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# Obesity Prevalence Among Older People in Tabriz, Iran: Data from Health Status of Aged People in Tabriz (HSA-T) Study

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**Abstract**

**Objectives:** To estimate the obesity prevalence in a representative sample of community-dwelling older adults in Tabriz, Iran.

**Design:** Cross-sectional study.

**Setting(s):** Tabriz, the capital of East Azerbaijan Province, Iran.

**Participants:** A representative sample of 1071 (514 males and 557 females) community-dwelling older adults aged ≥ 60 years were selected using the probability proportional to size (PPS) sampling method. Then, anthropometric measures were conducted on 1041 subjects (506 males and 535 females).

**Outcome measures:** Anthropometric measures including weight, height, body mass index (BMI), hip circumference (HC), waist circumference (WC), and waist-to-hip ratio (WHpR) were conducted and used for the evaluation of overweight and obesity. Obesity was determined according to traditional BMI classifications and population-appropriate WC criterion cut-offs for the estimation of central adiposity.

**Results:** The prevalence of overweight and obesity was 37.4%, 95% CI: 34.5 to 40.4 and 34.3%, 95% CI: 31.4 to 37.3, respectively. Obesity was more prevalent in females (46.6%, 95% CI: 36.9 to 57.2) than in males (21.2, 95% CI: 13.5 to 30.3), but the overweight prevalence was greater in males. Moreover, mean BMI was lower in males than in females ($26.9 \pm 4.2$ kg/m$^2$ vs. $29.9 \pm 6.0$ kg/m$^2$; $P < 0.001$) and significantly decreased with increasing age. Similarly, mean WC was lower in males than in females ($99.7 \pm 13.6$ cm vs. $102.3 \pm 14.3$ cm; $P = 0.002$) and decreased significantly with age.

**Conclusions:** The high prevalence of obesity in older people highlights the necessity of designing effective healthy lifestyle interventions and national policies to focus on dietary modification and lifestyle changes and promote physical activity to reduce obesity in aged people, particularly in older Iranian women.

**Keywords:** Older adults, Obesity, Overweight, Anthropometry, BMI, Malnutrition

## Introduction

Aging and obesity are two growing public health challenges worldwide in the present century.[1, 2] Parallel to the population aging, the prevalence of obesity among older people is also increasing. It has increased over the past decade and reached epidemic proportions in European countries.[3] Obesity is defined as "an unhealthy excess of body fat, which increases the risk of morbidity and premature mortality among young and middle-aged adults".[4] In older adults, obesity is associated with mobility disability and exacerbates the onset of chronic morbidities, leading to premature mortality.[2, 5-7] Furthermore, compared to non-obese status, obesity amongst older adults is a known metabolic phenotype associated with higher risks of cardiometabolic diseases, including type 2 diabetes and cardiovascular diseases (CVDs).[8]

Obesity and aging are topics that raised much discussion in the research literature and clinical practice, particularly in relation to effective treatment and management strategies.[9] As such, it is valuable to track the obesity prevalence in older people.[10, 11] An increased prevalence of overweight and obesity has previously been reported among all age groups, which is a major health concern across the lifespan in both developing and developed countries,[5, 12, 13] and it has reached epidemic proportions globally.[14] However, the prevalence of obesity varies among countries and across different age groups. Even though the population is aging, previous data has mostly focused on younger and middle-aged individuals.[15, 16] In Iran, as a developing country, there has been no published study to assess the prevalence of obesity amongst older community dwellers using a representative sample.[15, 16] Therefore, this study aimed to estimate the obesity prevalence in a representative sample of community-dwelling older adults in Tabriz, Iran.

## Methods

The current study was embedded within the Health Status of Aged People in Tabriz (HSA-T) study, as a representative sample of noninstitutionalized people aged ≥ 60 years living in Tabriz, Iran.

### Study Setting

This study was conducted in Tabriz, the metropolitan region in northwest Iran in 2015. According to the last national census data, the total population aged ≥ 60 years is about 180 000 which is equivalent to 10.5% of the total population of the city.[17]

### Study Population

The statistical population included all of the community-dwelling older people ≥ 60 years living in Tabriz, Iran.

