Original Article

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Relationship between Blood Pressure and Passive Smoking in Elementary School Children

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Abstract

Objective: Many diseases form their basis during childhood. One example is the changes in vascular structure and function, leading to atherosclerosis. In this study, we have assessed the impact of exposure to cigarette smoke on blood pressure of elementary school children in Kermanshah.

Methods: 80 elementary school children exposed to cigarette smoke and 80 not exposed to smoke were studied in fall 2010. Information regarding the smoking status of parents and the children's health were obtained through questionnaires completed by parents. After physical examination and exclusion of those children with acute and chronic diseases as well as those consuming medicine, we measured and compared blood pressure in the exposure and non-exposure groups. Data were analyzed using the ANOVA statistical test. Values are expresses as Mean±SD.

Findings: The mean systolic and diastolic blood pressures of the exposure group were higher than those of the non-exposure group (109.3±9.97/64.92±7.36 vs105.47±8.98/62.5±7.01, respectively; CI: 0.95, $P<0.05$). Meanwhile, difference between two groups according to sex was not statistically significant.

Conclusion: Our study indicates that systolic and diastolic blood pressures are higher in those elementary school children exposed to cigarette smoke compared to those who are not.

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Key Words: Passive Smoking; Systolic Blood Pressure; Diastolic Blood Pressure; Elementary School Children

Introduction

Many diseases form their basis during childhood. One example is the changes in vascular structure and function, leading to atherosclerosis.

There is evidence corroborating the relationship of vascular dysfunction during the first decade of life with risk factors such as familial hypercholesterolemia and hypertension[1].

Cigarette smoking is a major factor contributing to atherosclerosis and hypertension. The role of cigarette smoke in vascular dysfunction is well established[2]. However, the question whether or not people exposed to cigarette smoke also develop these dysfunctions remains controversial.

Numerous studies have been conducted on adults exposed to passive smoking, particularly partners of smokers, and various aspects of cigarette smoke on these individuals have been evaluated[2,3,4,5-7]. However, only a few limited

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studies have addressed the issue of children exposed to passive smoke and the consequences on their blood pressure.[8,9,10,11]

Parental smoking affects children and neonates, and is associated with low birth weight, sudden infant death, asthma, bronchitis, pneumonia, otitis media, increased risk of contracting tuberculosis on exposure, Crohn's disease, learning disorders, development retardation and dental caries[12]. Nevertheless, it is not yet clear whether children exposed to passive smoke develop vascular dysfunction or major changes in blood pressure.

Since the impact of cigarette smoke on children's blood pressure will provide yet another logical reason for parents to quit smoking or avoid smoking in the presence of their children, we have conducted this study to assess this relationship.

Subjects and Methods

According to reference 8, standard deviation of blood pressure in exposed group was 4 mmHg and in not-exposed group was 3mmHg. Therefore, with precision of 7mmHg (α=0.01 and β=0.90), sample size for our study was 8 in each grade and sex and total sample size in both sexes and five grades was calculated as 80 (8×2×5 =80) in each group.

80 elementary school children exposed to cigarette smoke and 80 not exposed to smoke were studied in fall 2010. Range of age was7 to 12 years and average was 9.5 years in both groups. Passive smoking was defined as breathing in a place where another person has been smoking over a period of at least 3 years with a daily consumption of 5 cigarettes or more[13,8].

After acquisition of necessary permissions from the Department of Education of the province and its triple regions, 8 elementary schools in Kermanshah were selected through cluster sampling. In each school one class from each grade was randomly allocated. In each class, two exposed children and two cases of not-exposed children were selected. If we did not find enough cases of exposure in a grade, another school was substituted. Finally, 80 cases of exposed and 80 cases of not-exposed children with same sex and age were enrolled from 12 elementary schools. Subsequently, the principals and teachers were provided with enough information regarding the study, and questionnaires were submitted to parents to collect information regarding parental consent for participation in the study, as well as the health status of the children and their exposure to passive smoke. The questionnaires did not record the children's names and were only indentified with a code.

We asked about parents and other families' smoking habits who lived with the students and if the answer was positive continued questions about the location of smoking and how long and how many cigarettes do they smoke near their children?

Once the questionnaires were collected, their data were matched with those in the children's health certificate. Subsequently, the passive smokers of each class were identified and for each exposed child, one non-exposed counterpart of the same age and gender was randomly selected from the same class.

