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OCCUPATIONAL HEALTH : INDIAN SCENARIO

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ABSTRACT

Studies carried out recently in relation to 1241 cotton mill workers. 789 asbestos workers and 4129 community subjects are briefly presented herein which depicts the occupational health scenario in India. The prevalence of byssinosis was 24 percent, 21 percent and 10 percent in 3 mills (semi-modern, old and new mills) respectively. The prevalence of bronchitis in these mills were 18 percent, 22 percent and 12 percent in the dust exposed departments. Byssinosis is claimed to be a distinct disease. Asbestos related radiographic changes were seen in 36.1 percent workers. Various analyses done on 4 communities in relation to respiratory symptoms, mortality due to chronic respiratory and cardiac diseases were correlated with air pollutant levels. Daily health diaries recording fluctuations in respiratory symptoms indicated that symptoms exacerbated when SO_2 levels were above 50 ug/m^3. The other factors affecting health morbidity but to a smaller degree were age, nutrition, occupation, smoking and cooking fuel. However the role of air pollution was judged to be the largest.

PROLOGUE

Several parts of India have industrialized rapidly. Numerous hazardous materials are handled (e.g. asbestos, cotton), mined (silica) and chemical products widely manufactured. Several types of machinery and processes used in this industrial effort evoke dust concentrations, which are much above the acceptable safety norms.

It would be surprising to think that long term exposures to these agents would be harmless and no occupational diseases prevail as our population is immune or our industrial processes are clean. Pillai *et.al*., reported several occupational disease cases.

Recently the results of a long term study on effects due to environmental pollution has been reported. All these data lead us to suspect that health hazards due to these factors form a major cause. This paper highlights illustrative details.

MATERIAL & METHODS

For a prospective 5 - year study, 1241 cotton mill workers from 3 mills (old, new and semi - modern) were randomly selected **(Table 1)**. The sample studied was such that it would represent the regular working population of mills in western India belonging to all age and service groups.

As seen from **Table 1**, adequate numbers from each of three dusty and 3 non - dusty departments were included. **Table 2** gives initial prevalence from this population. It is seen that there was 16 percent Byssinosis and 9 percent bronchitis in semi-modern mill (A); in mill B these figures were 8 percent and 8 percent while in mill C (new) these were 3 percent and 1 percent respectively.

These prevalences were by typical international criteria. When over 5 years this criteria **(Table 3)** was evolved in the regularly followed groups, prevalence of byssinosis was 24 percent (including 14 percent mixed) in mill A, 21 percent in mill B and 10 percent in mill C. the prevalences for bronchitis were 18 percent, 22 percent and 12 percent in dust exposed workers of these mills. The prevalence of tuberculosis was 0.17 percent and eosinophilia 2.3 percent. This situation is not surprising as dust levels in dusty areas were as high as 4-8 mg/m^3; when cleaning procedures were carried out the levels even reached 48 mg/m^3.

It was also found that byssinotics had a distinct pattern of progress; remissions were seen of tener, serum immunoglobulins (G and E) were raised and yearly long functional doclinos were distinctive in comparison to normal or bronchitic subjects. The decline in lung function seen over workshift reversed partially with bronchodilator drugs.

Certain measures to modify textile machinery to improve dust control and reduce prevalence of byssinosis (which was related to higher dust levels were suggested in some publication. A few cases of byssinosis in workers in cotton industry in not so dusty areas were observed as in cotton testing, ginning warping. Despite the disease being compensatory, hardly any have been compensated.

Recently, it is observed that several workers are complaining of breathlessness from asbestos industry. An indication about this was heard from 789 **(Table 4)** regular workers amongst whom the major radiographic abnormalities were related to dust exposure. Thus while nonspecific scars were found in

TABLE - 1
Constitution of textile study population

Years of service	Exposed to dust (DE)			Control (C)		
	Carding	Spinning	Winding	Weaving	Folding	Administration
<5	66	125	7	1	24	35
6 - 15	68	85	68	35	30	42
16 - 25	120	105	75	36	42	24
>26	54	73	53	31	33	9
Total	308	383	203	103	129	110

TABLE - 2
Prevalences of initial diagnoses by mill and dust exposure

	Mills A (semimodern)		Mill B (Old)		Mill C (New)	
	DE	C	DE	C	DE	C
No.	432	177	311	115	156	50
Normal, %	59	64	65	70	67	82
Byssinosis, %	16	2	8	3	3	-
Nonspecific, %						
Total	24	33	27	28	10	18
Chronic bronchitis	9	10	8	4	1	2

