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Cross-Sectional Observational Study To Correlate Body Composition With Age And Gender In Healthy Attendees Of Cancer Patients

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Abstract

Objective: To investigate the correlation of body composition with age and gender in healthy cancer patients' attendants in a tertiary care hospital.

Methods: This is a cross-sectional comparative study conducted over one year at the oncology department of a tertiary care teaching hospital in collaboration with the Physiology Department of the affiliated medical college at Rawalpindi. A total sample of 100 participants (50% females and 50% males) was taken by convenient sampling in this cross-sectional comparative study.

Results: Females had significantly higher levels of per cent body fat and total body fat, while males had statistically significant levels of total body water, fat-free mass and skeletal muscle mass. Fat mass increased significantly with age.

Conclusion: Females have higher levels of per cent body fat and total body fat, while males have higher levels of skeletal muscle mass. Fat mass increases with advancing age.

Keywords: Age, Body composition, fat mass, gender, skeletal muscle mass

Introduction

Body composition is the measure of lipids/fats, proteins and water content of the body in percentages.[1] A fat-looking person may have more muscle mass (protein content), and a thin-looking person may have no muscles at all, and all visible flesh may be fat. So knowing the body composition is very important. The body fat content has implications for metabolic syndromes, and body protein content is directly related to the ability to perform physical work.[2]

Male and female bodies are anatomically and physiologically different depending on the type of stresses their bodies have to undergo throughout life.[3] Males have historically been the breadwinners of the family, and for that, they had to be physically vigorous and sound. This has changed drastically owing to the digitalisation of the world. Females have to undergo physiological processes like pregnancy and lactation, and their physical makeup and structure in designed accordingly by nature.[4] Now, due to growing family needs and inflation, women also work outdoors, and trends are changing. The modern age of gadgets and machinery has made travelling easy and daily chores manageable with little or no physical exertion.[5] However, the lifestyle has progressively become sedentary and more stressful emotionally. This has caused a substantial rise in the metabolic syndrome and culminated in a higher frequency of cardiovascular disorders and insulin resistance, leading to increased morbidity and mortality in the masses.[6,7] This is more prevalent in Pakistan as the society still has not been motivated or encouraged enough to adopt the lifestyle changes vital for a healthy body and sound mind. Only a physically fit and healthy individual can withstand the emotional and physical strains of life, as metabolic syndrome is the new age pandemic leading to a worsening of the duration and quality of active and productive life.[8] Growing age is one of the major factors leading to changes in lifestyle and, hence, the body composition.[9] Young adults are physically more active and do strenuous work. With growing age,

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people settle in businesses and physical activity usually decreases, which leads to changes in body composition.[10] As people age, there is a noticeable rise in overall body fat mass along with a reduction in muscle mass and bone density. These are the changes that occur regardless of fluctuations in weight or body mass index (BMI). Ageing also alters the pattern of fat distribution, often causing an increase in abdominal fat. This shift can contribute to health issues such as cardiovascular conditions, osteoporosis, sarcopenia and type 2 diabetes.[9]

Our institute is a major oncology centre for federal government employees, their families and the civilian population. An enormous population from diverse areas of the country visits our institute for cancer treatment. This research seeks to explore the relationship between age, gender, and body composition among healthy individuals accompanying patients in the oncology department. Given the extensive reach of the Radiation Oncology department, the findings can be considered broadly applicable to the Pakistani population. While numerous studies have examined body composition, most focus on individuals already diagnosed with conditions like cardiovascular disease, metabolic disorders, or cancer. In contrast, this study uniquely targets a young, healthy, and disease-free population to better understand how age and gender influence body composition. By including participants from across Pakistan, this study ensures a diverse representation. The outcomes aim to enhance public health by recommending dietary adjustments, lifestyle changes, physical activity, and other non-pharmacological strategies for individuals with higher fat levels. The objective of the study is to examine the relationship between age, gender, and body composition in healthy individuals accompanying cancer patients in Pakistan.

Materials And Methods

This study was carried out at the Physiology Department, Army Medical College Rawalpindi/ National University of Medical Sciences (NUMS), in collaboration with the oncology department of Combined Military Hospital (CMH), Rawalpindi. This study was conducted over one year, in which a total sample of 100 healthy, young participants was taken, consuming comparable three times a day meals and matching physical activity (50% females and 50% males). The sample size was calculated using by WHO calculator by taking reference from a study done in India. It was a cross-sectional comparative study, and convenience sampling was done to collect data after approval from the institutional review board.

