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Assessing Visceral Fat Percentage with Advancing Age in Women Using Bioelectric Impedance Analysis

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Abstract
Obesity and related morbidities are rising globally. This study aims to evaluate the relationship between visceral fat percentage (VF%) and advancing age in 126 female participants aged 20-70 years. These participants underwent anthropometric measurements and Bioelectric Impedance Analysis (BIA). The correlation between VF% and advancing age was 0.42 ($P<0.001$). BIA is a simple and effective measurement technique for estimating VF%, which can be performed by trained health professionals. This study demonstrated a strong correlation between VF% and advancing age in females.

Keywords: Visceral Fat, Bioelectric Impedance Analysis, Advancing Age, Obesity

1. Introduction

Obesity is characterized by abnormal and excessive fat accumulation. According to WHO data from 2019, high Body Mass Index (BMI was responsible for 5 million deaths from non-communicable diseases. Obesity-related comorbidities include cancers, coronary artery diseases, type 2 diabetes, respiratory diseases, hypertension, congestive heart failure, metabolic disorders, and increased risk of disabilities "[1]". The prevalence of obesity is higher in females than males in developing countries, leading to significant health concerns [2, 3]. Visceral fat, while a small proportion of total body fat, is associated with various health risks [4, 5]. Visceral fat can be measured by direct and indirect methods, including anthropometric techniques and computed tomography (CT). While imaging techniques such as CT and magnetic resonance imaging (MRI) provide accurate measurements, other methods have limited potential in assessing visceral fat. Subcutaneous fat, not visceral fat, can often be estimated using age and anthropometric measurements [6, 7]. Several studies support the use of anthropometric measurement techniques for estimating visceral fat [8, 9, 10], while others use dual-energy X-ray absorptiometry and CT to assess VF% and its effects with advancing age [6, 11, 12]. This study aims to find a method for estimating VF% based on considerations such as accuracy, convenience, cost, and accessibility in routine practice. A weak relation was observed between anthropometric method and occurrence of disease [13,14]. However, very few studies performed to study impact of age-related charges in visceral fat and its outcome in form of related health risks such as glucose resistance and insulin sensitivity

"[15]". Given the discrepancies in the literature, this study evaluates the relationship between visceral fat percentage and advancing age in females.

2. Material and Methods

The study was conducted at Dr. D.Y. Patil Medical College, Hospital and Research Center, involving 126 healthy females aged 20-70 years. Women under 20, pregnant, and lactating women were excluded. Informed consent was obtained from all participants, and they were instructed to fast for 1 to 3 hours and avoid heavy physical activity before measurements. Weight and height were measured using a digital weighing machine and a wall-mounted stadiometer, respectively. Body Mass Index (BMI) was calculated as weight (kg) divided by height squared (m^2). VF% was measured using the Omron body composition analyzer model HBF 500.

Data were compiled as mean, standard deviation (SD), and p-value. The Pearson correlation coefficient was used to assess the statistical relationship between VF%, body fat mass, muscle mass, and age.

3. Results

Visceral fat percentage in females was assessed using bioelectric impedance analysis (BIA). Participants were divided into three age groups as shown in Table 1. The mean age was 42.1 ± 15.03 years. The distribution of participants across age groups I-III was 37.30%, 44.44%, and 15.87%, respectively Table 2. Statistical analysis indicated an increase in VF% with advancing age [Figure 1]. The correlation between VF% and age was 0.42 ($P<0.001$) Table 3, demonstrating a significant relationship between VF% and advancing age in females.

