Abstract

To evaluate the effect of some environmental factors on smoking, and to assess some health hazards of smoking in adolescents, this cross-sectional study was performed among 1950 students, ages11-18, selected by multi-stage random sampling from three cities in Iran. According to self-administered questionnaires, 12.9% of boys and 4% of girls reported to be smoker (OR=3.34, 95%CI: 2.33, 4.77, $p<0.001$). The mean values of total- and LDL-cholesterol were higher in smokers and their HDL-C was lower than non-smokers (163.33± 33.83, 90.73± 31 and 46.7± 12.24 vs.156± 29.53, 85±26.5 and 49.4±13.7 mg/dl, respectively, $p<0.05$). The mean systolic and diastolic blood pressures were higher in smokers than non-smokers (110.7± 14.5, 67.6± 11.55 vs. 104.9± 14.3, 63.2± 10.8 mmHg, respectively, $p<0.05$). The smokers had higher BMI than non-smokers (20.34 ±3.84 vs. 19.55 ± 3.66, $p<0.05$). The mean food consumption frequency was lower for fruits and vegetables and higher for fat/salty snacks and fast foods in smokers than non-smokers. Logistic regression analysis showed significant association between sex, age, the number of family members and number of smokers in the family and smoking in students. The findings of this study have implications for future tobacco prevention strategies through community-based interventions. ***Asia Pac J Public Health 2004; 16(1): 15–22.***

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Smoking, Adolescents and Health: Isfahan Healthy Heart Programme-Heart Health Promotion from Childhood

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Introduction

Health–risk behaviours are often established during youth, extend into adulthood and are preventable. Smoking causes mortality of nearly four million a year and this is estimated to rise to 8.4 million by the year 2020, 70% of which occurs in developing countries[1-2]. Although in recent years the health programs in developed countries has led to some decrease in smoking, it has been spreading rapidly among young people in developing countries[3]. Different studies reveal that both in developing or developed countries, the smoking prevalence in the young is going to increase and the age of starting to smoke has decreased[4-5].

Cigarette smoking among adolescents co-occurs with the use of other substances[2]. In addition, it has been worthy of attention worldwide as one of the leading causes of preventable premature death[6]. Considering that starting smoking from younger ages multiplies its hazards, the necessity of paying more attention to its prevention from adolescence is emphasized[7].

Assessment of effective factors of adolescents' preference for smoking can be useful in tobacco control plans. One of the effective factors in this regard is smoking in the family[8]. Surveys show that the most preference for smoking has been in the ages of 11-17; it is recommended to increase the awareness about the smoking hazards from the early school years for better prevention of such preferences[9].

In addition, smoking or even prolonged exposure to the cigarette

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smoke are important risk factors for non-communicable diseases especially cardiovascular diseases (CVD). This can be due to dyslipidemia in the form of increase in triglyceride, total cholesterol (TC) and LDL-C, decrease in HDL-C and or due to insulin resistance[11-12].

Studies have shown differences between weight, body mass index (BMI), duration of TV watching and dietary habits of adolescent smokers and the others[13].

Data concerning smoking among adolescents in Iran are limited. This study performed in three cities in Iran as the first phase of a longitudinal study aimed to determine the prevalence of cigarette smoking in adolescents, its relation to some environmental factors and differences in CVD major risk factors and some related lifestyle habits between smoking and non-smoking adolescents. Its findings can provide some insights for planning community-based interventions to reduce priority health- risk behaviours among youth.

Subjects and Methods

An integrated comprehensive community-based program for CVD prevention and control called Isfahan Healthy Heart Program (IHHP) including eight projects with different target groups is now being carried out in Iran by the Isfahan Cardiovascular Research Centre and Isfahan Provincial Health Office on a population of 20000. The program methodology is described elsewhere[14]. The present results are from the first phase (the present situation analysis) of one of its projects: Heart Health Promotion from Childhood (HHPC) and indicates the situation before interventions.

Two intervention counties (Isfahan and Najaf Abad) and one reference county (Arak), all located in the central part of Iran were selected. Besides annual evaluation, after five years (2005) the post intervention outcomes will be evaluated and compared.

The population studied by HHPC consisted of 2000 students (1000 girls, 1000 boys) aged between 11-18, selected by multi-stage random sampling from 56 middle and high schools of different urban and rural areas of three counties. Regarding their population distribution according to the national population census 1999, the rural ratio of studied subjects was 30%, 45% and 35%, respectively. Initially, census blocks based on data of the Iranian Ministry of Health were randomly selected. Schools were randomly selected from different randomly selected clusters of these blocks and within schools, the students were selected at random.

The principal, the superintendent, the student counsellor, the health care professional, the exercise instructor, and four randomly selected biology teachers in each school, filled out the questionnaire. In addition to students, one of their parents (2000 samples) and 500 school staff members have been studied.