It included healthy adults of both genders, with an age bracket of 18-60 years. They were free from any metabolic disorders, had a routine physical activity background and were on a regular three-times-a-day diet.

Individuals suffering from metabolic, musculoskeletal and cardiovascular disorders or those on any medications like corticosteroids, selective serotonin reuptake inhibitors, monoamine oxidase inhibitors, anticonvulsants, and migraine prophylactic drugs were excluded from the study. Also, athletes and pregnant or lactating females were not included in the study.

The study was conducted after getting formal permission from the Ethics Review Committee of Army Medical College, Rawalpindi. Written informed consent was obtained from all the participants of the study. Only individuals giving informed consent to participate were included in the study. The participants filled out the consent form after a clear elaboration of the whole sampling procedure. Participants were given identification numbers, and their identities were kept in full confidential. Demographic details like their native area, age and gender were recorded.

Age was recorded in the form considering age on last birthday, as the age in years. Gender was also recorded in the form. Body composition of the participants was evaluated by a bioelectric impedance analysis machine (InBody370S) at a tertiary care hospital. The body composition was determined by parameters such as skeletal muscle mass (SMM), per cent body fat mass (PFM), total body water, body fat mass and fat free mass.

Statistical Package for Social Sciences (SPSS) version 22.0 was used for the data analysis. Quantitative variables were expressed as Mean ± SD, and qualitative variables were expressed as frequency and percentages. Spearman's rank correlation was applied to find out the correlation.

Results

The study was performed on 100 participants, having a mean age of 31.33 ± 6.26 years. Details of the participants' age and gender distribution are presented in Table 1. The participants were age and gender matched, as indicated by no significant difference statistically between the gender groups.

Table 1: Age and gender distribution of participants (N=100)

Gender	Frequency-n (Percentage)	Age (Years)	p-value
Male	50 (50%)	32.40±6.34	0.08
Female	50 (50%)	30.38±4.74	

Table 2 shows the association of body composition variables with gender along with mean values with standard deviation and statistical significance.

Table 2: Association of body composition with gender (N=100)

Body Composition	Gender		p-value
	Male	Female	
Body fat mass	22.19±6.90	26.49±3.14	<0.001
Skeletal muscle mass	34.23±3.48	17.62±3.03	<0.001
Total body water	43.11±6.71	27.42±4.19	<0.001
Fat-free mass	58.58±8.13	33.69±6.56	<0.001
Per cent body fat	26.36±6.24	44.18±6.30	<0.001

Table 3 shows the association of body composition variables with age, along with the values of the correlation coefficient and statistical significance.

Table 3: Association of body composition with age (N=100)

Body Composition	Age	
	r-value	p-value
Body fat mass	0.35	<0.001
Skeletal muscle mass	0.11	0.27
Total body water	0.03	0.77
Fat-free mass	0.09	0.38
Per cent body fat	0.13	0.19

Discussion

There were 50 female and 50 male participants in our study. Males had an average age of 32.40±6.34 years, and females had a comparable average age of 30.38±4.74 years. Males and females in our study were then compared for body composition, which showed that males had more mean muscle mass (34.23±3.48 kg) than the females (17.62±3.03 kg). Consequently, their means of total body water and fat-free mass (43.11±6.71 kg and 58.58±8.13 kg, respectively) were also significantly more than the corresponding mean values for the females (27.42±4.19 kg and 33.69±6.56 kg). All these correlations were statistically significant. However, the body fat mass and therefore, the per cent body fat (26.49±3.14 kg and 44.18±6.30%) were significantly higher in females as compared to values in the males (22.19±6.90 kg and 26.36±6.24 %).

