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Gender Disparities in Obesity among Elderly Urban Residents of Mangalore: An Indian Community-Based Study

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Abstract The incidence of obesity is increasing among the elderly population in India, potentially leading to a heightened incidence of non-communicable diseases. The purpose of this study is to compare general and central obesity between elderly men and women living in Mangalore city in South India. One hundred and sixty people, 60 years of age and older, participated in a community-based cross-sectional study. Anthropometric measurements are determined according to the standard guidelines of the World Health Organization. Body Mass Index (BMI) is computed and categorized using the BMI classification specific to the Asian population. Data are analyzed using SPSS software. The student's unpaired t-test is used to evaluate statistical differences across groups. The results indicate that 18.8% of elderly men and 37.5% of elderly women are classified as having general obesity or being overweight. The mean waist circumference is significantly higher in elderly women (88.54 ± 11.05 cm) compared to their male counterparts (84.69 ± 13.56 cm) with $p < 0.05$. Central obesity is prevalent in 66.2% of elderly men and 83.8% of elderly women. The findings underscore an increased prevalence of general obesity in older women when compared to elderly men in this urban cohort. Additionally, elderly women exhibit greater waist and hip circumferences than men. However, no significant difference is observed in the waist-hip ratio between the genders. These findings demonstrate the need for gender-specific interventions to address obesity and related health risks in the elderly urban population of India.

Keywords Aged, Body Mass Index, Nutritional Status, Overweight, Obesity, Waist-Hip Ratio

1. Introduction

The 2011 Population Census report shows that there are approximately 103.9 million elderly population in India, with 51.1 million belonging to the male population and 52.8 million belonging to the female population [1,2]. The proportion of elderly in India is approximately 8.6%, with males making up 8.2% and females 9% [3]. It is anticipated that by 2046, the percentage of the elderly population will surpass that of the adolescents in India [4].

As life expectancy rises, the disease patterns are gradually changing from infectious to chronic non-communicable diseases. The Indian Council of Medical Research–India Diabetes (ICMR–INDIAB) study reports that "prevalence rate of obesity and central obesity are varies from 11.8% to 31.3% and 16.9% to 36.3%

respectively" [5]. Obesity has escalated to epidemic proportions in India, with 5% of the population being affected by morbid obesity [6].

Due to the rapid changes in lifestyle and sedentary habits during the recent past years, there is a higher risk of morbidity conditions and mortality especially among the elderly. While being moderately overweight might provide a survival advantage for older adults, a body mass index (BMI) of 30 kg/m ^{2}or higher is linked to numerous adverse health risks in the elderly, such as stroke, osteoporosis, etc. [7-9]. For obese individuals, intensive lifestyle interventions that focus on exercise and strength training can significantly enhance general well-being and life quality. Studies on the Indian geriatric population showed that the BMI and quality of life are gender-specific and dependent on the dwelling place of the people [10,11].

Understanding the dietary habits of the elderly is crucial. While India has traditionally faced issues of malnutrition, there is now a growing prevalence of overweight, and their associated consequences. Previous studies have identified several nutritional challenges including unintentional weight loss, disabilities, chronic diseases, higher protein requirements, and lower energy needs [12]. A study conducted in Chandigarh, Northern India, assessed obesity among elderly individuals and found that 33% were overweight, 8% were obese, and 14% were underweight [13]. A study conducted in rural areas of South India to examine the incidence of malnutrition among older individuals, revealed that approximately 14% of the study participants were malnourished while 49% of the elderly people were vulnerable to malnutrition [14]. Kaufusi [15], in his study on Tongan American society, recommended changes in dietary behavior for preventing obesity.

Obesity is a global epidemic that is linked to a high risk of morbidity and mortality [16,17]. Advancing age poses a challenge to morphological and physiological function [18]. Clinically, the body fat distribution is a key factor in determining obesity. Obesity is broadly categorized as general obesity and central obesity. Abdominal or central adiposity pertains to an increased risk of cardiovascular and metabolic diseases [19,20]. In elderly patients, waist circumference is suggested to be a more suitable indicator of adiposity than BMI [21].

General obesity is assessed using BMI. "BMI is a ratio of weight in kilograms divided by height in metres squared (Kg/m^2)" [5]. Based on guidelines by World Health Organization (WHO), "BMI can be classified as underweight (BMI<18.5), normal (BMI of 18.5 to 24.99), overweight (BMI of 25 to 29.99) and obese (BMI>30)" [22]. These values are age-independent and the same for both genders. According to previous studies, those who are overweight or obese have a higher chance of developing diabetes and cardiovascular disease, especially among the Asian population [23-26].

