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STUDIES ON THE EFFECTS OF SOME AIR POLLUTANTS ON BLOOD CHARACTERISTICS OF HUMAN POPULATION OF KATRAS-DHANBAD COAL-FIELD AREA

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ABSTRACT

Effects of certain air pollutants on the peripheral blood of human population of Katras-Dhanbad area of Jharkhand state have been studied in this paper. People living in this area have suffered a lot due to pollutional effects in respect to changes in R.B.C. count, haemoglobin percentage and E.S.R.

INTRODUCTION

Atmospheric pollution is the presence of contaminants in the ambient air in such concentration and duration so as to cause nuisance to be injurious or potentially injurious to human or animal life, vegetation or property (Durham 1974, Khoshee 1984, Katyal & Satake 1989). In the present century trend of industrialization, mechanization of agriculture and urbanization is such that we are adding more and more pollutants to the atmosphere. All combustion processes such as combustion of coal in power plants, combustion of petroleum and burning of coal and refuse etc. produce air pollutants of various kinds. The gases like SO_2, NO_2 and CO etc. cause different types of pathological implications to the people causing serious haematological problems and even death (Sharma 1981). The general folk comprising generations or dependents of coal workers, traders, businessman, officials, miners, mechanics and all other classes of people living in the coal belt area have to bear the brunt of polluted environment.

In the present investigation attempt has been made to study the effects of different air pollutants (NO_2, SO_2) on the peripheral blood of human population of Katras-Dhanbad coal field area of Jharkhand state with special reference to changes in R.B.C. count, haemoglobin percentage and E.S.R.

MATERIALS AND METHODS

The air pollutants were collected from different sites of the coal mine areas, industrial areas and heavy traffic areas in the vicinity of Katras-Dhanbad belt, and the analysis of the same was done in the chemical laboratory of Ranchi University, Ranchi at regular intervals.

The test persons, i.e., blood donors were all adults and with different social status or living conditions. They visited the clinical laboratory for blood examination between 8 am and 11 am. For estimation of R.B.C. Hayem's solution was used as diluting media and R.B.C. count was made by the following formula:

$$\text{No. of R.B.C. per cubic mm of blood} = \frac{\text{No. of cells counted} \times \text{dilution} \times 4000}{\text{No. of small squares counted}}$$

Haemoglobin content of blood was determined by haemometer (Systronics, India make) and the results obtained were recorded in g/100 mL of blood. Alternatively, the use of Sahli's haemometer (Superior, Germany make) with permanent coloured glass comparison standard was also made. For the determination of erythrocyte sedimentation rate (E.S.R.) of the blood, Westergren's method was employed.

The blood of as many as 416 persons was tested for different parameters during 28 months of the experimental work, i.e., between January 1988 to April 1990.

RESULTS AND DISCUSSION

Observations in the present study on the quality and quantity of main air pollutants and their effects on the peripheral blood characteristics of the human population of Katras-Dhanbad show that it is a highly polluted area. For easy description and interpretation the different seasons were given meaningful scientific abbreviation. Thus, W1, W2, W3 represented respectively the winter reason of 1988 (Jan-Feb), 1988-89 (Nov to Feb) and 1989-90 (Nov to Feb). Likewise S1, S2, S3 were respectively summer seasons of 1988 (March-June), 1989 (March-June) and 1990 (March-April) and R1 and R2 represented the rainy reasons of 1988 (July-Oct) and 1989 (July-Oct).

Investigation on the quantitative analysis of the atmospheric air revealed several kinds of air pollutants, especially SO_2 and NO_2, in high concentration to warrant for the occurrence of setback in health of local population (Table 1). It was interestingly marked that the concentration of SO_2 and NO_2 was on a higher side in winters, whereas the rainy reason showed comparatively less concentration. Thus, in winter season (Nov-Feb) the mean value of SO_2 concentration was 823µg/m^3 and that of NO_2 was 51.3µg/m^3; whereas in the summer season (March-June) the mean values of these were 54µg/m^3 for SO_2 and 33.7µg/m^3 for NO_2 and in the rainy season (July-October) these were 32.5µg/m^3 for SO_2 and 32.25µg/m^3 for NO_2.

The concern of SO_2 with the incident of death of human population and domestic animals is a direct one which needs elaboration. The miners, factory workers and other professionals are liable to inhale air containing pollutants of different kinds. This inhaled air containing SO_2 causes irritation in the respiratory epithelium and pathological implications in the lungs occur in human beings, and in acute cases morbidity may come (Batch 1972, Doll 1978). In the present investigation it has been found that the atmospheric air of Katras-Dhanbad area contained varied levels of NO_2 in different seasons of the year. The present pattern of variations of NO_2 in different seasons is in conformity with the reporting of Billings (1974), Mohaney (1974) and Katyal & Satake (1989).

