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Assessment of Longitudinal and Cross-sectional Effects of Age on Adult Obesity in an Iranian Population: Results from a Large Population-Based Cohort Study

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Abstract

Background: The risk of obesity commonly changes with age, which is a longitudinal (aging) effect. Moreover, the individuals who enter the study at the same age have similar living conditions that may influence their obesity risk in a particular way; this is a cross-sectional effect. Both cross-sectional and longitudinal effects of age should be considered for a better understanding of the effect of age on obesity and the related factors.
Objectives: The present study aimed to (i) assess both the cross-sectional and longitudinal effects of age on obesity and (ii) determine how obesity changes with age in the target population using a Marginal Logistic Regression (MLR) model.
Methods: The current study made use of the information of individuals who had participated in the Isfahan Cohort Study. Participants were a large group of Iranian adults over 35 years of age who lived in the central region of Iran in 2001. Repeated measurements were obtained in 2001, 2007, and 2013.
Results: From 2001 to 2013, the percentage of obesity in men and women raised from 13% and 31% to 18% and 44%, respectively. Both cross-sectional and longitudinal effects of age were significantly associated with the odds ratio of obesity. There was a rise in the probability of obesity for individuals aged 35-60 years at baseline and a decline for the older ones. The odds of obesity had about a 2% increase (on average) per year, regardless of the baseline age.
Conclusion: The obtained results pointed to a difference between the cross-sectional and longitudinal effects of age on the probability of obesity in the target population. The high and rising prevalence of obesity was a serious public health issue among participants, especially women, aged 35-60 years. The assessment of changes in obesity in a population-based study provides opportunities to target subpopulations that need more care and attention in public health interventions.

Keywords: Adult, Age factors, Aging, Obesity

1. Background

Obesity is a significant risk factor for noncommunicable diseases, metabolic diseases, and heart diseases. It is associated with age, gender, education, economics, inappropriate diet, and a sedentary lifestyle (1,2). The global prevalence of obesity is increasing in low, middle, and high-income countries (3). In Iran, several studies have pointed to a high and rising prevalence of obesity (1,4-11). Moreover, age, place of residence, educational level, gender, and marital status were reported to be associated with obesity in Iran (5,10-12). Obesity distribution patterns differ by age due to biological and sociocultural differences (13).

Longitudinal and cross-sectional effects of age on obesity were separately investigated in some limited studies (13-16). The decomposition of these two effects could provide valuable information (13,14). These two sources of information regarding age (age is a time-varying covariate) can provoke great conflict over the nature and magnitude of the age effect (17). The longitudinal effect of age (aging effect) refers to common developmental changes associated with particular ages or across life stages resulting from accumulated exposure, as well as social and biological changes (13,15).

Cross-sectional effects of age refer to the changes that characterize populations of the same age, independent of the aging process (13,18,19). The cross-sectional effect of age on obesity allows us to compare the effect of age on obesity for individuals of different ages, while the longitudinal effect of age on obesity sheds light on the effect of age on obesity across each individual's life course. Longitudinal studies in which individuals are measured repeatedly through time are required to distinguish between longitudinal and cross-sectional effects of age.

In light of the aforementioned issues, the present study aimed to (i) assess the cross-sectional and longitudinal effects of age on obesity using a Marginal Logistic Regression (MLR) model and (ii) determine how obesity changes with age in the target population.

2. Objectives

This is a large community-based study conducted on a group of Iranian adults over 35 years of age who live in the central region of Iran. The current study was the first to assess the longitudinal and cross-sectional effects of age on obesity in Iran. The investigation of obesity changes in a population-based study provides opportunities to target subpopulations in need of special care and attention in public health interventions.

3. Methods

The current study made use of the information of individuals who participated in the Isfahan Cohort Study (ICS). The ICS was a longitudinal population-based study conducted in urban and rural areas of three provinces in the central part of Iran (Isfahan, Arak, and Najafabad) in 2001. The referred study used a multi-stage random sampling of adults with Iranian nationality, mentally competent, not pregnant, without a history of cardiovascular diseases, age ≥35 years (20). Repeated measurements of all related factors were obtained in 2001, 2007, and 2013. Written informed consent was obtained from all subjects, and ethical permission was issued by the Ethics Committee of Isfahan Cardiovascular Research Center (ICRC) (20).

