



# LUND UNIVERSITY

## The prevalence of adulthood overweight and obesity in Tehran: findings from Urban HEART-2 study.

Ahmad Kiadaliri, Aliasghar; Jafari, Mehdi; Vaez Mahdavi, Mohammad-Reza; Faghihzadeh, Soghrat; Kalantari, Naser; Asadi-Lari, Mohsen

*Published in:*  
Medical Journal of the Islamic Republic of Iran

2015

[Link to publication](#)

### *Citation for published version (APA):*

Ahmad Kiadaliri, A., Jafari, M., Vaez Mahdavi, M.-R., Faghihzadeh, S., Kalantari, N., & Asadi-Lari, M. (2015). The prevalence of adulthood overweight and obesity in Tehran: findings from Urban HEART-2 study. *Medical Journal of the Islamic Republic of Iran*, 29(178), 1-9.  
[http://mjiri.iums.ac.ir/browse.php?a\\_id=2696&sid=1&slc\\_lang=en](http://mjiri.iums.ac.ir/browse.php?a_id=2696&sid=1&slc_lang=en)

*Total number of authors:*  
6

### **General rights**

Unless other specific re-use rights are stated the following general rights apply:  
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: <https://creativecommons.org/licenses/>

### **Take down policy**

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117  
221 00 Lund  
+46 46-222 00 00

## The prevalence of adulthood overweight and obesity in Tehran: findings from Urban HEART-2 study

Aliasghar Ahmad Kiadaliri<sup>1</sup>, Mehdi Jafari<sup>2</sup>, Mohammad-Reza Vaez Mahdavi<sup>3</sup>  
Soghrat Faghihzadeh<sup>4</sup>, Naser Kalantari<sup>5</sup>, Mohsen Asadi-Lari<sup>6</sup>

Received: 23 December 2013

Accepted: 27 July 2014

Published: 14 February 2015

### Abstract

**Background:** To estimate and compare prevalence of overweight and obesity among adult people across the 22 districts of Tehran in 2011.

**Methods:** This was a cross-sectional study using data on 47,406 women and 47,525 men aged  $\geq 15$  years from a large population-based survey (Urban HEART-2). Age-standardized prevalence (ASP) of overweight ( $25 \leq \text{BMI} < 30$ ) and obesity ( $\text{BMI} \geq 30$ ) were estimated for the Tehran's districts. Pearson Chi2 tests and logistic regression were used to examine any significant differences in prevalence of these disorders across sociodemographic groups.

**Results:** ASPs of overweight were 36.5% and 32.0 % among men and women, respectively ( $p < 0.001$ ). These figures for obesity were 10.7% and 15.3% among men and women, respectively ( $p < 0.001$ ). Crude prevalence of overweight and obesity rose with age up to the age of 54 years and decreased thereafter. Across education groups, the lowest prevalence of overweight/obesity was seen among most educated people. The results showed that being young, single and student were associated with lower odds of overweight/obesity.

**Conclusion:** This study showed a high prevalence of overweight and obesity among adult in Tehran. There were significant associations between sociodemographic characteristics and prevalence of overweight/obesity among adults in Tehran. The results of this study might be used in identifying high risk groups of overweight and obesity in Tehran.

**Keywords:** Overweight, Obesity, Prevalence, Tehran.

**Cite this article as:** Ahmad Kiadaliri A, Jafari M, Vaez Mahdavi M.R, Faghihzadeh S, Kalantari N, Asadi-Lari M. The prevalence of adulthood overweight and obesity in Tehran: findings from Urban HEART-2 study. *Med J Islam Repub Iran* 2015 (14 February). Vol. 29:178.

### Introduction

World Health Organization (WHO) describes obesity as one of the main public-health problem that threatens to overwhelm the entire world (1). Obesity is a medical disorder that also leads to a large number of comorbidities including hypertension, type 2 diabetes and cardiovascular disease (2). This association is profoundly important

for the affected individuals, but the associated morbidity is also economically damaging for society (3). Recently, WHO European region office has reported that overweight and obesity are responsible for about 80% of cases of type 2 diabetes, 35% of ischemic heart disease, and 55% of hypertensive disease among adults in the region, and cause more than one million

1. Postdoctoral Researcher, Clinical Epidemiology Unit, Orthopaedics, Department of Clinical Sciences-Lund, Lund University, Lund, Sweden. [aliasghar.ahmad\\_kiadaliri@med.lu.se](mailto:aliasghar.ahmad_kiadaliri@med.lu.se)

2. Department of Health Management, School of Health Management, Iran University of Medical Sciences, Tehran, Iran. [mejafaris@gmail.com](mailto:mejafaris@gmail.com)

