Effect of Air Pollution on Peak Expiratory Flow Rate in Urban Industrial and Non-industrial Adolescents

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Abstract:

A prospective cross-sectional study was done over a period of one year, to observe the changes in peak expiratory flow rate (PEFR) in urban adolescents. For this purpose, 200 adolescents of both sexes with age ranging from 15 to 18 years were selected. PEFR was assessed by VMI ventilometer in standing position. Age and sex matched 100 apparently healthy adolescents of both sexes were taken from rural area as controls. The mean percentage of predicted value of PEFR in urban industrial adolescents was significantly lower (p<0.05) in case of male than that of rural area. Again, the mean percentage of predicted value of PEFR in adolescent male of urban industrial and non-industrial areas and also that of the urban non-industrial and rural areas were lower, but the differences among them were not statistically significant. In case of female, the observed values of the urban industrial adolescents was lower but not significant than those of the urban non-industrial and rural areas. Industrial area male are more affected due to air pollution, because of their excess exposure to pollutants.

Introduction:

Ambient (outdoor) air pollution is now recognized as an important problem, both nationally and worldwide[1]. The quality of air in the major cities of the country has become a big concern; numerous studies are done to discover important health effects from air pollution on city dwellers[2,6,10-14]. The polluted air may cause headache, eye irritation, throat pain, asthma, breathing trouble, heart disease, kidney trouble and even cancer[5,6].

As Bangladesh is a developing country, its industrialization is gradually increasing day by day. But unplanned industrialization and improper management of the industries are detrimental to human health, especially for children and adolescents[7,8]. The air adjacent to a factory is usually contaminated by the harmful gases and dust. A large number of families are residing in different slum areas near the industries and are exposed to air pollution. Again, non-industrial slum areas of Dhaka city of Bangladesh is also contaminated by environmental pollutants and the smoke emitted from the automobiles. The environmental conditions in the slum area are bad due to indiscriminate dumping of solid wastes, blockage of drains and outfalls, and the high occupancy of slums[9]. On the other hand, air in rural areas are actually vast expense of green fields.

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Since the main sources of air pollution, the transport vehicles, factories and developmental activities, have still not reached the villages, the air in the rural areas is still comparatively fresh and pollution free. Spirometric measurements of PEFR has been used for many years to assess the integrity of the overall function of the lungs[3,4,7]. Some workers have worked on pulmonary function in different countries on the people of air polluted areas[1,2,6-14]. But no such work has yet been carried out on lung function in adolescents residing in urban industrial and non-industrial areas in this country. Therefore, the present study was designed to observe the effects of air pollution on lung function.

Materials and method:

PEFR was studied in 300 adolescents of both sexes, age ranged from 13-18 years and of poor socioeconomic status. Of them, 200 adolescent were randomly selected from slum areas of different industrial and non-industrial zones of Dhaka city (experimental group). Age and sex matched 100 subjects were selected as control group from villages of Deviddar thana of Comilla district.

The subjects were grouped according to sexes, male (group-A) and female (group-B). Again, subjects were subdivided into different groups according to their residence into A_1, A_{2a} and A_{2b} (adolescent male residing in rural, non-industrial and industrial areas respectively) and B_1, B_{2a} and B_{2b} (adolescent female residing in rural, non-industrial and industrial areas respectively) and are shown in Table-I. Adolescents suffering from any cardio-respiratory diseases or are obviously unhealthy, smokers, not willing to co-operate or failed to follow the correct procedures were excluded from the study. The subjects were briefed about the aim and objectives, and demonstrated the test procedures before performing the study. The PEFR was done by VMI ventilometer. The tests were carried out in the morning during the post-absorptive phase and in resting condition. Measurements were done in standing position, the highest one of the three test readings were included in data compilation. Results were expressed as mean of the percentage of predicted values. Statistical analysis was done by using "Z" test. P value less than 0.05 was accepted as significant.

