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Socio-Economic Status and Prevalence of Self-Reported Osteoporosis in Tehran: Results from a Large Population-Based Cross-Sectional Study (Urban HEART-2)

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Abstract Osteoporosis is a widespread disease among older peoples. The aim of this study is to estimate the prevalence of self-reported osteoporosis and assessing its association with socio-economic status. A population-based cross-sectional study was conducted in Tehran, Iran in 2011. Participants were 45,990 individuals aged above 20 years from 22 urban districts. Osteoporosis was measured by self-administrative questionnaire. Wealth index was constructed using principal component analysis based on household assets. Chi-square test, chi square test for trend, and crude odds ratio were used to assess associations in univariate analysis. Multiple logistic regression utilized to estimate adjusted associations between self-reported osteoporosis and socio-economic status.

The overall estimated prevalence of self-reported osteoporosis was 4% (95% CI 3.88–4.13), 1.19% in men, and 6.84% in women ($P < 0.001$). The prevalence increased considerably as age increased (P for trend < 0.001). In multivariable analysis, education and wealth status were negative, and smoking was positively associated with the prevalence of self-reported osteoporosis. No association was found between participants' skill levels and Townsend deprivation index with the prevalence of self-reported osteoporosis.

The findings of the present study have improved understanding of the association between socioeconomic status and osteoporosis in the Iranian population. It is important to consider socioeconomic status in screening and prevention programs.

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Introduction

Osteoporosis is one of the globally hidden health disorders that more frequently affects older adults. It is estimated 200 million women suffer from this problem worldwide [1]. Osteoporosis causes about 9 million fractures annually, whereupon an osteoporotic fracture every 3 s in the world [2]. It is predicted that the worldwide incidence of hip fracture in men increases by 310 and 240% in women by 2050 [3]. In addition, more than about 50% of all osteoporotic hip fractures will occur in Asia by the year 2050 [3]. In 2010, there were 50,000 osteoporotic fractures in Iran, and it is expected to increase to 62,000 fractures, by 2020 [4]. This serious health problem may have major burden on family, society, and health systems. A reason for this is that 0.83% of the global burden of non-communicable disease related to osteoporotic fractures [2]. Also, some evidences showed excess mortality up to 5 years following osteoporotic fractures in both sexes [5]. It is estimated that there were $20 billion and $30 billion annual cost of all osteoporotic fractures in the USA and in the European Union, respectively [5].

The impact of social inequality and socioeconomic status (SES) on all aspect of health is well established [6]. Little information exist about role of demographic factors including SES in developing osteoporosis [7]. Several studies have showed the role of social inequality in the osteoporosis and its outcome, osteoporotic fractures [7–10]. The other studies have indicated low income, low educational level, and being unmarried as risk factors for osteoporosis and osteoporotic fractures [11, 12]. One systematic review reveals that despite of several limited good quality researches that indicate the association between SES and the risk of osteoporosis, there is need for further research [7].

Certainly, to reduce osteoporosis frequency and incidence of osteoporotic fractures, knowing about magnitude of problem and identification at-risk peoples is necessary [6]. The purpose of this study was to estimate the prevalence of self-reported osteoporosis and determine the association between SES and self-reported osteoporosis. The results can lead health policy makers and decision makers to better planning and conducting preventive and screening programs.

Methods

The studied sample was drawn from second round of Urban HEART project. Urban HEART project was a large population-based cross-sectional study conducted in Tehran, Iran, in fall 2011. The participants were interviewed at their house. Al the interviewers were trained in a 2-day workshop prior to collecting data.

Sampling Method

A multistage cluster sampling was applied in the study design. Twenty-two districts were considered as stratum in the first stage. Then 200 clusters in each district and eight households in each cluster were selected using systematic random sampling method. Household persons were utilized as the primary sampling unit. All eligible members of the selected households were recruited for interview. Inclusion criteria included people aged 20 years and older, willing to participate in the study, and staying at least 1 year in the area of interest. People with complete disability or sever impairment in answering questions or with apparent psychological illness were excluded from the study. To estimate required sample size, each district was considered independently. Based on Cochrane formula, for each district, 1535 households were calculated. Two hundred blocks were selected in each district, equally. In each block, eight households were selected systematically. To collect samples at neighborhood level, method of the probability proportional to size of each district was used. The total sample size was 34,116 households covering 118,542 individuals from 22 districts and 368 neighborhoods. After excluding participants aged less than 20 years, the analysis was performed on data of the remaining 45,990 individuals, who were above 20 years. The overall response rate of this study was 72.8% which can be satisfactory.