3. Department of Physiology, School of Medicine, Shahed University, Tehran, Iran. [vaezmahdavi@shahed.ac.ir](mailto:vaezmahdavi@shahed.ac.ir)

4. Department of Biostatistics and Epidemiology, School of Medicine, Zanjan University of Medical Sciences, Zanjan, Iran. [faghihz@modares.ac.ir](mailto:faghihz@modares.ac.ir)

5. Department of Community Nutrition, National Nutrition and Food Technology Research Institute, Faculty of Nutrition Sciences and Food Technology, Shaheed Beheshti University of Medical Sciences, Tehran, Iran. [nkalantari1334@gmail.com](mailto:nkalantari1334@gmail.com)

6. (Corresponding author) Department of Epidemiology, School of Public Health and Oncopathology Research Centre, Iran University of Medical Sciences, Tehran, Iran. [asadilari@iums.ac.ir](mailto:asadilari@iums.ac.ir)

deaths and 12 million life-years of ill health each year (4).

Like many other countries in the world, overweight and obesity is common in Iran. A recent nationwide survey reported that age-adjusted prevalence of overweight or obesity ( $BMI \geq 25$ ) was 42.8% and 57.0% in men and women, respectively in 2004-2005 (5). Among these people, 11.1% of men and 25.2% of women were obese ( $BMI \geq 30$ ) (5). Urbanization and changes in life style including improper eating habits and physical inactivity are considered as main causes of increasing obesity in Iran (6, 7). It is expected that these changes are more common among population in Tehran as capital of the country. While some previous studies examined the prevalence of overweight and obesity in Tehran, but they either reported an overall rate (8) or estimate a rate for a specific district (9).

The aims of the current study were to present an update estimate of overweight and obesity prevalence among Tehranian adults and examining the distribution of these disorders across the 22 districts of Tehran using data from a large population-based survey (Urban HEART) in 2011.

## Methods

Urban Health Equity Assessment and Response Tool (Urban HEART) is rather an approach for evidence-based practice and policy making at national and local levels to identify and analyze inequities in health between people living in various parts of cities, or belonging to different socioeconomic groups within and across cities. It facilitates decisions on viable and effective strategies, interventions and actions that should be used to reduce inter- and intra-city health inequities (10). In October 2011, the second round of Urban HEART project was conducted to determine inequalities in physical, mental, social and environmental health components supported by Municipality of Tehran.

### Sampling design

To collect data in 22 districts and 368

neighborhoods of Tehran, a multistage sampling was applied. Comprehensive map of Tehran in 2011 separated by the districts and neighborhoods was selected as the sampling frame. The first and the second stages were stratified sampling. 22 districts of the municipality and 368 neighborhoods were considered as stratum in the first stage and the second stage respectively. The third stage was cluster sampling and each block was treated as one cluster. A two-dimensional systematic sampling method was used to select blocks in each neighborhood using GIS maps. Then the houses were numbered in each block and 8 houses were selected in each block systematically based on an eight-box table including four age groups (15-24, 25-44, 45-64, and 65 and over) and both sexes.

The sample size was determined as 1535 households in each district based on a prevalence of 10% with a margin of error of 0.015% and a confidence interval (CI) of 95%. Then to facilitate the allocation of sample to the mentioned eight-box table that must be completed for the individual questionnaires expanded to 1600 households. For sample allocation at neighborhood level, the method of the probability proportional to size of each district was used.

### Questionnaires

In this project, there were three types of questionnaires consisted of 20 parts that the first 14 parts were completed for all selected households in the blocks and the remaining six parts (mental health, health-related quality of life, social capital, physical pain, physical activity and oral health) were completed by a selected individual in each household. The last type of questionnaire was special for nutrition and was completed for a selected household in each block. In Urban HEART-2 we have collected data about demographics, assets, children health, accidents, domestic violence, disabilities, smoking and addiction, chronic diseases, household costs, nutrition habits, food insecurity, health service utilization

and also individual data about mental health, health-related quality of life, pain, physical activity, social capital and oral health, through a multi-stage cluster random sampling proportional to population size at neighborhood level. Further details have been published earlier (11).

### Statistical analysis

Using self-reported data on height and weight, we calculated body mass index (BMI) as weight (kg)/height (m)<sup>2</sup>. Then, overweight and obesity were defined following WHO recommendation: overweight  $25 \leq \text{BMI} < 30$ ; obesity  $\text{BMI} \geq 30$ . The frequencies were provided as per cent. Data were stratified by sociodemographic characteristics and districts. Age-standardized prevalence (ASP) was calculated using the WHO reference population (12). In univariate analysis, we used Chi<sup>2</sup> test to examine significant differences in prevalence of overweight and obesity across sociodemographic strata. Multivariate analysis was conducted using logistic regression. STATA version 11 (Stata Corp LP, College Station, TX, USA) was used for statistical

analysis.