Teams including expert nurses had been specially trained for one week aimed at this survey to carry out the examination. All instruments had been standardized before the examination and zero was calibrated on the balances and sphygmomanometers.

Written informed consent was obtained from parents of pupils for blood sampling after full explanation of the procedure. It was distributed in schools to be taken home by pupils and returned.

Three structured questionnaires (for students, parents and school staff) were prepared and their validity was confirmed after a pilot study, then were completed in the sample size of 100, 50 and 50 students, parents and school staff members, respectively. Their content validity was considered to be supported based on the observation of a panel consisting of the experts of the Research Method Committee - and Research Council of Isfahan Cardiovascular Research Centre. Item analysis and reliability measures were assessed based on the response of 100 students, 50 parents and 50 members of the school staff. Cronbach alpha reliability coefficient was assessed for the different concepts.

The student questionnaire included demographic information, questions about knowledge, attitude and practice (KAP) in relation to smoking and tobacco consumption in the family, physical activity and a 20-item food frequency questionnaire. The students' and the school staff's questionnaires were completed confidentially in schools. A three-day food record form (one weekend and two school days) for students and the parents' questionnaires were filled at home and returned to school.

In schools, the student's weight was measured to the nearest 200 grams with subjects being lightly dressed and barefoot and standing height to the nearest 0.2 cm. Physical examination and venous blood sampling (after $\geq$12 hours of fasting) were made during 8:00-9:30 AM during the school days.

The blood samples were centrifuged for 10 minutes at 3000 rpm; sera frozen at –20°C and transported to the Isfahan Cardiovascular Research Centre laboratory, which is under external quality control of St. Rafael University, Department of Epidemiology, Leuven, Belgium. TC, HDL-C and TG were measured by enzymatic method using an Elan 2000 auto analyzer (Ependrof, Germany). LDL-C was calculated (in serum samples with TG$\leq$400mg/dl) according to the Friedwald formula[15].

The Mercury sphygmomanometer with suitable cuff sizes for each subject was used for measuring sitting blood pressure two times from the right arm under the criteria of the World Health Organization (WHO). The mean of two measurements of Korotkoff phase I and the mean of two values of phase IV were recorded for systolic (SBP) and diastolic blood pressure (DBP), respectively. The economic status of family was evaluated by questions based on data from the Iranian Plan and Budget Organization.

Data concerning dietary intake was evaluated and analysed by a specialized nutritionist. Those students who reported to smoke at least one cigarette per day were defined as being smokers.

Statistical analysis

Data were analysed using the SPSS statistical package version 11 for windows (SPSS Inc., Chicago, USA) by Chi Square, the student t test and logistic regression analysis. The

Mantel-Hanzel test was used to compare the prevalence of smoking adjusted for age and sex. The interaction between smoking and different variables was evaluated by multivariate analysis. Results were deemed to be significant when the probability value was <0.05.

Results

In this study, 1950 students (97.5%), the same number of parents (97.5%) and 469 of school staff members (93.8%) replied on the questions about smoking in the distributed questionnaires.

From the 1950 questionnaires of the students, 51.4% (n=1004) were girls and 48.5% (n=946) boys. Overall, 64.3% (n=1254) of students were from urban and 35.7% (n=696) from rural areas. 8.7% (169) of all students (4% of girls and 12.5% of boys) reported to be smokers (P<0.001). In this study, 23.6% of the smokers were girls (n=40) and 76.4% (n=129) were boys (OR: 3.34, 95% CI: 2.33, 4.77, p<0.001).

The mean age (±standard deviation) of smokers was higher than non-smokers (14.7±1.68 and 13.97±1.69 years, respectively, p<0.001). The mean age of smoking was not significantly different in girls and boys (14.6±1.7vs. 14.8 ±1.69 years, respectively p=0.5).

As shown in Table 1, there were no smokers in the home of 49.7% (n=84) of students who smoked and 60% (n=1068) of non-smokers (p=0.012). Comparing urban and rural areas, the prevalence of smoking was higher only in the urban area of Isfahan city and this difference was not significant between Najaf-Abad and Arak (Table 2).

Considering the KAP, 76.6% of students, 75.2% of parents and 86.7% of school staff members believed that children having parents who smoked had a greater chance of becoming smokers in future (Table 3), but the prevalence of smoking in students was not significantly different in those with or without this belief (p=0.95). Among students, 76.5% of non-smokers and 77.5% of smokers had this belief (p=0.99). In addition, 67.6% of students mentioned that TV programs had a positive role in promoting their knowledge about smoking health hazards, while 5.8% of them had been informed of this by members of their school staff. There was no significant difference between smokers and non-smokers in this regard.