Recent studies have shown that it is not the overall deposition of fat, but the regional adiposity that is associated with increased mortality [27,28]. Regional adiposity can be measured by anthropometric data. Central or abdominal obesity, which is indicator of deposition of intra-abdominal fat, is measured using the waist-hip ratio (WHR). “Waist hip ratio can be calculated by dividing waist circumference by hip circumference” [29]. According to WHO, abdominal obesity is termed when WHR is above a threshold of 0.9 for men and 0.85 for women [30].

With advancing age, regional adiposity was found to increase consistently with age whereas BMI does not [31]. Therefore, at the population level among elderly individuals, the measurement of hip and waist circumferences can be utilized as a predictor of the body fat distribution. Individuals with an increased waist circumference have an apple shaped appearance and are more prone to health related adverse effects as compared to those individuals with increased hip circumference with a pear shaped body appearance. Studies have reported that there is a correlation between a larger hip circumference and a decreased risk of diabetes and coronary heart disease [32,33].

Various studies assessed the obesity of the elderly Indian population [34-36]. However, there are very few studies on the comparison of obesity in elderly men and women in the south Indian urban regions. The objective of this study is to compare the general obesity and central obesity among the elderly male and female population residing in urban areas of Mangalore, using BMI measure and waist and hip circumference values.

2. Materials and Methods

This paper describes a cross-sectional descriptive study on obesity among the elderly residing in Mangalore City in the southern part of India. The study included a 160 senior citizens, 80 of whom were men and 80 of whom were women. The research data were collected from January 2013 to April 2014 over a period of 15 months. The Scientific Committee and Institutional Research Ethics Committee of Manipal Academy of Higher Education, Karnataka, gave its approval to the protocol. All of the participants in this study provided written informed consent.

2.1. Study Design

This research study targets the older adults aged 60 years and above. The study participants comprised healthy elderly people as well as older individuals with chronic diseases such as hypertension and diabetes mellitus. Elderly individuals with any disability and those who declined to give their approval for the research were excluded. The sample size was determined using a 95% confidence interval and 90% study power. Thus, 160 participants were selected for this research, comprising 80 elderly male and 80 elderly female subjects.

2.2. Data Collection

Data were collected from the older adults residing in senior living facilities in Mangalore with prior permission from the concerned authorities. Data were also collected using a survey conducted from house to house in the urban areas of Mangalore in South India. The participants were chosen through simple random sampling.

The physical health of the study participants is assessed by the following anthropometric measurements, which include Height (cm), Body weight (kg), Waist Circumference (cm) and Hip Circumference (cm).

The height of the participants is determined with a standard scale to the nearest cm. The subjects are instructed to stand upright, barefoot, with their gaze forward, heels together, and back against a wall.

The weight of the subjects is determined to the closest 1 kg, using a weighing machine. The participants are requested to wear light clothing.

The waist and hip circumferences are recorded in cm using a non-stretchable measuring tape. Subjects are instructed to stand straight with their feet together. The circumference of the waist is calculated as the horizontal girth between the midpoint of the costal margins and the iliac crest during normal inspiration. The hip circumference is measured at the level of the greater trochanters of the femur.

2.3. Statistical Analysis

To perform statistical analysis, SPSS software is utilized. The comparisons of qualitative data are evaluated with the significance threshold at $p < 0.05$ using the student's unpaired t-test. The data are presented as mean and standard deviation (SD) and frequency is presented as percentage. Descriptive statistics, tables, and figures are employed for presentation.

3. Results

A total of 160 elderly individuals are included in this research work, out of whom 80 are females and 80 are males, with the maximum number (49.3%) of respondents belonging to the age group 60-64 years. In this study, 11.8%, 13.7%, 10.6%, and 14.3% of the elderly are between the ages of 65 and 69, 70 and 74, 75 and 79, and more than 80, respectively. Figure 1 displays the distribution of the elderly population based on their age.

Figure 2 depicts the distribution of men and women among different age groups. In this study, 12.5%, 13.8% and 12.5% of elderly men are in the age groups of 65-69 years, 70-74 years, and 75-79 years, respectively, while 11.2%, 13.8% and 8.8% of elderly women are in the corresponding age groups. There are 17.5% women and 11.2% men among those who are above the age of 80 years.