The sampling method and size, as well as questionnaires and procedures, were described in previous papers (21,22). The present study merely used the information of individuals who lived in Isfahan and Najafabad on three measurement occasions. The number of participants was 3,181, 1,769, and 1,735 in 2001, 2007, and 2013, respectively. Changes in phone numbers and addresses were mentioned as the leading cause of loss to follow-up in ICS (23). The loss to follow-up was at random and it was not biased. Details of the study design and ICS challenges were described in previous papers (20,23).

3.1. Variables understudy

Body Mass Index (BMI) was defined as the weight (Kg) divided by height squared (m2) (24). Obesity was defined by the World Health Organization (WHO) as BMI greater than or equal to 30 kg/m2 (24,25). Although baseline measurements for all subjects were recorded at the same calendar time (2001), the age of individuals varied at the entry time to the study. Accordingly, obesity variations had two potential sources of information related to age: cross-sectional and longitudinal. Cross-sectional or between-subject information represents how baseline age affected obesity changes. Longitudinal or within-subject information was raised since individuals were measured repeatedly through the study time.

The 'baseline age' was defined as the individual age (year) at baseline measurement. The 'age-baseline age' was defined as the years passed since baseline measurement ('age' is the current age at each measurement time and 'age' minus 'baseline age' was considered 'age-baseline age') (16,17). We also considered and controlled other related factors, including gender, place of residence (urban or rural region), educational level (illiterate, elementary school, middle school or high school, and university degree), job (governmental, nongovernmental, housewife, retired), marriage status (married, single, divorced, widowed), and smoking status (current, past, or never smoker).

3.2. Statistical analysis

The characteristics of participants at the three measurement occasions are presented as a percentage or mean and standard deviation (SD) when appropriate. The MLR model was used (Equation 1) considering the outcome as a binary variable (individual with obesity ($Y_{ij} = 1$)) or without obesity ($Y_{ij} = 0$)). The parameters in the model were estimated using Generalized Estimating Equations (GEE) method.

(1)

$$log_e \left\{ \frac{P(Y_{ij})=1}{P(Y_{ij})=0} \right\} = \beta_0 + \beta_1 X_{ij1} + \cdots + \beta_p X_{ijp}$$

In Equation 1, denotes the binary response variable for the individual on the occasion. Moreover, denotes a vector of covariates associated with the response at each occasion for each individual (17).

In the current study, the main effects include 'baseline age' (Age_{i1}), 'age-baseline age' ($Age_{ij} - Age_{i1}$), 'baseline age squared' ($Age_{i1}{}^2$), and 'age squared-baseline age squared' ($Age_{ij}{}^2 - Age_{i1}{}^2$) (Equation 2). This model considers separate parameters for the longitudinal and cross-sectional effects of age on the binary response (obese ($Y_{ij} = 1$) or not obese ($Y_{ij} = 0$)), providing an estimation of both effects of age, simultaneously (17). We also considered and controlled other related factors, including gender, place of residence (urban or rural region), education level (Illiterate, elementary school, middle school or high school, and university degree), job (governmental, nongovernmental, housewife, retired), marital status (married, single, divorced, widowed), smoking status (current, past, or never smoker), and total daily physical activity score.

The final model with only significant factors is displayed in Equation 2.

(2)

$$log_e \left\{ \frac{P(Y_{ij}) = 1}{P(Y_{ij}) = 0} \right\} = \beta_0 + \beta_1 Age_{i1} + \beta_2 Age_{i1}{}^2 + \beta_3 (Age_{ij} - Age_{i1}) + \beta_4 Gender_i + \beta_5 Place\ of\ Residence + \beta_6\ Education\ level1 + \beta_7\ Education\ level2 + \beta_8\ Education\ level3$$

In Equation 2, the linear combination of and indicates the cross-sectional effect of age. They describe how the log odds ratio (OR) of obesity changes with age at baseline. On the other hand, signifies the longitudinal effect of age since it represents how within-subject differences in the log OR of obesity are associated with within-subject changes in age (18,26). Statistical analysis was performed using R v. 3.6.3. A p-value of 0.05 was considered statistically significant.

