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A Case Study Upon Health Impact of Man Due to Sponge Iron Factory in Angadpur Area Under Burdwan District, West Bengal, India

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Abstract:

In the present investigation some people were selected those are never smoking within 1 and 2 kilometer radius from the sponge iron factory region of Angadpur industrial area(Durgapur, West Bengal, India). Significant variation were observed on the people in their health condition such as cardio-respiratory system and sputum cytology under heavy loaded air pollution exposure. Most of the people who was surveyed within 1 km. radius were suffering from asthma, bronchitis, cold cough, wet cough, nose allergy etc. Most of the people's sputum cytology shows great variation from control people. Here the maximum number of sputum slide shows carbonaceous and fibrous materials in comparisom to controll. Again alveolar macrophages of many people's sputum sample in polluted area shows brownish colour due to iron deposition. The people of the radius within 2 km region is also suffering from asthma, bronchitis, cold cough, wet cough, nose allergy etc but here effected percentage is lesser than 1 km radius zone of the factory. This region's people also shows brownish type of alveolar macrophages in sputum slides. The 1 and 2 km radius zone exhibits high level of air pollution load in comparisom to controll region.

Key words: Sputum, cytology, macrophage, siderophore

1. Introduction

Air pollution is recognised as a major threat to human health. Due to heavy loaded industrial air pollutants the people are suffering with a wide range of health effects, especially on the cardio respiratory system (Bates 1989, Dockery 1989, pope 1989). The World Health Organisation (WHO) has estimated that urban air pollution is responsible for approximately 800000 deaths and 4.6 million lost life each year around the globe(WHO,2002). It is observed that during the last few years, there has been phenomenal growth of sponge and ferro alloy units in certain parts of Durgapur city and such growth has been accompanied by serious environmental impact in the surrounding areas, resulting in contamination of water resources and destruction of food crops, disturbance of people's cardio-respiratory system. The United Nations Environment Programme has estimated that globally 1.1 million people breathe unhealthy air (UNEP 2002). Thus sponge iron industry units are critically air polluting in nature having serious problem of emission of high concentration of particulate matter not only from point sources (rotary kilns, cooler discharge, raw material handling and product seperation house). Full proof air pollution abatement system for such units are yet to be arrived at. In spite of installation of emission control system, the sponge iron units are also causing environmental disturbances. In general combustion is the chief contributor to outdoor air pollution. In most cities the major source of combustion is fuel use, which tends to increase along with population size and economic activity. The different types of obnoxious gases are released from this industrial area these are oxides of nitrogen and sulphur and different diameter of particulate matter, respiratory suspended particulate matter. Particulate matter(PM) is a complex mixture of suspended solid and liquid particle in semi equilibrium with surrounding gases (Brook et al., 2003).

1.1. Research Objectives

- To assess air pollution related respiratory symptoms among the residents of angadpur area.
- To assess the degree of lung function impairment in persons chronically exposed to this air.
- To create a awareness in local people about this hazardous effect.

2. Materials and Methods

2.1. Site Selection

For this study three specific sites were selected. Two sites were situated within one kilometer and two kilometer radius zone respectively in or around the sponge iron factory region (Angadpur area, Burdwan, West bengal, India). The rest of of site was choosen as a typical pollution free zone (Golapbug farm house, burdwan) where there is no such industry regarded as control zone. The control zone is situated towards north west of Burdwan town is however, a relatively pollution free zone, as it is surrounded by dense canopy of trees with less movement of vehicles.

2.2. Species Selection

For observing study the different people of this industrial area in-around one and two kilometer radius zone from this factory were selected. The different people means the different age category people such as child, young, middle age man, aged, old.

2.3. Study Protocol

- Evaluation of respiratory symptoms through questionnaire survey and clinical examination.
- Assessment of cellular lung response to air pollution by sputum cytological test.

2.4. Type of Study

The study was conducted by questionnaire survey, and testing clinical examination of non smoking person’s sputum sample. At first 25 non smoking and 200 non smoking different age category people’s sputum samples were collected from control zone and industrial zone respectively. Within 200 people 100 people were one kilometer radius zone and rest 100 people were outside the previous zone within two kilometer. All of these persons were never smokers. The sputum samples were collected in a sterile plastic container. Smeres were made and the slides were semi dried in air and fix in different medium. Ethyl alcohol for PAP staining, buffered formalin for non specific esterase, 10% formalin for Perl’s Prussian Blue reaction.

