

# Factors related to obesity among Iranian men: results from the National Health Survey

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Submitted 15 May 2009: Accepted 29 December 2009: First published online 4 May 2010

## Abstract

**Objective:** To our knowledge, only a few Iranian studies have investigated factors associated with obesity among men. The aims of the present study were to explore the associations between sociodemographic factors, smoking and obesity in Iranian men and compare these associations between Iranian men and women.

**Design:** We used data from the National Health Survey in Iran. A generalised estimating equations model included 11 697 men and 14 854 women aged 20–69 years (12 850 households). Body weight and height were objectively measured. BMI was calculated as kg/m<sup>2</sup>, and subjects were classified into obese (BMI ≥ 30 kg/m<sup>2</sup>) and non-obese (BMI < 30 kg/m<sup>2</sup>).

**Results:** Among men, adjusted obesity OR were 0·62 (95% CI 0·52, 0·74), 1·09 (95% CI 0·90, 1·32), 1·003 (95% CI 1·00, 1·007) and 0·57 (95% CI 0·40, 0·81) for smokers, married, economic index and active workforce groups, respectively. Using low education as the reference group, the obesity OR for men were 1·06 (95% CI 0·89, 1·26) and 0·75 (95% CI 0·57, 0·99) for the moderate and high education groups, respectively. Using rural as the reference group, the obesity OR was 1·87 (95% CI 1·56, 2·26) for urban men.

**Conclusions:** Our findings may point towards a better understanding of the social and cultural mechanisms of obesity in Iranian men. The above sociodemographic factors are large contributors to obesity and provide the greatest opportunity for actions and interventions designed for prevention and treatment.

## Keywords

Generalised estimating equation  
Obesity  
Odds ratio  
Iranian men

The obesity epidemic has become a worldwide phenomenon in recent years<sup>(1,2)</sup>. Nearly half a billion of the world's population is now considered to be overweight or obese<sup>(3)</sup>. In 2003–2004, approximately 32% of the US adult population was obese<sup>(4)</sup>. Obesity in men is considered a major problem in Europe and the prevalence of obesity has increased by 10–40% in the past 10 years<sup>(5)</sup>. Almost one-third of adult Canadians are at increased risk of disability, disease and premature death due to obesity<sup>(6)</sup>. In 2001, 58% of Australian men and 42% of Australian women were classified as overweight or obese<sup>(7)</sup>. Obesity is not only classified as a disease in its own right, but also has been reported to be a risk factor for CVD, diabetes, hypertension, some cancers and other diseases<sup>(8–15)</sup>.

Obesity is caused by many factors. Most studies have investigated the relationship between sociodemographic factors and obesity. One potential predictor could be age<sup>(16–19)</sup>. Another predictor is socio-economic status that

has shown an inverse relation with obesity among women, but weaker and less consistent among men<sup>(20–23)</sup>.

In low-income countries, obesity is more common among middle-aged women, people of higher socio-economic status and people living in urban communities<sup>(19,24,25)</sup>. Molarius *et al.*<sup>(22)</sup> found that low education was associated with a higher BMI (BMI was calculated as kg/m<sup>2</sup>) in about half of the male and in almost all of the female populations of the WHO MONICA Project.

Although the association of obesity with smoking has been analysed in many studies, the findings are not consistent<sup>(26–31)</sup>.

A study that had a sample size sufficient to explore factors associated with obesity among Iranian men has not been carried out in Iran. The primary aim of the present study was to examine the relationship between sociodemographic factors, smoking and obesity among men by using cross-sectional data from the National

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Health Survey in Iran (NHSD). A secondary aim was to compare these associations between men and women.