TABLE - 3
Overall diagnosis at 5 years in regularly followed population of textile study

	Mills A (semimodern)		Mill B (Old)		Mill C (New)	
	DE	C	DE	C	DE	C
No	288	120	195	67	113	33
Normal, %	52	60	52	55	74	75
Bronchitis, %	18	25	22	22	12	27
Byssinosis, %	10	1	9	4	6	-
Mixed, %	14	4	12	4	4	-

16.3 percent and tuberculous lesions in 2.8 percent, definite asbestos related fibrosis was seen in 28.2percent workers. In another 7.9 percent cases doubtful relationship to asbestos existed. In another series of 28 asbestos workers studied in detail it is found that, 26 (93 percent) had dyspnoea, 79 percent had anorexia and weakness, 57 percent had chest pain and 46 percent had cough. Finger clubbing was seen in 25 percent Radiologically, 22 (79 percent) showed linear and nodular fibrosis in lower and midzones. In 13 of these there were pleural scars also. In 2 there were only pleural scars.

In comparison to significant proportions with pneumoconiosis, only a small prevalence of tuberculous abnormalities is found in factory surveys. As a part of occupational health study, 125 workers were observed from nitric acid plant. In radiographs basal scars and deposits were seen in 51 percent; these were significantly more frequent with longer work exposure. In 36 percent workers, there were work related symptoms, which were more often in those working longer,. Those with both abnormalities had significantly lower lung function. There is experimental evidence supporting this change, that electron microscopic studies of rat lungs after exposure to NC_2, show increased thickening of basement membrane and collagen (Stephens, 1991).

While environment at a factory could give concentrated exposure to hazardous dust, industrial pollution in an Indian city could lead to enhanced health morbidity. While acute episodes like London fog (ministry of Health, 1994) are known to cause sudden increase in death and illness among its residents, it was uncertain if chronic rise in ambient air pollutants would load to an increase in health abnormalities.

TABLE - 4
Patterns of radiographic abnormalities in asbestos workers

789 regular workers				Asbestos		
% Nonspecific scars	Pleural scars	T.B. scars	Doubtful	Gr.1/2	1	2
16.3	2.8	2.4	7.9	8.4	18.3	9.9
28 Suspected asbestosis						
% Normal	Nonspecific	Pleural scars	Parenchymal linear scars	Pleural and parenchymal scars		
2	2	2	9	13		

TABLE - 5
Age sex distribution of 4 communities in air pollution study

	Census	Index	Number of Male	Number of Female	1- 10 M	1- 10 F	11 - 19 M	11 - 19 F	20 - 44 M	20 - 44 F	45+ M	45+ F
Urban High	5092	1008	522	486	21	18	24	25	35	44	20	14
Urban Medium	2140	1122	586	536	22	26	26	24	33	41	12	9
Urban Low	2586	992	468	524	20	23	26	21	30	33	24	18
Rural	2110	1007	501	506	30	24	30	28	26	33	1	4

From an Indian city's preliminary air monitoring study it was discovered that the highest levels of air pollution in central zone and eastern suburbs moderately raised levels and western suburbs the lowest levels. Alongwith a rural locality, a total census of 11,928 subjects in 4 enclosed communities was carried out. From these for age, sex, duration of residence and occupation census families were matched and interarea differences hecame smaller. In the final index study population of 4129 subjects, there were 432 voluntary alongwith other randomly selected subjects. The former did not behave significantly different from the latter group. **Table 5** also shows that the population included subjects from all ages and both sexes.

Table 6 gives details of housing, tobacco smoking, monthly income (per family unit) and cooking fuel. There were more poor persons in rural area and more with higher income in urban low area; the other two areas were similar. There were more ex-smokers in high area and more bidee smokers in rural area. In all areas there were 14.4 to 17.6 percent male smokers. In rural area, housing was poor and most, were using wood as cooking fuel.