3.1. Anthropometry and BMI

In this research, study examining anthropometry in elderly people, the mean height among the men participants is 1.64 m and that among women participants is 1.52 m. Table 1 compares the anthropometric measurements among elderly men and women. A significant difference ($p < 0.001$) in height among elderly men is observed when compared to the height of elderly women. No significant changes are observed in the mean body weight among the men (56.95 ± 11.97 kg) and women (55.30 ± 13.15 kg) in the study groups. While there is a notable disparity in height between elderly men and women with elderly men being taller, their body weights do not significantly differ.

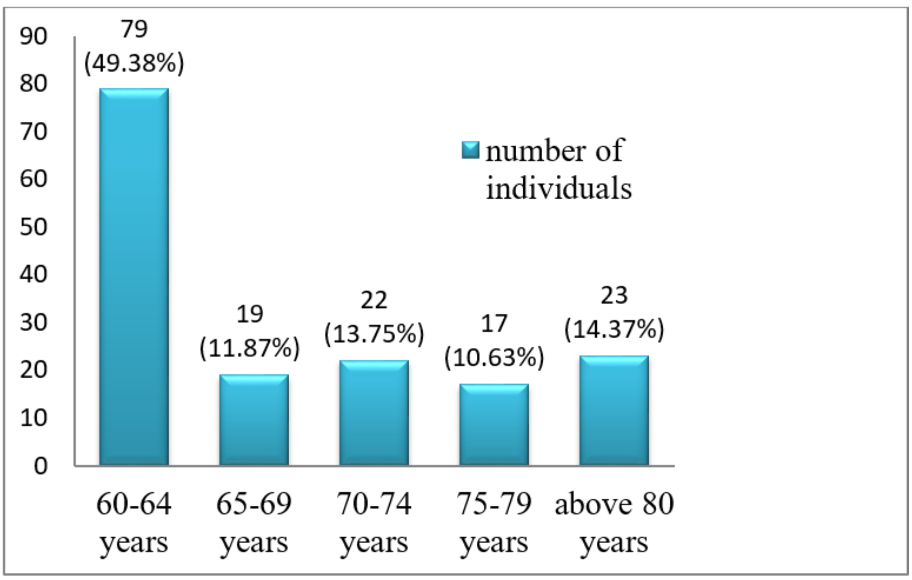

Figure 1. Distribution of the elderly population based on their age

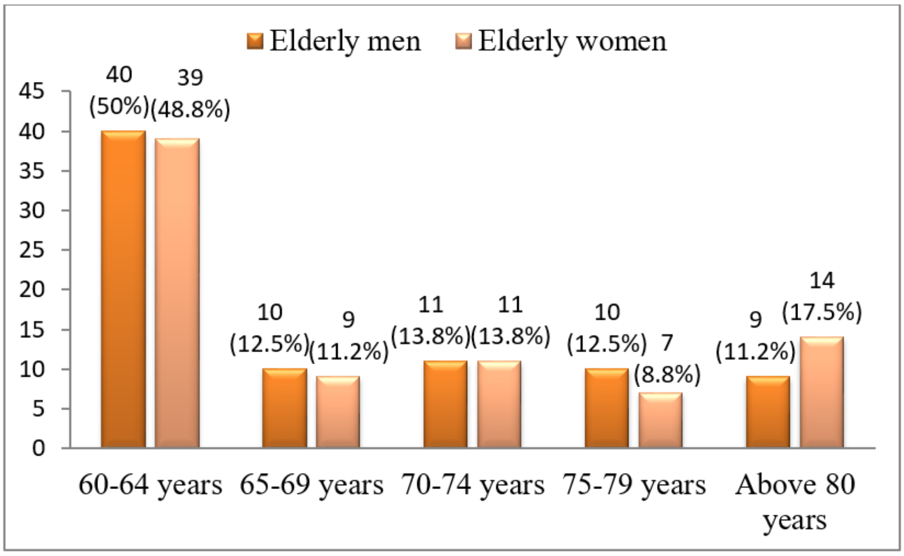

Figure 2. Gender-wise distribution of the elderly population according to their age groups