Measures

SES Checklist

To calculate wealth index, as an individual-level of SES, the principal component analysis (PCA) was performed on household assets [13]. Fourteen assets including: owning a fridge, a personal computer, a telephone, a mobile phone, a washing machine, a microwave oven, a car, a motorcycle, a kitchen, a bathroom, a toilet, house

ownership, number of rooms per capita (less than one vs. one and more), and area of the house (below the median vs. above the median) were considered. All of these 14 assets are originally binary or converted to binary variables via classification of a numerical variable. Finally, to estimate each household wealth status, based on the first principal component, the scores converted to five-ordered categories from poorest to richest. In addition, we used the Townsend deprivation index, as an area-level indicator of SES, and educational level and skill level as individual socio-economic indicators [14, 15].

Self-Report Osteoporosis

Whereas gold standard for measuring osteoporosis is bone mineral density (BMD), measuring BMD is not practical for many large-scale studies. In the present study, we used the self-reporting method to classify participants on osteoporosis status. Although, some studies showed poor agreement between self-reported osteoporosis and bone mineral density [16, 17], but Peeters et al. showed acceptable validity and reliability of self-reporting method for osteoporosis diagnosis so that both concurrent and construct validity was acceptable for self-reported prevalent osteoporosis. Sensitivity and specificity were at least 68.8 and 88.6%, respectively, for different age and sex groups for self-reported prevalent osteoporosis [18].

Statistical Analysis

Descriptive statistical analysis were used to describe the data. Principle component analysis was used to combine asset variables and construct the wealth index. Body mass index (BMI) was calculated using the formula weight (kg)/height (cm^2). Chi-square test, chi square test for trend, and crude odds ratio were used to assess associations in univariate analysis. In multivariate analysis, adjusted odds ratios from unconditional logistic regression model were used as the measures of association between the study variables. Hosmer-Lemeshow test conducted to goodness of fit of model. All reported *P* values are based on two-sided tests and compared to a significance level of 0.05. STSTA version 12.0 was used for all the statistical calculations.

Results

Table 1 shows the characteristics of study participants; among 69,173 participants, 49% ($n = 33{,}884$) were female and the rest were male. The mean age ± SD of the participants was 41.5 ± 11.37 years. The overall weighted prevalence of self-reported osteoporosis in participants was 4% (95% CI 3.88–4.13). Among the females, lowest (0.34%) and highest (26.62%) weighted prevalence was observed in age group of 20–29 and 70–79 years, respectively. For males, the age group of 20–29 years has the lowest weighted prevalence (0.12%), and the age group of higher than of 80 years has the highest weighted prevalence (7.4%) (Table 1).

Bivariate analysis showed that the prevalence of self-reported osteoporosis is different in level of age group, educational level, marital status, body mass index (BMI), wealth status, job, and Townsend index

Table 1 Prevalence rates of osteoporosis by sex and age groups

Age group	Male			Female			*P* value
	n	Case	Prevalence (%) (95% CI)	*n*	Case	Prevalence (%) (95% CI)	
20–29	13,016	16	0.12 (0.07–0.19)	12,473	42	0.34 (0.23–0.51)	0.001
30–39	9221	16	0.17 (0.11–0.24)	10,057	112	1.11 (0.92–1.43)	< 0.001
40–49	8256	47	0.57 (0.38–0.79)	8909	409	4.59 (4.24–5.36)	< 0.001
50–59	7234	114	1.58 (1.31–1.92)	7580	979	12.92 (12.21–13.72)	< 0.001
60–69	4655	143	3.07 (2.69–3.67)	4191	913	21.79 (20.49–23.13)	< 0.001
70–79	2716	141	5.19 (4.32–6.24)	1950	519	26.62 (24.72–28.62)	< 0.001
+ 80	892	66	7.40 (5.21–9.93)	663	160	24.13 (20.87–27.59)	< 0.001
Total	45,990	543	1.19 (1.10–1.30)	45,824	3134	6.84 (6.61–7.07)	< 0.001

($P < 0.001$). In addition, the overall weighted prevalence of self-reported osteoporosis was higher among females than males, significantly ($P < 0.001$). The result of trend analyses clearly indicates significantly an upward pattern for age group, BMI, Townsend index ($P < 0.001$), while this pattern was downward for educational level and wealth status ($P < 0.001$). The prevalence of self-reported osteoporosis was significantly higher among older than younger people. Osteoporosis prevalence increased with increasing of BMI category ($P < 0.001$), see Table 2 for more details. As shown in Figs. 1and 2, educational level and wealth status had a negative association with self-reported osteoporosis.

