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Original article

Association of socioeconomic status and hypertension based on habitual smoking among Iranian population: IHHP study

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Summary. *Background:* Along with tripartiteclose relationship of socioeconomic level, smoking, and prevalence of hypertension, the present study aimed to assess the relationship between socioeconomic status (SES) and hypertension based on habitual smoking in Iranian population. *Methods:* The present study analyzed the individuals subsample consisted of 9623 subjects, out of all people resident in Isfahan province in Iran of the wave of the Isfahan Heart Health Project (IHHP) in three cities in Iran: Isfahan, Najafabad and Arak. Systolic and diastolic blood pressures were measured in supine position using an automated blood pressure monitor. Smokers were defined as persons who were smoked prior to the survey and never smokers were defined as a person who had never smoked. *Results:* Those individuals who experienced cigarette smoking, SES class was significantly lower in hypertensive patients compared with normotensive subject so 7.8% of hypertensive patients and 92.2% of normotensive ones classified in SES class IV ($p<0.001$). Univariate analysis showed hypertension was related to lower SES class when compared with normotension status in both smoker and nonsmoker groups ($p<0.001$). In stepwise logistic regression models adjusting sex, age, global dietary index and leisure time physical activity, hypertension could be predicted by lower SES in nonsmoker group, while this predictive role for SES could not be reveal in smoker group. *Conclusion:* The significant SES-smoking association may determinate in the increasing blood pressure even adjusted for other covariates such as demographics as well as dietary behaviors and leisure time physical activity. (www.actabiomedica.it)

Key words: socioeconomic status, blood pressure, smoking, prediction

Introduction

Socioeconomic status (SES) accountedfora significant partof thepublic healthaspects. Because of the availabilityof different communityhealth care subsets, it seems that the lack of these health supportive conditions may potentially lead to endangermentof public health in each community (1). In this regard, a close relationship between low SES and increasing trend of cardiovascular disease and its related risk factors is predictable. In fact, an inversely relationship has been well revealed between SES and cardiovascular mortality and morbidity (2). Although this association is more evidenced in developing countries especially among urban areas, but developed nations have moreattempted to reduce and identify cardiovascular risk factors such as hypertension, smoking, diabetes, and hyperlipidemia especially among low SES groups

by designing more national appropriate screening and managing strategies (3,4).

In this regard, epidemiological surveys have shown that lower SES is associated with higher prevalence of hypertension (5). In this regard, the heterogeneity and different degrees of economic development have been argued as the main reason for different prevalence of controlled and uncontrolled hypertension (6). Besides, some modifiable risk factors have been identified to affect level of blood pressure such as high body mass index, high waist circumference, alcohol use, low physical activity, and also smoking (7). Although association between hypertension and most pointed risk factors have been clearly described, but the evidences of elevated risk for hypertension in smokers are scarce so some studies could confirm converse relation between habitual smoking and low blood pressure (8), while in some other studies, smoking has been shown to be associated with transient rise of blood pressure (9). Some studies found that discrepancies in smoking-habitincreasedthe variation in systolic blood pressure, especially in the lowest educated womenand mencompared with the highest educated (10). In other studies, smoking neither increased nor decreased the SES differences in blood pressure (11-13).

Along with tripartite close relationship of the socioeconomic level, smoking, and hypertension, the present study aimed to assess relationship of SES and hypertension based on smoking habit among Iranian population.

Methods

Study population

The present study analyzed the subsample consisted of 9572 subjects which participated in the first phase of Isfahan Healthy Heart Study (IHHP) which has done in Isfahan Najafabad and Arak. The IHHP study method was previously described in detail (14). Briefly, IHHP was designed as a population-based longitudinal panel survey to assess and screen cardiovascular risk factors states as well as SES, lifestyle, and nutritional habits among general population. In this study, a multistage random sampling was applied to randomly selecting study individuals across primary samples. The IHHP study, the dataset of which is publicly available for research purposes has been granted ethicalapproval by the Commerce Faculty Ethics Committee at the Isfahan Cardiovascualr Research Center.