Table 1. Comparison of anthropometric measurements among elderly men and women

Anthropometric parameters	Elderly men (Mean ± SD)	Elderly women (Mean ± SD)	t-value	p-value
Height (m)	1.64 ± 0.08	1.52 ± 0.10	8.072	0.000†
Weight (kg)	56.95 ± 11.97	55.30 ± 13.15	0.830	0.408
BMI (kg/m^2)	21.30 ± 4.31	23.98 ± 5.07	-3.605	0.000†
Waist circumference (cm)	84.69 ± 13.56	88.54 ± 11.05	-1.968	0.05*
Hip circumference (cm)	91.29 ± 10.99	97.69 ± 11.32	-3.629	0.000†
WHR	0.93 ± 0.08	0.91 ± 0.07	1.485	0.140

*p<0.05, †p<0.001, SD- standard deviation

There is a statistically significant rise in BMI ($p < 0.001$) in the females (23.98 ± 5.07 kg/m^2) when compared with that of males (21.3 ± 4.3 kg/m^2), as shown in Table 1. Figure 3 represents the prevalence of general and central obesity in elderly men and women in the given sample population. It is found that 18.8% of elderly men and 37.5% of elderly women are having general obesity or overweight with BMI > 25 kg/m^2. These results indicate an increased prevalence of general obesity in older women in the urban Indian population. Central obesity is categorized according to the criteria: "WHR>0.9 for males and WHR>0.85 for females" [30]. It is observed in Figure 3 that 66.2% of the elderly men and 83.8% of the elderly women are having central obesity.

3.2. Anthropometry and WHR

On analyzing the anthropometric measurements of the study participants, the mean waist circumference shows a significant increase ($p < 0.05$) in the elderly women (88.54 ± 11.05 cm) when compared with elderly men (84.69 ± 13.56 cm), as reported in Table 1. The hip circumference shows a significant decrease ($p < 0.001$) in elderly men (91.29 ± 10.99 cm) when compared to elderly women (97.69 ± 11.32 cm). These findings underscore distinct gender-specific patterns in body composition among the elderly population. The increase in waist circumference in elderly women suggests a higher propensity for central adiposity. Conversely, the decrease in hip circumference in elderly men may reflect age-related changes in fat distribution, potentially contributing to altered health outcomes. However, no significant difference is observed in the waist-hip ratio among men (0.93 ± 0.08) and women (0.91 ± 0.07) in the study groups, as shown in Table 1.

3.3. Nutrition Status and BMI Classification

Statistical analysis is done to analyze the obesity and nutritional status in elderly men and women. Among the study population, it is found that 40.6% of the elderly population have a healthy normal nutritional status. The remaining 59.4% are malnourished, comprising 95 participants who are either underweight, overweight, or obese. Specifically, 31.9% of the sample are underweight, 21.9% are overweight, and 5.6% are obese.

A gender-specific analysis reveals significant differences in nutritional status among the older adults, as shown in Table 2. A greater proportion of males (22.5%)

are underweight compared to females (9.4%). Conversely, the percentage of overweight individuals is larger among females (15%) than males (6.9%). Furthermore, among the elderly male study population, the underweight, overweight and obese categories comprise 45%, 13.8% and 5%, respectively. In contrast, within the elderly female study population, 18.8%, 30% and 6.3% are underweight, overweight and obese, respectively.

The high prevalence of underweight status among males suggests that elderly men are particularly vulnerable to undernutrition, which could be due to various factors such as inadequate dietary intake, socioeconomic status, and health conditions that affect nutrient absorption or metabolism. This undernutrition puts them at risk for various health issues, including weakened immune function, muscle wasting, and increased susceptibility to infections.

On the other hand, the elevated occurrence of overweight and obesity among females points to distinct health concerns. Older women with excess weight face increased susceptibility to chronic ailments like cardiovascular diseases, diabetes, and hypertension. This could be attributed to factors like hormonal changes post-menopause, dietary habits, and lower levels of physical activity.

Among the malnourished population, there is no statistical difference between elderly men and women in the underweight and overweight categories. However, the obese category presents a significant difference ($p < 0.05$), with a higher number of elderly women (37.44 ± 3.56) compared to men (31.57 ± 1.49), as seen in Table 2. This statistical significance highlights a critical area of concern, as obesity in elderly women can lead to severe health consequences, including mobility issues, joint problems, and an elevated risk of chronic conditions.

3.4. Central Obesity and WHR Classification

In this research study, there are significant gender disparities in waist circumference and WHR. Table 3 compares the waist circumference and WHR among elderly male and female groups. Out of 80 elderly men, 40 percent have a larger waist circumference and 66.3 percent have a higher waist-hip ratio. Among the 80 elderly women, 70 percent have a larger waist circumference and 92.5 percent have a higher waist-hip ratio.