### Results

The study population included 94,931 individuals 15 years or older distributed in the 22 districts of Tehran. Table 1 shows baseline characteristics of the sample. The mean age was 40.3 ( $\pm 16.8$ ) and 50.1% were male. The mean BMI was 25.2 ( $\pm 4.5$ ) for total sample. In total, 34.6% and 13.1% of the sample were overweight and obese, respectively.

Fig. 1 displays crude prevalence of overweight and obesity across age groups by gender. Among men, the highest prevalence of both overweight and obesity was observed in the age group of 45-54. Among women, the highest prevalence of overweight was observed in the age group of 55-64 while the highest prevalence of obesity was seen in the age group of 45-54. In both gender groups, the lowest prevalence of overweight and obesity was observed in the youngest age group.

Table 2 presents crude prevalence of overweight and obesity across sociodemographic strata in Tehran. The lowest and the

Table 1. Baseline characteristics of the study sample from Urban HEART-2 study stratified by gender.

	Women	Men
N	47,406	47,525
Age (mean $\pm$ SD)	39.9 $\pm$ 16.2	40.6 $\pm$ 17.3
BMI (mean $\pm$ SD)	25.3 $\pm$ 4.8	25.2 $\pm$ 4.2
BMI categories (%)		
BMI < 18.5	5.7	3.7
18.5 $\leq$ BMI < 25	46.5	48.8
25 $\leq$ BMI < 30	32.4	36.8
BMI $\geq$ 30	15.4	10.7
Education		
No formal education	17.8	12.8
Primary school	10.9	11.7
Secondary school	13.6	16.3
High school	29.2	29.4
Associate degree	8.1	9.0
Bachelor and higher	20.4	20.8
Marital status		
Single	28.9	35.8
Married	61.3	61.8
Widow/widower	7.8	1.3
Divorced	2.0	1.1
Employment status		
Employed	11.0	55.4
Unemployed	8.2	13.9
Student	15.1	13.4
Housekeeper	60.6	0.6
Retired	5.1	16.7

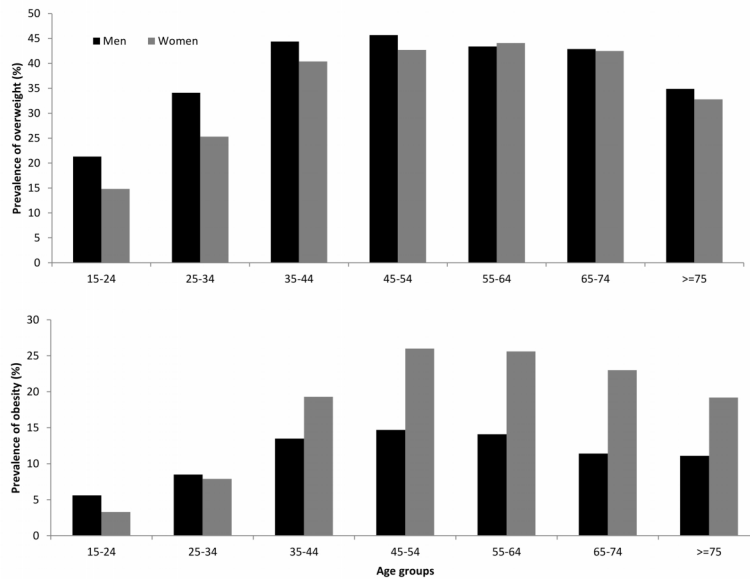


Fig. 1. Crude prevalence of overweight and obesity across age groups stratified by gender.

highest prevalence of overweight and obesity were observed in people in the age groups of 15-24 and 45-54 years old, respectively. It can be seen that prevalence of overweight and obesity rose with age up to the age of 54 years and decreased thereafter. The univariate analysis showed an inverse association between education and prevalence of overweight and obesity. Across marital groups, single people had the lowest prevalence of overweight and obesity. Students had the lowest prevalence of overweight and obesity across employment strata.

The results of logistic regression (Table 2, Columns 4 & 5) showed that females, the age group of 15-24 years old, bachelor and higher education, being single and student were associated with the lowest odds of being overweight. After control for other covariates, there was no gender disparity in prevalence of obesity. There was an inverse association between education and obesity, all else equal. Single people and students had the lower odds of being obese than other groups.

