Original Article

Are there any differences in education levels and changes of cardiovascular risk factors among urban and rural population: Isfahan Healthy Heart Program

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ABSTRACT

Background: This study aimed to find the influence of education level on the trends of changes of these risk factors among a great sample of Iranian population. **Materials and Methods:** This cross-sectional study is a secondary analysis of Isfahan Healthy Heart Program (IHHP). Blood samples were taken to determine the lipid levels including total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), low levels of high-density lipoprotein cholesterol (HDL-C), and triglycerides. Education categorized based on training system in Iran as 1-5, 6-12, and more than 12 years training. **Results:** The prevalence of diabetes was higher among illiterate participants in both areas. Hypertension was more prevalent in illiterate subjects (2001; 44.0% and 2007; 46.3%) in intervention area ($P < 0.001$). Dyslipidemia was more prevalent among illiterate people ($P < 0.001$). In the intervention, illiterates have higher BMI in both 2001 and 2007 ($P < 0.001$). The prevalence of current smoking was the highest in education level range 6 to 12 years and was steadily decreased in higher education levels ($P < 0.001$). Subjects with 6-12 years of education have more unhealthy nutritional habits in both areas. In 2001, subjects with 12 years of education or more had more physical activity than other groups ($P < 0.001$), whereas, in 2007, subjects with 6-12 years of education were more active ($P < 0.001$). **Conclusion:** Although the prevalence of diabetes, hypertension obesity, and dyslipidemia are more in illiterate subjects and prevalence of diabetes and hyperlipidemia was sharply decreased with education level, it seems that well educated participants have higher daily physically activity compared with those who have lower education without considering the place or residency.

Key words: Cardiovascular risk factors, education, Iran, rural, urban

INTRODUCTION

Cardiovascular disease (CVD) is now emerging as the leading cause of death and disability whole of the world. The burden of CVD, especially ischemic heart disease, varies remarkably between regions of the world, with declining rates in Europe, North America, and Australia/New Zealand, burgeoning epidemics in the former socialist economies and India, and relatively lower impact in developing regions.[1]

Some studies have indicated that education is inversely associated with the occurrence of CVD and the level of CVD risk factors,[2] whereas there are studies revealing an opposite

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trend. Iran as a developing country undergoes behavioral changes due to some improvement in level of education and is the largest developing country in the world; CVD has become the major cause of death, especially in urban areas. Two studies[3,4] indicated an inverse association of education and CVD risk factors in urban populations of Iran. To our knowledge, there has been no previous study reporting the trends of CVD risk factors in the Iranian population.

The prevalence of the major heart disease risk factors such as obesity, elevated cholesterol levels, and high blood pressure also differs significantly among men and women of different race and ethnic backgrounds.[4] On the other hand, it seems that educational level has a key role in the rise of cardiovascular disease.[5] Some studies have described overarching factors influencing variations in CVD by literacy and the influence of education in their specific population.[6] However, there is no population-based study assessing patterns and the presence of specific cardiovascular risk factors among Iranians in different age groups with different educational level, which widely varies. The purpose of this population-based study was to investigate the relationship of education level with the prevalence of coronary artery disease risk factors such as current smoking, diabetes, and high cholesterol level among a great sample of Iranian population.