Table 2 Prevalence of osteoporosis by demographic and socio-economic characteristics of study participants

Variable		Total	Cases	Prevalence % (CI 95%)	*P* value	*P* value for trend
Age group	20–29	25,489	58	0.23 (0.18–0.28)	< 0.001	< 0.001
	30–39	19,278	128	0.66 (0.57–0.75)		
	40–49	17,165	458	2.67 (2.38–2.86)		
	50–59	14,814	893	6.03 (5.73–6.42)		
	60–69	8846	660	7.46 (6.94–8.02)		
	70–79	6221	920	14.79 (13.92–15.70)		
	+ 80	1555	226	14.53 (12.82–16.39)		
Sex	Male	45,990	543	1.18 (1.08–1.28)	< 0.001	
	Female	45,824	3134	6.84 (6.61–7.07)		
Marital status	Married	59,659	2654	4.45 (4.28–4.62)	< 0.001	
	Single	24,599	93	0.38 (0.32–0.44)		
	Widow or Divorced	5917	915	15.46 (14. 61–16.42)		
Educational level	Illiterate	6684	890	13.32 (12.49–13.97)	< 0.001	< 0.001
	Primary school	8171	756	9.25 (8.62–9.93)		
	Middle school	10,867	609	5.60 (5.18–6.05)		
	High school	37,633	1037	2.76 (2.59–2.93)		
	University	27,914	356	1.28 (1.12–1.43)		
BMI	Under Weight	3130	73	2.33 (1.78–2.86)	< 0.001	< 0.001
	Normal	40,733	1144	2.81 (2.65–2.97)		
	Over Weight	31,609	1427	4.52 (4.29–4.75)		
	Obese	12,191	920	7.55 (7.24–7.98)		
Current smoking	No Smoker	84,603	3491	4.13 (3.99–4.26)	< 0.001	
	Smoker	7227	187	2.59 (2.20–3.02)		
Wealth status	Poorest	17,550	1189	6.39 (6.38–7.18)	< 0.001	< 0.001
	Poor	16,543	719	4.35 (4.03–4.72)		
	Moderate	17,187	622	3.62 (3.31–3.93)		
	Rich	17,599	520	2.96 (2.71–3.22)		
	Richest	16,772	422	2.52 (2.29–2.83)		
Job	Skill Level I	2662	49	1.84 (1.38–2.42)	< 0.001	0.006
	Skill Level II	12,170	155	1.27 (1.08–1. 53)		
	Skill Level III	2591	36	1.39 (1.03–1.87)		
	Skill Level IV	3724	86	2.31 (1.93–2.84)		
Townsend index	Most Affluent	17,097	617	3.61 (3.32–3.91)	< 0.001	< 0.001
	Affluent	12,040	442	3.67 (3.28–4.03)		
	moderate	17,325	655	3.78 (3.51–4.12)		
	Deprived	20,734	875	4.22 (4.02–4.53)		
	Most Deprived	20,006	923	4.61 (4.28–4.89)		

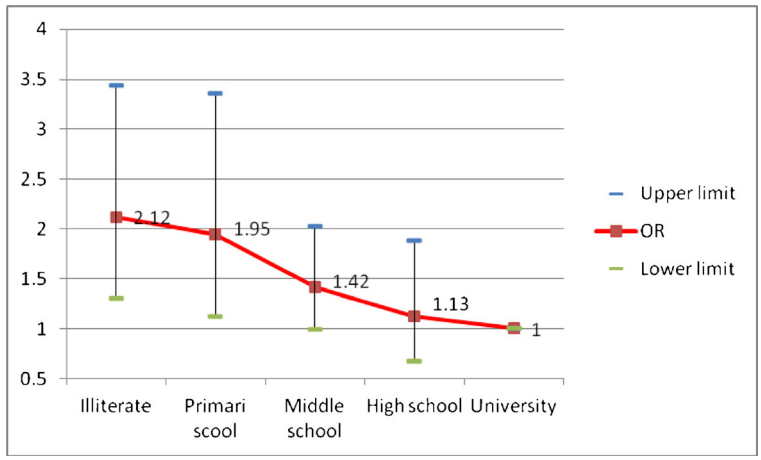

Fig. 1 Adjusted odds ratios (95% CI) of osteoporosis according to levels of education

