



# Dust Storms; The Case of Children's Health and School Attendance

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## Abstract

**Background:** Dust storms affect a wide range of arid or semi-arid countries every year and thus impose a threatening health risk to the affected people whether young or old. Children are regarded as a high-risk group in public health concerns.

**Objectives:** The aim of this study was to evaluate the relationship between occurrence of dust storms on schoolchildren's health and school absenteeism.

**Methods:** The study was performed from October 2016 to June 2017 in Ahvaz. Fifty primary schools with 4200 pupils in total participated in the study. Data was collected by a questionnaire.

**Results:** The highest number of absenteeism happened after the first dust storm with 885 absent students from a total of 3486 (25.36%), with mostly one day absence duration. The difference between absenteeism rates of boys and girls in different schools was evaluated. The results showed a significant difference between boys and girls in both kinds of schools and amounts of absence days.

**Conclusions:** It can be concluded that dust storms and exposure to high levels of particulate matter can increase the frequency of respiratory symptoms and illnesses in schoolchildren and consequently more children cannot attend school.

**Keywords:** Absenteeism, Schoolchildren's Health, Dust Storms

## 1. Background

People become exposed to ambient air pollution every day, no matter where they work or live. Moreover, the extent of this exposure depends on many various factors such as different kinds of air contaminant sources (stationary vs. mobile), topological condition, lifestyle etc. (1, 2). But dust storms, free from many of these determining factors, affect a wide range of arid or semi-arid countries every year and thus impose a threatening health risk to the affected people whether young or old, living in urban or rural districts. In considering public health in different communities, attention should be paid to the relation between environmental exposure to pollutants and upcoming adverse effects and illnesses in children (3-6). Some studies reported higher chance of exposure to environmental pollutants in children than adults (7, 8). Children as a high-risk group in public health concerns have specific and different behavioral patterns beside more inhalation rate, which increases the risk of being exposed to environmental contaminants such as precipitated particulate matter, which remains after occurrence of dust storms (6). The scientific interest regarding health effects of children's exposure to dust particulates especially after dust storms is a trending

field. Various researchers have reported a statistically significant relationship between dust events and the resulted exposure and mortality or hospitalization due to cardiovascular and respiratory diseases (9-15). Deserts such as the Sahara desert in Africa, some parts of western China and Arabian Peninsula are considered as three main sources of mineral dust storms which are estimated to be origins of dust storms affecting the world annually (16-18). Few studies are conducted on the dust storms from the third abovementioned source (19). Which reported the amount of PM<sub>10</sub> in Kuwait and Saudi Arabia to be up to 3000 mg/m<sup>3</sup> (20). Ahvaz, the main city of Khuzestan province in south-western Iran is located close to Kuwait, Iraq and Saudi Arabia and thus is affected by dust storms which are originated in this part of the world. The other source of dust storm in this part of Iran is local, mainly due to nearby wetlands degradation as reported by Iran's environmental protection agency. In the last decade, several dusty days have occurred and many people have suffered from the adverse impacts. Sometimes in severe storms, the schools were closed and the children were sent home in the polluted air. These particulates affect the children's fragile health state and the more susceptible ones get sick and

stay at home or even become hospitalized for some days, and thus cannot attend their school routinely. School absenteeism has been associated with children's health in some studies, e.g. asthma and respiratory infections are the main causes of short-term absenteeism due to the children's illnesses (21-26).

## 2. Objectives

The aim of this study was to evaluate the relationship between occurrence of dust storms on schoolchildren's health and school absenteeism.

## 3. Methods

This cross-sectional study was conducted from October 2016 to June 2017 in Ahvaz. Fifty primary schools (30 private schools and 20 governmental schools) participated in the study, ranging from 250 up to 1100 pupils in the schools, in total, 4200 pupils (girls and boys) in first to sixth grade. A questionnaire was designed to be sent to the children's parents via social networks and was intended to be completed after every dust storm. At the beginning, a meeting was held with the schools principals and then with the volunteer parents who participated in the study. The questionnaire had four parts; the first part included demographic information of the child (age, gender, weight, height, and grade). The second part items included the child health status, respiratory disease symptoms such as cough, fever, asthma history, shortness of breath, headache, rhinorrhea, vomiting, sneezing and fatigue. The third part contained a question regarding a physician visit (yes or no) and last part asked about school absenteeism (none, one day, two days, three and more). The questionnaire was credited via expert certification. The data was analyzed for descriptive and analytical statistics (*t*-test, ANOVA), with SPSS software version 17. *P* value was considered at  $< 0.05$ .

## 4. Results

Of the study population, 3486 participants (83%) completed and returned the questionnaire after each dust storm. Table 1 represents descriptive statistics of the schoolchildren. Results of comparison between groups showed no significant difference.