MATERIALS AND METHODS

This cross-sectional study is a part of Isfahan Healthy Heart Program (IHHP), which has been previously described elsewhere.[6,7] In this study, two intervention counties (Isfahan and Najaf-Abad) and a control area (Arak, 375 km north-west of Isfahan), all located in central Islamic Republic of Iran, were studied. Arak was selected as a control area because it resembled the intervention areas in its socio-economic, demographic, and health profile and offered good cooperation. Arak was monitored for evaluation purposes but did not receive any intervention. In each community, a random sample of adults was selected yearly by multi-stage cluster sampling in both 2001 and 2007.[6,7] Research Council of Isfahan Cardiovascular Research Center approved this study. Only participants who had lived in their respective areas for at least 10 years were included. Exclusion criteria included pregnancy, mental retardation, and physical disabilities. All participants underwent a 30-minute face-to-face interview to complete validated questionnaires containing questions on demographic, socio-economic status, smoking behavior, physical activity, nutritional habits, and other healthy behaviors regarding cardiovascular disease. In this program, blood pressure and body mass index (BMI) measurements were done, then fasting blood samples were taken for 2 hpp, serum (total, HDL, and LDL) cholesterol and triglyceride levels. After initial venous blood sample in the fasting status, participants drank glucose solution over five minutes. A second blood sample was taken two hours later. Serum total cholesterol and triglycerides were measured using enzymatic colorimetric methods. HDL cholesterol was determined after dextran sulfate-magnesium chloride precipitation of non-HDL cholesterol. LDL cholesterol level was derived from the friedewald equation in the presence of increased triacylglycerol levels. The coefficient of variation was <5% for all laboratory measurements.[8] All blood samples were collected from each center in the three cities then immediately frozen at -20°C until assayed within 72 hours in the central laboratory of Isfahan Cardiovascular Research Center, in which reference samples were created at the beginning of the study and included in each day's analysis to check laboratory variation. This assessment was made at the two time points (2001 as baseline and 2007 as the follow-up point). Education categorized based on training system in Iran as, illiterate, primary,[1-5] high school,[6-12] and university training (>12). Global dietary index (GDI) was calculated representing the general dietary behavior. In addition, two consumption indices were calculated for specific food groups, i.e. meat products and major sources of fat.[13] The usual dietary intake was assessed using a 49-item food frequency questionnaire (FFQ) listing foods commonly consumed by Iranians and administered by trained technicians. For each food item, participants were asked to report common portion sizes and consumption frequency during the previous year. The latter was recorded in terms of daily (e.g. bread), weekly (e.g. rice, meat), and monthly (e.g. fish) consumption, and the daily intake of each food was derived by dividing weekly consumption by 7 and monthly consumption by 30. Data on physical activity, expressed as metabolic equivalent task (METS) minutes per week, were obtained through an oral questionnaire. Several questions on smoking behaviors and the frequency of smoking in a day, week, or month were asked.[14]

The IHHP conducts integrated activities in health promotion, disease prevention, and health-care treatment and rehabilitation. The IHHP intervention promotes healthy nutrition and increased physical activity and conducts tobacco control and stress management activities via mass media, intersectional cooperation and collaboration, community participation, education, and involvement of health professionals. Interventions are targeted to individuals, populations, and the environment depending on the results of baseline surveys on diet, physical activity, and smoking and stress management and on an assessment of needs in these areas and of their coverage by existing health services.

Results were reported as mean ± standard deviation (SD) for quantitative variables and percentages for categorical variables. The groups were compared using the *t* test or one-way ANOVA test for continuous variables and the chi-square test for categorical variables. *P* values of 0.05 or less were considered statistically significant. All the statistical analyses were performed using SPSS version 16.0 (SPSS Inc., Chicago, IL, USA) for Windows.

RESULTS

Totally, 8739 (55.4%) lived in the intervention area and 2,959 (44.6%) lived in the reference area [Table 1].

There were totally no significant differences in age and current cigarette smoking between the intervention and the control groups. But, intervention groups had higher prevalence of hyperlipidemia and were also more likely to be diabetics [Table 1]. The reference group had similar behavior between two genders regarding participants' age and prevalence of diabetes as well as hyperlipidemia.