TABLE - 6
Basic characteristics of study population

	Urban high(%)	**Urban Medi-umlow (%)**	**Urban low (%)**	**Rural (%)**
A) Income/ Month family Unit				
Upto Rs 200	32	37	10	78
Rs. 201 - 400	48	44	39	18
7 401	20	19	51	4
B) Tobacco Smoking (Males)				
Cigarette	13.2	13.3	14.7	5.6
Bidee	1.9	4.3	0.6	8.8
Ex — smoker	6.3	3.2	2.4	1.2
C) Housing				
Temporary	1.0	0.0	0.0	39.0
Upto - 250 sq.ft.	8	7	16	29
251 - 500 ft.	10	58	48	21
7 500 ft.	81	33	46	11
D) Cooking fuel wood/coal	21	6	0.1	96
Difference : P/0.01				

Table 7 shows success at follow up and mean levels of 3 pollutants. Though the proportions followed declined over 3 years in all areas, in rural areas larger sections were lost. Of total 42 - 52 percent urban and 25 percent rural subjects only were regularly followed. the major cause of default was non-cooperation in most areas. Other common problem was shifting of residence and temporary leave. The mean pollutant levels were studied at the community sites for 7 week days every month. As the rural site showed very low levels, it was monitored for 7 week days every season. It is seen that for SO_2, 4 areas were significantly different, for NO_2 only rural area was low and for SPM all areas showed similar levels.

TABLE - 7
Follow up untensity and mean air pollutant levels

		Urban High	Urban Medium	Urban Low	Rural
a) Index Population		1008	1122	992	1007
% followed : 1 Year		75	61	71	46
% followed : 2 Year		67	61	68	56
% followed : 3 Year		60	54	53	44
b) Mean Annual Levels in µg/m³/day					
SO_2	: 1 Year	128	65	28	-
2 Year	: 97	59	35	6	
3 Year	: 90	37	27	7	
SPM	: 1 Year	454	341	233	-
	: 2 Year	255	222	204	235
	: 3 Year	264	236	231	313
NO_2	: 1 Year	52	66	38	-
	: 2 Year	23	27	18	7
	: 3 Year	25	22	17	6

TABLE - 8
Initial clinical prevalence of abnormalities

	Urban High	Urban Medium	Urban Low	Rural
a) Respiratory Symptoms, %				
Breathlessness	7.3	6.0	3.2	5.5
Common cold	18.0	20.8	12.1	11.0
Intermittent cough	15.6	5.8	0.4	3.7
Chronic cough	5.1	2.7	1.7	3.3
b) Diagnosis, %				
Chronic bronchitis	4.5	4.5	2.3	5.0
T. B.	0.4	0.2	0.1	0.2
Other chest	1.0	0.6	0.8	3.0
Heart	6.8	4.3	8.2	2.7
General Disease	2.8	9.1	1.9	3.4
c) Minor Symptoms %				
Skin allergy	8.8	8.7	5.4	0.7
Stuffy Nose	19	24	12	11
Chest pain	7	8.6	4.9	4.9
Eye irritation	10.1	7.2	2.0	0.6
Headache	12.4	10.0	3.9	9.2

TABLE - 9
Effects of slums : cross effects of slums

	Urban High		Urban Medium		Urban Low		Rural
	R	S	R	S	R	S	
No.	4624	579	7888	1347	4273	427	3124
Smokers (Male)	17.8	17.6	16.7	24.4	17.3	30.7	15.8
Diarrhoea	12.6	12.2	8.6	13.6	9.1	11.7	5.6
Breathlessness	10.0	3.7	3.8	22.4	4.2	3.0	3.4
Cough	29.4	28.8	39.3	45.2	30.6	30.4	22.5
Frequent colds	26.9	33.1	23.3	46.6	20.9	34.7	12.2
High B. P.	11.2	2.7	8.6	5.1	6.8	2.6	7.8

R: Resident, S : Slum

TABLE - 10
Daily health morbidity in relation to seasons

No. Studied	Urban High	Urban Medium	Urban Low	Rural
1ST year	710	300	596	126
2nd year	623	524	342	103
3rd year	445	465	328	100
Symptoms 1st year				
a) Monsoon (July)				
Colds	24.8	39	24	2
Cough	19	46	7	4
Dyspnoea	6	8	1	1
Medical treatment	32	63	8	2
b) Winter (December)				
Colds	18	53	23	11
Cough	13	42	17	2
Dyspnoea	3	5	3	2
Medical treatment	24	57	17	2
c) Summer (April)				
Colds	21	39	13	2
Cough	13	29	9	1
Dyspnoea	3	5	3	1
Medical treatment	26	36	7	2

Table 8 shows prevalence of (a) respiratory symptoms, (b) clinical diagnoses and (c) minor symptoms. Under (a) values are standardized for age, sex, smoking and duration of residence in 3 urban areas. Thus for breathlessness the low area was best for common colds the other two urban areas were worse. For intermittent cough, the high area was worst and the low was best (also for chronic cough).