Results:

Table I : The mean age, height and body surface area in different groups

Group	Subgroup	Age (years)	Height (cm)	Weight (kg)	Body surface area (m^2)
Male (n=175)	A_1(n=55)	15.4	152.1	42.4	1.39
	A_{2a}(n=60)	15.3	152.4	43.7	1.41
	A_{2b}(n=60)	15.2	154.8	43.7	1.44
Female (n=125)	B_1(n=45)	15.1	146.5	40.3	1.33
	B_{2a}(n=40)	15.0	147.7	39.5	1.33
	B_{2b}(n=40)	15.3	148.4	40.1	1.34

Table II: The predicted value, measured value and mean percentages of PER in different groups of adolescents of both sexes

Group	Subgroup	Predicted value (L/min)	Measured value (L/min)	Percentage of predicted value %
A (male)	A_1(n=55)	565	471	83
	A_{2a}(n=60)	567	427	75
	A_{2b}(n=60)	575	385	67
B (female)	B_1(n=45)	414	381	92
	B_{2a}(n=40)	416	358	86
	B_{2b}(n=40)	417	342	82
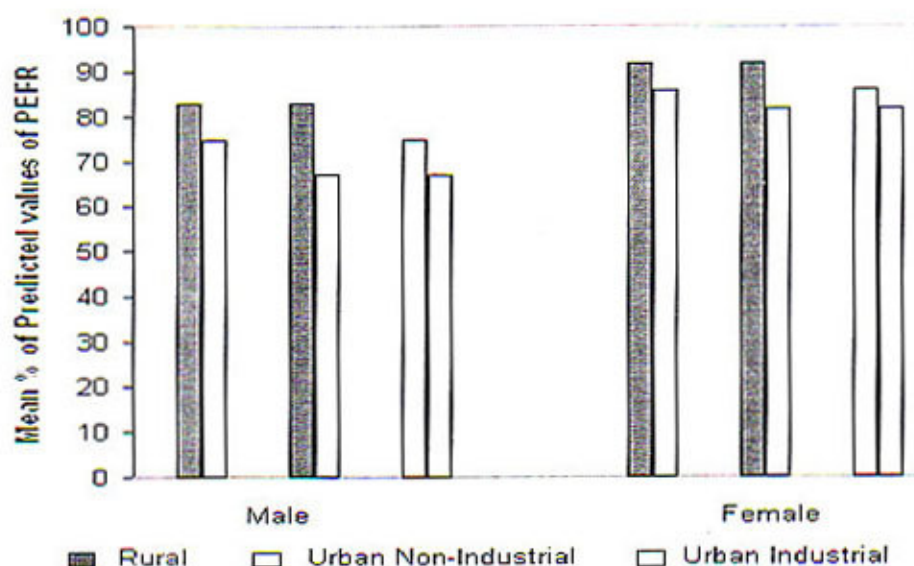
Figure-1: The mean percentages of PEFR in different groups of adolescents of both sexes.

The mean percentage of predicted values of PEFR was significantly ($p<0.05$) lower in male adolescents residing in industrial slum areas compared to those of rural areas. But the mean percentage of predicted values of PEFR was lower in male adolescents residing in non-industrial slum areas compared to those of rural areas, but the difference was not statistically significant (Table-II).

However, the mean percentage of predicted values of PEFR was lower, among different groups of female adolescents like industrial and rural, non-industrial and rural, but the differences were not statistically significant. On the other hand, predicted values of PEFR was lower between industrial and non-industrial in male and also in females of all groups, though differences were not statistically significant (Fig-1).

Discussion:

All the mean measured values of PEFR in the present study was lower than those of their predicted values. It has been suggested that poor nutritional status leads to poor growth of muscles and development of lungs and consequently decrease the pulmonary volumes and capacities[9]. PEFR in controls was almost similar to those reported by other workers of this country and also of regional countries[3,4]. The mean percentage of predicted value of PEFR was significantly lower in urban industrial adolescent male than those of controls. These findings are in agreement with those reported by some other workers of different countries[6-8,10-12]. The lower PEFR in male subjects of the experimental group is most likely due to presence of pollutants in the air, which may cause functional changes[3] in the airways or retardation in pulmonary function growth[8], as most of the industrial adolescents were residing in the polluted areas for a longer duration, even from birth. The allergic effect of air pollutants may be the additional factor for this lower lung function (PEFR) in adolescents residing in industrial area[8]. The mean percentage of predicted value of PEFR was though lower in female adolescent residing in industrial area compared to those of rural area, the difference was not statistically significant. Similar findings were also reported by other workers of different countries[13,14]. The higher effects of air pollution on pulmonary function in male than female adolescents were most likely due to more exposure to pollutants, as male were engaged in outdoor activities as evident from the history.

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