Table 1: Demographic characteristics and risk profile comparing intervention and reference area participants

Risk profile	Study area	2001	2007	*P*
Age	Intervention	38.66±14.79	38.64±15.32	0.963
	Reference	39.03±15.11	37.59±14.57	0.000
Smoking	Intervention	716 (14.7%)	490 (12.6%)	0.004
	Reference	614 (14.5%)	391 (14.0%)	0.516
Diabetes	Intervention	315 (6.5%)	288 (7.5%)	0.065
	Reference	225 (5.4%)	169 (6.1%)	0.205
Hyperlipidemia	Intervention	3219 (66.4%)	2539 (66.2%)	0.832
	Reference	2749 (65.7%)	1703 (61.3%)	0.000

In the intervention area, the mean age based on illiteracy, 1-5 years, and 6-12 years study is significantly more than reference area. However, the mean age of higher education level is significantly higher in the reference area. Relationship between some lifestyle factors such as smoking, having physical activity, and having healthy diet have shown in Table 2. The mean of global dietary index in intervention area is lower than reference area in all educational levels before and after interventions. Similarly, the same trend has seen in smoking habit. Participants with 6-12 years education have higher daily physically activity compared with those who have lower education in both reference and intervention areas in 2001 and 2007. The overall prevalence of cigarette smoking was decreased among all participants with different educational levels after

Table 2: Relationship between behavioral factors and education levels based on living area in 2001-2007

	Educational level				
	Illiterate	1-5 y	6-12 y	>12 y	*P*
Age (years)					
2001					
Intervention	56.92±13.07	41.73±12.91	31.96±10.64	33.64±11.03	<0.001
Reference	53.68±13.59	38.08±11.68	29.92±9.65	33.38±10.82	<0.001
P value	<0.001	<0.001	<0.001	0.706	
2007					
Intervention	58.87±13.65	44.66±13.82	33.25±11.75	31.35±11.07	<0.001
Reference	57.98±12.97	38.40±12.22	29.45±8.53	28.36±9.69	<0.001
P value	0.194	<0.001	<0.001	<0.001	
Global dietary index					
2001					
Intervention	0.99±0.28	1.05±0.27	1.06±0.28	1.07±0.28	<0.001
Reference	1.06±0.23	1.11±0.23	1.14±0.25	1.12±0.26	<0.001
P value	<0.001	<0.001	<0.001	0.005	
2007					
Intervention	0.79±0.29	0.82±0.31	0.85±0.31	0.80±0.29	<0.001
Reference	0.99±0.29	1.05±0.28	1.05±0.29	0.99±0.28	<0.001
P value	<0.001	<0.001	<0.001	<0.001	
Total daily physical activity					
2001					
Intervention	665.11±520.19	891.21±542.16	950.26±558.46	945.27±498.86	<0.001
Reference	769.03±515.92	952.64±538.55	940.90±509.11	1016.93±492.41	<0.001
P value	<0.001	0.001	0.549	0.020	
2007					
Intervention	577.36±512.62	768.51±592.98	890.76±658.98	787.39±574.15	<0.001
Reference	590.18±492.29	812.45±552.86	891.79±567.42	751.84±499.58	<0.001
P value	0.617	0.054	0.958	0.285	
Smoking					
2001					
Intervention	125 (13.4%)	274 (15.2%)	427 (15.8%)	87 (13.9%)	0.267
Reference	185 (10.3%)	325 (17.4%)	364 (17.2%)	79 (17.5%)	<0.001
P value	0.018	0.070	0.180	0.105	
2007					
Intervention	48 (8.6%)	132 (12.2%)	326 (15.3%)	97 (10.4%)	<0.001
Reference	89 (7.6%)	241 (16.3%)	314 (16.9%)	39 (11.7%)	<0.001
P value	0.447	0.004	0.185	0.521	

intervention in intervention area ($P < 0.001$). Table 3 shows the relationship between cardiovascular risk factors and educational levels based on living area in 2001 and 2007. The prevalence of diabetes was higher among illiterate participants in both areas. Similarly, hypertension was more prevalent in illiterate (2001; 44.0% and 2007 46.3%) in intervention area than higher education level (>12 years) ($P < 0.001$). In addition, dyslipidemia was more prevalent among illiterate people. Prevalence of hyperlipidemia was increased in all educational levels, except in residents with higher level of education since 2001 to 2007 in the intervention group.

In the intervention group, illiterates have higher BMI level in both 2001 and 2007.

