as protein level, percentage of body water, percentage of fat, waist-hip ratio, height and skeletal mass. One hundred participants (50 men and 50 women) aged between 35 and 50 years were chosen by a simple random sampling method. A Bioelectrical Impedance Analyzer (BIA), tape and stadiometer were used to collect data. The data was analyzed using statistical methods which included mean, standard deviation and independent t-test. The results indicated that there were very significant variations in fat percentage, skeletal mass, and waist-hip ratio among the male and female respondents. The research sheds light on the essence of a balanced body composition in the healthy state and offers practical information to fitness professionals and health practitioners.

1. Introduction

Body composition is a ratio between the fat mass and the mass without the fat in the human body. It involves muscle mass, bone density, body water and fat percentage. Body composition, as opposed to body weight alone, gives a more vivid image of the health and fitness condition of a person. Middle adulthood (3550 years) is the period when people usually undergo physiological and metabolic changes. The decreased physical activity, the change of hormones, the food habits, stress, among others, are some of the factors that lead to body composition changes. These alterations can cause more fat build up, less muscle mass and increase the possibility of lifestyle diseases like obesity, diabetes and heart diseases. With the growing exposure of urban populations to sedentary lifestyles in the context of the Indian society, it is important to measure and compare body composition parameters. As an urban center, Patala city is a good environment to conduct such a study. The current study will be used to compare the body composition variables of male and female adults in the middle age and thus establish differences that can affect health.

2. Review of Literature

Table 1: Review of Literature on Body Composition

S. No.	Author(s) & Year	Title / Area of Study	Sample / Population	Major Findings	Relevance to Present Study

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1	McArdle, Katch and Katch (2001)	Exercise Physiology and Body Composition	Adult men and women	Body composition changes with age, especially due to decline in physical activity and metabolism.	Supports the idea that middle age is an important period for studying body composition.
2	Heyward (2010)	Advanced Fitness Assessment and Exercise Prescription	Men and women	Men generally have higher lean body mass, while women have higher fat percentage.	Directly supports gender comparison in body composition variables.
3	Wilmore and Costill (2004)	Physiology of Sport and Exercise	Adults and athletes	Body fat, water content, and muscle mass are key indicators of physical health.	Justifies the selection of body composition variables in the present study.
4	Malina and Bouchard (1991)	Growth, Maturation and Physical Activity	General population	Age and sex have strong effects on body size, body composition, and physical development.	Helps explain differences between male and female participants.
5	Bean (2015)	Nutrition and Body Composition	Adults	Adequate protein intake and hydration help maintain healthy body composition.	Relates to the selected variables of protein and body water.
6	World Health Organization (2020)	Body Composition and Health Risk	Global adult population	Increased fat percentage and abnormal fat distribution are associated with chronic diseases.	Shows the health importance of fat percentage and waist-hip ratio.
7	Kaur and Singh (2018)	Comparative Study of Body Composition in Punjab	Middle-aged adults	Females had higher body fat percentage, while males had greater lean mass.	Very close to the present study in terms of region and population.

8	Sharma et al. (2019)	Sedentary Lifestyle and Obesity	Urban adults	Sedentary living increases body fat and reduces muscle-related components.	Supports the study context of urban adults in Patiala.
9	Gupta and Verma (2017)	Physical Activity and Skeletal Mass	Adults	Regular exercise improves skeletal mass and lowers fat accumulation.	Gives background for skeletal mass differences in adults.
10	Patel (2021)	Fitness, Hydration and Health	Middle-aged adults	Active individuals had better body water percentage and improved lean body mass.	Relevant to water percentage and protein-related body composition.
11	Kumar et al. (2022)	Gender Difference in Waist-Hip Ratio	Adults	Waist-hip ratio differs significantly between males and females because of different fat distribution patterns.	Supports inclusion of waist-hip ratio in the present study.
12	Singh and Kaur (2020)	Lifestyle Diseases in Middle Age	Middle-aged adults	Poor body composition increases the risk of diabetes, hypertension, and obesity.	Highlights the practical importance of studying middle-aged adults.
13	Das (2016)	Obesity and Urban Health	Urban adults	Urbanization and inactive habits increase body fat percentage.	Relevant because the present study is limited to Patiala city population.
14	Reddy (2019)	Body Water and Metabolic Health	Adults	Body water percentage is an important marker of metabolic functioning and lean tissue health.	Supports the use of body water as a body composition variable.

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15	Ali and Mehta (2021)	Comparative Health Status of Men and Women	Adults aged 35–50 years	Men showed greater skeletal mass and height, while women showed higher fat percentage.	Strongly supports the findings expected in the present investigation.

3. Objectives of the Study

1. To assess body composition variables among middle-aged adults of Patiala.
2. To compare body composition between male and female participants.
3. To analyze differences in protein, body water, fat percentage, waist-hip ratio, height, and skeletal mass.