Figs. 2 and 3 show the ASP of overweight and obesity across the Tehran's districts. The districts 16, 18, 19 had the highest ASP of both overweight and obesity. On the other hand, the districts 1, 3, 6, and 7

had the lowest ASP of both overweight and obesity. Table 3 shows the ASP of overweight and obesity across Tehran's districts for both genders. Overall ASP of overweight was 36.5% and 32.0% among men and women, respectively ( $p < 0.001$ ). These figures for obesity were 10.7% and 15.3% among men and women, respectively ( $p < 0.001$ ). The lowest ASP of overweight was observed among females in district 3 (26.8%) and the lowest ASP of obesity was reported among males in district 6 (7.2%). There were significant sex-disparities in ASP of both overweight and obesity across the Tehran's districts.

### Discussion

While the national estimate of overweight and obesity is an important tool for policy-making, examining the distribution of these conditions within- and between geographic areas are equally important for informed decision-making in resource allocation to preventive and therapeutic programs. In the current study, distribution of overweight and obesity across the 22 districts of Tehran was examined using data from a large population-based survey. The results of the study showed the high prevalence of overweight and obesity for all districts in Tehran. Moreover, there were significant dis-

Table 2. Association between sociodemographic characteristics and crude prevalence (%) of overweight and obesity in Tehran.

	Univariate analysis		Multivariate analysis (OR; 95% CI)	
	Overweight (25≤BMI<30)	Obesity (BMI≥30)	Overweight (25≤BMI<30)	Obesity (BMI≥30)
Gender				
Male	36.76	10.70	Ref	Ref
Female	32.35	15.45	0.66 (0.63-0.69)	1.00 (0.93-1.07)
P for independence	<0.001	<0.001		
Age groups				
15-24	18.09	4.46	Ref	Ref
25-34	29.60	8.22	1.42 (1.34-1.50)	1.40 (1.27-1.55)
35-44	42.34	16.51	1.98 (1.85-2.11)	2.26 (2.03-2.51)
45-54	44.08	20.60	2.03 (1.90-2.17)	2.62 (2.36-2.92)
55-64	43.71	19.77	1.99 (1.85-2.14)	2.36 (2.11-2.64)
65-74	42.73	16.64	1.93 (1.77-2.10)	1.76 (1.55-2.00)
≥ 75	34.04	14.42	1.36 (1.22-1.51)	1.40 (1.20-1.63)
P for independence	<0.001	<0.001		
Education				
No formal education	40.28	21.79	Ref	Ref
Primary school	40.77	19.56	1.06 (1.00-1.12)	0.95 (0.89-1.01)
Secondary school	33.14	13.51	1.05 (0.99-1.11)	0.84 (0.79-0.90)
High school	35.66	11.59	1.10 (1.05-1.15)	0.65 (0.62-0.70)
Associate degree	31.16	8.60	1.08 (1.01-1.15)	0.59 (0.54-0.65)
Bachelor and higher	27.84	6.72	0.93 (0.88-0.98)	0.47 (0.44-0.51)
P for independence	<0.001	<0.001		
Marital status				
Single	20.60	4.88	Ref	Ref
Married	41.76	16.73	1.60 (1.52-1.68)	1.64 (1.51-1.78)
Widow/widower	37.97	23.59	1.61 (1.48-1.75)	2.21 (1.97-2.48)
Divorced	32.30	12.50	1.23 (1.09-1.39)	1.37 (1.15-1.63)
P for independence	<0.001	<0.001		
Employment status				
Employed	38.06	11.17	Ref	Ref
Unemployed	25.85	7.75	0.88 (0.84-0.93)	0.97 (0.89-1.06)
Student	17.06	4.18	0.82 (0.77-0.88)	0.92 (0.82-1.04)
Housekeeper	39.61	20.76	1.29 (1.23-1.36)	1.57 (1.45-1.70)
Retired	41.99	14.63	0.98 (0.93-1.04)	1.01 (0.94-1.09)
P for independence	<0.001	<0.001		

parities in distribution of overweight and obesity across sociodemographic strata and the districts in Tehran.

The high prevalence of overweight and obesity in Tehran is consistent with previous national estimates in 2005 (5, 13). One may expect a high prevalence of overweight and obesity for Tehranian adults as it is most industrialized city of the country and experience rapid socioeconomic changes which are among main causes of overweight and obesity worldwide (14). This high prevalence means that overweight and obesity is a very serious health problem in Iran and implies that a high rate of obesity-related disorders is expected among Iranian population in coming years. Using the same reference population as the current study, Finucane et al. (15) reported

a worldwide ASP of obesity of 9.8% in men and 13.8% in women. This implies that prevalence of obesity is worryingly higher than worldwide average among men and women in Tehran.