Further analysis reveals that elderly men have a significantly greater waist circumference (mean value of 98.09 cm) as compared to their female counterparts (mean value of 93.93 cm), with p-value < 0.05. Similarly, elderly men have a significantly higher WHR (mean value of 0.96) than elderly women (mean value of 0.92), with p-value < 0.001, as observed in Table 3. Although a higher proportion of elderly women have larger waist circumferences and higher WHRs, elderly men with these conditions exhibit more extreme measurements. This suggests that central obesity, as indicated by WHR and waist circumference, is a serious health concern for both genders.

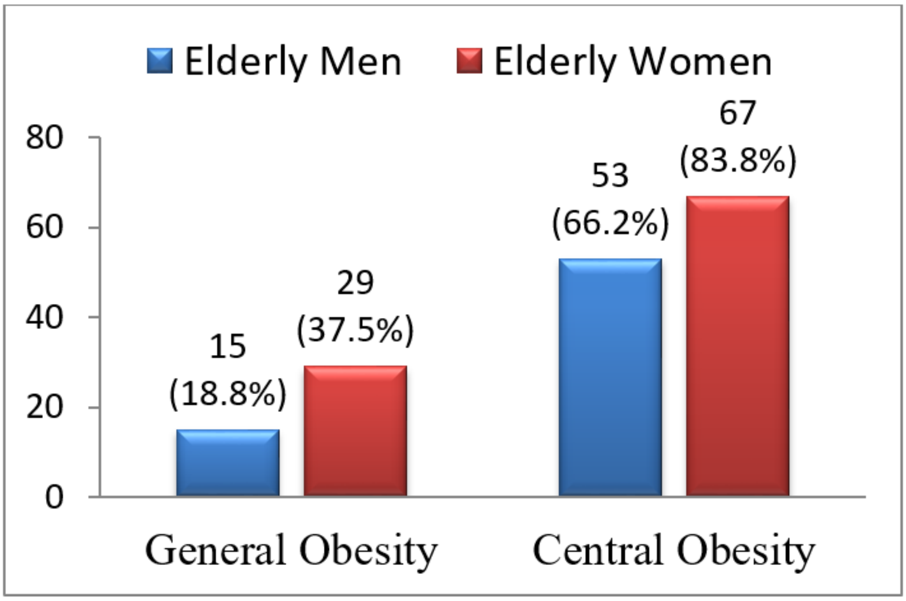

Figure 3. Gender-wise distribution of the elderly population based on obesity

Table 2. Nutritional status among elderly based on gender

Anthropometric parameters	Elderly men (Mean ± SD)	Elderly women (Mean ± SD)	p-value
Number of participants (n)	80	80	
BMI (kg/m^2)	21.30 ± 4.31	23.98 ± 5.07	0.000418 §
BMI categories, kg/m^2:			
Underweight, <20	17.64 ± 1.85 (n=36)	17.40 ± 1.80 (n=15)	0.67
Normal weight, 20–24.9	22.27 ± 1.15 (n=29)	22.87 ± 1.50 (n=36)	0.08
Overweight, 25–29.9	27.01 ± 0.98 (n=11)	26.96 ± 1.30 (n=24)	0.91
Obese, ≥30	31.57 ± 1.49 (n=4)	37.44 ± 3.56 (n=5)	0.0183*

*$p < 0.05$, §$p < 0.01$, SD- standard deviation

Table 3. Comparison of waist circumference and Waist-Hip Ratio among elderly men and women

Parameters	Elderly men (Mean ± SD)	Elderly women (Mean ± SD)	p-value
Number of participants (n)	80	80	
Waist Circumference (cm)	84.69 ± 13.56	88.54 ± 11.05	0.05*
High Waist Circumference (cm)	98.09 ± 8.53 (n=32, 40%)	93.93 ± 8.29 (n=56, 70%)	0.0274*
High Waist-Hip Ratio	0.96 ± 0.06 (n=53, 66.25%)	0.92 ± 0.06 (n=74, 92.5%)	0.00006†

*$p < 0.05$, †$p<0.001$, SD- standard deviation

4. Discussion

This study compared general and central obesity between elderly men and women residing in urban areas of Mangalore city in South India. Anthropometry is a good indicator of the nutritional status of the older adults. Nutritional status in individuals can be assessed in several ways [37]. The BMI and WHR have been commonly used as a practical measure for identifying overweight and obese individuals [38].