4. Results

The study population was approximately balanced according to gender (51.3% females and 48.7% males). The characteristics of participants by gender and measurement time are demonstrated in Table 1 (2001, 2007, and 2013).

In terms of education and marital status, the majorly of participants (92.7% in 2001) had less than 12 years of education and were married (90.3% in 2001). Moreover, 76.3% and 79% of cases were nonsmokers (never smoked) and resided in urban areas in 2001. The mean age sores of participants were reported as 50.5, 55.2, and 60.3 in 2001, 2007, and 2013, respectively. The baseline age was categorized into seven groups (35-39, 40-44, 45-49, 50-54, 55-59, 60-64, and ≥ 65 years) for descriptive analysis. For each of the baseline age groups, the frequencies of individuals with obesity at the three measurement occasions are displayed in Table 2. These percentages were reported based on the available data.

As illustrated in Table 2, in 2001, 2007, and 2013, 35.5%, 40.5%, and 42.8% of women had obesity, respectively, which is more than double the percentage of obesity among men (15%, 15.9%, and 18% in 2001, 2007, and 2013, respectively). From 2001 to 2013, the percentage of obesity raised from 15%-18%, 35.5%-42.8%, and 25.5%-30.4% in men, women, and the total population, respectively. Furthermore, we can identify the cross-sectional effect of age by considering obesity percentage in each of the measurement occasions and comparing it over different baseline age groups as depicted in Figure 1.

Table 1. Characteristics of the Study Participants in 2001, 2007, and 2013 by gender

		2001			2007			2013		
		Female	Male	Total	Female	Male	Total	Female	Male	Total
Number of Participants		1633	1548	3181	904	865	1769	881	854	1735
urban residence(%)		78.9	79.1	79	80.2	81.4	80.8	80.8	87.6	81.8
education† (%)	level 1	34.5	20.3	27.6	28.7	16.5	22.8	29.2	14.7	21.9
	level 2	39.2	35	37.2	42	37	39.5	40	35.4	37.7
	level 3	22.7	33.4	27.9	25	33	28.9	25.2	34.4	29.8
	level 4	3.6	11.3	7.3	4.3	13.5	8.8	5.6	15.5	10.5
married(%)		82.6	98.4	90.3	80.9	97.9	89.1	77.9	95	86.3
smoker(%)	current	2.5	33.2	17.4	1	26.2	13.3	2.2	25.6	13.7
	past	1.4	11.2	6.2	1	14.2	7.5	0.9	12.6	6.7
	never	96.1	55.6	76.3	97.8	59.2	79.2	96.3	61.4	79.1
age*		50 (11.3)	51 (11.8)	50.5 (11.6)	54.3 (10)	56.2 (11)	55.2 (10.5)	60 (9.7)	60.6 (9.7)	60.3 (9.7)
BMI*		28.5 (5.1)	25.9 (4.1)	27.2 (4.8)	28.9 (4.6)	26.2 (3.8)	27.6 (4.4)	29.4 (4.8)	26.5 (4.3)	27.9 (4.8)

*Data are presented as Mean (SD).
†level 1: illiterate, level 2: elementary school, level 3: middle school or high school, level 4: university degree

Table 2. Frequencies of individuals with obesity in 2001, 2007, and 2013 by gender for each baseline age categories