### Sample Size and Sampling Method

In brief, a random representative sample of 1071 older adults was selected using the probability proportional to size sampling method. In the first stage, 107 blocks were randomly selected out of 8531 urban blocks in Tabriz. In the next stage, 10 eligible older adults were randomly selected from each city block. Then, anthropometric measures were conducted among 1041 subjects (506 males and 535 females) out of the total 1071 participants in the HSA-T study. Details on the sampling method have been described elsewhere.[18]

### Data Collection Tools

Data were collected by trained interviewers. Socio-demographic information was obtained using a structured questionnaire from the HSA-T study. Anthropometric measurements were then used to collect the specific data for the study as described below:

### Anthropometric Measurements

Various anthropometric measures/indices were collected, including body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHpR). BMI was used to define obesity, whereas WC and WHpR were used to assess central adiposity and body fat distribution.[19-22] BMI and WHpR were calculated by dividing the values of weight (kg) by the square of height (m²) and dividing the WC by hip circumference (HC), respectively.[19, 23] Participants were weighed while wearing light clothes and without footwear. Measures of WC and HC were performed at the point recommended by World Health Organization (WHO).[22] All measures were performed by trained nutrition experts. To evaluate obesity and analyze the data, cut-off points recommended by WHO for BMI, WC, and WHpR were applied.[22] According to the WHO cutoff criteria, we considered BMI as a categorical variable containing underweight, normal weight, overweight, and obese. Furthermore, BMI of 30-34.99, 35-39.99, and ≥ 40 were considered as grade-I obesity, grade-II obesity, and grade-III obesity, respectively.[19, 23] Abdominal adiposity was defined as a WHpR of ≥ 0.90 for males and ≥ 0.85 for females.[24] In the European population, the cut-off points for WC have been recommended as ≥ 102 cm for males and ≥ 88 cm for females.[20, 25] However, given that different populations have different desirable cut-off points for the assessment of cardiometabolic risk,[26] the Iranian Ministerial Committee has declared that the anthropometric cut-off points derived from the European population should not be applied to an Iranian population[20] and suggested a criterion cut-off of ≥ 90 cm for both genders. Furthermore, individuals (males and females) with WC ≥ 95 cm are at substantial risk of CVD and need immediate preventive interventions.[20] For analyzing the data related to WC, in addition to WHO cut-off points, the standards recommended specifically for Iranians were used. In the present study, data analysis was performed in terms of gender and age groups.

### Statistical Methods

Descriptive data were presented as frequency (and percentages) and means ± standard deviations for continuous variables, including weight, BMI, HC, WC, WHpR, and age, respectively. The independent samples t-test and the analysis of variance (ANOVA) tests were used to compare the means of the two independent sub-groups and more than two independent sub-groups, respectively. The statistical analyses were performed using the SPSS version 23, and the level of significance was set at $P < 0.05$.

### Results

A total of 1041 participants (506 males and 535 females with mean age of 70.1 ± 8.2) were included in the final analyses. Findings related to anthropometric indices, including BMI, HC, WC, and WHpR by gender and age group showed that mean BMI and WC are lower in

males than in females and significantly decreased with increasing age (Table 1). In contrast, WHpR was lower in females but did not significantly change with increasing age.

Table 2 reports the prevalence of overweight and obesity, according to BMI classifications. Almost two-thirds of the studied cohort were overweight or obese (37.43% overweight and 34.25% obese), with a greater prevalence of obesity in females compared with males (females: 46.64%; males: 21.15%).

Table 3 presents categories of BMI according to age groups. Both overweight and obesity, as well as mean BMI (reported in Table 1), decreased significantly with increasing age. Similarly, As Table 4 illustrates, WC significantly decreased with increasing age. In contrast, this trend was not observed for WHpR, as depicted in Table 5. Lastly, Pearson correlation coefficients further revealed that weight (r = -0.255; $P < 0.001$), BMI (r = -0.212; $P < 0.001$), WC (r = -0.153; $P < 0.001$), and HC (r = -0.221; $P < 0.001$) were all inversely associated with age (Table 6).

## Discussion

The present study found a high prevalence of overweight and obesity in community-dwelling Iranian older people, particularly among older women. Several important physiological changes are associated with aging, including reductions in lean body mass and a simultaneous accumulation of fat mass. However, changes in fat distribution from subcutaneous adipose tissue to the abdominal visceral adipose tissue are of great concern,[27] since this increases the risk for cardiometabolic disorders. Moreover, a reduction in physical activity is also a strong contributing factor to obesity with advanced age.[28] In addition, most studies reported a lack of physical activity in females to be greater than in males[28-30]. In the following sections, the findings of the anthropometric indicators (BMI, WC, and WHpR) are discussed separately.