The mean age of study participants in both areas fell with education level and this trend was observed in both 2001 and 2007 years [Figure 1]. The prevalence of current smoking was the highest in education level range 6 to 12 years and was steadily decreased in higher education levels; however, this trend was not revealed in the intervention group in 2001 [Figure 2]. Meanwhile, prevalence of diabetes and hyperlipidemia was sharply decreased with education level [Figures 3 and 4] in both study time points.

DISCUSSION

The result of this study demonstrated that the prevalence of diabetes, hypertension, obesity, and dyslipidemia is more in

Table 3: Prevalence of cardiovascular risk factors and educational levels based on living area in 2001-2007

Risk factors				Educational level				
				Illiterate	1-5 y	6-12 y	>12 y	*P*
Diabetes		2001	Intervention	159 (17.1%)	133 (7.4%)	84 (3.1%)	9 (1.4%)	<0.001
			Reference	164 (9.3%)	82 (4.5%)	49 (2.4%)	10 (2.2%)	<0.001
			P value	<0.001	<0.001	0.111	0.330	
			Intervention	121 (21.9%)	104 (9.7%)	87 (4.1%)	19 (2.1%)	<0.001
			Reference	164 (14.0%)	88 (6.0%)	51 (2.8%)	9 (2.7%)	<0.001
Dyslipidemia		2007	*P* value	<0.001	<0.001	0.018	0.510	
			Intervention	696 (74.6%)	1260 (70.3%)	1635 (60.7%)	374 (60.1%)	<0.001
			Reference	1260 (71.1%)	1195 (65.0%)	1260 (60.7%)	257 (57.8%)	<0.001
			P value	0.056	0.001	0.989	0.436	
			Intervention	425 (77.3%)	773 (72.2%)	1344 (63.9%)	535 (59.0%)	<0.001
			Reference	869 (74.3%)	962 (65.5%)	1064 (57.6%)	138 (41.8%)	<0.001
HTN		2001	*P* value	0.188	<0.001	<0.001	<0.001	
			Intervention	410 (44.0%)	428 (23.8%)	263 (9.7%)	59 (9.5%)	<0.001
			Reference	565 (31.5%)	239 (12.8%)	142 (6.7%)	43 (9.6%)	<0.001
			P value	<0.001	<0.001	<0.001	0.956	
			Intervention	253 (46.3%)	233 (22.3%)	235 (11.5%)	85 (9.6%)	<0.001
			Reference	501 (42.6%)	227 (15.3%)	116 (6.2%)	24 (7.2%)	<0.001
Abdominal obesity		2007	*P* value	0.151	<0.001	<0.001	0.195	
			Intervention	571 (61.7%)	971 (54.4%)	1012 (37.5%)	157 (25.2%)	<0.001
			Reference	794 (44.6%)	610 (32.8%)	450 (21.5%)	71 (15.7%)	<0.001
			P value	<0.001	<0.001	<0.001	<0.001	
			Intervention	348 (64.7%)	470 (45.6%)	507 (25.1%)	142 (16.4%)	<0.001
			Reference	521 (56.9%)	429 (39.8%)	360 (25.8%)	35 (13.2%)	<0.001
			P value	0.004	0.007	0.682	0.209	
BMI group	<25	2001	Intervention	351 (38.3%)	688 (38.6%)	1330 (49.7%)	339 (54.5%)	<0.001
	25-30			347 (37.8%)	646 (36.3%)	930 (34.7%)	218 (35.0%)	
	>=30			219 (23.9%)	447 (25.1%)	417 (15.6%)	65 (10.5%)	
	<25		Reference	831 (46.7%)	924 (49.6%)	1244 (59.2%)	262 (58.1%)	<0.001
	25-30			627 (35.2%)	647 (34.7%)	624 (29.7%)	141 (31.3%)	
	>=30			321 (18.0%)	292 (15.7%)	234 (11.1%)	48 (10.6%)	
				<0.001	<0.001	<0.001	0.421	
	<25	2007	Intervention	164 (30.5%)	349 (33.9%)	979 (48.6%)	492 (56.9%)	<0.001
	25-30			210 (39.1%)	411 (39.9%)	739 (36.7%)	281 (32.5%)	
	>=30			163 (30.4%)	271 (26.3%)	298 (14.8%)	92 (10.6%)	
	<25		Reference	494 (42.2%)	630 (42.7%)	1047 (56.3%)	219 (66.0%)	<0.001
	25-30			446 (38.1%)	564 (38.3%)	593 (31.9%)	86 (25.9%)	
	>=30			230 (19.7%)	280 (19.0%)	219 (11.8%)	27 (8.1%)	
		Reference	Reference	<0.001	<0.001	<0.001	0.016	