We found significant variations in prevalence of overweight and obesity across the districts in Tehran. This difference maintained even after control for age differences between the districts. In a national survey, significant regional differences in distribution of BMI categories were observed in Iran (13). In addition, geographic variation in overweight and obesity levels for children and adults were also reported in other countries (16-20).

There are some potential explanations for this geographic variation: first, it might be due to differences in individuals' character-

Table 3. Age-adjusted prevalence (%) of overweight and obesity across Tehran's districts stratified by gender.

Districts	Overweight (25≤BMI<30)			Obesity (BMI≥30)		
	Males	Females	p	Males	Females	p
D1	35.83	28.26	<0.001	7.71	11.59	<0.001
D2	36.98	29.02	<0.001	11.24	13.43	0.024
D3	38.79	26.78	<0.001	8.09	10.12	0.024
D4	36.25	32.05	0.004	9.12	13.04	<0.001
D5	37.90	30.43	<0.001	10.63	14.53	<0.001
D6	35.53	27.36	<0.001	7.20	8.87	0.040
D7	33.96	29.71	0.003	10.40	13.39	0.002
D8	37.07	32.51	0.002	10.20	13.40	0.001
D9	35.26	34.04	0.416	10.24	15.78	<0.001
D10	35.55	31.49	0.006	9.98	14.07	<0.001
D11	38.07	33.75	0.004	11.03	14.95	<0.001
D12	35.18	33.72	0.309	11.66	17.00	<0.001
D13	35.16	32.10	0.039	11.09	15.42	<0.001
D14	36.67	33.28	0.023	12.35	16.75	<0.001
D15	35.51	33.50	0.141	12.24	19.20	<0.001
D16	37.63	33.91	0.013	12.90	18.80	<0.001
D17	36.74	33.03	0.015	11.32	17.43	<0.001
D18	37.07	34.71	0.080	11.25	18.38	<0.001
D19	37.66	35.18	0.083	13.37	20.65	<0.001
D20	36.62	32.26	0.001	12.11	18.18	<0.001
D21	35.58	32.15	0.012	10.72	16.43	<0.001
D22	39.01	32.45	<0.001	11.13	15.30	<0.001
Total	36.51	31.98	<0.001	10.70	15.28	<0.001

istics living in the districts such as attitudes, beliefs, socioeconomic status, and physical activity; second, it might be due to differences in environmental features of the districts such as availability of places for physical activity, access to health care; third, differences in implemented policies by health authorities or municipalities which support healthy life style.

While overweight was less common among females, they were more obese than males in all districts of Tehran. Similar trend was observed among adults in the other regions of Iran (21, 22) and other countries (23-27). Moreover, higher prevalence of obesity among females than males is a global phenomenon and has been widely examined (15, 28-30).

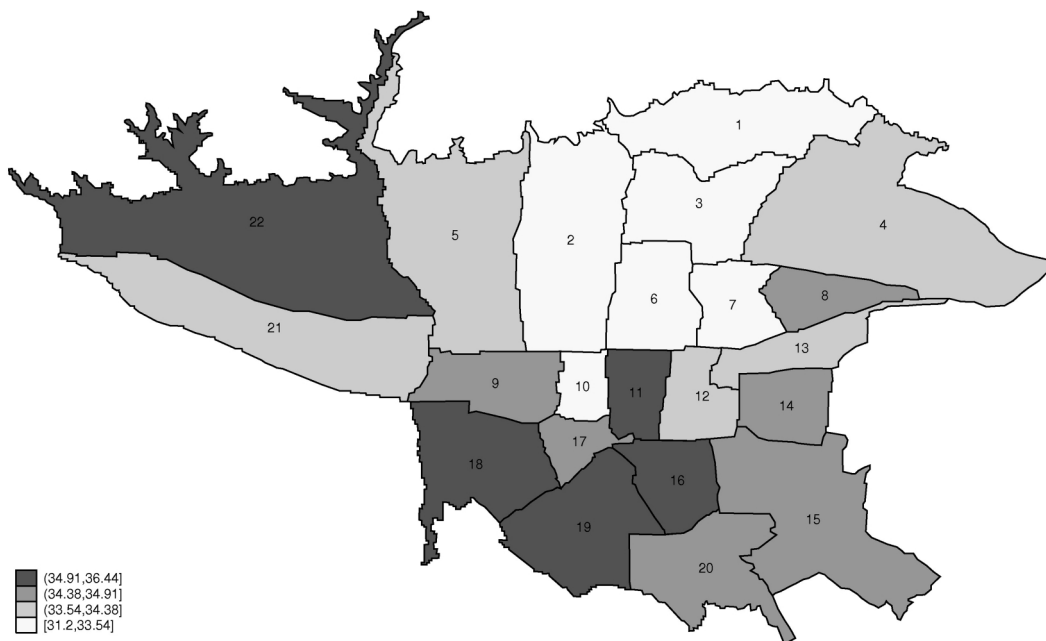


Fig. 2. Age-standardized prevalence of overweight (25≤BMI<30) across Tehran's districts.