Table 2 shows detailed information on schoolchildren absenteeism after occurrence of fifteen dust storms from October 2016 to June 2017. The highest number of absenteeism happened after the first dust storm with 885 absent students from a total of 3486 (25.36%). With mostly

one day absence duration. Table 3 presents total absenteeism reported after fifteen dust storms in school days. The *t*-test was performed in order to evaluate the difference between absenteeism rates of boys and girls in different schools. The results showed a significant difference between boys and girls in both kinds of schools ( $P < 0.05$ ). In addition, one way ANOVA test revealed that number of absence days was significantly different between four groups ( $P < 0.05$ ). Figure 1 illustrates the frequency of symptoms in schoolchildren as reported by parents after dust storms. The most frequent symptoms for both boys and girls were cough with 85% and 94%, respectively. Also, 20% and 23% of girls and boys had a background history of asthma. Further statistical analysis showed that these children had longer absence duration with more frequent respiratory symptoms. Physician visit was reported after each dust storm by parents of at least one-third of children. In each dust storm,  $PM_{10}$  concentration was 10 times or higher above standard level ( $150 \mu g/m^3$ ).

## 5. Discussion

The question of whether dust storms have a notable adverse impact on public health of the affected areas, especially on children is a trending field of study. The aim of this study was to evaluate the relationship between occurrence of dust storms on schoolchildren's health and school absenteeism. In other words, to describe the symptoms and problems children suffer from after dust storms in one of the most polluted cities of Iran, in event of these storms, the particulate concentration were at least 10 fold of the standard level and the situations were regarded as extremely unhealthy. In a few similar studies, the reported concentration of  $PM_{10}$  fraction of dust events was much lower than this study (9, 10, 20). However, they reported a significant increase in respiratory disease and cardiovascular disease and mortality (9, 10, 20). Absenteeism due to exposure to high concentrations of particulate matter in the air was found to be a major problem which can affect children school performance. The fact that exposure to dust affects the children's health to a level that they become ill and cannot attend school routinely is an emerging concern for their parents. In some cases these concerns have made the parents send the child to school even with respiratory symptoms and fever so that the child would be able to participate in school classes and again the child performance will suffer. School absenteeism due to unhealthy environmental conditions was evaluated in some studies which mainly considered school building conditions and its effects on children's health and school attendance (1, 21, 23-26). It should be noted that in these studies the air pollutant concentrations were below the standard level or mod-

**Table 1.** Descriptive Statistics of Schoolchildren<sup>a</sup>

Variables	Governmental Schools		Private Schools		P Value
	Girls (N = 936)	Boys (N = 900)	Girls (N = 815)	Boys (N = 835)	
Age, y	9.7 ± 3.8	9.6 ± 4.2	9.5 ± 3.6	9.7 ± 4.1	0.543
Weight, kg	22.5 ± 14.8	23.2 ± 16.2	23 ± 15.1	24 ± 14.2	0.713
Height, cm	118.2 ± 22.2	120.1 ± 23.3	118.2 ± 21.9	121.4 ± 24.1	0.840

<sup>a</sup>Values are expressed as mean ± SD.

**Table 2.** Absenteeism Rates in Fifteen Dust Storms

Pupils/Absenteeism	Occurrence of Dust Storm															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
<b>Governmental School</b>																
<b>Girls, N = 936</b>																
none	745	844	900	790	850	880	921	936	930	900	936	936	922	918	833	13241
1 day	143	53	21	104	65	56	6	0	6	27	0	0	0	18	78	577
2 days	40	32	7	30	21	0	0	0	0	9	0	0	10	0	10	159
≥ 3 days	8	7	8	12	0	0	9	0	0	0	0	0	4	0	15	63
<b>Boys, N = 900</b>																
none	775	846	890	878	876	890	900	900	897	900	889	900	890	890	867	13188
1 day	96	44	10	18	24	10	0	0	2	0	11	0	10	8	20	253
2 days	19	7	0	4	0	0	0	0	1	0	0	0	0	2	9	42
≥ 3 days	10	3	0	0	0	0	0	0	0	0	0	0	0	0	4	17
<b>Private School</b>																
<b>Girls, N = 815</b>																
none	548	734	770	790	800	795	815	812	800	815	810	813	799	801	783	11685
1 day	189	48	35	20	12	9	0	3	15	0	5	2	16	10	13	377
2 days	56	23	6	5	3	6	0	0	0	0	0	0	0	4	12	115
≥ 3 days	22	10	4	0	0	5	0	0	0	0	0	0	0	0	7	48
<b>Boys, N = 835</b>																
none	533	755	790	800	800	806	830	835	820	835	818	835	801	810	786	11854
1 day	202	53	36	25	23	24	5	0	13	0	15	0	23	15	35	469
2 days	84	22	8	10	12	0	0	0	2	0	0	0	11	5	8	162
≥ 3 days	16	5	1	0	0	3	0	0	0	0	2	0	0	0	6	33