The mean (±SD) of some major CVD risk factors are shown in Table 4. The mean value of TC and LDL-C were significantly higher in adolescents smokers and their HDL-C was lower than non-smokers, their TG level was not significantly different; the mean SBP and DBP were also higher in smokers. The mean value of body mass index (BMI) was higher in smokers than non-smokers (20.34± 3.84 vs. 19.55± 3.66 kg/m^2, respectively, p=0.009).

The mean consumption frequency of some kind of foods among the two groups is presented in (Table 5) and shows lower

Table 1. Number of smokers in the families of smoking and non-smoking students

Number of smokers in family	Smoker students n (%)	Non-smoker students n (%)
None	84(49.7)	1068 (60.0)
One	65(38.5)	600 (33.7)
Two	14 (8.3)	84 (4.7)
More than two	6 (3.6)	29 (1.6)
Total	169 (8.0)	1781 (91.0)

χ^2, p=0.012

Table2. Smoking prevalence in urban and rural areas

	Urban n (%)	Rural n (%)	OR[1]	95% CI[2]	p value[3]
Isfahan	41 (87)	6 (23)	3.12	1.34 - 7.250	0.004
Najaf Abad	11 (38)	18 (62)	0.70	0.40 - 1.037	0.164
Arak	53 (57)	40 (43)	1.47	0.95 - 2.250	0.075

[1]Odds Ratio, [2]95% Confidence Interval, [3]p value of Chi-square

Table 3. Students', parents' and school staff's viewpoints on the effects smoking parents have on their adolescent children.

Group	Has effect n (%)	No effect n (%)	No idea n (%)
Students	1494 (76.6)	195(10.0)	261(10.0)
Parents	1467 (75.2)	228 (11.7)	255 (13.1)
School Staff	404 (86.1)	359 (7.6)	29 (6.3)

Table 4. Comparison of mean ±SD of some major cardiovascular disease risk factors in smoking and non-smoking students

Variable		Smokers	Non-smokers	p value*
Cholesterol	(mg/dl)	163.33±33.83	156.0 ±29.53	0.007
Triglyceride	(mg/dl)	119.20±50.40	119.8 ±53.40	0.880
LDL-C	(mg/dl)	90.73±31.00	85.0 ±26.50	0.024
HDL-C	(mg/dl)	46.70±12.24	49.4 ±13.70	0.011
SBP[1]	(mmHg)	110.70±14.50	104.9 ±14.30	0.001
DBP[2]	(mmHg)	67.60±11.55	63.2 ±10.80	0.040

*p value of t test, [1]Systolic blood pressure, [2]Diastolic blood pressure

consumption of fruits and vegetables and higher consumption of fast foods and salty/fat snacks among smoker adolescents. Duration of watching TV was higher among the students who smoked when compared to non-smokers (4.51± 2.14 vs. 3.92± 1.2 hours/day, respectively, p=0.021).

The odds ratio (OR) of smoking for those students with parents who smoked and others was 1.56 (95%CI: 1.1, 2.07, p=0.01), the OR of smoking for the students whose parents disagreed with extracurricular sports for their children was 1.68 (95%CI: 1.22, 2.32, p=0.001).

There was a significant difference between the levels of education of fathers who smoked and did not smoke; meanwhile, such difference was not significant between their mothers (Table 6). The prevalence of smoking was not different between adolescents with different socio-economic levels.

With a sensitivity of 91%, the logistic regression analysis showed that age, sex, education level, the number of smokers in family and the number of family members highly predicted the smoking in adolescents (Table 7). In addition, as the standard error (SE) of ß coefficient for SBP, and BMI was greater than the ß coefficient, so in spite of non-significant p values, the expected ß was considered of more significance than their p values.

Table 5. Frequency of food consumption (time/week) in smoking and non-smoking students

	Smoker	Non-smoker	p[1]
Red meat	3.04±1.69	2.8 ±1.69	NS
Chicken	1.8 ±0.6	1.5 ±0.4	NS
Fish	0.5 ±0.1	0.6 ±0.2	NS
Soy	0.9 ±0.02	0.7 ±0.5	NS
Dairy products	5.9 ±2.7	5.8 ±2.1	NS
Bread	10.4 ±3.2	11.2 ±2.8	NS
Rice	5.8 ±1.8	5.4 ±1.7	NS
Potato	3.6 ± 0.7	3.8 ±0.2	NS
Cereal	3.2 ±1.2	3.7 ±1.5	0.03
Vegetables	3.7 ±1.1	5.1 ±1.0	0.02
Fruits	4.2 ±1.7	5.1 ±2.1	0.04
Salad	2.1 ±0.7	3.3 ±0.8	0.02
Fast foods	1.9 ±0.2	0.7 ±0.4	0.04
Salty/fat snacks	3.7 ±0.8	2.2 ±0.6	0.04

[1]p value of t test, NS=Not significant

Discussion

In the present study, despite the appropriate knowledge of students and parents, smokers or non-smokers alike, on smoking hazards and effect of environmental and familial factors in children's preferences to smoking, there was no significant difference between their practices in this regard.