Multivariable Analysis

As shown in Table 3, multiple logistic regression revealed that report of osteoporosis had significant association with the age group, sex, educational level, current smoking, and wealth status. Hosmer-Lemeshow test showed that goodness of fit of model was good (Chi-square = 8.55, df = 8, $P = 0.382$). There were significant age group trends for odds ratio of self-reported osteoporosis ($P < 0.001$). The odds of report osteoporosis in the age group of 30–39 was 43% higher than the age group of 20–29 as a reference group ($P < 0.001$). The adjusted odds of self-reported osteoporosis in female was nearly 5.5 times males ($P < 0.001$). Although the marital status variable had no statistically significant association with the self-reported osteoporosis, but the odds of report osteoporosis in widow or divorced participant was nearly two times of single participants [OR = 1.96 (95% CI; 1.03 to 3.74)]. Level of education was the other variable that had statistically significant trends in odds ratio of self-reported osteoporosis ($P < 0.001$). This means that as the level of education increased, the odds of self-reported osteoporosis decreased. The odds ratio for report of osteoporosis in illiterate participant was 2.12 times higher than those with university degrees.

After adjustment for all variables in the model, current smokers had significantly higher odds of self-reported osteoporosis compare with non-smoker [OR = 1.54 (95% CI; 1.07 to 2.22)].

Self-reported osteoporosis was significantly associated with lower wealth status adjusted for other variables in model. Participants in the poorest category of wealth had odds of self-reported osteoporosis 6.39 times that of those in the richest category (95% CI = 6.38 to 7.18).

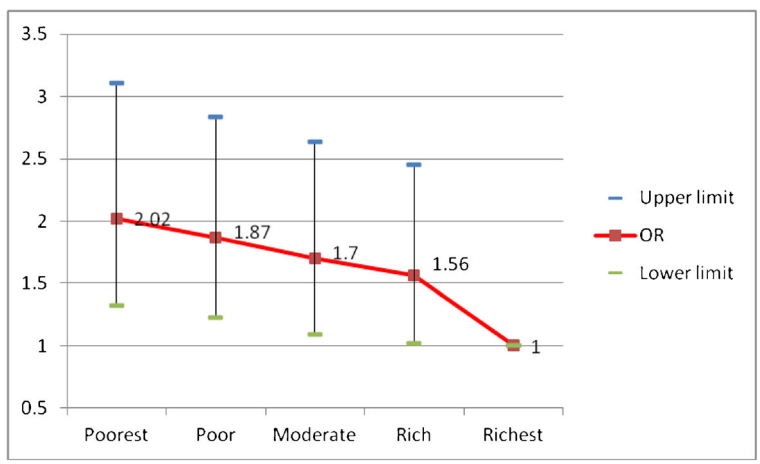

Fig. 2 Adjusted odds ratios (95% CI) of osteoporosis according to wealth status

Table 3 Crude and adjusted odds ratios using logistic regression model

Variable		Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)	*P* value
Age group	20–29	1	1	< 0.001
	30–39	2.96 (2.17–4.03)	1.43 (0.56–3.68)	
	40–49	11.97 (9.10–15.74)	4.28 (1.79–10.24)	
	50–59	34.94 (26.81–45.53)	13.65 (5.86–31.81)	
	60–69	59.44 (45.58–77.52)	28.77 (12.21–67.78)	
	70–79	74.20 (55.21–99.72)	32.82 (20.56–80.69)	
	+ 80	72.26 (55.14–94.71)	55.54 (13.92–150.02)	
Sex	Male	1	1	<0.001
	Female	6.14 (5.60–6.74)	5.19 (4.99–5.40)	
Marital status	Single	1	1	0.098
	Married	12.27 (9.97–15.09)	1.62 (0.79–3.34)	
	Widow or divorced	48.20 (38.86–59.79)	1.96 (1.03–3.74)	
Educational level	Illiterate	10.50 (9.26–11.90)	2.12 (1.31–3.44)	0.014
	Primary school	4.78(4.21–5.43)	1.95 (1.13–3.36)	
	Middle school	3.33 (2.92–3.80)	1.42 (0.99–2.03)	
	High school	1.98 (1.68–2.13)	1.13 (0.67–1.89)	
	University	1	1	
BMI	Under weight	0.27 (0.22–0.34)	1.90 (0.92–3.82)	0.153
	Normal	1	1	
	Over weight	1.90 (1.75–2.05)	1.30 (0.81–1.86)	
	Obese	3.11 (2.85–3.40)	0.99 (0.75–1.30)	
Current smoking	No smoker	1	1	0.021
	Smoker	0.62 (0.53–0.72)	1.54 (1.07–2.22)	
Wealth status	Poorest	2.82 (2.51–3.15)	2.02 (1.32–3.11)	0.008
	Poor	1.76 (1.56–1.99)	1.87 (1.23–2.84)	
	Moderate	1.46 (1.28–1.65)	1.70 (1.09–2.64)	
	Rich	1.18 (1.04–1.34)	1.56 (1.02–2.45)	
	Richest	1	1	
Job	Skill level I	0.69 (0.50–0.95)	0.92 (0.64–1.31)	0.482
	Skill level II	0.49 (0.21–0.75)	0.86 (0.53–1.39)	
	Skill level III	1.28 (0.90–1.82)	1.21 (0.76–1.94)	
	Skill level IV	1	1	
Townsend index	Most affluent	1	1	0.233
	Affluent	1.02 (0.90–1.15)	1.01 (0.68–1.51)	
	Moderate	1.05 (1.05–1.17)	0.87 (0.56–1.36)	
	Deprived	1.18 (1.06–1.31)	1.03 (0.72–1.47)	
	Most deprived	1.29 (1.16–1.43)	0.65 (0.42–1.01)	