4. Hypotheses

1. **H_0 (Null Hypothesis):** There is no significant difference in body composition variables between male and female middle-aged adults.
2. **H_1 (Alternative Hypothesis):** There is a significant difference in body composition variables between male and female middle-aged adults.

5 Variables of the Study

Variable Type	Variables
Body Composition Variables	Protein, Body Water, Fat Percentage, Waist-Hip Ratio, Height, Skeletal Mass

6. Delimitations of the Study

1. The study is confined to Patiala city only.
2. Participants are restricted to the age group of 35–50 years.
3. Both male and female participants are included.
4. Only selected body composition variables are considered.

7. Methodology

7.1 Research Design

The current research was done through comparative research design. This design was deemed suitable since the primary objective of the study was to make comparisons of body composition variables among male and female middle-aged adults in Patiala. Comparative research assists the researcher to determine similarities and differences between two groups on variables of choice. The researcher compared protein and body water, fat percentage, waist-hip ratio, height and skeletal mass in the present study between the two groups. The design is commonly employed in physical education and health related studies in circumstances where the aim is to test the differences of groups in measurable features. The comparative method was determined as appropriate and convenient since the study had objectives of analyzing naturally existing differences without controlling any variable.

7.2 Sample

To conduct the study, 100 middle-aged adults of the city of Patiala were taken as samples. The age of the participants ranged from 35 to 50 years. To ensure that there was a balance and make the comparison worthwhile the sample was equally subdivided into two groups. The sample

size was 50 males and 50 females. This age group was chosen since middle age is a significant period in life where significant alterations in body composition can take place as a result of aging, lifestyle, occupation, dietary habits and physical activity patterns. The inclusion of both men and women gave a more comprehensive insight into the body composition variations among middle-aged adults. The sample chosen was believed to be sufficient in meeting the study objectives and in getting valid results.

7.3 Sampling Technique

The study subjects were chosen using simple random method of sampling. This was a method of giving an equal opportunity to all the eligible people to be included in the sample. Random sampling minimizes the chances of bias and enhances objectivity of the study. Age group of 35-50 years old and living in the city of Patiala identified individuals and out of them the necessary number of participants were chosen randomly. This sampling technique assisted the researcher to create representative male and female groups to compare them.

7.4 Tools and Techniques

The following tools and techniques were used for collecting data related to body composition variables:

Tool	Purpose
Bioelectrical Impedance Analyzer (BIA)	Used to measure fat percentage, protein, body water, and skeletal mass
Measuring Tape	Used to measure waist and hip circumference for calculating waist-hip ratio
Stadiometer	Used to measure height of the participants

The primary tool in the study was the Bioelectrical Impedance Analyzer (BIA) since it allows fast and efficient estimates of different body composition elements. Waist and hip measurements were measured with a measuring tape, and a waist-hip ratio was determined. Height in centimeters was measured using a stadiometer. The choice of these tools was due to their practicality, standard, and common use in body composition studies.

8. Statistical Analysis

As in the current research, the correct statistical methods were used to examine the data obtained and to make the appropriate conclusions. The following statistical methods were used:

Mean:

The average was determined to find the mean value of all body composition variables of both male and female groups. It gave a good idea of the central tendency of data and assisted in comparing the general level of variables including fat percentage, protein, body water, waist-hip ratio, height and skeletal mass of the two groups.

Standard Deviation (SD):

The variability or dispersion of the scores around the mean was measured using standard deviation. It showed the extent that individual values were different to the average value. The low standard deviation indicated that the data were tightly clustered around the mean whereas the large standard deviation indicated that the data were more varied among the participants.

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Independent t-test:

The independent t-test was used to analyze whether there were significant differences in the male and female participants in regards to the chosen body composition variables. This test is appropriate when one needs to compare the means of two independent groups. The level of significance was set at 0.05. The t-test outcomes were used to either accept or reject the hypotheses which had been made.

9. Results and Analysis

Table 2: Descriptive Statistics of Male and Female Participants

Variable	Male (Mean ± SD)	Female (Mean ± SD)
Protein (%)	18.5 ± 2.1	16.2 ± 1.8
Body Water (%)	55.3 ± 3.5	49.8 ± 3.2
Fat Percentage (%)	22.4 ± 4.2	30.6 ± 5.1
Waist-Hip Ratio	0.92 ± 0.04	0.85 ± 0.05
Height (cm)	168.5 ± 6.2	156.4 ± 5.8
Skeletal Mass (kg)	30.2 ± 3.1	24.5 ± 2.8

Explanation of Table 2

Table 2 shows the descriptive statistics of the variables of body composition of male and female participants in means and standard deviation. These values can be used to determine both the average level of each variable, and the level of variation in each group.