Studies have shown a relationship between parent and adolescent smoking[4] and parents who smoke are considered as one of the contributing factors in tendencies to take up smoking, like friends who smoke[16]. In the present study 40% of non-smokers and 60% of smokers have at least one smoker member in their family who smoked which is consistent with other studies in which 40% of adults have been reported as smokers[17]. The finding of the youth tobacco surveillance study showed that in USA, 70% of middle school and 57% of high school students who smoked had a family member who smoked[18]. In the study of Yorulmaz *et al.* in Turkey, 71.9% of parents smoked at home and 47.2% of non-smokers had parents who smoked[19].

The socio-economic conditions were not shown to be an important factor for preferences to smoke in this study, though in some other studies, such preferences had been mostly seen among the poor socio-economic class. However, in some developed and

Table 6. The level of education of parents of smoking and non-smoking students

		Girls		Boys		Total	
		Smoker	Non-smoker	Smoker	Non-smoker	Smoker	Non-smoker
Father's Level of Education	Elementary	8 (20)	152 (15.7)	30 (23.3)	103 (12.6)	38 (22.4)	255 (14.3)
	High School	30 (75)	679 (70.3)	78 (60.4)	577 (70.6)	108 (63.9)	1256 (70.5)
	University	2 (5)	13 (14)	21 (16.4)	136 (16.8)	23 (13.7)	269 (15.2)
	p value[1]	0.25		0.005		0.018	
Mother's Level of Education	Elementary	12 (30)	269 (27.9)	38 (29.4)	181 (22.1)	50 (29.5)	450 (25.2)
	High School	28 (70)	633 (65.6)	86 (66.6)	578 (70.7)	114 (67.4)	1211 (70.5)
	University	-	62 (6.5)	5 (4)	58 (7.2)	5 (3.1)	120 (6.8)
	p value[1]	0.25		0.102		0.102	

[1]Mantel-Hanzel test

developing countries, this difference has been significant[4,19-20]. This can be interpreted as a reflection of socio-cultural differences.

The findings of the present study are in line with the Brooke information assessment in which there was no significant difference between two groups of children having either parents who smoked or did not smoke regarding their knowledge about smoking, meanwhile preference for smoking in the children having parents who smoked was significantly more than the others[8].

In the present study according to a self-administered questionnaire, 8.7% of the students reported to smoke at least one cigarette per day. It is obvious that some others must have denied the fact (of being smokers); as in the other study performed in Isfahan in 1996, where none of the students claimed to be smoker. Meanwhile their cotinine test had shown that 14.7% of boys and 10.2% girls were smokers[21].

Many studies have been performed about smoking in youth, with variations in study design, age group of subjects studied and measures of smoking behaviour in different studies, so their findings cannot be precisely comparable with the present study, however, such comparisons can provide some insights about different communities. In a study in Scotland, on the basis of questionnaires, 9% of boys and girls were smoking[19], in some other European countries the prevalence of smoking in the 15-year group varied from 18% in Denmark to 23.6% in Germany[4]. Data about adolescents' smoking in the eastern Mediterranean region (EMRO) is limited. The study of Maziak in Syria showed that 16% of boys and 7% of girls attending high school were current smokers[22]. A study performed among high school boys in the United Arab Emirates demonstrated that 19% of them were current smokers and 54% of smokers started smoking between 10 to 15 years of age[23]. The study of Sugathan *et al.* performed among university male students in Kuwait revealed that 30% of the students started smoking by age 20 and 50% by age 24[24]. In another study, 34.4% of adult males in Kuwait were current smokers and 17.7% were former smokers with the highest probability of starting smoking in the age group of 15-20 years[25]. These studies can indirectly show a high prevalence of smoking among Kuwaiti adolescents. In an epidemiological study performed among individuals aged above eight years in Pakistan, the overall prevalence of smoking was 14.2% in individuals aged above eight and 19.4% among those aged more than 15 years[26]. The survey of Omair *et al.* among medical students of a university in Pakistan revealed 26% of male and 1.7% of female students to be smokers[27]. In another study performed among adults living in a rural area of northern Pakistan, the age-standardized prevalence of smoking was 40.5% for men and 6.3% for women, the majority of whom started smoking quite early in life[28]. According to the results of these studies, it can be assumed that smoking is prevalent among adolescents in Pakistan. In the survey of Idris *et al.* in Sudan, the prevalence of smoking was 2% among subjects aged 4-17 with a sharp increase up to 25% in late adolescence[24].

A study performed in the last decade among university students in Egypt, 52% of males and 9% of females were smokers with 80% of males and 57% of females starting smoking before reaching 18 years of age[20]. Overall, the findings of these studies demonstrate that smoking in youth is a major public health problem in developing countries in EMRO.

