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EFFECTS OF DUST AND SUSPENDED PARTICULATE MATTER ON SOME HAEMATOLOGICAL CHARACTERS OF THE HUMAN POPULATION OF KATRAS-DHANBAD COAL FIELD AREA

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ABSTRACT

In the present study, effects of coal dust and suspended particulate matter, present in the polluted air, on peripheral human blood, especially TLC and DLC, have been studied. It has been found that the people living in the coal field area of Katras-Dhanbad have suffered a lot in respect to variations in their TLC and DLC, and other diseases.

INTRODUCTION

Due to combustion of coal, petroleum, refining crude oil, use of motor vehicles, combustion of wood, forest fires, burning of coal refuse and agricultural wastes, various types of pollutants are released in the air, chief among them are dusts, suspended particulate matter (SPM) and gases causing injuries to humans or animal life, vegetation and property (Khosee 1984, Katyal & Satake 1989, Kumar & Mohaptra 1991, Mishra et al. 1995, Singh 1995, WHO 1997, Park et al. 2000). Suspended particles are always present in the atmospheric air in the form of finely divided solids or liquids of different sizes, large sized dust and small sized particles. Sometimes, small particles may coagulate to form large particles which may result in fallout or dustfall, bringing severe health consequences in humans in several ways such as bronchitis, other respiratory problems, lung damage and death (WHSQ 1990, WHO 1999, Smith 2000).

Katras-Dhanbad coal belt area of Jharkhand has rich coal deposits. For exploration of coal from mines several kinds of activities are in progress which produce pollutants of various kinds in the atmosphere, and the overall condition of the atmosphere is so much deteriorated that even smog, sometimes, appeared in the moist conditions causing serious health problems of the people, coal workers, miners and other persons living in coal belt area.

In the present investigation an attempt has been made to study the variations in TLC and DLC of human population of Katras-Dhanbad coal field area in respect to SPM and dustfall as air pollutants.

MATERIALS AND METHODS

The air pollutants were collected from several spots in the vicinity of coal mine operation areas, industrial areas, heavy traffic area of Katras-Dhanbad and the analysis of the same was done in the laboratory, Department of Zoology, Ranchi University, Ranchi. The suspended particulate matters were measured by Owen's dust counter and estimation of dustfall was done by using deposit gauge collection and then weighing it by chemical balance.

All test persons, i.e., blood donors were in adult age (20-24 yrs) and belonged to different economic groups. They visited the clinical laboratory for blood examination in the forenoon between

8:00 and 11:00 a.m. For estimation of total leucocyte count (TLC) and differential leucocyte count (DLC) blood was taken by vein puncture in the lower arm. TLC was made according to Blaxhall & Diasley (1973) by the following formula:

Number of W.B.C. present in large squares \times 500

DLC was counted by the following formula:

$$\text{DLC} = \frac{\text{No. of cell type}}{\text{Total no. of WBC}} \times 100$$

Thus, the blood of as many as 416 persons was collected during 28 months between January 1988 -April 1990 and different parameters of environmental factors and quantum of pollutants in the atmospheric air and changes in blood parameters were studied. For convenience in description and interpretations, the different seasons were meaningfully given specific abbreviations. Thus W1, W2, W3 represented respectively the winter season of 1988 (Jan-Feb), 1988-89 (Nov-Feb) and 1989-90 (Nov-Feb). Likewise, S1, S2, S3 were respectively the summer seasons of 1988 (Mar-June), 1989 (Mar-June) and 1990 (Mar-Apr), and R1 and R2 represented the rainy season of 1988 (Jul-Oct) and 1989 (July-Oct).

RESULTS AND DISCUSSION

Observations in the present investigation on the quality and quantity of main air pollutants and their effects on the peripheral blood characteristics of human beings of Katras-Dhanbad show that this area is highly polluted. Investigation on the quantitative analysis of air has been summarily given in Table 1. From the table it appears that several kinds of air pollutants such as dusts, suspended particulate matter and gases are present in high concentration to warrant for occurrence of setback in health of local population. It was found that there was direct impact of season on concentration of particulates in the atmospheric air. In respect of dustfall it was found that the quantity was high in summer season and the lowest in rainy season. The reason for decreased quantity of dust during rainfall was related to its settling to the ground.

It was observed that suspended particulate matter occurred in different quantities such as 689 $\mu\text{g}/\text{m}^3$, 451.7 $\mu\text{g}/\text{m}^3$ and 241 $\mu\text{g}/\text{m}^3$ as mean average weight during winter, summer and rainy seasons of 1988-1990 as shown in Table 1. Such variation in concentration of SPM has also been reported by several research workers (WHO 1997, Trivedi 1998). Particulate matters show variation in chemical composition, size of the particles and their distribution as shown by earlier workers (Mitchell & Carell 1989, Romien et al. 1990).

For estimation of the effects of atmospheric air on the quality of blood in respect to W.B.C., the blood of 416 persons was tested and it was observed that the blood of local population of Katras has an increased level of total leucocyte count (T.L.C.). Occurrence of high level of leucocyte count was more pronounced in winter months, but for the females, the rainy season was also unfavourable as given in Table 2.