baseline age categories	2001			2007			2013		
	Female	Male	Total	Female	Male	Total	Female	Male	Total
35-39	32.4 (27,37)*	12.9 (9,16)	23.7 (20,26)	38.9 (32,45)	18.2 (12,23)	29.9 (25,34)	44.4 (38,50)	15.8 (11,20)	31.4 (27,35)
40-44	37.4 (32,42)	15.2 (11,19)	26.2 (23,29)	45.8 (38,52)	17.9 (12,23)	31.7 (27,36)	49 (41,56)	18.1 (13,23)	32.6 (28,37)
45-49	39.4 (33,45)	16.3 (11,21)	29.1 (25,33)	45.1 (37,52)	16.5 (9,23)	33.2 (27,38)	39.6 (32,47)	20.3 (13,27)	31.2 (26,36)
50-54	40.9 (33,48)	20.9 (15,26)	30.3 (25,35)	43.4 (33,53)	18.8 (11,26)	30.7 (24,36)	45.7 (34,56)	21.4 (14,28)	31.3 (25,37)
55-59	42.4 (34,50)	19.5 (13,26)	31.4 (26,36)	38 (26,49)	16 (7,24)	26.7 (20,33)	40 (28,51)	16.9 (8,25)	27.9 (20,35)
60-64	30.3 (22,38)	13.9 (7,20)	22 (17,27)	37.5 (24,50)	11 (4,18)	22.5 (15,29)	43.5 (30,57)	15.1 (5,24)	28.3 (20,37)
≥ 65	28.2 (22,34)	10.2 (6,14)	18.8 (15,22)	20.9 (11,30)	7.1 (2,12)	12.7 (7,17)	22.8 (12,33)	17.5 (7,27)	20.2 (13,27)
Total	35.5 (33,37)	15 (13,16)	25.5 (24,27)	40.5 (37,43)	15.9 (13,18)	28.5 (26,30)	42.8 (39,46)	18 (15,20)	30.4 (28,32)

Data are presented as percentage.
Obesity: BMI≥30 (World Health Organization recommendation)
*Confidence Interval: 95%

In Figure 1, there is an increase in the odds of obesity in baseline ages less than 50-54 and 55-59 years for men and women, followed by a modest decrease in probability for those in the older baseline age groups. This finding points to the curvilinear effect of baseline age. The women aged 55-59 years at baseline (women born between 1942 and 1946) and the men aged 50-54 years at baseline (men born between 1947 and 1951) had the highest percentages of obesity.

Furthermore, the highest percentage of obesity among women in 2001 belonged to those with a baseline age of 55-59 years; nonetheless, obesity rates were highest among those with the baseline age of 40-44 years in 2007 and 2013s. Among men, those aged 50-54 years at the baseline had the highest percentage of obesity in all three measurement times. In addition, to identify the longitudinal effect of age, we can consider each baseline age group separately and compare the percentages of obesity through time as demonstrated in Figure 2. During the study period, the probability of obesity changed for subjects in each baseline age group. In general, the percentage of obesity in almost all baseline age groups increased or remained the same after 12 years. Table 2 and Figure 1 demonstrate the curvilinear effect of age on the rate of obesity and higher rates of obesity for women of all ages. Accordingly, firstly, an MLR model, including gender, linear and quadratic age, and the gender by age interactions, was fitted (age was considered a continuous variable).

In this model, the gender by age interactions was not significant (P=0.45 and 0.35 for gender by age and gender by age squared, respectively. Therefore, the interaction terms were omitted from the models. Thereafter, an MLR model, including 'baseline age' (P< 0.001), 'age-baseline age' (P< 0.05), 'baseline age squared' (P< 0.001), and 'age squared-baseline age squared' (P> 0.05), was fitted (age and baseline age were considered continues variables). In this model, we also considered and controlled other factors,

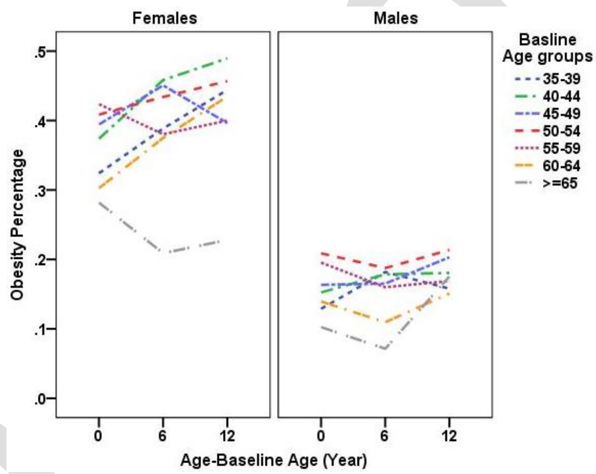

Figure 1. Frequencies of individuals with obesity in three measurement occasions for each baseline age group