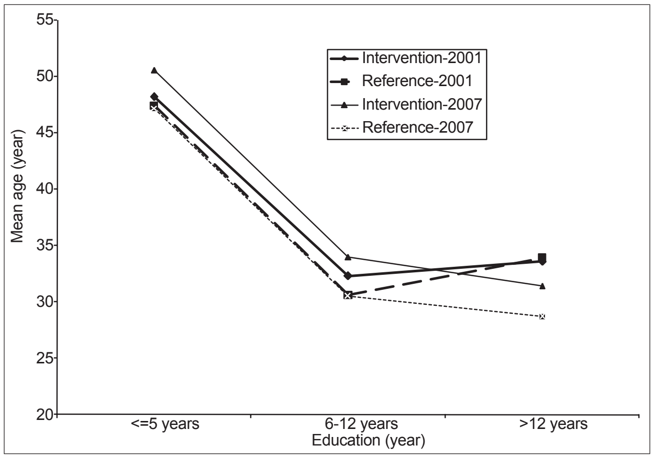

Figure 1: Education level trends in mean age by study area and time point

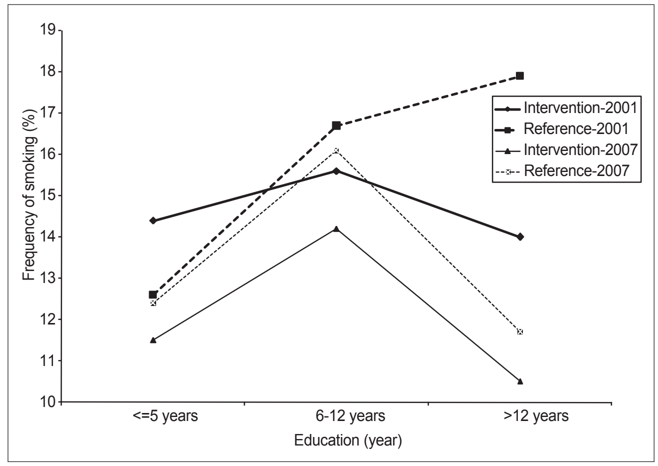

Figure 2: Education level trends in smoking by study area and time point

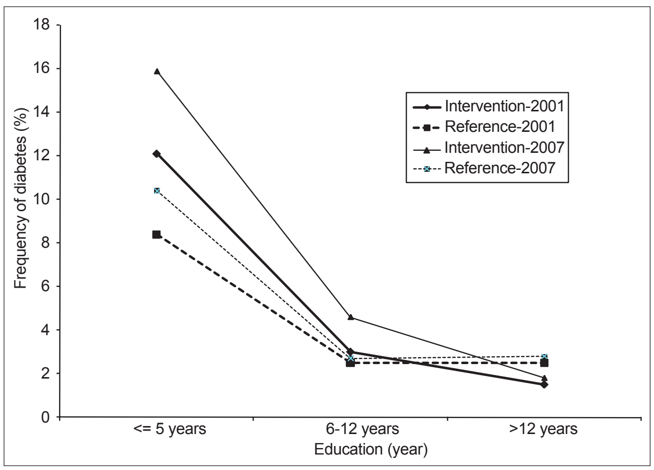

Figure 3: Education level trends in diabetes by study area and time point

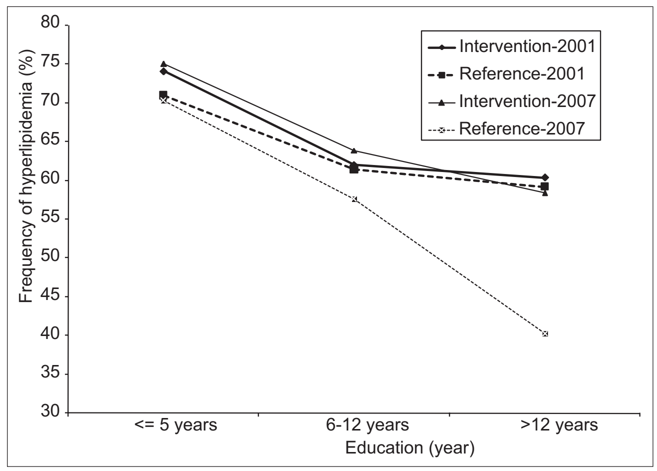

Figure 4: Education level trends in hyperlipidemia by study area and time point

illiterate subjects. Interestingly, education level has inverse relationship with prevalence of diabetes and hyperlipidemia. Apparently, subjects who have higher level of education have higher daily physical activity, lower smoking rate, and better nutritional habits compared with those who have lower education without considering the place or residency.

Results of North Karelia study indicated that this model is efficacious and cost-effective to prevent cardiovascular disease.[8] Many published studies revealed that cardiovascular risk factors such as smoking, high blood pressure, unhealthy diet, sedentary life style, and social factors play a major role in the incidence of myocardial infarction and stroke, and these diseases can, to some extent, be prevented if such risk factors are eliminated.[13-18]

This study revealed that social status, manifested by education level, was a more important mediator of the association between the individual CVD risk markers and urban status, even than health behavior or other CVD markers. In this study, prevalence of CVD risk factors was steadily decreased in higher education level. In a similar study in Spain, educational attainment was inversely associated with arterial hypertension in both genders and with overweight in women, and directly associated with cigarette smoking in women.[19] These findings support with another Iranian study, which stated those of developed countries that, along with other CVD risk factors, educational status has an converse relationship with CVD in elder population.[20] Also, in a Swedish survey, low socio-economic status exerted a stronger adverse influence on cardiovascular risk factors of women than it does on those of men.