When specific staining methods were employed for differential leucocyte count (D.L.C.), several interesting results were found. The percentage figures of four different kinds of leucocyte cells, i.e., lymphocyte, monocyte, polymorphic leucocyte and eosinophilic leucocyte, and seasonal average percentage of different leucocytes in the blood of test persons of Katras-Dhanbad have been made explicit in Table 3.

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Table 1: Quantity of the air pollutants (mean value) in $\mu\text{g}/\text{m}^3$ in Katras-Dhanbad area in different seasons of the years (1988-1990).

Seasons	Year	Dust Fall $\mu\text{g}/\text{m}^3$	SPM $\mu\text{g}/\text{m}^3$	SO ₂ $\mu\text{g}/\text{m}^3$	NO ₂ $\mu\text{g}/\text{m}^3$
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	26.5	439	54	35
R2	1989	9.2	248	31	31
W3	1989-1990	17.3	678	78	46
S3**	1990	27.5	448	46	28

*Winter season for two months only (January-February); **Summer season for two months only (March-April)

Table 2: Quality of health of the local population (in percentage) of Katras-Dhanbad area in respect to condition of total leucocyte count (T.L.C.) in blood in different seasons of years (1988-1990).

Sl. No	Season	Year	Female		Male		Both sexes	
			Normal (N)	Above N	Normal (N)	Above N	Normal (N)	Above N
1.	W1	1988	6(18.18)	11(33.33)	5(15.15)	11(33.33)	11(33.33)	22(66.67)
2.	S1	1988	5(07.69)	25(38.46)	13(20.00)	22(33.85)	18(27.69)	47(72.31)
3.	R1	1988	7(09.33)	20(26.67)	24(32.00)	24(32.00)	31(41.33)	44(58.67)
4.	W2	1988-89	9(15.79)	20(35.09)	5(08.77)	23(40.35)	14(24.56)	43(74.44)
5.	S2	1989	10(15.38)	10(15.38)	22(33.85)	23(35.38)	32(49.23)	33(50.77)
6.	R2	1989	8(16.33)	17(34.69)	11(22.45)	13(26.53)	19(38.78)	30(61.22)
7.	W3	1989-90	9(21.95)	4(09.76)	15(36.59)	13(31.71)	24(58.54)	17(41.46)
8.	S3	1990	12(35.29)	7(20.50)	3(8.82)	12(35.29)	15(44.12)	19(55.88)

Winter for two months only (January-February); Summer for two months only (March-April)
Percentage figures in parentheses.

A closer view of cells of lymphocytes showed that effects of polluted atmospheric air have also been in respect to their percentage figures. It was found that during winter, 20.02% and 23.55% of female and male persons had lymphocyte count as above normal. It was also deduced from the review of the table that average percentage of normalcy among test persons was like: 16.36, 18.89 and 16.09 among females and 23.03, 20.5 and 18.77 among males in winter, summer and rainy seasons respectively. In case of monocyte it was observed in both male and female persons, that the winter season had maximum effect, as there being decreased percentage figure of monocytes (Table 4).

In the microscopical examination of blood it was found that a sizeable population of Katras-Dhanbad area had been affected by inhalation of polluted atmospheric air, as they had abnormal polymorphic leucocytes in their blood. The rainy season was most unfavourable for both male and female persons.

Eosinophilic leucocytes were present in the blood of test persons in a number higher to normal range. The abnormalcy was more in summer and winter than in rainy season. Thus, 27.35%, 23% and 19.6% female persons had increased (above normal) percentage of eosinophils, whereas among male persons these seasonal figures were 42.13%, 43.45% and 38.15% respectively (Table 5).

Table 3: Quality of health of the local population (in percentage with both sexes taken together) of Katras-Dhanbad area in respect to condition of differential count of leucocyte (D.L.C.) in different seasons of the years (1988-1990).

Sea Son	Year	Lymphocytes			Monocytes			Polymorphs			Eosinophils		
		Normal (N)	Below (N)	Above (N)									
W1	1988	42.42	18.18	39.39	27.27	72.73	00.00	33.33	45.45	21.21	30.30	00.00	69.79
S1	1988	46.15	23.08	30.77	35.38	62.63	00.00	44.62	38.46	16.92	27.69	00.00	72.31
R1	1988	32.00	18.67	49.33	56.00	44.00	00.00	22.67	60.00	17.33	30.67	00.00	69.33
W2	1988	38.60	15.79	45.61	47.37	62.63	00.00	22.81	54.39	22.81	29.82	00.00	70.18
S2	1989	53.85	13.85	30.31	69.23	30.77	00.00	47.69	40.00	12.31	21.54	00.00	78.46
R2	1989	37.74	30.19	32.08	64.15	35.05	00.00	15.09	39.62	45.28	54.72	00.00	45.28
W3	1989	37.14	17.14	45.71	62.00	37.14	00.00	31.43	48.57	20.00	31.43	00.00	68.57
S3	1990	18.18	33.33	48.48	81.82	18.18	00.00	11.21	48.48	30.30	48.48	00.00	51.52

Table 4: Quality of health of the local population of Katras-Dhanbad area in respect to condition of D.L.C., monocytic and leucocyte count in different seasons of the years (1988-1990).