## Experimental methods

### Data set examined

The NHSD is a survey designed to gain comprehensive knowledge and information about health-care problems and difficulties in Iran during 1999–2000. All citizens living in Iran were considered as the survey population. Preliminary studies and preparation of the questionnaire took 4 months, but finally, in August 1990, this project was started in all provinces with the help of medical universities, the Undersecretary for Primary Health and the Blood Transfusion Centre. The pilot study was carried out in Semnan province, and later other provinces were also studied. For certain information, the subject sample was the family and for other it was the person (age 2–69 years). Household was defined as those living in the same residence, participating in the household's expenses and usually eating together. Any individual living single was also considered a household. Sampling was conducted on the basis of the cluster method, and each cluster consists of eight households. The choice of eight households for the cluster size was based on the 1 d performance capacity of the data collection group: four professional persons (two physicians, one interviewer and one lab technician). The statistical framework was based on the household lists available in every Health Department in the provinces, usually updated annually. The ratio of the sample size to the total population was taken as 1:1000 (according to the latest census figures). Where household lists were available, selection of the cluster was made systematically. In the present study, 11 697 men and 14 854 women (12 850 households) aged 20–69 years were examined. We excluded pregnant women from the analyses. The study is approved by the Ethics Committee of the Tehran University of Medical Sciences.

### Measurements

Data derived from the medical history, physical examination and laboratory findings were recorded. Laboratory studies were carried out for 84.6% of the total population studied. Paraclinical tests were performed in the laboratories of each province. They included haemoglobin and haematocrit levels, mean cell volume, hepatitis B surface antigen and stool examination. Six different questionnaires were completed. Questionnaire 1 contained general information about cluster; questionnaire 2 contained information about the standard of hygiene in the household; questionnaire 3 contained information about foodstuffs ingested by the family within the last 48 h; questionnaire 4 contained questions about hygienic conditions, medical history, general physical state and psychological health; questionnaire 5 contained information about clinical findings detected by the

examining physicians; and questionnaire 6 contained information about the results of blood and stool examinations.

Height was measured without shoes to the nearest 5 mm. Weight was measured to the nearest 0.1 kg with the subject in light indoor clothes, with emptied pockets and without shoes. Weight and height were, respectively, measured using calibrated precision scales and portable wall-mounted stadiometers, following standardised procedures. BMI, used as a measure for relative weight, was calculated as  $\text{kg/m}^2$ , and subjects were classified into obese ( $\text{BMI} \geq 30 \text{ kg/m}^2$ ) and non-obese ( $\text{BMI} < 30 \text{ kg/m}^2$ ).

### Independent variables

Information about the respondents' age was based on their self-reported birth year, and subjects were stratified into five 10-year age groups (20–29, 30–39, 40–49, 50–59 and 60–69 years).

Education was defined as the total number of years of education. The respondents were categorised into three groups: those with low (0–8 years), moderate (9–12 years) or high (more than 12 years) education. The three categories used two dummy variables.

Economic index was defined as square metre of living place divided by number of people in household.

The original questionnaire item included twelve response categories. For this analysis, housewife, student, retired and unemployed were grouped into one category named 'non-active workforce' *v.* 'active workforce' (others). The subjects were grouped according to their place of residence as living in cities (urban) or villages (rural). Smoking status was dichotomised into smoker *v.* non-smoker. To make the marital status variable, it was dichotomised into legally married and non-married groups.

### Statistical analysis

The generalised estimating equation (GEE) approach was used to carry out logistic regression for correlated dichotomous responses. As subjects' responses are correlated within the same household, the GEE model with a logit link and exchangeable correlation structure were used to model the relationship between the odds of obesity and age, education, economic index, workforce, smoking, marital status and place of residence. An interaction was found between sex and educational level, and hence the results were presented separately for men and women. All two-way interaction terms were dropped from the models, because they were not statistically significant. The results are presented as OR and their 95% CI. All analyses were carried out using the SAS statistical software package version 9.1 (SAS Institute, Cary, NC, USA).

### Results

The mean BMI of men was  $23.91 \text{ kg/m}^2$  (95% CI 23.84, 23.98). The women had a mean BMI of  $25.3 \text{ kg/m}^2$  (95%

**Table 1** Mean BMI by sex and age group in a random sample of 26 551 men and women in Iran, 1999–2000

Age group (years)	Men			Women			P value
	n	Mean BMI (kg/m <sup>2</sup> )	SD	n	Mean BMI (kg/m <sup>2</sup> )	SD	
20–29	3689	22.64	3.43	5346	23.50	4.50	<0.001
30–39	3283	24.27	3.73	3999	25.94	4.92	<0.001
40–49	2266	24.96	3.96	2696	26.78	5.07	<0.001
50–59	1241	24.63	3.88	1497	26.91	4.91	<0.001
60–69	1218	24.09	3.96	1316	25.83	4.91	<0.001
All	11 697	23.91	3.83	14 854	25.30	4.96	<0.001