The sputum was stained by three different technique, one staining is Papanicolaous stain developed by Hughes and Dodds,1966; other staining is non specific esterase staining was done by Fast Blue B method developed by Oliver et.al; 1991). And the other method known as Perl’s Prussian Blue reaction by the method of Pearse1985.

Air quality analysis: Ambient air quality in terms of common air pollutants i,e SOx,NOx and SPM were analysed at all the three indicator stations. Ambient air monitoring was done by high volume sampler following standard methods. For estimation of SOx Indian standard methods of measurement of air pollution, part-II Sulpher Di Oxide 2001,IS:5182(part-II); for NOx Indian Standard methods of measurement of air pollution, PartVI Nitrogen oxides.1975:IS:5182(part VI); For SPM Indian Standard Methods of measurement of air pollution, Part IV Suspended Particulate Matter.1999 IS: 5182(Part IV)

3. Result and Discussions

Total number of residents studying questionnaire survey and clinical test	Number of child between age 5-15	Number of young between age 15-30	Number of middle age man between age 30-50	Number of aged between age 50-65	Number of old Man age >65
Within 1 km radius (100) residents	20	20	20	20	20
Within 2 km radius (100) residents	20	20	20	20	20
Control zone(25)	5	5	5	5	5

Table 1: People’s number from different ages from 3 different sites

	Child		young		Middle age		Aged		Old	
	affected	Non affected	affected	Non affected	affected	Non affected	affected	Non affected	affected	Non affected
Zone within 1 km	16	04	12	08	14	06	16	04	18	02
Zone within 2 km	14	06	13	07	12	08	15	05	17	03
Controll zone	0	05	0	05	0	05	0	05	0	05

Table 2: List of number of affected people from 3 different sites (in questionnaire survey)

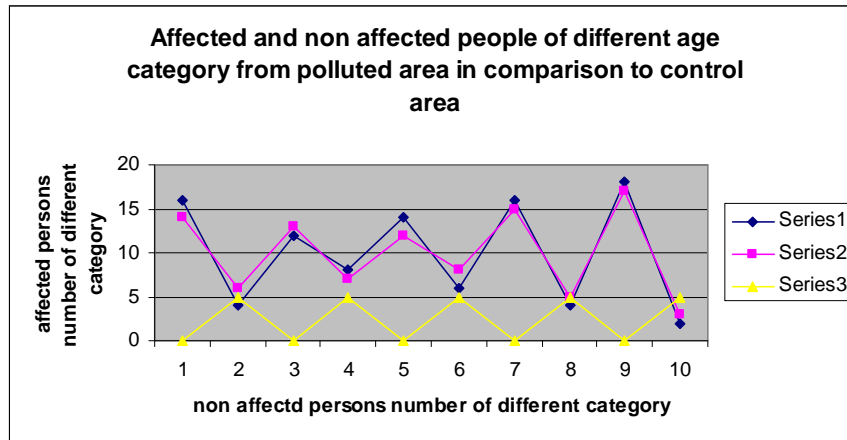


Chart 1: a line chart in comparison to affected and non affected people in all three sites (from questining survey)

	Child		young		Middle age		Aged		Old	
	affected	Non affected	affected	Non affected	affected	Non affected	affected	Non affected	affected	Non affected
Zone within 1 km	15	05	13	07	16	04	17	03	19	01
Zone within 2 km	13	07	12	08	14	06	15	05	18	02
Controll zone	0	05	0	05	0	05	0	05	0	05

Table 3: List of number of affected people from 3 different sites (in sputum cytologic test)