The observations made on the morphology of R.B.C. have been summarily given in Table 2. It has been found that in W1 season, out of 33 examined cases, 10 females and 11 males had normal R.B.C. count whereas 7 females (21.2% of examined cases) and 5 males (15.15% of examined cases) had R.B.C. in abnormal range. In S2 season altogether 65 cases were examined, out of which 19 females and 44 males had normal R.B.C. On the other hand, the rest were abnormal, i.e., in higher range. Incidentally W1 winter season of 1988 and S2 summer season of 1989 represented the highest and lowest levels of abnormality in R.B.C. parameters of the population of Katras-Dhanbad area. Male persons on an average 6.22 % out of three winter seasons of 1988-90, 2.56% out of three summer reasons (1988-90) and 4.49 % out of two rainy seasons (1988-90) had abnormality in their R.B.C count. In respect to female persons the trend of rise in R.B.C. value was well marked in view of the existence of direct relationship between these aspects and quality and quantity of air pollutants (Banerjee 1989, Banerjee et al. 1992).

Table 1: Quantity of the air pollutants (mean value) in μg/m^3 in Katras-Dhanbad area in different seasons during the years 1988-1990.

Seasons Code	Year	Dustfall μg/m^3	SPM μg/m^3	SO_2 μg/m^3	NO_2 μg/m^3
W1 *	1988	18.2	694	86	56
S1	1988	27.0	468	62	38
R1	1988	9.6	234	34	34
W2	1988-1989	17.4	686	83	52
S2	1989	28.5	439	54	35
R2	1989	9.2	248	31	31
W3	1989-1990	17.8	678	78	46
S2 **	1990	27.5	448	46	28

* Winter season for 2 months only (Jan-Feb); ** Summer season for 2 months only (Mar-Apr)

Table 2: Quantity of health of the local population (in percentage) of Katras-Dhanbad area in respect to condition of R.B.C. in different seasons during the years 1988-1990.

Sea-sons	Year	Female		Male		Both Sexes	
		Normal (N)	Above N	Normal (N)	Above N	Normal (N)	Above N
W1*	1988	10 (30.30)	7 (21.21)	11 (33.33)	5 (15.15)	21 (63.64)	12 (36.36)
S1	1988	20 (30.77)	10 (15.38)	31 (47.69)	4 (06.15)	51 (78.46)	14 (21.34)
R1	1988	22 (29.33)	5 (06.67)	44 (58.67)	4 (05.33)	66 (88.00)	9 (12.00)
W2	1988-89	22 (38.67)	7 (12.28)	26 (45.61)	2 (03.51)	48 (84.21)	9 (15.79)
S2	1989	19 (29.23)	1 (01.54)	44 (67.69)	1 (01.54)	63 (96.92)	2 (03.08)
R2	1989	19 (35.83)	6 (11.32)	25 (47.17)	3 (05.06)	44 (83.02)	9 (16.98)
W3	1989-90	9 (25.71)	1 (02.86)	25 (71.43)	0 (00.00)	34 (97.14)	1 (02.86)
S3**	1990	17 (51.52)	2 (06.06)	15 (42.42)	0 (00.00)	31 (93.94)	2 (06.06)

* Winter season for 2 months only (Jan-Feb); ** Summer season for 2 months only (Mar-Apr)

As such the possibility of intake of the pollutants by common people was more in winter and the stipulated risk for health was obviously greater. There was some sort of physiological disorder in the body system due to inhalation of the polluted air. In such a condition lowering of oxygen tension of the arterial blood and subsequent increase in the production of R.B.C. was a natural outcome.

For estimation of effect of atmospheric air on haemoglobin percentage, blood of 326 persons was tested and the results are presented in Table 3. It was interestingly marked that in a large population the haemoglobin percentage has gone down. It was curiously marked that decreased level of haemoglobin occurred in contrast to increased number of RBC in sizable population of this area. An interesting aspect of observation in the present study is that the winter season was more effective in male persons for lowering haemoglobin concentration whereas the summer was more effective to the female persons. One of the explanations for this sort of difference may be that the pollutants in the atmospheric air were present in a more concentrated form in winters and due to the outdoor professional work the males become more susceptible to the adverse quality of atmospheric air in this season.

On clinical examination of the blood samples it has been marked that 31.8% and 53.53% of the male and female persons in winter, 25.63% and 67.23% in summer, and 26.17% and 62.16% in

Table 3: Quantity of health of the local population (in percentage) of Katras-Dhanbad area in respect of condition of haemoglobin content (in g/100mL) in blood in different seasons during the years 1988-1990.