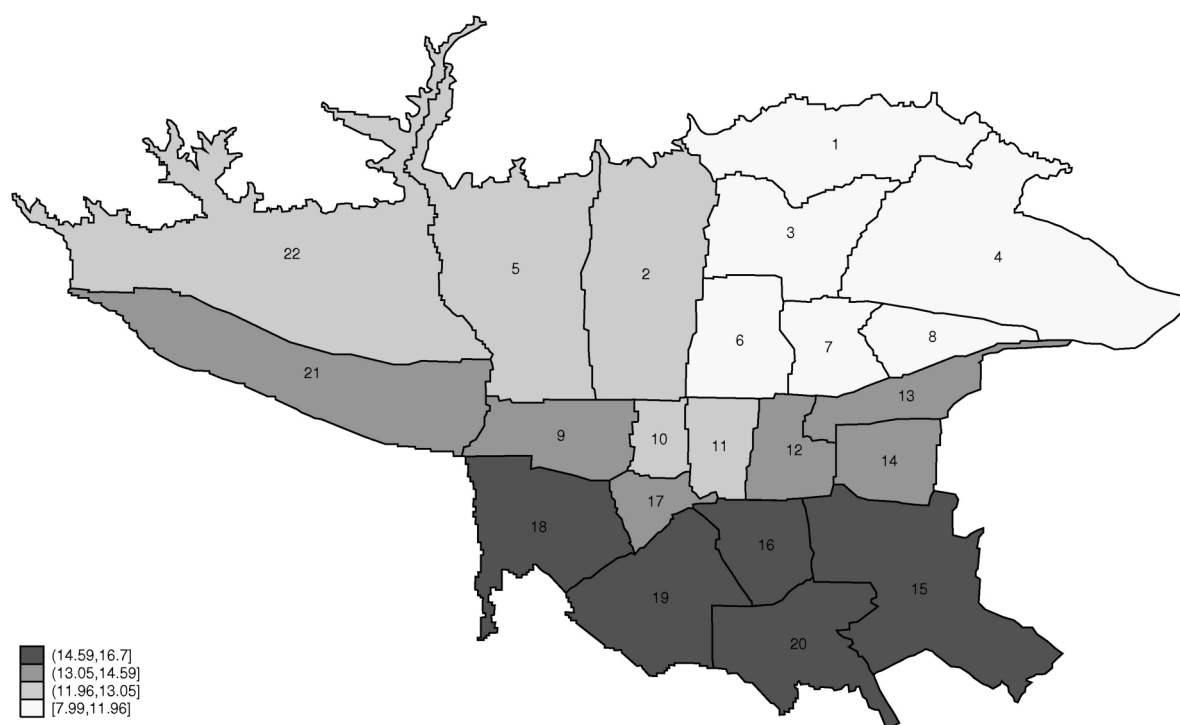


Fig. 3. Age-standardized prevalence of obesity (BMI $\geq$ 30) across Tehran's districts.

Consistent with some previous studies in Iran (5, 13), the results showed that overweight and obesity rose with age until age 54 and decrease later on. This higher prevalence of overweight and obesity up to middle age and a decline thenceforth was also observed in other countries (2, 31). This could be possibly explained by weight loss occurring in old age or/and higher risk of mortality for obese (32, 33).

While there is no consensus on association between overweight/obesity and marital status, our finding of lower prevalence of overweight/obesity among single people was in line with previous studies in Iran and other countries (34-36). Less physical activity, changing of dietary pattern, less concern about being attractive and having more social support for married people constitute main explanations for this association (34, 37). In line with previous studies (38-40) we found an inverse association between obesity and education in our study. It is argued that better education is associated with health literacy which might result in higher consumption of fruits and vegetables and lower consumption of fats (41).

Using data from a large population-based survey and providing update estimates of prevalence of overweight and obesity for the 22 districts of Tehran are main advantages of the current study. However, the results of this study should be interpreted in light of some limitations. First, data on weight and height were self-reported by participants. These are prone to bias (downward bias for weight and upward bias for height) (42) which might cause downward bias in our estimated prevalence here. Second, this is a descriptive cross-sectional study meaning that no casual inference from findings is possible. Third, cross-sectional design of the study limits us to examine changes in prevalence of overweight and obesity over time.