Discussion

The two focuses of the present study were to obtain the prevalence estimate using a self-report measure and specify the adjusted association between SES and self-reported osteoporosis. The results from this study showed a relatively low prevalence of osteoporosis among general population. We estimated that prevalence of self-reported osteoporosis among the participants of this study was 4%. One study demonstrates that the overall prevalence of self-reported osteoporosis in the Australian population was 3.2% [19]. Another study shows that the prevalence of self-reported osteoporosis among

54,369 Brazilian people was 4.4% that is similar to our result [20]. In addition, Gill et al. reported the prevalence of self-reported osteoporosis among Australian aged 15 years and over, between 1995 and 2010, was 4.8% (95% CI 4.6–5.0). Our finding was consistent with these studies. However, the prevalence of self-reported osteoporosis was not similar in the other studies [16, 21, 22] .

The results indicated a reverse relationship between wealth status and the self-reported osteoporosis. Participants in lower wealth quintiles were significantly more likely to report osteoporosis compared to those within the highest wealth quintiles. To the best of our knowledge, there is no published report of the association between wealth status and the self-reported osteoporosis. Although, several studies show that the association between socioeconomic status and osteoporotic fracture, but Brennan et al. reported that there is conflicting evidence for the association between osteoporotic fracture and level of income and education [7, 9, 10, 23].

This population-based study revealed strong associations between several variable and self-reported osteoporosis. Based on trend analysis, as we expected, the prevalence of self-reported osteoporosis increased in higher age-group categories. This increasing trend was observed for job, BMI, and Townsend index. In addition, self-reported osteoporosis decreases as educational level increases from illiterate to group with a university degree.

In the present study, BMI did not show association with self-reported osteoporosis, while Asomaning et al. show that odds ratios for low, high, and obese compared with moderate BMI women were 1.8 (95% CI 1.2–2.7), 0.46 (95% CI 0.29–0.71), and 0.22 (95% CI 0.14–0.36), respectively [24].

Current smoking is the other variable that was significantly associated with reporting of osteoporosis. Although, crude OR for current smoking and self-reported osteoporosis was protective, the adjusted OR shows that current smoking increases odds of self-reported osteoporosis by 54% compare to no smoking. Kanis et al. report current smoking increased risk of osteoporotic fracture compared to non-smokers [25]. The other study shows that current smoking was associated with bone loss, and cigarette smoking is one of the important components of bone health [26].

A major strength of our study is the large sample size in relation to previous studies conducted in Tehran, Iran. This leads to provide more precise estimates as it can obviously be seen in the narrow confidence intervals for the estimated rates. Moreover, a high level of response rate was another major strength of this study. Our study had several limitations: first, the founded associations are not proof of causality because the study design was a cross-sectional survey and reverse causality bias could be occurred. Second, it was logistically difficult to use laboratory tests in this survey; hence, all measurements in this study were self-reported, so we could not present new and undiagnosed cases of osteoporosis in the study population. This can lead to both underestimating true osteoporosis prevalence and producing non-differential misclassification that can bias estimated associations toward the null although, self-reported measurements were frequently used in other chronic diseases [27, 28].

In summary, self- reported prevalence of osteoporosis among general population was relatively low. The finding of this study revealed that socioeconomic status is one of the strongest predictors for self-reported osteoporosis. Our results highlight the need to consider socioeconomic status in screening and prevention programs. The traditional public awareness programs about healthy-eating and physical activity can increase bone health in population. Future research is necessary for osteoporosis prevention and risk reduction.

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