Based on BMI classifications, the present study indicated that more than one-third of the cohort were obese, with most being identified as grade-I obesity. In comparison, in a study conducted in Hamadan, 39.9% of older people were identified as overweight (BMI: 25-29.9), and 14.9% were obese (BMI ≥ 30).[31] Furthermore, a study conducted in Tehran showed that the average BMI of older adults was 24.9 ± 4.68 kg/m².[32] Similar results have also been reported in older people living in Urmia,[33] Birjand,[34] and

the Razavi-Khorasan province.[35] Comparing the results of previous studies with the current study, a greater BMI was observed amongst community-dwelling older adults in the current study.

In the present study, the average BMI in females was significantly higher than that in males $P < 0.001$). Specifically, the prevalence of obesity among females was twice that of males. In a study of older adults living in Tehran, 45.36% of males were overweight or obese, with 51.41% of females being overweight or obese.[32] Reports of significant gender disparities in the prevalence of overweight and obesity have also been found in Birjand,[34] Hamadan,[31] and the Razavi-Khorasan province[35] with a greater prevalence of overweight and obesity amongst females, akin to the present study.

The average BMI amongst older adults significantly reduced with increasing age in the present study. The prevalence of both overweight and obesity had a decreasing trend by increasing the age group from 60-69.9 to 80 years or older. In Europe, the United States, and the majority of the developed countries, BMI increased with increasing age and reached its peak at the age of 60, before gradually reducing with age.[19, 36-38] In fact, this trend was also observed in the present study. In contrast to obesity and overweight, the prevalence of underweight increased with increasing age.

Although obesity is a well-documented risk factor for chronic disease and premature mortality in adults,[39, 40] using the BMI in isolation for the assessment of obesity is limited by the fact that the BMI is not a measure of body composition and provides an indirect estimation of adiposity.[41] Therefore, the present study used WC, a useful proxy measure for abdominal or central distribution of fat[21, 22, 42] as well as total body fat,[22] for the assessment of

**Table 2.** BMI Classification by Sex among Community-dwelling Older Adults

| BMI Classes | Gender | | Total No. (%) |
|---|---|---|---|
| | Male No. (%) | Women No. (%) | |
| Overweight (BMI: 25-29.99) | 223 (44.07) | 167 (31.16) | 390 (37.43) |
| Obese (BMI ≥ 30) | 107 (21.15) | 250 (46.64) | 357 (34.26) |
| Obese-class 1 (BMI: 30-34.99) | 94 (87.85) | 158 (63.20) | 252 (70.59) |
| Obese-class 2 (BMI: 35-39.99) | 9 (8.41) | 60 (24) | 69 (19.33) |
| Obese-class 3 (BMI ≥ 40) | 4 (3.74) | 32 (12.80) | 36 (10.08) |

Note. BMI: Body mass index.

**Table 1.** Anthropometric Measures by Sex and Age Group among Community-dwelling Older Adults

| Characteristics | Gender | | | Age Group | | | |
|---|---|---|---|---|---|---|---|
| | Male 506 (48.5) | Women 535 (51.4) | P* | 60-69.9 N (%) | 70-79.9 N (%) | 80 + N (%) | P** |
| BMI (mean ± SD) | 26.9 ± 4.2 | 29.9 ± 6.0 | <0.001 | 29.4 ± 5.5 | 27.9 ± 5.0 | 26.3 ± 5.2 | <0.001 |
| HC (cm) (mean ± SD) | 101.6 ± 10.7 | 107.7 ± 13.4 | <0.001 | 107.3 ± 12.0 | 103.2 ± 12.4 | 99.53 ± 12.8 | <0.001 |
| WC (cm) (mean ± SD) | 99.7 ± 13.6 | 102.3 ± 14.3 | 0.002 | 103.0 ± 13.6 | 100.0 ± 13.9 | 96.5 ± 14.2 | <0.001 |
| WHpR (mean ± SD) | 0.98 ± 0.08 | 0.95 ± 0.07 | <0.001 | 0.96 ± 0.08 | 0.97 ± 0.08 | 0.97 ± 0.08 | 0.185 |

Note. BMI: Body mass index; WC: Waist circumference; HC: Hip circumference; WHpR: Waist-to-hip ratio; SD: Standard deviation.
* Two sample t-test; ** One-way analysis of variance.