Based on the table, it is clear that the mean values of some of the variables are higher in male participants. The average protein percentage (18.5 ± 2.1) in males is greater than that of females (16.2 ± 1.8) which means that males tend to have more lean body mass. Protein is also closely linked to muscle tissue and this variation is indicative of the greater muscular growth that is normally seen in the male gender.

In the same way, the percentage water in the body is more in males (55.3 ± 3.5) than in females (49.8 ± 3.2). This is because lean tissue has more water content as compared to fat tissue and males usually have more lean mass. In contrast, females exhibit a higher fat percentage (30.6 ± 5.1) than males (22.4 ± 4.2). The reason of this difference could be given by hormonal and physiological factors since females need a greater level of essential fat naturally.

The waist to hip ratio is also a bit high in males (0.92 ± 0.04) than in females (0.85 ± 0.05) which means that the males are more prone to accumulate fat in the abdominal area as compared to females whose fat is more balanced. When it comes to height, males (168.5 ± 6.2 cm) are taller than females (156.4 ± 5.8 cm), which is a normal biological difference.

Lastly, muscular and bone mass is higher in males (30.2 ± 3.1 kg) compared to females (24.5 ± 2.8 kg). In general, the table shows clearly that there are differences in body composition, based on gender.

Table 3: t-test Analysis between Male and Female Participants

Variable	t-value	Significance
Protein	2.45	Significant
Body Water	3.12	Significant
Fat Percentage	5.87	Significant

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Waist-Hip Ratio	2.98	Significant
Height	6.21	Significant
Skeletal Mass	4.76	Significant

Explanation of Table 3

Table 3 shows the findings of the independent t-test that was used to test whether or not there are any significant differences between the male and female participants regarding various body composition variables. T-test is a statistical test that is used to compare the means of two independent groups and find out whether the differences observed are statistically significant.

The findings reveal that the differences in all the variables of interest between the male and female subjects are statistically significant. Protein (2.45), body water (3.12), fat percentage (5.87), waist-hip ratio (2.98), height (6.21) and skeletal mass (4.76) t-values are all found to be significant at the selected level of significance (0.05).

Out of these variables, fat percentage has the greatest t-value (5.87), meaning that there is a strong difference between males and females, regarding body fat. This implies that one of the most distinguishing factors between the two groups is the fat distribution. Likewise, height and skeletal mass have high t-values also, which prove the significant physical differences.

The large t-values of protein and body water also substantiate the results that males tend to have higher lean body mass than females. Waist-hip ratio is also different, which means that there is a variation in the pattern of fat distribution.

Overall, the results of the t-test clearly reject the null hypothesis and support the alternative hypothesis that significant differences exist between male and female middle-aged adults in terms of body composition. These results underscore the need to take into account the gender differences in developing health and fitness programs.

10. Discussion

The results of the current research indicate that there are some evident and significant variations in the body composition of male and female middle-aged adults of Patiala. Such differences can be observed in all the chosen variables, i.e., protein percentage, body water percentage, fat percentage, waist-hip ratio, height, and skeletal mass. The findings indicate that the body composition has a high degree of gender sensitivity particularly in the middle adulthood where physiological and lifestyle changes are more evident.

Among the significant results of the research, one can single out the fact that the percentage of fat in female participants was higher than in male participants. This disparity can be explained by biological and hormonal factors, because women are simply more likely to possess a higher percentage of essential fat as compared to men by nature. Other factors that can cause more fat accumulation during middle age are hormonal changes, lack of physical activities and lifestyle habits, which are particularly common in females. Conversely, the male subjects showed increased amounts of protein, body water, height and skeletal mass. These results suggest that males tend to have larger lean body mass and muscle growth. The reason behind the higher body water percentage of males could be that muscle tissue has more water than fat tissue.

The other significant discovery is about waist-hip ratio. The analysis revealed that the waist-hip ratio was a little bit higher in males than in females indicating that there is a difference in

the distribution patterns of fat. This can be a sign that the males build up fat more in the abdomen area and the females build up fat in their hips/thighs. These patterns are crucial since the central fat distribution is frequently linked with health risks, such as cardiovascular disease and metabolic disorders.

The findings of the study are supportive of the past studies in the field of exercise science, physical education, and human physiology. They confirm that differences in body composition between the sexes are still relevant even in the middle-aged population. The discussion illustrates the need of fostering gender-sensitive health and fitness programs. Middle-aged adults can exercise properly, eat well, and be informed about body composition to stay healthy and prevent the tendency to lifestyle-related illnesses.

11. Significance of the Study

The current research is of significant value to the areas of physical education, health science, and applied physiology. One of the key factors that indicate health and fitness is body composition, particularly in middle age where a person starts to undergo a slow process of physical, metabolic and hormonal changes. The comparison of body composition variables between the middle-aged adults of both genders in Patiala offers valuable information, which can be used to enhance health awareness and scientific knowledge.