Study measurement

The included currently phase of IHHP study sought basic data carried out in 2007 obtained sociodemographic data regarding health behavior, such as nutritional habits, physical activity and smoking behavior. Socioeconomic class was defined based on the education level, income, occupational and marital status. We categorized SES in four classes (low, lower middle, middle and high). More details of SES measured by car and house ownership, number of travel in year and place of travel, having personal computer, number of children in each family and having several jobs. Education categorized based on training system in Iran as, illiterate, elementary, middle school, high school or diploma and university training. The number of completed years of formal education was recorded and categorized into four levels: less than five; five to nine; ten to twelve and more than twelve years.Participants currently engaged in a remunerated occupation were classified as manual, no manual jobs, and the remaining as retired, students unemployed or housewives. Among Iranian population non manual works consider as higher level of occupation.Also, information on participant's income was collected. Income was categorized in five levels 1000000 Rials monthly income or less considered as low income and more than 10,000,000 consider as high. Each one American dollar was equal to 10000 Iranian Rials, approximately in the time of study. Marital status was recorded in four categories: single, divorced, widowed and married. Blood pressure was measured 3 times after a 10 minutes rest in a seated position, using mercury sphygmomanometers and appropriately sized cuffs. The mean of the 3 measurements was calculated (15).

Systolic and diastolic blood pressures were measured in supine position twiceby trained nurses in the left arm after a 5 minuterest period, using an automated blood pressure monitor. Nutritional status was

Table 1. Demographic characteristics of study population

Characteristics	Non smoker	Smoker 7838 (82.0)	P value 1724 (18.0)
Sex			
Female	4711 (60.1)	70 (4.1)	<0.001
Male	3127 (39.9)	1654 (95.9)	
Age Grope			
19-44	5448 (69.5)	1247 (72.4)	
45-64	1594 (20.3)	332 (19.3)	0.031
≥65	793 (10.1)	144 (8.4)	
Marital Status			
Married	6051 (77.2)	1375 (79.8)	
Single	1322 (16.9)	314 (18.2)	<0.001
Divorced	32 (0.4)	9 (0.5)	
Dead	430 (5.5)	24 (1.4)	
Education			
Illiterate	1526 (19.5)	208 (12.1)	
Elementary	2067 (26.4)	496 (28.9)	
Middle school	1238 (15.8)	403 (23.5)	<0.001
High school and diploma	1926 (24.6)	421 (24.5)	
University	1058 (13.5)	188 (11.0)	
Employment			
Housewife - not working - housewife	4958 (63.6)	267 (15.7)	
Retired	356 (4.6)	130 (7.6)	<0.001
manual jobs	1507 (19.3)	925 (54.3)	
Non-manual jobs	973 (12.5)	380 (22.3)	
Family Income			
<1,000 ,000 Rials	1357 (17.4)	227 (13.2)	
1,000,000 - 3,000,000 Rials	4508 (57.6)	953 (55.5)	
3,000,000 - 5,000,000 Rials	1471 (18.80	375 (21.8)	<0.001
5,000,000 - 10,000,000 Rials	412 (5.3)	131 (7.6)	
>10,000,000 Rials	73 (0.9)	31 (1.8)	
Diabetes			
No	7226 (93.2)	158 (93.4)	0.712
Yes	530 (6.8)	112 (6.6)	
Global dietary index	0.92±0.31	0.99±0.31	<0.001
Leisure time physical activity	140.05±205.76	186.86±253.29	<0.001

determined using the global dietary index (GDI), evaluated by the average of the mean of twenty-nine questions in seven categories on a food frequency questionnaire (FFQ). It represented behavior and dietary quality. A lower GDI indicates better behavior (15). Smoking status: current cigarette smokers considered as persons who were smoking tobacco at the time of the survey, ex-smokers were defined as persons who had smoked prior to the survey but had stopped and never smokers was defined as a person who had never smoked (16). This information was obtained from an interview and questionnaire. Physical activity was measured by questionnaire and presented as metabolic equivalents (METs). We used total physical

activity, frequency and duration of activities per week. Participants were divided on the basis of their monthly income into four socioeconomic classes including high class, high-middle class, low ,middle class and below poverty line group. The stratification was based on the criteria internationally provided (17).