**Table 3.** The Distribution of BMI (kg/m²) among Old Community Dwellers by Age Group

| Gender | BMI Indicator | Age Groups (y) | | | Total No. (%) | P* |
| | | 60-69.9 No. (%) | 70-79.9 No. (%) | 80+ No. (%) | | |
|---|---|---|---|---|---|---|
| Male | Overweight | 114 (49.14) | 83 (44.62) | 26 (29.55) | 223 (44.07) | 0.026 |
| | Obese | 44 (18.97) | 44 (23.66) | 19 (21.59) | 107 (21.15) | |
| | BMI±mean | 27.02±3.91 | 27.15±4.23 | 25.75±4.83 | 26.8±4.2 | |
| Female | Overweight | 92(30.16) | 48(30.00) | 27(38.03) | 167 (31.16) | <0.001 |
| | Obese | 170(55.74) | 64(40.00) | 16(22.54) | 250 (46.64) | |
| | BMI±mean | 31.22±5.78 | 28.69±5.75 | 26.99±5.58 | 29.9±6.0 | |
| Total (Both sex) | Overweight | 206 (38.36) | 131 (37.86) | 53 (33.33) | 390 (37.43) | <0.001 |
| | Obese | 214 (39.85) | 108 (31.21) | 35 (22.01) | 357 (34.26) | |
| | BMI±mean | 29.41±5.47 | 27.86±5.04 | 26.31±5.41 | 28.4±5.4 | |

Note. BMI: Body mass index; * One-way analysis of variance; Underweight (BMI<18.50); Normal weight (BMI: 18.50-24.99); Overweight (BMI 25-29.99); Obese (BMI≥30).

**Table 4.** The Distribution of Waist Circumference (cm) among Old Community Dwellers by Age Group

| Gender | WC Indicator | Age Groups (y) | | | Total No. (%) | P* |
| | | 60-69.9 No. (%) | 70-79.9 No. (%) | 80+ No. (%) | | |
|---|---|---|---|---|---|---|
| Male | WC≥102 | 108(47.57) | 89(47.84) | 26(32.10) | 223(45.14) | 0.084 |
| | WC≥90 | 180(79.29) | 148(79.57) | 53(65.43) | 381(77.13) | |
| | WC≥95 | 154(67.84) | 132(70.97) | 40(49.38) | 326(65.99) | |
| | WC mean±SD | 100.5±14.0 | 100.0±13.1 | 96.7±13.0 | 99.7±13.6 | |
| Female | WC≥88 | 272(89.47) | 123(79.35) | 52(74.29) | 447(84.50) | <0.001 |
| | WC≥90 | 265(87.17) | 117(75.48) | 48(68.57) | 430(81.29) | |
| | WC≥95 | 243(79.93) | 98(63.23) | 38(54.29) | 379(71.64) | |
| | WC mean±SD | 104.8±13.0 | 99.8±14.9 | 96.5±15.3 | 102.3±14.3 | |
| Total (Both Sex) | WC≥90 | 445(83.80) | 265(77.71) | 101(66.89) | 811(79.28) | <0.001 |
| | WC≥95 | 397(74.76) | 230(67.45) | 78(51.66) | 705(68.91) | |
| | WC mean±SD | 103.0±13.6 | 99.9±14.0 | 96.6±14.1 | 101.0±14.0 | |

Note. WC: Waist circumference; SD: Standard deviation; *: One-way analysis of variance; WC was measured by centimeter.

**Table 5.** The Distribution of WHpR among Old Community Dwellers by Age Group

| Gender | WHpR Indicator | Age Groups (y) | | | Total | P* |
| | | 60-69.9 N (%) | 70-79.9 N (%) | 80+ N (%) | | |
|---|---|---|---|---|---|---|
| Male (n=492) | WHpR≥0.9 | 199(88.44) | 165(88.71) | 70(86.42) | 434(88.21) | 0.645 |
| | WHpR mean | 0.98±0.088 | 0.99±0.074 | 0.98±0.078 | 0.98±0.082 | |
| Female (n=526) | WHpR≥0.85 | 286(94.39) | 146(94.19) | 64(94.12) | 496(94.30) | 0.227 |
| | WHpR mean | 0.95±0.070 | 0.95±0.079 | 0.97±0.077 | 0.95±0.074 | |
| Both Sex | WHpR mean | 0.961±0.080 | 0.969±0.078 | 0.971±0.077 | 0.965±0.079 | 0.084 |

Note. WHpR: Waist-to-hip ratio; *: One-way analysis of variance.