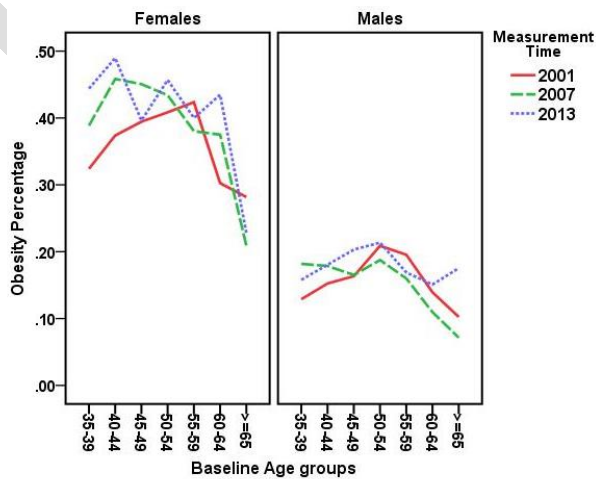

Figure 2. Frequencies of individuals with obesity in each baseline age group through time

Table 3. Results from Marginal Logistic Regression Model to assess longitudinal and cross-sectional effects of age on obesity

Parameter		Estimate (β)	Standard Error	P-value	OR	95% CI OR
baseline age		0.13	0.03	<0.001	1.13	(1.06, 1.22)
baseline age squared		-0.0014	0.0003	<0.001	0.998	(0.998, 0.999)
age- baseline age		0.02	0.0041	<0.001	1.02	(1.01, 1.03)
gender (women)		1.14	0.08	<0.001	3.12	(2.63, 3.66)
place of residence (urban region)		0.24	0.10	0.013	1.27	(1.05,1.55)
education†	Level 1	0.50	0.20	0.011	1.64	(1.11,2.43)
	Level 2	0.71	0.18	<0.001	2.03	(1.41,2.91)
	Level 3	0.43	0.19	0.021	1.53	(1.06,2.22)

QIC= 12070.3512; QICu= 12066.9720

†level 1: illiterate, level 2: elementary school, level 3: middle school or high school, level 4: university degree (Reference)

including gender (P< 0.001), place of residence (P< 0.05), education level (P< 0.05), job (P> 0.05), marital status (P> 0.05), and smoking status (P> 0.05). After the omission of non-significant factors, the final model was selected as presented in Equation 2.

As displayed in Table 3, significant coefficients of 'baseline age' and 'Baseline age squared' show that the log OR of obesity changed with 'baseline age', and the changes had a curvilinear shape (P< 0.001). According to Table 3, the linear combination of significant coefficients for 'baseline age' and 'baseline age squared' in the model can be interpreted as the cross-sectional effect of age (controlling for the longitudinal effect of age and other related factors) (14). The curvilinear effect of 'baseline age' on obesity can be understood according to the frequencies presented in Table 2 and Figure 1. Moreover, the significant coefficients for 'age-baseline age' in the model can be interpreted as the longitudinal effect (controlling for the cross-sectional effect of age and other related factors) (14). It signifies that the odds of obesity changed over time within individuals. The odds of obesity had about a 2% increase (on average) per year, regardless of the baseline age.

As illustrated in Table 3, women were more susceptible ($XP(1.14) = 3.12$) to obesity (almost three times) than men (controlling for other related factors). In addition, the residents of urban areas were more likely ($EXP(0.24) = 1.27$) to be obese (about 27%) (controlling other related factors). Furthermore, individuals without university education were more prone to obesity, compared to those holding university degrees (64%, 103%, and 53% for individuals with level 1, level 2, and level 3 of education, respectively).