Statistical analysis

Results were presented as mean ± standard deviation (SD) for quantitative variables and were summarized by frequency (percentage) for categorical variables. Continuous variables were compared across the different socioeconomic classes using ANOVA test or Nonparametric Kruskal-Wallis H test whenever the data did not appear to have normal distribution or when the assumption of equal variances was violated across the study groups. Categorical variables were, on the other hand, compared using chi-square test. The multivariate stepwise regression model was used to determine crude and adjusted odds ratios of SES class for hypertension based on smoking group. For the statistical analysis, the statistical software SPSS version 16.0 for windows (SPSS Inc., Chicago, IL) was used. P values of 0.05 or less were considered statistically significant.

Results

A total number of 9562 enrolled in this study and 1724 smoker subjects participated in this sub-study. Smoking habit was men significantly more prevalent among men than woman. There is no significant differences in the age distribution between groups (p=0.031).Whereas, significant differences has seen in marital status, educational level and income (P=0.001)

Those individuals who experienced cigarette smoking, SES class was significantly lower in hypertensive patients compared with normotensive subject so 7.8% of hypertensive patients and 92.2% of normotensive ones classified in SES class IV (p<0.001) (table 2). Similarly in those patients who never smoked, higher SES class was specified to normotensove group than to hypertensive ones (SES class IV: 8.3% in hypertensive group and 91.7% in normotensive group, p<0.001). Univariate analysis showed hypertension was related to lower SES class when compared with normotension status in both smoker and nonsmoker groups (p<0.001). In stepwise logistic regression models adjusting sex, age, global dietary index and leisure time physical activity (table 3), hypertension could be predicted by lower SES in nonsmoker group, while this predictive role for SES could not be reveal in smoker group.

Discussion

It has been recently shown a close association between elevation of blood pressure and experience of heavy smoking especially is some sociodemographic subgroups. In this regard, some studies have shown that has found that older men who were heavy and moderate smokers have significantly higher systolic blood pressure than nonsmokers (19). However, in another study, smoking has been related with lower risk of high blood pressure in younger subgroups (20). Besides, smoking is strongly associated with SES so a study in Europe has shown that smoking is related with lower SES among young adult men and women (21). Besides this, in Norway lower SES isassociated with smoking (22). In fact, socioeconomic depriva-

Table 2. Socioeconomic statues and Hypertension based on smoking group

Smoking		SES class				p-value
		Class 1	Class 2	Class 3	Class 4	
Smoker	Hypertension	62 (22.9%)	84 (23.3%)	47 (11.1%)	50 (7.8%)	**<0.001**
	No Hypertension	209 (77.1%)	277 (76.7%)	376 (88.9%)	587 (92.2%)	
Neversmoked	Hypertension	549 (35.1%)	514 (27.6%)	163 (9.2%)	207 (8.3%)	**<0.001**
	No Hypertension	1013 (64.9%)	1346 (72.4%)	1601 (90.8%)	2295 (91.7%)	

Table 3. Crude and adjusted odds ratios (95%CI) of SES class for Hypertension based on smoking group