### Conclusion

The results of this large population-based survey showed a high prevalence of overweight and obesity among Tehranian adults. Moreover, there were significant disparities in distribution of overweight and obesity across sociodemographic strata in Tehran. A high incidence of obesity-related disorders is expected in coming years im-



plying considerable economic burden for health system which needs to be considered by health authorities and policy-makers in Iran.

## References

1. WHO, (2000) Obesity: preventing and managing the global epidemic. Report of a WHO consultation. WHO, Geneva.
2. Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA*. 2003; 289(1):76–79.
3. Haslam DW, James WPT. (2005) Obesity. *Lancet* 366 (9492): 1197-209.
4. Branca F, Nikogosian H, Lobstein T. (2007) The challenge of obesity in the WHO European Region and the strategies for response. WHO Regional Office for Europe. Copenhagen, Denmark.
5. Janghorbani M, Amini M, Willett WC, Gouya MM, Delavari A, Alikhani S, et al. 2007. First nationwide survey of prevalence of overweight, underweight, and abdominal obesity in Iranian adults. *Obesity*; 15(11): 2797-2808.
6. Ghassemi H, Harrison G, Mohammad K: An accelerated nutrition transition in Iran. *Public Health Nutr* 2002; 5:149–155.
7. Mimiran P, Mohammadi F, Baegy F, Kalantari N, Azizi F: Assessment of dietary intake based on food guide pyramid in a group of Tehranian adults: Tehran Lipid and Glucose Study. *J Iran Univ Med Sci* 2003; 32:767–778.
8. Azizi F, Azadbakht L, Mirmiran P. Trends in Overweight, Obesity and Central Fat Accumulation among Tehranian Adults between 1998–1999 and 2001–2002: Tehran Lipid and Glucose Study. *Ann Nutr Metab* 2005; 49:3-8.
9. Azadbakht L, Mirmiran P, Shiva N, Azizi F. General obesity and central adiposity in a representative sample of Tehranian adults: prevalence and determinants. *Int J Vitam Nutr Res* 2005; 75: 297–304.
10. Asadi-Lari M, Vaez-Mahdavi MR, Faghihzadeh S, Montazeri A, Farshad AA, Kalantari N, et al. The application of urban health equity assessment and response tool (Urban HEART) in Tehran; concepts and framework. *Medical Journal of the Islamic Republic of Iran*. 2010; 24(3):175-85.
11. Asadi-Lari M, Vaez-Mahdavi MR, Faghihzadeh S, Chergian B, Esteghamati A, Farshad AA, et al. Response-oriented measuring inequalities in Tehran: second round of Urban Health Equity Assessment and Response Tool (Urban HEART-2), concepts and framework. *Medical Journal of the Islamic Republic of Iran*. 2013; 27(4):236-48.
12. O Ahmad, C Boschi-Pinto, A Lopez, C Murray, R Lozano, M Inoue. Age standardization of rates: a new WHO standard. World Health Organization, Geneva, 2001.
13. Kelishadi R, Alikhani S, Delavari A, Alaedini F, Safaie A, Hojatzadeh E. Obesity and associated lifestyle behaviours in Iran: findings from the First National Non-communicable Disease Risk Factor Surveillance Survey. *Public Health Nutr* 2008, 11(3):246-51.
14. Wang Y, Lobstein T. Worldwide trends in childhood overweight and obesity. *Int J Pediatr Obes* 2006, 1(1):11-25.
15. Finucane MM, Stevens GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, et al. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9·1 million participants. *Lancet* 2011; 377(9765):557-67.
16. Hawkins SS, Griffiths LJ, Cole TJ, Dezateux C, Law C; Millennium Cohort Study Child Health Group. Regional differences in overweight: an effect of people or place? *Arch Dis Child* 2008, 93(5):407-13.
17. Hahn RA, Heath GW, Chang MH. Cardiovascular disease risk factors and preventive practices among adults--United States, 1994: a behavioral risk factor atlas. Behavioral Risk Factor Surveillance System State Coordinators. *MMWR CDC Surveill Summ* 1998, 47(5):35-69.
18. Willms JD, Tremblay MS, Katzmarzyk PT. Geographic and demographic variation in the prevalence of overweight Canadian children. *Obes Res* 2003, 11(5):668-73.
19. Tudor-Locke C, Kronenfeld JJ, Kim SS, Benin M, Kuby M. A geographical comparison of prevalence of overweight school-aged children: the National Survey of Children's Health 2003. *Pediatrics* 2007, 120(4):e1043-50.
20. El Mouzan MI, Al Herbish AS, Al Salloum AA, Al Omar AA, Qurachi MM. Regional variation in prevalence of overweight and obesity in Saudi children and adolescents. *Saudi J Gastroenterol* 2012, 18(2):129-32.
21. Hajian-Tilaki KO, Heidari B. Prevalence of obesity, central obesity and the associated factors in urban population aged 20-70 years, in the north of Iran: a population-based study and regression approach. *Obes Rev* 2007;8(1):3-10
22. Rashidy-Pour A, Malek M, Eskandarian R, Ghorbani R. Obesity in the Iranian population. *Obes Res*. 2001; 9 (Suppl 4):228S-233S.
23. Gao Y, Ran XW, Xie XH, Lu HL, Chen T, Ren Y, et al. Prevalence of overweight and obesity among Chinese Yi nationality: a cross-sectional study. *BMC Public Health* 2011; 11:919.
24. Andrade FB, Caldas Junior Ade F, Kitoko PM, Batista JE, Andrade TB. Prevalence of overweight and obesity in elderly people from Vitória-ES, Brazil. *Cien Saude Colet* 2012; 17(3):749-56.
25. Pasco JA, Nicholson GC, Brennan SL, Kotowicz MA. Prevalence of obesity and the rela-