In many European countries, smoking was mostly seen in girls rather than boys[4]. The surveys performed on both genders in EMRO and many other Asian countries found a higher prevalence of smoking among females[19-20,22,26-28,30]. In the current study, the prevalence of smoking in girls was significantly lower than boys, but we should not ignore the increasing rate of smoking among girls in comparison to the previous research in our community where none of the girls had mentioned being smokers in their questionnaires[21]. In the present study, the mean age of starting to smoke among the girls was lower than boys, although this difference was not significant, but it is consistent with the other data showing lower ages of smoking in girls[4,31].

A meta-analysis on 20 epidemiological studies showed a significant relationship between smoking or passive smoking and CVD[32]. The meta-analysis performed by Craig *et al.* demonstrated that, when compared with non-smokers of similar age, smokers in the 8- to 19-year- old age group had significantly higher serum levels of TG (+11.8%)

Table 7. Logistic regression analysis of different factors on smoking

	OR (EXP(ß))[1]	Sig	SE[2]	ß
Sex	3.52*	<0.0001	0.2	0.892
Age	1.28*	<0.0001	0.05	0.19
Number of smokers	1.48*	<0.0001	0.11	0.39
Education level	1.78*	0.0001	0.18	0.31
TV watching	1.05	0.199	0.039	0.05
Type of house[3]	0.89*	0.63	0.24	-0.114
BMI	1.02*	0.34	0.022	0.021
Number of family members	1.002*	0.96	0.049	0.002
Social class	0.93	0.98	0.18	0.24
SBP[4]	1.005*	0.52	0.008	0.005
DBP[5]	1.01	0.25	0.012	0.014

*Significant OR, [1]Odds Ratio (expected ß, [2]Standard Error, [3]Rental or private, [4]Systolic Blood Pressure, [5]Diastolic Blood Pressure

and LDL-C (+4.1%) and significantly lower serum levels of HDL (-8.5%) and TC (-3.7%). All these smoking-associated changes were in line with those found in adults except for TC[33]. Also, in the study of Bermingham *et al.*, adolescent smokers had lower TC levels than non-smokers[34]. In the present study as well, TC was significantly higher in adolescent smokers. In the study of Facchini *et al.*, the mean value of TC and TG was higher and HDL-C was lower in smoker adolescents[12], the study of Brischetto *et al.* and Sinha *et al.* showed similar results in adults[35-36]. Findings of the present study are consistent with these studies regarding TC and HDL-C but not for TG.

In the study of Cundiff, smokers had higher levels of LDL-C and TG, and lower levels of HDL-C than non-smokers, findings of the present study is in line with his study regarding LDL-C and HDL-C[37]. As Altuntas *et al.* have shown smoking hazards even on LDL oxidation, it is recommended to perform further studies in this regard[38].

Several researches have shown an association between smoking and improper dietary habits increasing the susceptibility to non-communicable diseases especially CVD. Such food style included high cholesterol - and limited fruit and vegetable consumption[13,37,39]. Some studies have shown higher vegetable and fruit consumption in non-smokers whereas fat consumption and eating fast food have been demonstrated to be higher among smokers[30,40]. In the present study, as well, smoker adolescents consumed more fast foods, fat/salty snacks and less fruit and vegetable than the others. These findings are in line with the study of Yorulmaz *et al.* in Turkey; they found that while fast food consumption was higher among smokers, vegetable, fruit and meat consumption, as well as having breakfast rates were lower[19]. In the study of al Senaidy and colleagues, students who smoked had significantly higher serum levels of lipid peroxides and significantly lower serum concentration of beta-carotene than non-smokers[41]. In the study of Dietrich and colleagues, serum antioxidant levels has been lower in smokers than the others even after adjusting the amount of antioxidant intake, which shows another health hazard of smoking[42]. It is suggested that the combination of cigarette smoking and low dietary intake of antioxidants may provoke damage by oxidants present in cigarette smoke. Future studies are recommended in this area.

A survey performed in France showed that most of the patients suffering from hypertension had a history of smoking and a survey in England also showed higher prevalence of hypertension among smokers with lower rate of diagnosis and treatment compliance than the others[43-44]. The study of Foucan and colleagues revealed that after obesity and dyslipidemia, smoking is the third risk factor for hypertension[45]. In the present study, the mean SBP and DBP of smokers were higher than others and considering the long-lasting effect of smoking on hypertension, it is suggested that many of the adolescents smokers will suffer from hypertension later in life.

Researchers have shown the relationship between smoking and gaining or reducing weight[46-49]. Lowry and colleagues have shown a direct relationship between adolescents' BMI and smoking[50]. In the study of Raftopoulos *et al.* on male volunteers aged 15-18, students who reported having smoked regularly had higher mean BMI than non-smokers and BMI tended to higher in the longer-term smokers[51]. In the present study as well, the mean BMI in smokers was more than the others. This finding is suggested to be in consequence with their improper dietary habits and physical inactivity.