[21] But, some studies conversely showed that higher socio-economic status groups had greater prevalence of CAD risk factors than lower socio-economic status groups.[22] Of course, economic level of people has a crucial role in changing prevalence of CVD risk factor in each population. In this context, Christopher[22] showed that non-communicable diseases caused 34% of deaths among the poor and up to 85% of deaths among the richest sections of the population. The transition from poverty to affluence is likely to lead to a decline in communicable diseases compared to non-communicable diseases. In many countries, this transition tends to favor the adoption of atherogenic diets and physical inactivity, which are considered to be major

CHD risk factors.[23-26] However, more epidemiological studies are needed in each region of our country to provide baseline data against which future trends in risk factor levels can be assessed and preventive strategies planned.

This research also indicated that based on implementing and monitoring IHHP program, CVD risk factors had a decreasing trend with the study follow-up time. In the developed world, increased awareness and education about diet and lifestyle risk factors may have been partly responsible for the decline in CHD prevalence among the higher social classes. However, the situation in developing countries is different. Rapid industrialization and urbanization have brought about enormous changes in dietary patterns and lifestyles.[27] This is most obvious among higher socio-economic status groups, which tend to experience greater prevalence of CHD risk factors.[28]

CONCLUSION

Overall, this research results showed that the prevalence of diabetes, hypertension obesity, and dyslipidemia are more in illiterate subjects and prevalence of diabetes and hyperlipidemia was sharply decreased with education level. But, it seems that well educated participants have higher daily physically activity compared with those who have lower education without considering the place or residency.

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