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Different patterns of association between education and wealth with non-fatal myocardial infarction in Tehran, Iran: A population-based case-control study

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Abstract

Background: Myocardial Infarction (MI) is a main cause of death and disability worldwide, which involves a number of genetic, physiopathologic and socio-economic determinants. The aim of this study was to assess the patterns of association between education, wealth and some other risk factors with non-fatal MI in Tehran population.

Methods: Data derived from a second round of large cross-sectional study, Urban HEART-2, conducted in Tehran in 2011. Out of 118542 participants, all 249 self-reported incident cases of non-fatal MI were selected as the case group. A number of 996, matched on age and sex, were selected as controls. Principle component analysis (PCA) was used to calculate wealth index and logistic regression model to assess relations between the study variables.

Results: Mean (SD) age of participants was 60.25 (12.26) years. A total of 870 (69.9%) of the study subjects were men. Education, wealth status, family violence, hypertension and diabetes were observed as independent predictors of non-fatal MI. Overall, as the level of education increased, the odds of non-fatal MI decreased ($p<0.001$). We observed an almost J-shaped association between wealth status and non-fatal MI. No significant associations were found between marital status, BMI and current smoking with non-fatal MI ($p<0.05$).

Conclusion: We found different patterns of association between education and wealth with nonfatal MI among Tehran adults. Lower risk of non-fatal MI is linked to high educated groups whereas economically moderate group has the lowest risk of non-fatal MI occurrence.

Keywords: Myocardial infarction, Education, Wealth, Case-control, Iran.

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Introduction

Myocardial Infarction (MI) is a globally major cause of death and disability. Of the 57 million global deaths in 2008, MI ac-

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counts for 7.3 million deaths, about 12.8% of all d eaths(1). Projection of global mortality and burden of disease for 2030 have predicted that MI will be the main single cause of death in 2030 (2). Over the past two decades, deaths from cardiovascular diseases (CVDs) have been decreasing in many developed countries, but have increased in developing and transitional countries, mostly because of increasing longevity, urbanization, and lifestyle changes (1, 3, 4).

The associations between MI and risk factors such as high blood pressure, smoking, diabetes and obesity have been the subject of extensive studies. However, fewer studies have documented social determinants of the condition(5). Numerous measures of socioeconomic status (SES), including occupation, education, household income and wealth, have been shown to affect health outcomes, but these measures are not interchangeable (6-8). There are some variations in respect of the direction and magnitude of this association with various diseases (9). Besides, different aspects of SES are differentially linked to health across different place, time and population of sub-groups (6, 7). Education is frequently used as an indicator of SES in epidemiological studies (6, 7, 10). It is associated with individuals' work and economic circumstances, and health behaviors, well as. Wealth, as an economic component of SES, includes financial and physical assets(11). Wealth has been assumed as a better measure of SES and consequently a better predictor of health rather than income alone(6). Several studies have shown an inverse gradient between SES and cardiovascular morbidity and mortality so that lower SES is often associated with increased risk of MI (5, 10, 12-14). The strongest associations were seen in high-income countries, while the results were inconsistent for middle and low-income regions (10).

It is known that identifying the risk factors and their strength in each specified population can help to offer insights into prevention and control the condition for that population. Therefore, the goal of this study was to determine which possible risk factors are independently related to nonfatal MI. Also we aimed to show the patterns of association between education and wealth with non-fatal MI in Tehran population.

Methods

The present study is a population-based case-control study on associated factors of non-fatal MI. The data were derived from second round of a large cross-sectional study using Urban Health Equity Assessment and Response Tool (Urban HEART-2) at Tehran, in fall 2011(15). A total number of 118542 participants were visited at their houses. Of those, 1507 participants have reported a history of MI. Because it is preferable to select incident rather than prevalent cases when studying disease etiology (16), only incident cases, namely cases that their MI occurred during the period of 12 months before the survey, were included in this case-control study. There were a total of 249 incident cases with a first episode of non-fatal MI in the study sample. We selected all of them as the case group. Then, a random sample of 996 healthy subjects, frequency matched with the case group by age and sex, was selected as the control group. In the survey all participants were visited at their houses by interviewers who were trained and instructed on the details of the study in a tow-day workshop prior to the data gathering of the survey.