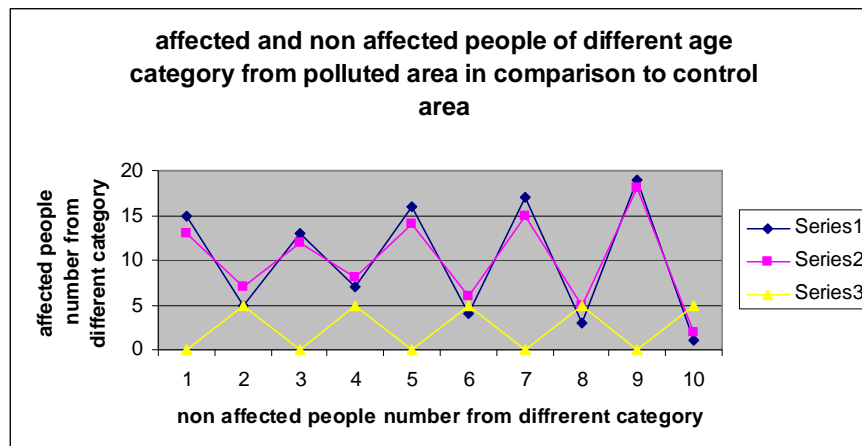


Chart 2: a line chart in comparison to affected and non affected people in all three sites (from sputum cytological test)

Index value	Remarks
0-25	Clean air
26-50	Light air pollution
51-75	Moderate air pollution
76-100	Heavy air pollution
>100	Severe air pollution

Table 4: Rating scale for indices

Bioindicator stations	Pollutants ($\mu\text{g}/\text{m}^3$)			Air pollution index
	SPM	SOx	NOx	
Zone within 1 km	1645	16.19	825.78	343.33
Zone within 2 km	1247	12.48	753	295.46
Control zone	131	2.59	10.43	27.23

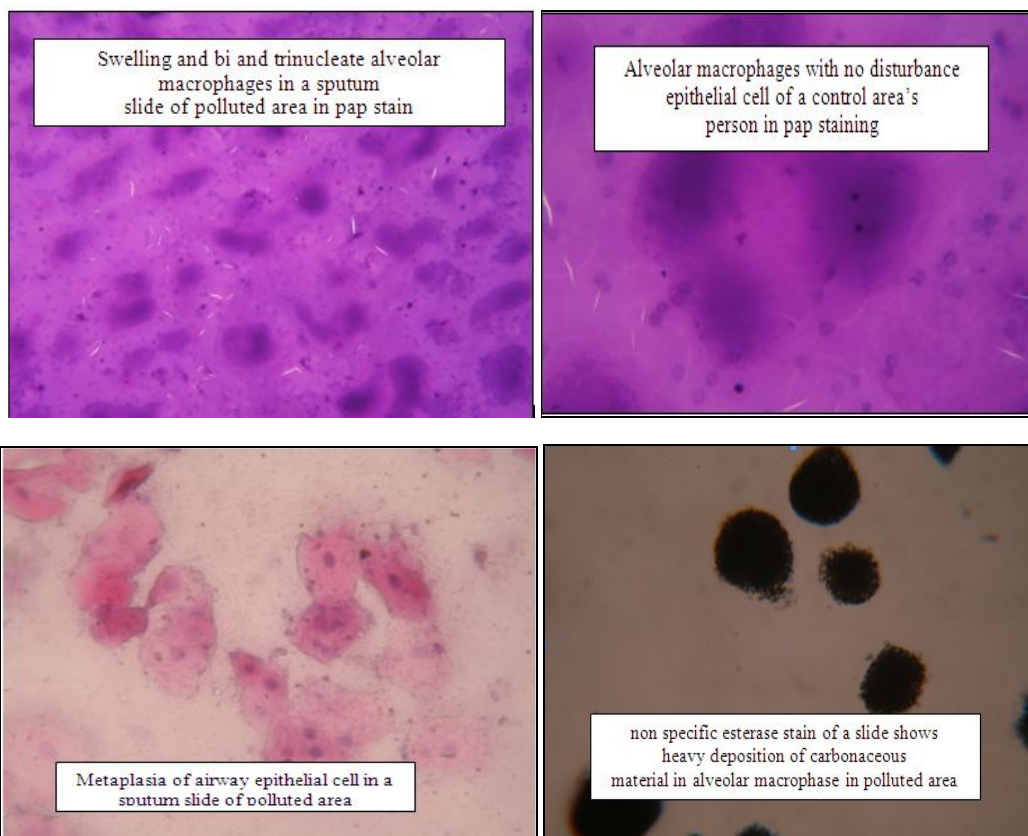
Table 5: Ambient air quality and air pollution index for three different study sites