Sl.No	Season	Year	Female			Male		
			Normal N	Below N	Above N	Normal N	Below N	Above N
1.	W1	1988	7(21.21)	10(30.30)	0(00.00)	2(06.06)	14(42.42)	
2.	S1	1988	8(12.31)	22(33.85)	0(00.00)	15(23.08)	20(30.77)	
3.	R1	1988	16(21.33)	11(14.67)	0(00.00)	26(34.67)	22(29.33)	
4.	W2	1988-89	15(26.32)	14(24.56)	0(00.00)	12(21.05)	16(28.07)	
5.	S2	1989	13(20.00)	7(10.77)	0(00.00)	32(49.23)		
Winter for two months only (January-February); Summer for two months only (March-April)								
6.	W3	1989	16(30.19)	9(16.96)	0(00.00)	18(33.96)	10(18.87)	
Percentage figures in parentheses								
7.	Results of clinical tests for blood parameters, e.g. (HbC), DLCs and others may be considered as							
8.	S3	1990	18(54.55)	1(03.03)	0(00.00)	9(27.27)	5(15.15)	

Reflective of the inner health conditions in view of the existence of direct relationship between these aspects and quality and quantity of the air pollutants. Investigation by Hulsse & Thielebevie (1988), Banerjee (1989), Banerjee & Verma (1992), Banerjee et al. (1992), Quli & Banerjee (1994) and Sharma & Saxena (1997) provide support to this view. In case of TLC a variation in different seasons among male and female persons has been found. It is likely that the appearance of leucocytes in the peripheral blood was dependent on the health condition of people.

It is prevalent practice that the percentage of lymphocytes, monocytes, polymorphs and eosinophils provide some useful indications to the health condition of body as reported by Cooper (1982). In respect to lymphocytes during winter season, 9.76 % persons had lymphocyte count below normal and 23.55% had above normal range. These figures for females were 7.27% below normal and 20.02% above normal. The male persons were most affected in rainy seasons, whereas the females suffered more in winter. More cases of suffering by males in rainy season is explained by the fact that the moist or rainy atmosphere keeps outdoor going males more susceptible to infections of any sort, and inhalation of atmospheric air containing pollutants becomes additional causative factor to hit the normalcy in respect to lymphocytes and their components of leucocyte counts.

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Table 5: Quality of health of the local population Katras- Dhanbad area in respect to condition EosinophilicLeucocyte count in different seasons of the year (1988-1990).

Sl.No	Season	Year	Female			Male		
			Normal N	Below N	Above N	Normal N	Below N	Above N
1.	W1	1988	6(18.18)	0(00.00)	11(33.33)	4(12.12)	0(00.00)	
2.	S1	1988	14(21.54)	0(00.00)	16(24.62)	4(06.15)	0(00.00)	
3.	R1	1988	36(48.00)	0(00.00)	11(14.67)	0(00.00)	16(21.33)	12(16.00)
4.	W2	1988-89	11(19.30)	0(00.00)	18(31.58)	6(10.53)	0(00.00)	
5.	S2	1989	11(19.30)	0(00.00)	18(31.58)	6(10.53)	0(00.00)	
6.	R2	1989	36(48.00)	0(00.00)	11(14.67)	0(00.00)	16(21.33)	12(16.00)

Winter for two months only (January-February); Summer for two months only (March-April)
 Present figures in parentheses.
 7. In the present investigation almost 50% of males had abnormal features of polymorphs in the rainy season. The females were worst sufferers in the rainy seasons. In case of monocytes, among males 33.02%, 21.97% and 24.1% had below normal range in winter, summer and rainy seasons respectively. Among females 21.14%, 15.88% and 15.83% had abnormal monocytes. In the present case of after effects on inhalation of polluted air by local people, the present findings on decreased number of polymorphs and monocytes can, thus, be explained (Douglas 1971).

In the present investigation of human population of Katras-Dhanbad area, it has been found that 43.57%, 37.19% and 38.2% of the people have eosinophil count above normal range in winter, summer and rainy seasons respectively. For explaining this trend of increase in eosinophil count, one has to take into consideration the established fact that the number of eosinophils in blood varies over each 24 hour period, probably because the secretion of hydrocortisone by adrenal gland varies over the same period and, thus, these two items are interrelated. The other explanation is that the increased number of eosinophils seems to be related to the presence of toxic substances in blood, which occurred as a result of inhalation of the air containing pollutants. Several earlier workers including Archer (1963), Johlin (1963) and Basten & Beason (1970) have drawn similar conclusion in respect to functional behaviour of eosinophils in the peripheral blood system.

In consideration to the above findings and in consequence to accumulative effects of atmospheric pollution, it is imperative to create alertness in the administrative managers, owners and general public and suggest measures of preventing atmospheric pollution.

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