5. Discussion

This was a large community-based study conducted on a group of Iranian adults over 35 years of age who live in the central region of Iran. Based on the results, the total frequency of individuals with obesity increased from 25.5% in 2001 to 30.4% in 2013 in Isfahan and Najafabad. According to the National Health Survey in Iran (NHSI), the prevalence of obesity in the total population of Iranian adults over 20 years of age was reported as 12% in 2000 and raised to 22% in 2011. Moreover, NHSI reported an increase in obesity among Iranian adults in genders, all ages, and all places of residence (7). It can be concluded that between 2001 and 2011, the percentage of obesity in our target population in the central region of Iran was higher (about 10%) than the total population of the country.

In the current study, there was an 8% increase in the frequency of individuals with obesity during 12 years, while NHSI reported a 10% increase during 11 years. These massive increases are comparable to an elevation in obesity prevalence in the American adult population (the obesity prevalence raised from 20% in 2000 to 29% in 2016) (25,27). The result of the present study indicated that between 2001 and 2013, the frequency of obesity increased from 13%-18% and 31%-44% in adult men and women, respectively. Women had not only a higher percentage of obesity than men in all three phases but also a higher rise throughout the study period.

According to the NHSI data, from 2000-2011, the prevalence of obesity raised from 6.6%-14.6% and 17%-27.9% for Iranian adults men and women, respectively (7). Moreover, the result of the Tehran Lipid and Glucose Study revealed that the prevalence of obesity in the population of the capital city of Iran, Tehran, raised from 15.8% and 31.3% in 2001 to 21.1% and 38.6% in 2008 among men and women, respectively (5). This is indicative of the higher prevalence of obesity among people who live in Tehran, in comparison with the inhabitants of other parts of Iran. The odds of obesity increases with shifts in diets and eating habits, including energy-dense foods high in sugars and fat, higher consumption of red meat, salt, and saturated fatty acids, less physical activity due to the sedentary work styles, types of transportation, and lifestyle changes (25).

The present study found a difference between the cross-sectional and longitudinal effects of age on the probability of obesity in the target population using an MLR model. The findings of the current research on the association between the probability of obesity and age are comparable with the results of other studies (10,12,28). In two studies in China and France, both cross-sectional and longitudinal effects of age had a significant effect on BMI and prevalence of obesity (14,19). Nonetheless, in two studies in the United States of America, only the longitudinal effect of age had a significant effect on the prevalence of obesity (13,15). The longitudinal and cross-sectional effects of age might be different in the presence of period or cohort effects (17). The cohort effect will cause bias in the cross-sectional estimate but not the longitudinal estimate. Moreover, the period effect will cause bias in the longitudinal estimate but not the cross-sectional estimate. Alternatively, differences between longitudinal and cross-sectional effects of age may be due to the biasing effects of selective dropouts (17). In the present study, as mentioned earlier, there was no selection bias in dropouts (23); therefore, cohort or period effects are probable and an Age-Period-Cohort (APC) study is recommended for a more accurate assessment.

The cross-sectional effect of age is suggestive of differences among people in their baseline age. In the present study, there was approximately an elevated probability of obesity in younger baseline age cohorts, less than 50-54 years for men (men born in around 1947 and later) and less than 55-59 years for women (women born in around 1942 and later), followed by a modest decrease in probability for people who were in the older baseline age groups. This is indicative of the curvilinear effect of baseline age. Furthermore, the highest proportion of obesity was for women aged 55-59 years at baseline (women born within 1942-1946) and men aged 50-54 years at baseline (men born within 1947-1951). This can be ascribed to some common life conditions for the individuals born in a special cohort, which is called a cohort effect.

Since individuals in a cohort grow older together, they experience the same historical and social events at the same time points (13,18,19). Other studies have reported that Iranian adults gain weight until the age of about 50-60 years old, and after this age, BMI tends to decrease (5,10,28,29). In a similar vein, the curvilinear effect of age was reported in three studies in the USA and China. Based on these studies, BMI had a tendency to be higher in middle-aged individuals, in comparison with young adults; moreover, it tended to be constant or decrease in older individuals. Furthermore, younger cohorts are at higher risk of an obesogenic environment due to sedentary lifestyles and high-calorie diets (13,18,19).