There were three types of questionnaires consisting of 20 parts. The first 14 parts were completed for all selected households. Of these, demographic, socioeconomic, and MI and its potential risk factors consist of hypertension, diabetes, smoking, obesity and family violence data were used for this analysis. All the data were gathered based on the participants' self-reports. Any participant that had already diagnosed as hypertensive patient by a physician or who has used antihypertensive medications at the time of study conduct was considered as a hypertensive case(17).Body mass index (BMI) was calculated using the formula weight (kg)/height (m2). In this classification we considered a BMI less than 18.5 as underweight, between 18.5 to 24.9 as normal, between 25 to 29.9 as overweight, and greater than or equal to 30 as obesity.

Wealth index was calculated using principle component analysis (PCA) on 14 assets and other household data consist of: 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). In principle component analysis, the first component explains the largest proportion of the total variance, thus assets that were more unequally distributed across the sample had a higher weight in the first component. The weights (coefficients) for each asset from this first component were used to generate the wealth scores, with higher score indicating higher wealth status and vice versa. Finally, based on quintiles, the scores converted to five ordered categories, from poorest (1^{st} quintile) to richest (5^{th} quintile), to determine each household wealth status. A history of occurrence of any type of violence in family such as physical or verbal violence was assessed to determine family violence status.

Sampling method and sample size

A multistage random sampling was used in this study. First stage was stratified by districts. Then 200 clusters were selected randomly in each district and finally eight household were selected in each cluster by systematic random sampling method and all the household persons were selected as primary sampling units. To estimate required sample size for the survey, each district was considered independently to calculate sample size based on Cochrane formula as 1535 households in each district. Then to facilitate the allocation of sample to the mentioned eight-box table that had to be completed for the individual questionnaires and also to reach higher precision, the sample was expanded to 1600 households, regardless of the population size in each district. Therefore, we assigned 200 blocks to each district equally. Out of the 118542 participants in the survey, all 249 incident cases of non-fatal MI were selected as the case group. Then, using systematic random sampling from reminded healthy participants, a number of 996, frequency matched with the case group by age and sex, were selected as the control group. For this, first, the number of cases in each age-sex group was determined. Then from each K persons in a defined age-sex group from reminded healthy participants, one person was selected systematically.

Statistical analysis

Descriptive statistical measures (including measures of central tendency, dispersion, the weighted prevalence and incidence rates) were used to describe the data. PCA was used to construct the wealth index. Chi-square and odds ratio (OR) were used to assess associations in univariate analysis. In multivariate analysis, ORs from Logistic Regression model were used as the measures of association between the study variables. A $p<0.05$ was considered statistically significant. STATA 12.0 software was used for all the statistical calculations.

Results

Table 1 compares the characteristics of the study participants including matching factors (age and sex) using univariate analysis. A total number of 1245 subjects, 249 cases, and 996 controls were included in this study. Mean (SD) age of participants was 60.25(12.26), ranged from 20 to 92 years. A total of 870 (69.9%) of the study subjects were men and 375 (30.1%) were women.

There were no significant differences in age and sex between the case and control