In this study, 27.5% of elders are overweight and have general obesity, while 75% of elders have central obesity. This result is in agreement with a recent study involving 60,006 participants reporting that “the pooled prevalence of overweight/obesity among elderly persons in India was 21.5%” [34]. The gradual shifts in nutritional patterns and physical activities are likely the primary reasons for the increased rates of overweight geriatric population [39-41]. It could also be influenced by environmental conditions like easy accessibility to junk food, lack of sidewalks and diminished provisions for recreational activities [42-44]. A recent study on Bangladeshi elderly people showed that they consume junk food like fried or sugary snacks and beverages frequently and that less physical activities like television viewing had a significant impact on increased intake of unhealthy food habits [45]. The role of dieticians and awareness of nutrition literacy is inevitable [46].

In this study, 18.8% of men have general obesity and 66.2% have central obesity. Among women, 37.5% have general obesity and 83.8% have central obesity. These results are in agreement with similar studies showing an increased prevalence of obesity among elderly female than male [47]. Furthermore, the mean BMI, waist and hip circumferences are larger in elderly women as compared to elderly men. Most studies in the literature indicate that elderly women have a higher prevalence of obesity in comparison to elderly men [35,48,49]. Our results are consistent with these studies. Among the malnourished, there are more elderly women who are obese than elderly men. A simple BMI assessment on a regular basis especially among women could help detect the progression to obesity, which could prevent the chances of adverse health risk.

The main highlight of our research study is that it included elderly who are living in family setup and elderly residing in old age care homes [50]. Our study included the majority in the young-old category of the elderly. Early assessment for obesity in the elderly can help the caregivers monitor their dietary patterns and include healthy food habits [51,52]. Mild exercise can help in reducing the probability of obesity and non-communicable diseases [53,54]. Breathing exercise and yoga practice are reported to produce positive effects on improving the quality of life in overweight older adults [55-57].

In this study, elderly women have a larger waist circumference and hip circumference than men. However, there is no significant difference in the WHR measure. Among those who have a higher waist circumference and higher WHR according to WHO criteria, men have significantly higher measurement values than elderly women. This calls to the importance of determining the WHR in elderly men. Our results suggest that the assessment of simple anthropometric measures is sufficient to determine obesity in the elderly in medical practice [58].

The implications of our research study underscore the necessity for gender-specific nutritional interventions [59]. For elderly men, strategies should focus on addressing undernutrition, potentially involving nutritional supplementation, improving dietary diversity, and ensuring regular health check-ups to monitor and manage underlying health conditions that could contribute to weight loss. For elderly women, interventions should emphasize weight management through balanced diets and increased physical activity. These interventions could include community-based programs to encourage healthy nutritional habits, physical exercise routines tailored to the elderly, and regular monitoring of weight and health parameters to prevent obesity-related complications.

Furthermore, these findings call for public health policies that address the nutritional needs of the elderly. Policymakers should consider creating programs that provide access to nutritious foods, especially for those in lower socioeconomic brackets. Many countries have proposed policies for prevention of obesity in elderly population [60,61]. Health education campaigns aimed at the elderly and their caregivers can play a significant role in promoting healthy aging [62,63].

The limitation of our research study is that the prevalence of gender-based obesity in India as a country could not be calculated precisely, since the representative sample used in this study is small. Large-scale population-based longitudinal studies taking into consideration the age and different anthropometric indices for adiposity could be done.

This study focused on a representative population of the urban areas in South India. Further studies can be explored to investigate the prevalence of obesity and nutrition status in rural population of India.

5. Conclusions

This study reveals a higher prevalence of general obesity among older women as compared to older men in a South Indian based on sample population. Elderly women have a larger waist circumference and hip circumference than men. However, there is no significant difference in WHR. This study highlights significant nutritional disparities among elderly men and women, emphasizing the need for interventions to address both undernutrition and obesity. Regular monitoring using tools like Geriatric Nutrition Assessment and community-based screening have the potential to enhance the health conditions of the elderly population. Urgent public health interventions are needed to alleviate the problem at an early stage. Thus, by reducing the burden of malnutrition-related health issues and encouraging healthy aging for both genders, we can improve the general health and quality of life for the senior population.

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Conflicts of Interest

The authors have no competing interests to declare.

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