**Table 3.** Total Absenteeism Reported After 15 Dust Storms in School Days

Variables	Number of Absenteeism			P Value <sup>a</sup>
	1 Day	2 Days	≥ 3 Days	
<b>Governmental schools</b>				0.001
Girls	577	159	63	
Boys	253	42	17	
<b>Private schools</b>				0.003
Girls	377	115	48	
Boys	469	162	33	
<b>P value<sup>b</sup></b>	0.021	0.001	0.034	

<sup>a</sup>t-test: to compare between boys and girls at each groups.

<sup>b</sup>ANOVA test.

erately higher than the standard level. According to the findings of the present study, absence days of one day duration were the most frequent; 18% of schoolchildren were absent. On average five percent of children were absent, this finding is similar to Simons et al. who assessed the relationship between school building conditions and student

absenteeism in Upstate New York (1).

The most common diseases and symptoms during dust storm days were respiratory conditions. This finding is supported by Pan et al. who also reported higher frequency of respiratory diseases and symptoms after stormy days (27). The present study is unique in Iran, even though

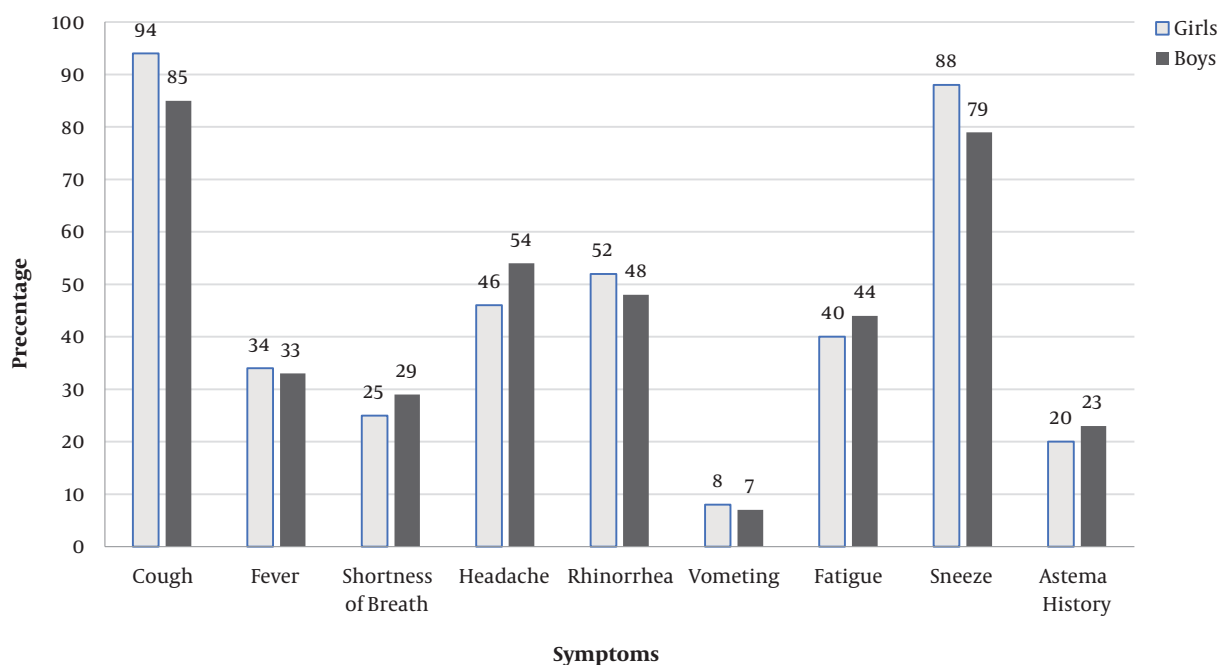


Figure 1. Frequency of symptoms in schoolchildren after dust storms

this country faces the problem of dust storms for at least ten years. This study is valuable regarding the fact that parent participation made it possible to gather the data. On the other hand, this study had some limitations. Lack of national data banks on school absenteeism records and poor school building conditions can be noted among many.

### 5.1. Conclusions

It can be concluded that dust storms and exposure to high levels of particulate matter can increase the frequency of respiratory symptoms and illnesses in schoolchildren and consequently, more children cannot attend school. It is suggested to evaluate the economic impacts of occurrence dust storms in the affected areas.

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### Footnotes

**Authors' Contribution:** Concept, study design, data collection, and manuscript writing: Leila Ebrahimi Ghavam Abadi; concept, study design, data analysis, manuscript

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