Smoking habit		SES class							
		Class 1		Class 2		Class 3		Class 4	P-value
		OR(95%CI)	P-value	OR(95%CI)	P-value	OR(95%CI)	P-value		for trend
Smoker	Crude	3.48(2.32,5.22)	**<0.001**	3.56(2.44,5.20)	**<0.001**	1.47(0.97,2.23)	0.073	R	**<0.001**
	Model 1	0.74(0.45,1.22)	0.239	1.12(0.72,1.76)	0.606	1.23(0.79,1.90)	0.347	R	0.143
	Model 2	0.85(0.51,1.43)	0.541	1.27(0.80,1.99)	0.311	1.28(0.83,1.99)	0.270	R	0.181
Never smoked	Crude	6.01(5.04,7.17)	**<0.001**	4.23(3.55,5.04)	**<0.001**	1.13(0.91,1.40)	0.269	R	**<0.001**
	Model 1	1.25(1.01,1.56)	**0.044**	1.17(0.95,1.45)	0.151	1.00(1.07,1.26)	0.995	R	0.152
	Model 2	1.35(1.08,1.69)	**0.008**	1.25(1.00,1.55)	**0.047**	1.03(0.82,1.29)	0.818	R	**0.019**

• Data expressed as odds ratio (95% CI) obtain from multivariate logistic regression, which adjusted by other variables.
• Variable entered on model: Step 1: Sex, age group, Step 2, adjust sex, age, global dietary index and leisure time physical activity

tion may lead to smoking or make quitting more difficult, because of the significant relationships between hypertension and smoking and also between SES and smoking, were presently hypothesized that the power of association between SES and hypertension can be influenced and based on smoking status. Our study and in crude analysis showed that SES class could predict hypertension in both smoking and nonsmoking status, but when adjusting other underlying factors such as sex, age, Global Dietary Index and leisure time physical activity, hypertension could be predicted by lower SES in nonsmoker group, but not in smoker ones. On the other hand, association between elevated blood pressure and lower SES may be interacted by experience of cigarette smoking.Thus, the bilateral synergistic effects of smoking and lower SES leading elevated blood pressure may be doubtful according to our observation, because SES-hypertension association was only revealed in nonsmokers not in smokers.

Interestingly, in addition to the effects of smoking on significant association between lower SES and higher blood pressure, other intermediate risk factors have been shown to affect this association. It was found the body mass index/waist circumference has a mediator role in this association (23). Also, higher educational level is related with higher alcohol use, lower odds of physical activity, lower odds of obesity, and lower odds of smoking (23). Thus, our observed association might be influenced by these factors that our used models were adjusted for some factors including dietary habits and level of physical activity, but were not adjusted for some others.

Moreover, health is influenced by income inequality throughnegative emotions such as shame and distrustthat are translated into stress inducedbehavior like smoking (24). Thepsychosocial conditions that influencehealth are social support, social network, job demand and control socialites, perceived supportandhopelessness, stress and depression (25-29). Brummett et al. found that household income remained associated with SBP even with control for all of the covariates including smoking (30). Chaix et al., showed that smoking as a specific risk factors of hypertension intervene as mediators in the associations between individual or neighborhood socioeconomic characteristics and systolic blood pressure (31). Lower SESis associated with higher bio-behavioral risk profile including smoking and also with higher systolic blood pressure. So recent evidences from population-based studies have shown that health behaviors may account for a sizable amount of the association between SES and systolic blood pressure (32-34), prolonged and excessive smoking may strongly mediate association between SES and hypertension.

One of the remarkable finding in our study was to reveal an relationship between hypertension and SES level in non-smokers butnot in smokers. On the other hand, the variable of smoker can be considered as afactor affecting relationship between hypertension and SES. In our society, both hypertension and smoking is more prevalent in those with lower SES level, but smoking is not specified to cigarette smoking. On the other hand, although cigarette smoking is more prevalent in low SES level, but other types of smoking

including extensive opioids is more prevalent in high SES. One of another reason for this discrepancy may be the difference in the description of isolated cigarette smoking in our population that should be matched with the definitions in other studies. Also, in assessing the relation between hypertension and SES, other probable variables such as level of physical activities and genetic factors should be considered as the probable confounders.

In conclusion, the significant SES-smoking association maydetermination-increasing blood pressure adjusted for other covariates such as demographics as well as dietary behaviors and leisure time physical activity. However, in our survey, assessing the distribution of blood pressure and smoking habits and their associations with SES in an urban Iranian populationcould demonstrate the role of SES in predicting hypertension only in nonsmokers.

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