Table 1. Comparison of participants' characteristics between cases and controls

Variable		Case n (%)	Control n (%)	p-value
* Sex	Male	174(69.9)	696(69.9)	1.000 ***
	Female	75(30.1)	300(30.1)	
Marital Status	Married	206(82.7)	845(86.5)	0.009 ***
	Single	5(2.0)	41(4.2)	
	Widow or Divorced	38(15.3)	91(9.3)	
Education	Illiterate	63(25.5)	164(16.7)	0.004 ***
	Primary school	41(16.6)	155(15.8)	
	Middle school	45(18.2)	149(15.1)	
	High school	61(24.7)	319(32.4)	
	University	37(15.0)	197(20)	
BMI	Under Weight	4(1.6)	12(1.3)	0.24 ***
	Normal	96(39.5)	374(39.9)	
	Over Weight	91(37.4)	398(42.5)	
	Obese	52(21.4)	153(16.3)	
Current Smoking	No Smoker	207(83.1)	842(84.5)	0.59 ***
	Smoker	42(16.9)	154(15.5)	
Wealth Status	Poorest	75(32.1)	223(25.5)	0.017 ***
	Poor	48(20.5)	178(19.5)	
	Moderate	26(11.1)	181(19.8)	
	Rich	37(15.8)	161(17.6)	
	Richest	48(20.5)	162(17.7)	
Family violence	No Violence	215(87.8)	909(93.2)	0.004 ***
	Violence	30(12.2)	66(6.8)	
Hypertension	No Hypertension	187(75.1)	861(86.4)	<0.001***
	Hypertension	62(24.9)	135(13.6)	
Diabetes	No Diabetes	187(75.1)	875(87.9)	<0.001***
	Diabetes	62(24.9)	121(12.1)	

* Matched variable, ** Using two samples independent t-test, *** Using Chi-square test

groups. Mean (SD) age of the cases and the controls were 60.55 (12.25) and 60.17(12.27) years respectively (p=0.66). Also BMI and current smoking were not significantly different between the two groups. However, the other assessed variables were significantly different between the case and control groups so that compared to controls, cases were less educated, reported more frequently a history of hypertension and diabetes, had higher BMI and reported more family violence. Also widow or divorced subjects were more frequent in cases than controls.

PCA was used to construct the wealth index. PCA results on 14 assets determined 5 assets consist of owning a fridge, personal computer, washing machine, microwave oven and car, as the first component (the wealth index) with the largest eigenvalue equal to 2.25. The proportion of variance explained by this component was 18.25%. Based on quintiles, the scores converted to five ordered categories, from poorest (1st quintile) to richest (5th quintile). Frequency distribution of the wealth index by case and control groups is presented in Table 1. The results show that compared to moderate wealth condition, both rich and poor conditions of wealth were more frequent in cases than controls.

Table 2 presents crude and adjusted ORs (95% CI) from univariate and multiple analysis using Logistic Regression model. Adjustment for the possible risk factors did not change the results much except for a significantly decreased OR in widow or divorced participants in relation to the singles and a significantly increased OR in rich group compared to moderate wealth status. Among the variables assessed as possible risk factors, marital status, BMI and current smoking were not identified as independent predictors of non-fatal MI. On the other hand, education, wealth status, family violence, hypertension and diabetes were observed as independent predictors of non-fatal MI.

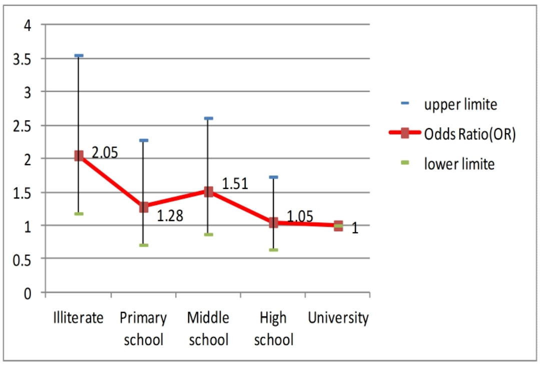
Illiterate participants had about a two times (OR=2.05, 95% CI: 1.18 – 3.55) odds

Table 2. Crude and adjusted OR (95% CI) from univariate and multivariate analysis using Logistic Regression model.