tionship between the body mass index and body fat: cross-sectional, population-based data. *PLoS One* 2012; 7(1):e29580.

26. Fouad M, Rastam S, Ward K, Maziak W. Prevalence of obesity and its associated factors in Aleppo, Syria. *Prev Control* 2006; 2(2):85-94.

27. Khader Y, Batieha A, Ajlouni H, El-Khateeb M, Ajlouni K. Obesity in Jordan: prevalence, associated factors, comorbidities, and change in prevalence over ten years. *Metab Syndr Relat Disord* 2008; 6(2):113-20.

28. James PT. Obesity: the worldwide epidemic. *Clin Dermatol* 2004; 22(4):276-80.

29. Brooks R, Maklakov A. Sex differences in obesity associated with total fertility rate. *PLoS One* 2010; 5(5):e10587.

30. Case A, Menendez A. Sex differences in obesity rates in poor countries: evidence from South Africa. *Econ Hum Biol.* 2009; 7(3):271-82.

31. Sibai AM, Hwalla N, Adra N, Rahal B. Prevalence and covariates of obesity in Lebanon: findings from the first epidemiological study. *Obes Res* 2003; 11(11):1353-61.

32. Adams KF, Schatzkin A, Harris TB, Kipnis V, Mouw T, Ballard-Barbash R, Overweight, Obesity, and Mortality in a Large Prospective Cohort of Persons 50 to 71 Years Old. *N Engl J Med* 2006; 355(8):763-78.

33. Ringbäck Weitoft G, Eliasson M, Rosén M. Underweight, overweight and obesity as risk factors for mortality and hospitalization. *Scand J Public Health* 2008; 36(2):169-76.

34. Janghorbani M, Amini M, Rezvanian H, et al.

2008. Association of body mass index and abdominal obesity with marital status in adults. *Arch Iran Med* 11(3):274-81.

35. Tzotzas T, Vlahavas G, Papadopoulou SK, et al. 2010. Marital status and educational level associated to obesity in Greek adults: data from the National Epidemiological Survey. *BMC Public Health* 10:732.

36. Lipowicz A, Gronkiewicz S, Malina RM. 2002. Body mass index, overweight and obesity in married and never married men and women in Poland. *Am J Hum Biol* 14(4):468-75.

37. Sobal J, Rauschenbach BS, Frongillo EA Jr. 1992. Marital status, fatness and obesity. *Soc Sci Med* 35(7):915-23.

38. McLaren L. Socioeconomic status and obesity. *Epidemiol Rev* 2007; 29:29-48.

39. Monteiro CA, Moura EC, Conde WL, Popkin BM. Socioeconomic status and obesity in adult populations of developing countries: a review. *Bull World Health Organ* 2004; 82:940-6.

40. Hajian-Tilaki KO, Heidari B. Association of educational level with risk of obesity and abdominal obesity in Iranian adults. *J Public Health (Oxf)* 2010; 32:202-9.

41. Hong SA, Kim K, Kim MK. Educational attainment and differences in fruit and vegetable consumption among middle-aged adults in the Korean National Health and Nutrition Examination Survey IV. *Nutr Res Pract* 2012; 6:263-9.

42. Shiely F, Hayes K, Perry IJ, Kelleher CC. Height and weight bias: the influence of time. *PLoS One.* 2013; 8(1):e54386.