With increasing age, dramatic alterations occur in food intake, energy consumption, appetite, as well as bone and muscle loss that affect body composition (7). Moreover, midlife adults are exposed to an elevated risk of obesity due to hormonal changes, lifestyle, and metabolism (13,15). According to body mass studies, after the age of 30, fat mass increases but fat-free mass (FFM) decreases progressively. The maximal FFM and the maximal fat mass are usually reached at the age of 20-30 and 60-70 years, respectively. Thereafter, both fat measures reduce during old age (29).

The longitudinal effect of age demonstrates changes over time within individuals. In the current study, during 12 years follow up, the odds of obesity increased or remained partially the same in almost all baseline age groups. The odds of obesity had about a 2% increase (on average) with each year of aging, regardless of the baseline age. In line with most studies, in the current research, there was an obvious aging effect on the high prevalence of obesity in middle age. In Iran, Azizi et al. (2005) indicated that the prevalence of obesity increased most rapidly among 30- to 40-year-old men and women in Tehran, within 1998-1999 and 2001-2002 (5). Moreover, in a study conducted by Sarrafzadegan et al. on ICS (Isfahan Cohort Study) data (2001-2007), it was reported that younger individuals gained more weight, as compared to older ones (10). Several factors, such as a decrease in appetite and abdominal obesity in the elderly, might be responsible for this reduction in the old baseline age groups (28). Frequent medical check-up and treatment in older people might be another reason (9,30); moreover, older people may not be interested in modern lifestyles, such as dietary preferences changes (30).

In addition, in the current study, women were more susceptible to obesity (almost three times) than men. The higher prevalence of obesity among women was reported in several studies in Iran (1,8,10,12,27,28,29,31). This higher prevalence can be attributed to lower physical activity level, pregnancy, menopause, higher rate of depression, lack of employment, lower socioeconomic status, lower educational level, and gender differences in food intake (7,32). Moreover, Iranian women may pay less attention to their body shape, in comparison to European and Oceanic women. In addition, less access to information and knowledge about weight loss may be another cause (5).

Furthermore, in the present research, urban residents were more likely to be obese, compared to rural residents, controlling for other related factors. Similar results were reported in other studies in Iran (1,6,8,28,29,31,33). Urban residents generally have a higher BMI, in comparison with rural residents. Moreover, they are more likely to eat fast foods and have a sedentary lifestyle. Furthermore, in most countries, urban residents generally consume a higher proportion of fat and protein, a lower proportion of carbohydrates, and have higher availability of calories (8).

In addition, individuals with less than 12 years of education were more susceptible to obesity, in comparison with those holding university degrees. The impact of education level on obesity and BMI has been reported in other studies (1,8,31,34). In general, higher education is associated with a lower probability of obesity, especially among women (35). People with higher education are more aware of health-related factors. Furthermore, individuals with high education levels are more likely to have higher income and better access to health care services (36).

Among the notable strengths of the present study, we can refer to its large sample size from a longitudinal community-based study of adults living in urban or rural areas in the central region of Iran. Furthermore, the current study assessed both longitudinal and cross-sectional effects of age on the odds of obesity. Nonetheless, despite the unique coverage of the current research, in comparison with other studies in Iran, the sample represented the population of central parts of Iran, limiting the generalizability of findings to the entire country. Furthermore, this study assessed the longitudinal effect of age based on only three measurements. It is recommended to use data with more repeated measures for individuals in order to improve the accuracy of results.

6. Conclusion

Obesity is a severe public health issue among Iranian adults, especially in the central region of the country. Available data in the present study indicated the high and rising prevalence of obesity among Iranian adults, especially women, aged 35-60 years. Both cross-sectional and longitudinal effects of age should be considered for a better understanding of the effect of age on obesity and the related factors. The assessment of obesity changes in a population-based study provides opportunities to target subpopulations that are in need of special care and attention in public health interventions.

Acknowledgments

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Data Availability

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy.

Footnotes

Conflicts of Interest: The authors declare that there they have no conflict of interest regarding the publication of this paper.

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