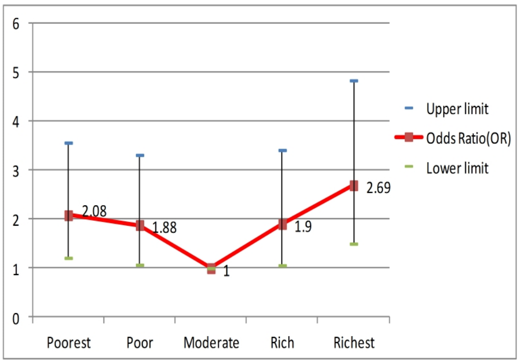
Variables		Cases n(%)	Controls n(%)	Crude Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)	p
Marital Status	Single *	5(2.0)	41(4.2)	-	-	
	Married	206(82.7)	845(86.5)	2.0(0.76 – 5.1)	1.27(0.48 – 3.37)	0.63
	Widow or Divorced	38(15.3)	91(9.3)	3.4(1.3 – 9.3)	1.56(0.53 – 4.55)	0.42
Education	Illiterate	63(25.5)	164(16.7)	2.05(1.30 – 2.23))	2.05(1.18 – 3.55)	0.011
	Primary school	41(16.6)	155(15.8)	1.41(0.86 – 2.30)	1.28(0.71 – 2.28)	0.41
	Middle school	45(18.2)	149(15.1)	1.61(0.99 – 2.61)	1.51(0.87 – 2.61)	0.14
	High school	61(24.7)	319(32.4)	1.02(0.65 – 1.59)	1.05(0.64 – 1.73)	0.83
	University *	37(15.0)	197(20)	-	-	
BMI	Under Weight	4(1.6)	12(1.3)	1.30(0.41 – 4.17)	1.22(0.32 – 4.73)	0.77
	Normal *	96(39.5)	374(39.9)	-	-	
	Over Weight	91(37.4)	398(42.5)	0.89(0.65 – 1.23)	0.87(0.61 – 1.23)	0.43
	Obese	52(21.4)	153(16.3)	1.32(0.90 – 1.95)	1.12(0.72 – 1.74)	0.62
Current Smoking	No Smoker *	207(83.1)	842(84.5)	-	-	
	Smoker	42(16.9)	154(15.5)	1.11(0.76 – 1.61)	1.27(0.84-1.91)	0.25
Wealth Status	Poorest	75(32.1)	223(25.5)	2.24(1.38 – 3.65)	2.08(1.21 – 3.56)	0.008
	Poor	48(20.5)	178(19.5)	1.88(1.12– 3.16)	1.88(1.07 – 3.31)	0.028
	Moderate *	26(11.1)	181(19.8)	-	-	
	Rich	37(15.8)	161(17.6)	1.60(0.93 – 2.76)	1.90(1.06 – 3.41)	0.032
	Richest	48(20.5)	162(17.7)	2.06(1.22 – 3.48)	2.69(1.50 – 4.83)	0.001
Violence	NO family Violence *	215(87.8)	909(93.2)	-	-	0.012
	Family Violence	30(12.2)	66(6.8)	1.92(1.22 – 3.03)	1.88(1.15 – 3.10)	
Hypertension	No hypertension *	187(75.1)	861(86.4)	-	-	0.005
	Hypertension	62(24.9)	135(13.6)	2.12(1.51 – 2.97)	1.72(1.18 – 2.53)	
Diabetes	No diabetes *	187(75.1)	875(87.9)	-	-	0.001
	Diabetes	62(24.9)	121(12.1)	2.40(1.70 -3.38)	1.95(1.33 – 2.86)	

*Reference level

of a non-fatal MI than university educated group (p=0.011). Graph 1 indicates that overall, as the level of education increased, the odds of non-fatal MI decreased (p for trend<0.001). Compared to moderate wealth status, all the other wealth status groups had higher odds of a non-fatal MI so that the adjusted ORs were 2.08(1.21 – 3.56) in the poorest group, 1.88(1.07 – 3.31) in the poor group, 1.90(1.06 – 3.41) in the rich group and 1.90(1.06 – 3.41) in the richest group. As presented in graph 2, there is an almost J-shaped association between wealth status and non-fatal MI. Family violence was positively associated with non-fatal MI so that the odds of the condition was 88% higher in participants reported a history of family violence in relation to the others (p=0.012). The cases were more likely to report a history of hypertension (OR=1.72, 95% CI: 1.18 – 2.53) and diabetes (OR=1.95, 95% CI: 1.33 – 2.86) than



Graph 1. Adjusted ORs (95% CI) of non-fatal MI according to levels of Education.



Graph 2. Adjusted ORs (95% CI) of non-fatal MI according to Wealth status.

the controls. No significant interactions were detected among the assessed risk factors of non-fatal MI.