**Table 2** Prevalence of obesity\* according to sex, socio-demographic characteristics and smoking in a random sample of 26 551 men and women in Iran, 1999–2000

Variable	Men		Women		P value
	n	%	n	%	
Age group (years)					
20–29	118	3.2	479	9.0	<0.001
30–39	222	6.8	788	19.1	<0.001
40–49	228	10.1	683	25.3	<0.001
50–59	114	9.2	382	25.5	<0.001
60–69	104	8.5	237	18.0	<0.001
Education level					
Low	480	6.8	2056	18.7	<0.001
Moderate	234	6.9	449	14.8	<0.001
High	72	5.7	64	7.9	0.028
P value	0.26		<0.001		
Place of residence					
Urban	619	8.0	1968	20.5	<0.001
Rural	167	4.2	601	11.5	<0.001
P value	<0.001		<0.001		
Workforce					
Inactive	750	7.1	2407	17.8	<0.001
Active	36	3.0	162	11.9	<0.001
P value	<0.001		<0.001		
Smoking status					
Non-smoker	605	7.4	2526	17.3	<0.001
Smoker	181	5.2	43	15.4	<0.001
P value	<0.001		0.38		
Marital status					
Non-married	146	6.2	437	15.7	<0.001
Married	640	6.9	2132	17.7	<0.001
P value	0.26		0.02		

\*Obesity, BMI ≥ 30 kg/m<sup>2</sup>.

CI 24.5, 26.1). Table 1 shows that the mean BMI of women was higher than that of men in all age groups. As the P values indicate, these differences were clearly statistically significant.

Table 2 illustrates that obesity was less prevalent among the highly educated women. The prevalence of obesity was higher among men who were non-smokers, inactive in the workforce and who resided in cities. The prevalence of obesity was higher among women who were married, inactive in the workforce and who resided in cities.

We used a GEE model, which includes age, education level, economic index, workforce level, smoking status,

**Table 3** Adjusted\* obesity† OR, among 26 551 Iranian adults in the GEE analysis, 1999–2000

Variable	Men		Women	
	OR	95% CI	OR	95% CI
Age group (years)				
20–29	1.00		1.00	
30–39	2.05	1.63, 2.59	2.30	2.03, 2.60
40–49	3.17	2.51, 4.01	3.09	2.71, 3.52
50–59	2.80	2.14, 3.67	3.01	2.57, 3.53
60–69	2.73	2.06, 3.62	1.79	1.49, 2.16
Education level				
Low	1.00		1.00	
Moderate	1.06	0.89, 1.26	0.77	0.68, 0.88
High	0.75	0.57, 0.99	0.43	0.33, 0.57
Workforce				
Inactive	1.00		1.00	
Active	0.57	0.40, 0.81	0.79	0.69, 0.96
Smoking status				
Non-smoker	1.00		1.00	
Smoker	0.62	0.52, 0.74	0.70	0.50, 0.97
Marital status				
Non-married	1.00		1.00	
Married	1.09	0.90, 1.32	1.16	1.03, 1.31
Place of residence				
Rural	1.00		1.00	
Urban	1.87	1.56, 2.26	2.06	1.85, 2.29
Economy index	1.003	1.00, 1.007	1.004	1.002, 1.006

GEE, generalised estimating equations.

\*Adjusted for all other variables.

†Obesity, BMI ≥ 30 kg/m<sup>2</sup>.

marital status, place of residence and sex. After adjustment for other variables, the adjusted OR and 95% CI were calculated (Table 3). All results are presented separately for men and women.

Among men, using 20–29 years as the reference group, the adjusted obesity OR for age groups 30–39, 40–49, 50–59 and 60–69 years were 2.05 (95% CI 1.63, 2.59), 3.17 (95% CI 2.51, 4.01), 2.80 (95% CI 2.14, 3.67) and 2.73 (95% CI 2.06, 3.62), respectively. Among women, the adjusted obesity OR for age groups 30–39, 40–49, 50–59 and 60–69 years were 2.30 (95% CI 2.03, 2.60), 3.09 (95% CI 2.71, 3.52), 3.01 (95% CI 2.57, 3.53) and 1.80 (95% CI 1.49, 2.16), respectively.