The exclusion criteria included: Chronic cardiac or renal diseases as expressed by parents or discovered in physical examination prior to measurement of blood pressure, any acute diseases, including respiratory and gastro-intestinal infections and consumption of any medicine, and discrepancy between information recorded in parental questionnaires and those in the children's health certificate.

During physical examination and measurement of blood pressure, we tried to render the children free of stress as much as possible. Therefore, the examinations were performed in school laboratories which created an attractive ambience for the students and also entailed the smallest stress and greatest facilities.

After explaining the situation to participants in a simplified language, the children were entertained with fruit snacks. Subsequently, both groups underwent cardiovascular examination and their blood pressures were recorded. The students did not have any activity for 15 minutes prior to blood pressure measurement and did not receive stimulant substances such as tea or coffee. The measurements were performed on the right

arm in the level of the heart and supported on a desk while the child was in a sitting position and his/her feet were on the ground. Appropriate cuff was defined as the width of cuff equal to 40% of arm circumference at the mid-arm. Systolic and diastolic blood pressures were measured using a digital instrument (E-7051-HEM Omron N_3 Intellisense, made in China) and repeated under the same conditions by a resident of pediatrics in the morning shift. Then, the mean of two measurements was noted. Systolic blood pressure was defined as first Korotkoff (K1) and diastolic as fourth or fifth Korotkoff (K4 or K5) sound.

Values are expresses as Mean±SD. A *P*-value <0.05 was considered statistically significant. Data were recorded and processed using SPSS software version 16. The values of blood pressure were compared for gender using one-way ANOVA test, and compared for gender and school grade using 2-way ANOVA test.

Findings

In this study, we measured the blood pressure of 160 elementary school (grades 1 to 5) children in Kermanshah in fall 2010. Thirty-two students were selected from each grade (consisting of 16 boys and 16 girls) equally distributed over the case and control groups.

The students were aged 6-12 years. The mean values of systolic and diastolic blood pressure of girls were 107.16±10 mmHg and 63.09±8.7 mmHg, respectively. For boys, the mean values of systolic and diastolic blood pressures were 107.16±9.32 mmHg and 63.98±7.13 mmHg, respectively.

In the exposure group, the mean values of systolic and diastolic blood pressures were 109.3±9.97 mmHg and 64.98±7.36 mmHg, respectively, while in the not-exposure group, the systolic and diastolic values were 105.47±8.98 mmHg and 62.15±7.01 mmHg, respectively.

The mean systolic and diastolic blood pressures of the exposure group were higher than those of the non-exposure group, with a confidence interval of 0.95 and *P* values of 0.012 and 0.016, respectively.

Girls exposed to cigarette smoke had a mean systolic blood pressure of 109.26±9.7 mmHg and a mean diastolic blood pressure of 64.66±10 mmHg, whereas girls not exposed to smoke had a mean systolic blood pressure of 105.06±10 mmHg and a mean diastolic blood pressure of 61.51±7.4, indicating no significant difference between the two groups (*P*=0.06 and 0.059, respectively).

Boys exposed to cigarette smoke had a mean systolic blood pressure of 109.34±10.3 mmHg and a mean diastolic blood pressure of 65.18±7.5 mmHg, whereas boys not exposed to smoke had a mean systolic blood pressure of 105.88±9.2 and a mean diastolic blood pressure of 62.79±6.61, also indicating no significant difference between the two groups (*P*=0.097 and 0.13, respectively) (Tables 1). Table 2 shows mean systolic and diastolic blood pressure in children exposed and not exposed to cigarette smoke according to their school grade.

Table 1: Comparison of mean (SD) systolic and diastolic blood pressure in exposed and non-exposed children to cigarette smoke

Blood Pressure	Gender	Exposed Mean (SD)	Not exposed Mean (SD)	*P* value
Systolic	Boys	109.34 (10.30)	105.88 (9.20)	0.1
	Girls	109.26 (9.70)	105.06 (10.00)	0.06
	Overall	109.30 (9.97)	105.47 (8.98)	0.01
Diastolic	Boys	65.18 (7.50)	62.79 (6.61)	0.1
	Girls	64.66 (7.30)	61.51 (7.43)	0.06
	Overall	64.92 (7.36)	62.15 (7.01)	0.02

SD: standard deviation

Table 2: Comparison of mean systolic and diastolic blood pressure in children exposed and not exposed to cigarette smoke according to their school grade

Blood Pressure	School grade	Exposed	Not exposed
Systolic	1	107.40	100.80
	2	104.34	106.47
	3	107.53	104.25
	4	111.16	104.84
	5	116.47	111.03
	Mean	109.41	105.54
Diastolic	1	62.72	60.12
	2	62.44	63.12
	3	64.12	61.19
	4	67.41	62.19
	5	67.91	64.13
	Mean	64.92	62.15

Discussion

Cigarette smoke consists of two constituents: 15% of cigarette smoke is the main stream and 85% is the side stream distributed into the environment from the burning cigarette between puffs[3].