A study in US revealed that the odds of smoking was 5.99 to 1 for adolescents watching TV more than five hours/day in comparison with those watching TV less than two hours/day[52]. In the present study, the mean duration of watching TV among the smokers was also more than the other. However in the present study, TV watching had no predictive value on smoking, this is suggested to be partly because tobacco advertisements are banned due to Government regulations. In addition, the wide distribution in TV watching time, can be assumed to be the reason for this result in the logistic regression analysis. Considering the other, findings of this study, that parents of smokers' had opposed regular extracurricular exercise for their children, the longer duration of watching TV might have been in relation to the lack of tendency to physical activity and exercise among smokers. Considering that this is similar to many other countries, the most common extracurricular activity of children and adolescents in our community is TV watching, and considering the key role of mass media, prevention projects with TV programming can be of value in the primary prevention of smoking in adolescents[53,54]. Such programs are shown to be effective in promoting the KAP of adolescents and their families about smoking hazards[55-56].

In this study, those students who reported to be smokers had different lifestyles in comparison to others and their fathers' education levels were significantly lower. This finding is contrary to the finding in the study performed in the United Arab Emirates showing the highest prevalence of smoking among sons of university graduates, and the lowest among sons of illiterate fathers[23].

Considering that the odds ratio of smoking in adolescents was higher in those with parents opposed to their extracurricular sport activities, it is suggested that the pressure to conform to a sedentary lifestyle may make adolescents more susceptible to negative habits such as smoking and also having even one smoker in the family had significant effect on the adolescents' smoking preference, it is necessary to consider on the importance of family lifestyle changes and the fact of forming habits from early life.

In addition, in the present study, few students had been informed of smoking hazards by their teachers and school staff, this finding has implications for future smoking prevention strategies in schools.

Smoking had an appreciable impact on major CVD risk factors and it is suggested to perform long-term longitudinal studies in this area.

One of the limitations of this study is the use of a self-administered questionnaire to identify smoker students, which can increase the possibility of underreporting by the

smoker. The cotinine level was not measured, but the prevalence of smoking in the present study is consistent with a previous research in Isfahan, which was based on cotinine level[21]. In addition, the 4-time repetition of the present study (for its process-and outcome evaluation) will give more information in this area. In addition, the questionnaire did not inquire about the length of time and the number of cigarettes that had been smoked. Another limitation is that the processes by which teenagers are socialized to smoke, including both being influenced by and influences on their parents and or friends has not been evaluated.

Evaluating the health consequences of smoking needs long term cohort studies and can not be appropriately assessed by such cross-sectional study; it is suggested that this can be assessed more precisely in the third phase of this study which would be performed five years after the present study.

Conclusion

This study presents a framework for longer local epidemiological studies with long term follow up to confirm the current findings. As mentioned, present data are based on the results of the first phase of the study, and currently vast interventions are performed in Isfahan and Najaf-Abad, while Arak remains as the reference. The main objective of interventions is to increase health knowledge and enhance health beliefs, which in turn can contribute to healthy behaviour. In addition to annual surveys, the outcome evaluation will be done in the fifth year that will indicate the usefulness of interventions and aim approaches. Future studies should use objective measures of carbon monoxide or cotinine levels for smoking and also should use further refined models to identify other potential factors involved in smoking among youth in developing countries.