An association was observed between economic index and obesity. Adjusted obesity OR were 1.003 (95% CI 1.00, 1.007) and 1.004 (95% CI 1.002, 1.006) for men and

women, respectively. In addition, for 1 m<sup>2</sup> increase in economic index, the OR of obesity was increased by 0.3% among men and 0.4% among women.

Married women were more obese. The adjusted obesity OR was 1.16 (95% CI 1.03, 1.31). Among men, this association was not significant (OR<sub>a</sub> = 1.09 (95% CI 0.90, 1.32)).

We observed an association between place of residence and obesity. The adjusted obesity OR were 1.88 (95% CI 1.56, 2.26) and 2.06 (95% CI 1.85, 2.29) for urban men and women, respectively.

We found a statistically significant inverse association between educational level and obesity among women. Using low level as the reference group, the adjusted OR for moderate level for men and women were 1.06 (95% CI 0.89, 1.26) and 0.77 (95% CI 0.68, 0.88), respectively. The adjusted OR for high level for men and women were (OR<sub>a</sub> = 0.75 (95% CI 0.57, 0.99)) and (OR<sub>a</sub> = 0.43 (95% CI 0.33, 0.57)), respectively.

An inverse association was observed between workforce level and obesity among both sexes. For active participants, the adjusted OR were 0.57 (95% CI 0.40, 0.81) and 0.79 (95% CI 0.66, 0.96) for men and women, respectively.

In general, smokers were less obese than non-smokers. The adjusted OR was 0.62 (95% CI 0.52, 0.74) and 0.70 (95% CI 0.50, 0.97) for men and women, respectively.

## Discussion

Concern about the increased prevalence of obesity has heightened interest in the association between socio-demographic factors and smoking with obesity among Iranian households. In the present cross-sectional study, we found obesity OR by identifying a variety of socio-demographic factors and smoking that are associated with obesity. In all age groups, women had greater prevalence of obesity than men, especially in the 30–40-year age group. An association was observed between age and obesity. Similar patterns were observed in other studies from Iran<sup>(32–37)</sup> and other countries<sup>(4,16)</sup>.

Our findings indicate that obesity is inversely associated with high education level in both sexes, but with moderate education level only in women.

In some studies, there was a significant negative association between education and obesity in both sexes<sup>(33,38)</sup>, but some other studies showed a negative association of education with obesity in women, whereas in men there was no association or even a positive association between education and obesity<sup>(39–44)</sup>. The negative association between education and obesity has also been shown in other studies from Iran<sup>(35,38,45)</sup>. Our findings on consistent educational variation of obesity in men and women are similar to those of other studies<sup>(17,20)</sup>. Iranian adults with high education may be more concerned about obesity and have higher awareness

regarding the consequences of obesity. The difference of obesity among highly educated men and women may have a significant public health impact and further work is needed to understand this difference.

In our study, in contrast with some earlier studies<sup>(31)</sup>, the prevalence of obesity was found to be lower among smokers than among non-smokers in both sexes. The inverse association seen between smoking and obesity should not be used to counteract the efforts undertaken against this habit. Biological mechanisms as well as psychological factors may be involved. An increase of energy expenditure while smoking, both in resting and in light physical activity conditions, may relate to lower prevalence of obesity in smokers. Our results are consistent with the findings of most other studies<sup>(26–30)</sup>.

Men and women who are inactive in the workforce had a higher prevalence of obesity than men and women who are active in the workforce. Obesity may be more acceptable among unemployed persons. It is also possible that there is more discrimination against the obese, or obese people may end up in lower status jobs through stronger selective processes in Iran. Another explanation for the effect of the workforce may involve energy expenditure at work or the structured lifestyle that active people impose.

Most of the studies showed that marriage is associated with obesity<sup>(46,47)</sup>. Iranian non-married women were less likely to be obese than their married counterparts. It is possible that the presence of a spouse may operate as a social factor on obesity. Women may have little time to spend on health behaviours. For example, they do not go to gyms and exercise centres<sup>(32)</sup>. It may also include physiological mechanisms in the women, especially after their pregnancy.