While these two streams are similar in quality, their quantity differs as the amounts of carbonmonoxide, benzopyrene, ammonia and other carcinogenic substances are higher in the side stream than in the smoke inhaled by the smoker[4].

Passive smoking has been associated with endothelial damage in healthy children and young adults, suggesting early arterial damage[13]. The impact of cigarette smoke is exerted on peripheral vasculature via the above mentioned substances to disrupt the function of vascular endothelial cells and jeopardize perfusion to vital organs, resulting in disorders of peripheral vasculature and increased risk of cardiovascular diseases [4].

Our findings indicate that systolic and diastolic blood pressures are higher in the exposure group compared to the non-exposure group; however, after consideration of the gender variable, the difference between exposed and non-exposed girls and boys was not significant.

Previous studies conducted on the effects of cigarette smoke on children's blood pressure or studies on adults who were exposed to cigarette smoke in childhood have yielded different results. In the study of Simonetti et al. blood pressure was determined in 3786 preschool children and parents' smoking habits were documented. Significantly higher blood pressure values were observed in children of smoking parents. (the mean Sys BP in exposed children was +1.2 mmHg higher than in not-exposed children, $P<0.05$)[9].

In another study by Feely and Mahmood, acute changes of blood pressure before and after exposure to cigarette smoke were measured in 21 young adults and compared to 12 healthy controls. The findings indicated that exposure to cigarette smoke after 60 minutes only resulted in systolic hypertension in brachial artery and aorta in the male group. The diastolic blood pressure in aorta and brachial artery of the male and female groups did not alter considerably before and after exposure to cigarette smoke[14].

In a Turkish study by Agirbasli et al family history of coronary artery disease and current smoking history of family members were not significantly associated with systolic and diastolic hypertension in their children (hypertension was defined as having a systolic or diastolic blood pressure >95% percentile for age and gender)[10].

Geerts et al reported the exposure of pregnant mothers to cigarette smoke, whether as secondary exposure to smoke or smoking by the mother herself, to be associated with higher systolic blood pressure in their newborns[11].

A study by Hunk evaluated the impact of smoking parents on diabetes, hypertension and metabolic syndrome in their male adult children

retrospectively. Data regarding the smoking status of parents during the prenatal period and childhood were obtained with questionnaires. The findings indicated that after correction for age, gender, race, education and smoking status of the person, participants whose parents were both smokers had a 1.55 fold increase in their risk for adulthood hypertension[15].

Our study also indicates that systolic and diastolic blood pressures are higher in school children who are exposed to cigarette smoke. Since signs of atherosclerosis begin to develop during the first decade of life, particularly in high-risk individuals such as those with hypertension, diabetes mellitus, and familial hypercholesterolemia, the exposure group is more likely to develop cardiovascular diseases in the future.

After addition of the gender variables, both the girls and the boys groups did not indicate a significant difference between exposed and non-exposed individuals. However, in the girls group, the difference was close to the level of significance, and therefore larger sample sizes may yield significant differences.

The greater impact of cigarette smoke on girls may be due to their longer presence at home and consequently greater exposure to smoke or it may reflect their intrinsic sensitivity to cigarette smoke.

Unlike the other factors of cardiovascular diseases, exposure to cigarette smoke is easily omissible; therefore, the authors recommend that given the sensitivity of parents about their children's health, the results of this study and similar studies be used for encouraging parents to quit smoking or smoke in places isolated from their children.

There are certain limitations in our study, the most important of which is the provision of inaccurate information by parents in questionnaires. Nevertheless, we tried to circumvent this challenge by not mentioning the children's names on questionnaires and comparing the information with the data recorded in students' health certificates (which contain information regarding the smoking status of the parents) to eliminate those questionnaires with discrepancy.

Another challenge was to control children's anxiety and activity, particularly those in the first and second grade, during blood pressure measurement. This problem was relatively controlled through entertaining and calming the children prior to measurements.

Conclusion

This study revealed that exposure to cigarette smoke can increase blood pressure in children with possible risk of cardiovascular diseases in future.

Acknowledgment

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Conflict of Interest: None

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