Discussion

This study was population-based, where cases were representative samples of the population cases and controls were also random samples of the source population of the cases. Moreover, using incident cases instead of prevalent cases in our study reduced the probability of survival bias. In the present study, education, wealth status, family violence, hypertension and diabetes were observed as independent predictors of non-fatal MI, whereas, marital status, BMI and current smoking were not associated with the condition. We found a linear inverse association between education and the odds of non-fatal MI (p for trend< 0.001), so that there was about a two times odds of a non-fatal MI for the lowest educational level than the highest one (OR=2.05, 95% CI: 1.18 – 3.55). The finding was in line with other studies (10, 12, 18-21). Increased awareness about lifestyle risk factors like unhealthy diet and low activity and also more frequently use of health services may have been partly responsible for the decrease in MI occurrence among the higher educational groups. On the other hand, we observed a significant and almost J-shaped association between wealth status and non-fatal MI. However the pattern differs from those observed in some other studies (4, 10, 19, 20, 22-24).

Iran may be in the transition from pattern of the condition seen in developing countries to that seen in developed ones, so higher rates of MI occurs in both poor and rich groups of people in relation to the moderate group. Although the rates of MI are high in both poor and rich groups, however, this may be partly due to existence of different risk factor sets in each group. In summary, it seems that these two different aspects of SES are differentially linked to the risk of non-fatal MI. In our study, as we expected, hypertension (OR=1.72, 95% CI: 1.18 – 2.53) was associated with non-fatal MI. Our findings are consistent with results from the previous studies that examined the association (18, 21-28). Also diabetes (OR=1.95, 95% CI: 1.33 – 2.86) was related to non-fatal MI. Several studies have showed the relationship between diabetes and MI (21, 24-28). Besides, a causal relationship between these conditions and CVD was demonstrated. Furthermore, we found family violence as a predictor of non-fatal MI (OR=1.88, 95% CI: 1.15 – 3.10). Although Parrish et al. did not found any association between the two variables(29). Family violence can increase the risk of MI via both short term and long term effects, mostly by induce and enhance stress in family members. Hence, it can lead to atherosclerosis and hypertension, the well known risk factors of MI. Moreover, according to the results of univariate analysis in the present study, widow or divorced participants had significant higher odds of non-fatal MI in relation to the singles. But after adjustment for the assessed risk factors, marital status was not significantly associated with non-fatal MI. This change indicates present of a positive confounding effect that have been controlled by adjustment. Several studies have shown a positive association between BMI and MI (21, 23, 30), but in our study, BMI was not significantly associated to non-fatal MI, like some other studies (18, 31). In the present study no significant relationship was found between current smoking and non-fatal MI. This finding differs from those seen in the other studies (4, 18, 20, 21, 23-26, 31-36). This disagreement may be partly explained by the fact that the outcome (MI) can influence the exposure status (smoking) so that probably some people with recent MI do not continue to smoke because of their physicians advises, although some of these studies have been conducted on current smoking and MI. Moreover, information bias could yield this result because participants with a history of MI maybe report smoking less than the control group.

Limitations

Our study is subject to several limitations. First, because of the nature of case-control studies, the observed associations are not proof of causality and temporal bias can be occurred. Second, the method of self-reporting used for gathering data can induce misclassification especially in hypertension, diabetes and BMI data. Hence some deviations in respect of direction or magnitude of the observed associations may be occurred. Furthermore, because this study has been carried out only on cases of non-fatal MI, the inferences should be restricted to this group.

Conclusion

Our study findings highlight different patterns of association between education and wealth, as different aspects of SES, with non-fatal MI among Tehran adults. In respect to this condition, lower risk of non-fatal MI is linked to high educated groups whereas economically moderate group has the lowest risk of non-fatal MI occurrence. Strategies for general education including fostering health education programs to increase public awareness of MI risk factors particularly for low educated people are highly recommended. Programs to enhance surveillance systems and implementation of community based screening programs to early detection of the condition are needed especially in high risk population subgroups. Moreover, conducting longitudinal studies on socio-economical predictors of MI may provide platform for more efficient health policy making.

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