We found a statistically significant association between economic index and obesity in both sexes. An inverse relationship between BMI and socio-economic status exists in affluent societies, especially in women<sup>(18)</sup>. It is not a straightforward matter to compare those results with ours, because of the different study designs, time spans, regions, and methods of analysis. Our results are consistent with some studies in developing countries<sup>(48)</sup>. Note that we have no information on household income, but economic index is surrogate for household income. Iranian taxation laws are highly complex and inconsistently applied. There are virtually millions of people who do not pay taxes in Iran and hence operate outside the formal economy. Informal economy is an economic activity that is neither taxed nor monitored by a government; as opposed to a formal economy. Due to ethical considerations, we did not ask respondents about their income, because they were afraid of paying their taxes.

In developing countries, because of the transition of the population from rural to urban areas and owing to changing lifestyles, there is a trend for an increasing obesity rate. For example, over a period of less than 5 years, there was a significant increasing trend of obesity

and overweight in the adult population of the Tehran Lipid Study<sup>(34)</sup>.

There are some advantages in our study. It was carried out in a nationally representative sample of Iranian men and women. To our knowledge, ours is the first study that had a sample size sufficient to study demographic and health behaviour factors and obesity in adult men and women in Iran. Height and weight were actually measured rather than self-reported. We used the same scales. The scales were calibrated on a daily basis. Self-reporting conditions might underestimate the prevalence of obesity. Obese persons are more likely to under-report their weights and over-report their heights than are non-obese persons and men are more likely to over-report their heights than are women, with both of these reporting patterns resulting in misclassification and leading to decreased calculated BMI<sup>(49,50)</sup>.

We used a large sample with high response rates. In Iran, the Ministry of Health and Medical Education is responsible for overall management of the public health system, and regulates the provision of private health services as well as NGOs. All Iranians are eligible for community-based preventive, public health, and limited curative health services financed and provided through the country's primary health care network. The network effectively reaches about 90% of the population and is particularly extensive in rural areas. Iran has 15 400 health houses, 25 000 behvarzes, 2200 rural health centres, 300 health posts and 1900 urban health centres. The behvarz is someone who works at health house. They know all households in rural areas.

Some households in the higher socio-economic classes in large cities such as Tehran did not participate in the present survey. If, at two different times, we realised that there was no one at home who could possibly be interviewed, another house in the neighbourhood was selected as the new sample unit. This bias was negligible.

Our findings are subject to several limitations. First, NHSI data are cross-sectional, so we were unable to draw conclusions regarding the causal association between socio-demographic factors, smoking and obesity. Second, income and physical activity were not used in our investigation although self-reporting income is subject to non-response and reporting bias. Third, marital status could be categorised into legally married and non-married only. Fourth, no validation of the smoking data could be achieved. However, there is evidence that a reporting bias according to smoking is negligible in population surveys<sup>(51)</sup>.

## Conclusions

In summary, earlier research has shown the associations between sociodemographic factors, smoking and obesity among Iranian women. These results suggest similar associations among Iranian men. Increased age, low

educational level, high economic index, being a non-smoker and living in an urban environment, as well as inactivity in the workforce, were clearly associated with obesity among men. Our findings may point towards a better understanding of the social and cultural mechanisms of obesity in households. These sociodemographic factors are large contributors to obesity and provide the greatest opportunity for actions and interventions designed for prevention and treatment. A fundamental policy shift is required to widen responsibility for the prevention of obesity in Iran.

## Acknowledgements

*Funding support:* The present study was financed by a grant from the Tehran University of Medical Science and Health Services. The authors acknowledge the National Health Survey for their data, coordinated at the Department of Biostatistics, School of Public Health and Institute of Public Health Research, Tehran University of Medical Science, Iran.

*Conflict of interest:* The authors have no conflict of interest.

*Authors' contributions:* E.B., K.M. and M.R.E. originated the idea for the present study, did the research proposal, data analysis and prepared the manuscript. Being the medical consultant, B.S. helped and edited the final version. All authors read and approved the final manuscript.

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