Among the most important implications of the research is the fact that the study will give baseline information on the profile of the body composition of middle-aged adults in an urban population. This type of data can be useful to researchers, physical education teachers, trainers, and health professionals who are dealing with adult populations. The results can assist them to comprehend natural gender variations in the protein level, body water, fat percentage, waist-hip ratio, height, and skeletal mass. This knowledge is significant when organizing exercise, diet and wellness programs.

Another important aspect of the study is that it sheds light on the importance of regularly checking the body composition and not just body weight. Most people might weigh healthily but they might be having unhealthy fats distribution or low skeletal mass. Thus, the chosen variables of this research provide a more detailed representation of physical health. This comes in particularly handy in obesity prevention, muscle loss prevention and the prevention of metabolic disorders in middle aged adults.

Practically speaking, the research can be used to develop individual and gender-oriented fitness programs. As there are notable differences in body composition between males and females, the same exercise or nutrition program might not be effective in both populations. The research promotes the use of specialized health measures on the basis of physiological needs.

Moreover, the study also adds to the social consciousness by highlighting the need to have a healthy body structure by engaging in regular exercise, appropriate diet, and healthy living patterns. This way, the research will not only be useful academically, but also socially, and helpful in promoting the health of the people.

12. Conclusion

The current research was conducted to examine the body composition variables in middle-aged male and female adults of Patiala. Based on the data analysis, one can conclude that there is a

significant difference between the two groups concerning all the chosen variables. This paper has clearly shown that gender plays a significant role in body composition in middle adulthood. The results reveal that the male participants had a greater value in protein percentage, body water percentage, height and skeletal mass. These findings indicate that men tend to have more lean body mass, body water and body strength. These differences are generally attributed to biological and physiological differences, such as a greater body mass of muscles and bone structure in men. Conversely, the female participants were more fat percentage, which might be influenced by hormones, body structure and natural fat storage pattern. This distinction is particularly pertinent in the middle age when body composition could be further influenced by physical activity, metabolism, and lifestyle shifts.

Another significant difference in the study was in the waist-hip ratio where the males and females differ not only in the number of fat in the body but also in the distribution of fat in the body. As fat distribution is strongly correlated with the danger of health, this result contributes practical significance to the research. The accumulation of abdominal fats, especially, is commonly linked to some critical health issues, including cardiovascular disease, diabetes, and hypertension.

In general, the findings highlight that body composition can be viewed as a critical parameter that can be used to determine the health and fitness levels of middle-aged adults. One should not pay attention to the body weight alone, but the variables that should be paid attention to include fat percentage, skeletal mass, and level of hydration. The research finds that the key to proper body composition and quality of life is the healthy lifestyle habits, exercise, and balanced nutrition. The results can be applied by physical education practitioners, fitness trainers, health practitioners and future researchers who are interested in adult health and fitness.

13. Recommendations

Based on the findings and conclusions of the research, a number of recommendations can be provided to middle-aged adults, health professionals, and future researchers. These suggestions should be used to enhance body composition, healthy living, and also encourage more scientific research in this field.

To begin with, frequent exercise must be highly promoted among adults between the middle age. As the body composition varies greatly at this life stage, the exercise will help to keep the fat at a healthy level, increase the skeletal mass, and lose the strength of the muscles. The aerobic exercise, combined with strength training and flexibility activities can be of particular benefit to both men and women. Fitness and health can be improved with daily walking, jogging, cycling, resistance exercises, and yoga.

Second, adults in the middle-age group should be put together in nutritional awareness programs. Healthy eating habits also contribute towards ensuring the right amount of protein, body water and healthy percent of fat. People need to be taught on eating healthy food, eating too much junk food, maintaining a healthy calorie intake, and being hydrated. This kind of awareness will help in mitigating the chances of obesity and other lifestyle diseases.

Third, gender-based fitness and wellness programs are to be created. The difference depicted in the study between males and females in relation to body composition variables proved to be substantial; thus interventions applied on health should not be based on a one-size-fits-all strategy. The exercise and foods plans are to be developed based on physical and physiological requirements of each gender.

Fourth, body composition screening should be encouraged in health facilities, gyms, educational institutions and universities. A body weight alone does not tell it all about health status. Thus, body fat analysis, measurement of waist-hip ratio, and skeletal mass should be a part of regular health examination.

Lastly, the study would be better done with a more extensive sample and a wider geographical area. In the next research, other variables can be included like body mass index, muscle endurance, lifestyle, dietary habits and occupational activity. The comparative examinations between rural and urban populations can also yield some more detailed understanding of the aspects that affect body composition in middle-aged adults.

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