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References

1. Murray CGL, Lopez AD. Alternative projections of mortality and disease by cause, 1990-2020: Global Burden of Disease Study. Lancet 1997; 349: 1498-504.
2. Center for Disease Control and Prevention. Preventing tobacco use among young people: A report of the Surgeon general. MMWR Recomm Rep 1994; 43: 1-10.
3. Mackay J, Crofton J. Tobacco and the developing world. Br Med Bull 1996; 52: 206-21.
4. Griesbach D, Amos A, Currie C. Adolescent smoking and family structure in Europe. Soc Sci Med 2003; 56: 41-52.
5. Fleming CB, Kim H, Harachi TW, Catalanno RF. Family process for children in early elementary school as predictor of smoking initiation. J Adolesc Health 2002; 30: 184 – 9.
6. Center for Disease Control and Prevention. Tobacco use-United States 1900-1999. MMWR 1999; 48: 986-93.
7. DuRant RH, Smith JA, Krowchuk DP. The relationship between early age of onset of initial substance use and engaging in multiple health risk behaviors among young adolescents. Arch Pediatr Adolesc Med 1999; 153: 286-91.
8. Brook U, Mendeklberg A, Galili A, Priel I, Bujanover Y. Knowledge and attitudes of children towards cigarette smoking and its damage. Patient Educ Couns 1999; 37: 49-53.
9. Chassin L, Presson CC, Sherman SJ, Mc Grow J. The changing smoking environment for middle and high school students. J Behav Med 1987; 10: 581–93.
10. Bauman KE, Laprelle J. The influence of three mass media campaigns on variable related to adolescent cigarette smoking: results of a field experiment. Am J Public Health 1991; 81: 597-604.
11. Criqui MH, Cowan LD, Tyroler HA, Bangdiwala S, Heiss G, Wallance RB, Cohn R. Lipoproteins as mediators for the effects of alcohol consumption and cigarette smoking on cardiovascular mortality: Results from the Lipid Research Clinics follow-up study. Am J Epidemiol 1987; 126(4): 629-37.
12. Facchini FS, Hollenbeck CB, Jeppesen J, Chen YD, Reaven GM. Insulin resistance and cigarette smoking. Lancet 1992; 339(8802): 1128-30.
13. Brox J, Bjornstad E, Olaussen K, Osterud B, Almdahl S, Lochen ML. Blood lipids, fatty acids, diet and lifestyle parameters in adolescents from a region in northern Norway with a high mortality from coronary heart disease. Eur J Clin Nutr 2002; 56(7): 694-700.
14. Sarraf-Zadegan N, Sadry G, Malek AH, Baghai M, Mohammadifard N, Shahrokhy S, *et al*. Isfahan Healthy Heart Program: A comprehensive integrated community-based program for cardiovascular disease prevention and control. Acta Cardiol 2003; 58(4): 309-20.
15. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma without use of the preparative ultracentrifuge. Clin Chem 1972; 18: 499-502.
16. Peters J, Heidley AJ, Lam TH, Liv J, Wong CM, Ong SG. Factors influencing smoking behavior in Hong Kong primary school children: Target for prevention. Asia Pac J Public Health 1995; 8: 102-8.
17. Center for Disease Control and Prevention. Projected smoking related death, among youth - United States. MMWR 1996; 95; 971-4.
18. Youth tobacco surveillance-United States, 2000. MMWR Surveill Summ 2001; 50: 1-84.
19. Yorulmaz F, Akturk Z, Dagdeviren N, Dalkilic A. Smoking among adolescents: relation to school success, socioeconomic status, nutrition, and self-esteem. Swiss Med Wkly 2002; 132: 449-54.
20. Gadalla MA, Gabal MS, Khella AK. When and why Ain Shams University students started smoking? J Egypt Public Health Assoc 1992; 67(3-4): 275-90.