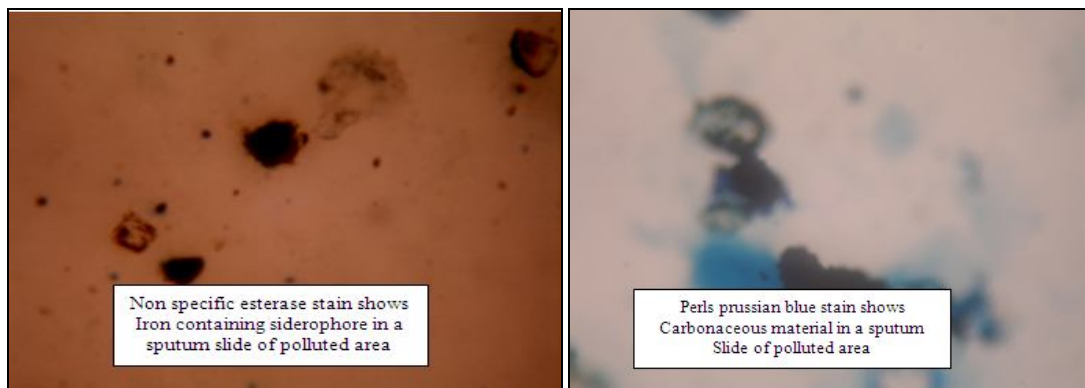
Air Pollution Index(API): The average of the sum of the ratios of three major pollutant concentrations to their respective air quality standards were obtained. The average was then multiplied by 100 to get the index(Rao & Rao,1989).

$$\frac{1}{3} [\text{SPM}/S_{\text{spm}} + \text{SOx}/S_{\text{sox}} + \text{NOx}/S_{\text{nox}}] \times 100$$

Where S_{SPM} , S_{SOx} , S_{NOx} represent the ambient air quality standards for SPM, SOx, & NOx. Where [$S_{\text{SPM}}=500$, $S_{\text{SOx}}=120$, $S_{\text{NOx}}=120$ unit($\mu\text{g}/\text{m}^3$)] in case of industrial area, and [$S_{\text{SPM}}=200$, $S_{\text{SOx}}=80$, $S_{\text{NOx}}=80$ unit($\mu\text{g}/\text{m}^3$)] in case of residential area.

- **Picture of Sputum Cytology**





4. Discussion

- After collecting the sputum samples from the persons of three different sites, slides were fixed stained and patho-lab analysed. Maximum number of slides of 1 and 2 kilometer radius zone of industry exhibited significant variation from control slides.
- Zone of 1 km radius: The zone of 1 km radius around the factory falls under heavy air pollution loaded area. Here 80 % child, 60 % young, 70 % middle age man, 80 % aged man, 90 % old man was affected from the surveyed of different category responds people. And it is truely observed from sputum cytological test that 75 % child, 65 % young, 80 % middle age man, 85 % aged man, 95 % old man was affected from the surveyed of different category responds people. Most of the people here responds that they were suffering from diseases such as bronchitis, cough, asthma, cold cough, allergic reaction etc, due to heavy loaded air pollution. Again most of the cytological slides exhibited heavy deposition of carbonaceous and fibrous material in sputum and alveolar macrophages turn into brownish colour due to heavy iron deposition of lung.
- Zone of 2 km radius: The zone of 2 km radius around the factory also falls under heavy air pollution loaded area. Here 70 % child, 65 % young, 60 % middle age man, 75 % aged man, 85 % old man was affected from the surveyed of different category responds people. And it is truely observed from sputum cytological test that 65% child, 60 % young, 70 % middle age man, 75 % aged man, 90 % old man was affected. from the surverior of different category responds people. Most of the people here responds that they were also suffering from airborne diseases such as bronchitis, cough, asthma, cold cough, allergic reaction etc, but here number of affected people is lesser amount in comparison to 1 km radius zone. Here lesser number of cytological slides exhibited heavy deposition of carbonaceous and fibrous materials in sputum in comparison to 1 km radius zone and alveolar macrophages turn into brownish colour due to heavy iron deposition into lung.
- Control zone: In control zone there were no positive responds of slides and questionnaire survey from people. No other significant variation is observed.

5. Conclusion

The heavy loaded industrial operation is a responsible factor for deteriorating the health condition of man. Different diseases developed on man and it will be chronic if there is no health check-up or some precautionary measures will be taken.

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