			Female		Male		Both Sexes	
Sl. No.	Seasons	Year	Normal (N)	Below N	Normal (N)	Below N	Normal (N)	Below N
1.	W1	1988	3 (09.38)	15 (46.88)	1 (03.12)	13 (40.62)	4 (12.50)	28 (87.50)
2.	S1	”	6 (10.71)	41 (73.21)	3 (05.36)	6 (10.71)	9 (16.07)	47 (83.93)
3.	R1	”	7 (12.73)	30 (54.55)	2 (03.64)	16 (29.09)	9 (16.36)	46 (83.64)
4.	W1	1988-89	4 (10.81)	22 (59.46)	0 (00.00)	11 (29.73)	4 (10.81)	33 (89.19)
5.	S2	1989	2 (03.17)	37 (58.73)	2 (03.17)	22 (34.92)	4 (06.35)	59 (93.65)
6.	R2	”	2 (04.65)	30 (69.77)	1 (02.33)	10 (23.26)	3 (06.98)	40 (93.02)
7.	W3	1989-90	5 (20.83)	13 (54.17)	0 (00.00)	6 (25.00)	5 (20.83)	19 (79.17)
8.	S3	1990	0 (00.00)	11 (68.75)	0 (00.00)	5 (31.25)	0 (00.00)	16 (100.00)

Winter for 2 months only (Jan-Feb); Summer for 2 months only (Mar-Apr);
No. of persons and the percentage figures (in parentheses)

Table 4: Quantity of health of the local population (in percentage) of Katras-Dhanbad area in respect of condition of erythrocytic sedimentation rate (E.S.R.) in mm/hr in different seasons during the years 1988-1990.

			Female		Male		Both Sexes	
Sl. No.	Seasons	Year	Normal (N)	Below N	Normal (N)	Below N	Normal (N)	Below N
1.	W1	1988	8 (40.00)	1 (05.00)	9 (45.00)	2 (10.00)	17 (85.00)	3 (15.00)
2.	S1	”	12 (30.00)	2 (20.00)	13 (32.50)	7 (17.50)	25 (62.50)	15 (37.50)
3.	R1	”	16 (21.92)	10 (13.70)	33 (45.21)	14 (19.18)	49 (67.12)	24 (32.88)
4.	W1	1988-89	9 (27.27)	5 (15.15)	10 (30.30)	9 (27.27)	19 (57.58)	14 (42.42)
5.	S2	1989	16 (26.27)	8 (13.33)	17 (28.33)	19 (31.67)	33 (55.00)	27 (45.00)
6.	R2	”	7 (24.14)	5 (17.24)	10 (34.48)	7 (24.14)	17 (58.62)	12 (41.38)
7.	W3	1989-90	15 (36.59)	4 (9.76)	16 (39.02)	6 (14.63)	31 (75.61)	10 (24.39)
8.	S3	1990	8 (27.59)	5 (17.24)	8 (27.59)	8 (27.59)	16 (55.17)	13 (14.83)

Winter for 2 months only (Jan-Feb); Summer for 2 months only (Mar-Apr);
No. of persons and the percentage figures (in parentheses)

rainy reason had haemoglobin percentage below normal range. It was observed that a greater percentage of females have lower level of haemoglobin which can be ascribed to the factors that are usually responsible for anaemic condition may be operative more vigorously in polluted conditions. The inhalation of polluted air might have brought disorder in the normal physiology of the body with the result that utilization of the protein was not in normal order and the synthesis of goblin part of haemoglobin got consequently affected. Secondly, the normal rate of oxyhaemoglobin formation might have affected as a result of intake of pollutants like NO_2, SO_2 and others in the blood circulatory system. This is in conformity with the review work of Lehman (1959), Riggs (1965), Benz & Forget (1974), Clegg (1974) and Calabrese (1978).

Investigation for the determination of E.S.R. gives indication of internal health condition of the body. About 16.66% of the females and 25.59% of the males in the three summer seasons taken together had abnormal E.S.R. as given in Table 4. It is well known that diseases alter the nature of plasma proteins and subsequent effect passes over to sedimentation rate of erythrocytes. In the present

investigation, it is obvious that inhalation of the air containing pollutants might have led to bringing disorder in the nature of plasma proteins with respect to certain components like fibrinogen, globulin and albumin. As fibrinogen is known to be the principal single factor, any effect on its percentage level is bound to raise the sedimentation rate of erythrocytes.

The relationship of the ill health of local population of Katras-Dhanbad coal field area with the air pollutants of the atmospheric air, as noted in the present work, through the blood examination, gets cognizance (Ehrlick 1966, Greenberg et al. 1973, Charles & Manzel 1975).

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