21. Sarraf-Zadegan N, Boshtam M, Shahrokhi SH. Tobacco use among Iranian woman and adolescents. Eur J Public Health (in press).
22. Maziak W. Smoking in Syria: Profile of a developing Arab country. Int J Tuberc Lung Dis 2002; 6(3): 183-91.
23. Bener A, al Ketbi LM. Cigarette smoking habits among high school boys in a developing country. J R Soc Health 1999; 119(3): 166-9.
24. Sugathan TN, Moody PM, Bustan MA, Elgerges NS. Age patterns of smoking initiation among Kuwait university male students. Soc Sci Med 1998; 47(11): 1855-8.
25. Moody PM, Memon A, Sugathan TN, el-Gerges NS, al-Bustan M. Factors associated with the initiation of smoking by Kuwaiti males. J Subst Abuse 1998; 10(4): 375-84.
26. Nasir K, Rehan N. Epidemiology of cigarette smoking in Pakistan. Addiction 2001; 96(12): 1847-54.
27. Omair A, Kazmi T, Alam SE. Smoking prevalence and awareness about tobacco related diseases among medical students of Ziauddin Medical University. J Pak Med Assoc 2002; 52(9): 389-92.
28. Shah SM, Arif AA, Delclos GL, Khan AR, Khan A. Prevalence and correlates of smoking on the roof of the world. Tob Control 2001;10(1):42-7.
29. Idris AM, Ibrahim YE, Warnaku lasuriya KA, Cooper DJ, Johnson NW, Nilsen R. Toombak use and cigarette smoking in the Sudan: estimates of prevalence in the Nile State. Prev Med 1998; 27(4): 597-603.
30. Juon HS, Shin Y, Nam JJ. Cigarette smoking among Korean adolescents: Prevalence and correlates. Adolescence 1995; 30: 631-42.
31. Kinght JC. Assessing smoking prevalence among children in health board region. Scott Med J 2000; 45(1): 8-11.
32. He J, Vupputturi S, Allen K. Passive smoking and risk of coronary heart disease - a meta analysis of epidemiologic studies. N Engl J Med 1999; 340: 920-5.
33. Craig WY, Palomaki GE, Johnson AM, Haddow JE. Cigarette smoking-associated changes in blood lipid and lipoprotein levels in the 8-to19-year-old age group; a meta analysis. Pediatrics 1990; 85(2): 155-8.
34. Bermingham MA, Jones E, Steinbeck K, Brock K. Plasma cholesterol and other cardiac risk factors in adolescent girls. Arch Dis Child 1995; 73(5): 392-7.
35. Brischetto CS, Connor WE, Connor SL, Matarazzo JD. Plasma lipid and lipoprotein profiles of cigarette smokers from randomly selected families: Enhancement of hyperlipidemia and depression of high-density lipoprotein. Am J Cardiol 1983; 52(7): 675-80.
36. Sinha AK, Misra GC, Patel DK. Effect of cigarette smoking on lipid profile in the young. J Assoc Physicians India 1995; 43(3): 185-8.
37. Cundiff DK. Diet and tobacco use: Analysis of data from the diabetic control and complication trial, a randomized study. MedGenMed 2002; 4(1): 2.
38. Altuntas I, Dane S, Gumustekin K. Effects of cigarette smoking on lipid peroxidation. J Basic Clin Physiol Pharmacol 2002; 13(1); 969-71.
39. Fitzgerald AL, Maclean DR, Veugelers PJ. Dietary reference intakes: a comparison with the Nova Scot Nutrition Survey. Can J Diet Pract Res 2002; 63(4): 176-83.
40. Scarinci IC, Robinson LA, Alfano CM, Zbikwoski SM, Klesges RC. The relationship between socioeconomic status, ethnicity, and cigarette smoking in urban adolescents. Prev Med 2002; 34: 171-8.
41. al Senaidy AM, al Zahrany YA, al Fageeh MB. Effects of smoking on serum levels of lipid peroxides and essential fat-soluble antioxidants. Nutr Health 1997; 12(1): 55-65.
42. Dietrich M, Block G, Norkus EP, Hudes M, Traber MG, Cross CE, Packer L. Smoking and exposure to environmental tobacco smoke decrease some plasma antioxidants and increase gamma-tocopherol in vivo after adjustment for dietary antioxidant intakes. Am J Clin Nutr 2003; 77(1): 160-6.
43. Asmar R, Vol S, Pannier B, Brisac AM, Tichet J, El Hasnaoui A. High blood pressure and associated cardiovascular risk factors in France. J Hypertens 2001; 19(10): 1727-32.
44. Gulliford MC. Low rates of detection and treatment of hypertension among current cigarette smokers. J Hum Hypertens 2001; 15(11): 771-3.
45. Foucan L, Bangou-Bredent J, Ekouevi DK, Deloumeaux J, Roset JL, Kangambega P. Hypertension and combinations of cardiovascular risk factors. An epidemiologic case-control study in an adult population in Guadeloupe (FWI). Eur J Epidemiol 2001; 17(12): 1089-95.
46. Tomeo CA, Field AE, Berkey CS. Weight concerns, weight control behaviors, and smoking initiation. Pediatrics 1999; 104: 918-24.
47. French SA, Perry CL. Smoking among adolescent girls: Prevalence and etiology. J Am Med Womens Assoc 1996; 51: 25-8.
48. French SA, Jeffery RW. Weight concerns and smoking. A literature review. Ann Behav Med 1995; 17: 234-44.
49. Camp DE, Klesges RC, Relyea G. The relationship between body weight concerns and adolescent smoking. Health Psychol 1993; 12: 24-7.
50. Lowry R, Galuska DA, Fulton JE, Wechsler H, Kann L. Weight management goals and practices among U.S. high school students: Associations with physical activity, diet, and smoking. J Adolesc Health 2002; 31(2):133-44.
51. Raftopoulos C, Bermingham MA, Steinbeck KS. Coronary heart disease risk factors in male adolescents, with particular reference to smoking and blood lipids. J Adolesc Health 1999; 25: 68-74.
52. Gidwani PP, Sobol A, DeJong W, Perrin JM, Gortmaker SL. Television viewing and initiation of smoking among youth. Pediatrics 2002; 110(3): 505-8.
53. Lopez GML, Lopez T, Comas FA, Herrero PP, Gonzalez BJ, Cueto EA, *et al*. Extracurricular activities of adolescents useful for smoking prevention programs. OCTOPUS team. Rev Esp Salud Publica 1999; 73: 343-53.
54. Kelishadi R, Hashemipour M, Ansari R, Rouhafza H, Sarrafzadegan N, Bashardoust N. Comparison of physical activity level among adolescents of Isfahan in 1994 and 2001. Res Med Sci 2002; 7(2): 112-7.
55. Pentz MA, Dwyer JH, Mac Kinnon DP, Flay BR, Hansen WB, Wang EY, Johnson CA. A multicommunity trial for primary prevention of adolescent drug abuse. Effects on drug use prevalence. JAMA 1989; 261: 3259-66.
56. Chew F, Palmer S, Slonska Z, Subbioh K. Enhancing health knowledge, health beliefs, and health behavior in Poland through a health promoting television program series. J Health Commun 2002; 7(3): 179-96.