Table 1. Details of Participants as Per Age

Age (Yrs)	Participants (n)	n%
20-39	47	37.3
≥ 40	59	44.44
≥ 60	20	15.87

Table 2. Mean and SD of Different Age Groups

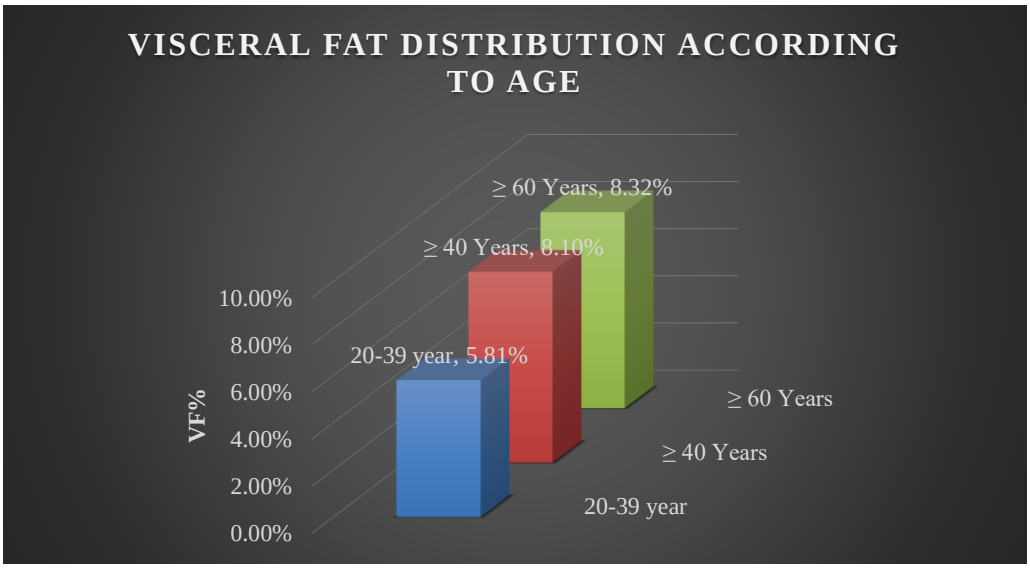
Age (Yrs)	No. of Females	Mean Age	SD
20-39	47	31.67	5.2
≥ 40	59	47.26	6.1
≥ 60	20	63.12	2.24

Table 3. Visceral Fat Distribution According to Age

Age (Yrs)	Mean VF%	SD VF%	r	p- Value
20-39	5.81	3.62	0.11	0.09
≥ 40	8.1	4.12	0.08	0.37
≥ 60	8.32	4.38	0.1	0.4

The above data is pictured in the next graph.

Figure 1: VISCERAL FAT DISTRIBUTION ACCORDING TO AGE



4. Discussion

Visceral fat, while comprising a small proportion of total body fat, significantly impacts health. According to Howard E. Lewine, visceral fat produces cytokines that can trigger low-level inflammation, increasing the risk of heart disease and other chronic conditions. It also produces angiotensin, which narrows blood vessels and raises blood pressure. Increased visceral fat is associated with several health risks, including cardiovascular disease, dementia, asthma, breast and colorectal cancer, and hepatic insulin resistance [4, 5]. Several techniques are available for estimating VF%, such as routine anthropometric measurements, ultrasonography, computed tomography, magnetic resonance imaging, and Dual Energy X- ray Absorptiometry (DEXA) [8, 9, 10, 11, 12]. Some studies support BIA as a reliable technique for estimating visceral fat, potentially serving as an alternative to CT [16].

BIA can detect excess visceral fat that may not be identified through waist circumference measurements [17]. Many studies have reported comorbidities associated with increased visceral fat, such as hypertension, dyslipidaemia, insulin resistance, metabolic syndrome, pre-hypertension, and systemic inflammation [16,17]. Visceral fat has been independently associated with body compositions studied in older populations, even in participants without chronic diseases [18]. Existing equations for body composition using BIA are of limited use when applied to elderly participants [18, 19, 20]. Errors in BIA measurements for VF% estimation have been reported due to factors like fluid accumulation, age, and other metabolic disorders [19, 20, 21].

Due to significant changes in body mass components and dimensions in elderly subjects, accurate methods for evaluating body composition are essential [20, 21, 22]. Accurate estimation of regional adipose fat deposition is becoming increasingly important, especially in countries with a large aging population. Visceral fat deposition serves as an early indicator for detecting cardiovascular and metabolic syndrome. Our study showed that VF% is closely correlated with advancing age and could be useful for screening health risks.

5. Conclusion

BIA is a safe, valuable, and non-invasive method for estimating VF%. This study found a strong correlation between VF% and advancing age in females, suggesting VF% could be a useful metric for

assessing obesity and associated health risks. Limitations of this study include a small sample size and measurement errors. Future studies should involve larger sample sizes and include comparative studies between male and female participants. Further research should also explore the role of VF% in detecting non-communicable diseases like cardiovascular disease and diabetes.

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