This is due to the hormonal influence of estrogen and testosterone on female and male bodies. Estrogen is responsible for the fat deposition in the lower abdomen, hips and thigh area in females.[11] However, in males, it is the impact of testosterone which causes the proliferation of muscle mass and an increase in strength.[12] Variations in fat distribution between genders are influenced by differences in enzyme activity responsible for fat storage and uptake. In females, the activity of lipoprotein lipase is more pronounced in the gluteal region, often leading to a pear-shaped body when obesity occurs. In contrast, males exhibit higher enzyme activity in abdominal or visceral fat, contributing to an apple-shaped body during weight gain.[13,14]

In males, testosterone inhibits lipoprotein lipase activity in femoral subcutaneous fat.[14] Human fat cells are regulated by antilipolytic α2-adrenergic and lipolytic β1–2 receptors, which play a key role in fat metabolism. Estradiol increases α2-adrenergic receptors in subcutaneous fat but does not affect intra-abdominal fat cells. Premenopausal women have a higher ratio of α2 to β1–2-adrenergic receptors in subcutaneous fat, leading to a reduced lipolytic response to adrenaline and noradrenaline. Additionally, estrogen receptor alpha (ERα) and estrogen receptor beta (ERβ) present on fat cells further influence fat accumulation.[15] Fat cells have limited water-retaining capacity, whereas skeletal muscle can hold significantly more water. As a result, estrogen contributes to higher fat content and lower water retention in females, while testosterone promotes greater muscle mass and higher water retention in males.

In 2018, Schorr et al. explored gender differences in body composition and their link to cardio-metabolic risk in a Caucasian population. Their study comprised 208 participants, including 94 men and 114 women, aged 37 ± 10 years. They revealed that females had higher mean fat mass and mean percent fat (38 Kg with p value < 0.004 and 42.2% with p value <0.0001) compared to men (34 Kg with p value < 0.004 and 33.4% with p value <0.0001) and on the other hand mean skeletal muscle mass in males was higher (33 Kg with p value <0.003) than females (23 Kg with p value <0.002).[16] Hence, the results of our study are consistent with this study. Another study done by Lee et al., in 2018 demonstrates that the mean fat mass and mean percent body fat in females was (22.5 Kg with p value <0.001 and 36.4% with p value <0.001) higher than that in males (19.6 Kg with p value <0.001 and 26.9 % with p value <0.001). Their sample size was 507, with 213 males and 294 females, and this study was performed on the Korean population. The range of age in this study was 28-89 years. This study also showed that mean fat free mass and mean skeletal muscle mass in males was higher (49.3 Kg with p value <0.001 and 22.1 Kg with p value <0.001) and in females it was

comparatively lower (36.1 Kg with p value <0.001 and 15.3 Kg with p value <0.001).[17] Values in above mentioned studies differ slightly, and the most probable reason is genetic and racial variations in body shape and size, as Schorr et al studied the Caucasian population, Lee et al. did research on the Korean population, and our study was done on the Pakistani population. In addition, the sample size of the above-mentioned studies were quite different, however, trend in these studies were the same which was that females had considerably higher levels of percent body fat and total body fat than the males of the same racial back ground but males had elevated levels of fat free mass and skeletal muscle mass. The same was proven by our study, and the reason is social barriers, which are still very much effective in restricting females to their houses, a lower level of education and a lack of motivation. Females also have an unawareness about the benefits of exercise and have to endure the effects of parity, which makes them more sedentary, and thus, triggers deterioration of muscle mass and accumulation of fat mass in addition to the effects of hormones and enzymes.

In the present study, the correlation of age with body fat in the participants was found to be r = 0.35 with p-value < 0.001, which was significant. However, the rest of the components of body composition have an insignificant association with age. Age-related decline in muscle mass was observed in all ethnic groups. However, Asians showed much marked deterioration and therefore, displayed inferior physical performance with advancing age,[18] or vice versa. In another study by Macek et al. in 2022, 4799 participants were analysed for age-related changes in body composition, and it showed that fat percentage is significantly increased with age.[17] This may be due to decreased physical activity and malnutrition with advancing age.[19] Similar results have been observed in studies conducted in India in 2016 and 2021, indicative of regional similarities.[20,21] Ageing brings about numerous physiological and nutritional changes that contribute to a decrease in fat-free mass, often accompanied by an increase in fat mass. Interestingly, even if body weight remains stable or decreases, there may still be an underlying rise in fat mass due to the loss of muscle tissue. Studies have shown a decline in fat-free mass with ageing, alongside an increase in fat deposition within muscle tissues, primarily due to a gradual reduction in basal metabolic rate (BMR).[18, 21]

Conclusions

Age and gender have a significant impact on defining body composition. With increasing age the physical activity decreases, leading to higher body fat and lower muscle mass, thus exposing individuals to increased incidences of metabolic and cardiovascular diseases. Females have higher body fat than males due to the hormonal and physical activity differences. However, this is a novel study in terms of its population type and has a limitation of time.

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