**Table 6.** Pearson Correlation Coefficient between Age and Anthropometrics in Free-living Older Adults

| | | Weight | BMI | WC | HC | WHpR |
|---|---|---|---|---|---|---|
| Age | Pearson correlation | -0.255** | -0.212** | -0.153** | -0.221** | 0.068* |
| | Sig. (2-tailed) | <0.001 | <0.001 | <0.001 | <0.001 | 0.030 |

Note. BMI: Body mass index; WC: Waist circumference; HC: Hip circumference; WHpR: Waist-to-hip ratio; ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).

abdominal adiposity.[41]

In the present study, the average WC of participants was higher than the criterion cut-off points determined for Iranians (≥102 cm for males and ≥88 cm for females).[20, 25] Specifically, the mean WC was greater than 90 cm in four-fifths of the studied population, and over two-thirds of older people had central obesity based on the criterion cut-off points for Iranians (WC of 95 cm or above).

Furthermore, females' average WC was higher than

males ($P = 0.003$). Based on the criterion cut-off points for Iranians, two-thirds of males and more than two-thirds of females had abdominal obesity. Regarding WHO standards, most females (84.5%) and about half of all males were identified with central obesity (WC ≥ 88 in females and WC ≥ 102 in males).

In the present study, the average WC among the studied population decreased with increasing age. Similar to the BMI, WC significantly decreased by increasing the age group from 60-69.9 to 80 years or older. Moreover, the percentage of central obese older adults (based on criterion cut-offs for Iranians) decreased by increasing the age group from 60-69.9 to 80 years or above.

The central obesity indices, compared to BMI, are more appropriate measures for application to determine or estimate risk factors of CVDs.[20, 42] It has been reported that WHpR is a more efficient predictor of overall mortality amongst older people; furthermore, it is a better predictor of CVD compared to WC or BMI alone.[21] This index is used more frequently than other indices in population-based studies as a proxy measure for abdominal adiposity.[26] On this basis, in addition to WC, the WHpR index was used in this study to assess abdominal adiposity in the studied cohort.[41]

In the current study, the average WHpR of older adults was higher than the criterion cut-off points for abdominal adiposity. The study of older people in Birjand showed that 63.5% of older adult population had abdominal adiposity (WHpR of above 0.9 for males and above 0.85 for females)[34]; however, in the present study, the prevalence of abdominal adiposity was much higher than such values.

Among females, the average WHpR was lower compared with males, which is likely attributable to the greater adiposity (higher HC) in females relative to males. Over three-quarters of the male cohort and nearly all females (94.30%) had a WHpR of more than the related criterion cut-off points. In a study conducted in Isfahan, the prevalence of abdominal adiposity (based on WHpR) among females was much higher than in males.[43] In the study of older people in Birjand, the prevalence of abdominal adiposity among women was also significantly higher than among men,[34] both of which are consistent with results presented in the current study. Further, in the present study, the average WHpR did not change significantly by increasing age in both genders.

## Conclusions

Overweight, obesity, and abdominal adiposity have a high prevalence among Iranian community-dwelling older people. This study found that the prevalence of obesity and abdominal adiposity decreased with increasing age, and both were higher among female participants compared with males. Therefore, regarding the status of the prevalence of overweight and obesity and considering the complications of obesity as a known risk factor for non-communicable and lifestyle-related diseases, the following suggestions are presented. (1) It is necessary to study the complications and effects of such status on older people's health in longitudinal studies. (2) As some epidemiological findings are in favor of a beneficial or neutral effect of a high BMI on survival in old age, it is valuable to track more comprehensive and robust studies to better understand the consequences and complications of overweight and obesity in aged people. (3) It seems necessary to implement proper interventions for older adults to improve their lifestyle and prevent overweight and obesity among this population.

### Author contributions
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All authors have read and agreed to the published version of the manuscript.

### Data availability statement
The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

### Ethical approval
This study was reviewed and approved by the Deputy of the Research Ethics Committee at the Tabriz University of Medical Sciences (Ethical ID: IR.TBZMED.REC.1392.243). Moreover, informed consent was obtained from all participants, and they were assured of the confidentiality of the information.

### Consent for publication
Not applicable.

**Conflict of interests**

The authors declare that they have no conflict of interests.

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