The prevalence of active tuberculosis was 0.1 to 0.4 percent; there was evidence of old tuberculosis in 1.5 to 2.5 percent subjects. Eosinophilia seemed higher in rural areas. Cardiac problems particularly high blood pressure and coronary heart disease were most prevalent in the low and high areas. Under minor symptoms, skin allergy, stuffy nose, eye irritation and chest pain were worse in two more polluted areas and best in the rural area. For headache, females were significantly worse and only the urban low area was best.

When the extent of greenery was measured by enumerating trees taller than 3 meters, there was no relation to symptoms in urban high and medium areas but in the low and rural subjects, for cough and breathlessness, prevalence were significantly lower in subjects living in more green surroundings.

Table 9 summarises results of cross sectional study to account the effect of slums. There were more smokers among slum dwellers. Diarrhoea was more frequent in all urban subjects, particularly slums. The improved slum in urban high area was a little better. The respiratory symptoms were worse in urban medium area particularly for slums and in all respects rural area was best. Only for high blood pressure, slums were better;

When the trends in death over 4 zones the city were studies for 4 years, it was seen that the largest cause of death was respiratory and the morbidity for respiratory, cardiac and cancer deaths follows trends in pollution, for all 9 years. The deaths due to infections or gastrointestinal diseases are now lower.

Table 10 lists the results of daily diary recorded over 3 years for these regularly co-operating, for one month of 3 seasons in first year as a sample. It is seen that the medium area is worse and in winter more so . The monthly trends are not related to season as much to trends in pollutant levels . With a change over to use of natural gas as fuel, in the medium area daily morbidity declined significantly in 2nd and 3rd year.

Table 11 shows correlation of daily health abnormalities with daily SO_2 levels, in first year. It is seen that all symptoms are more prevalent on days when SO_2 levels are above 100 ug/m^3 in the urban high and above 50 ug/m^3 in the urban medium area. the values for 2nd and 3rd year showed similar trends.

The role of carbon monoxide factor due to vehicle pollution at a traffic junction in an Indian metropolitan city was studied. There was higher build up of carboxyhaemoglobin levels in blood in a zone when moderate density vehicle traffic slowed down. At the zone of heavy fast traffic there was more cough and headache, while at the zone with heavy slow traffic there were more breathing problems and irritability. In zone with moderate low traffic chest pain and headache were more frequent. At the zone of low traffic, there was the lowest frequency of headache, chest pain or irritability.

In order to study contribution of food, fruit and water bacterial contamination the three markets were covered from heart of the city. A high bacterial counts (mainly klebsiella, staphylococci, proteus, E. coli and pseudomonas) were observed in all the samples.

There were little differences between whole sale and retain market samples. Generally, it is believed that bacterial counts should and exceed 10^2 or 10^4 in any surroundings and should not contain enteric pathogens . The bacteria from motions were compared in cases with diarrhoea with organisms isolated from vegetables consumed and found similar isolates . The water samples around the market were also widely contaminated with pathogens . From preliminary data from this study it was found that those consuming inadequate calories were getting frequent colds and those with poor protein were getting frequent colds and breathing problems more often ($P< O.05$).

Table 12 gives diet analyses from the main study population. It was seen that rural population was nutritionally poor though it was a relatively prosperous area. The groups divided as inadequate for calories (below 80 percent of optimum as per ICMR standards) and poor protein (below 30 gm daily) . In the urban high area those with abnormal chest symptoms were consuming inadequate calories ($P< O.05$) . In other areas though trends were similar those were insignificant .

At third year, the results on regularly followed subjects showed that females sufered from slightly more dyspnoca and common colds but males suffered from cough more often. While two more polluted areas had retained similar prevalence, the low area had significantly worsened.

When several interactions were studied, it was found that defaulting subjects in 3 urban areas may be having more prevalence for dyspnoea and many

TABLE - 11
Relation of daily SO_2 levels and daily health morbidity of 1st year in 8 urban areas

No. Studied	Urban High	Urban Medium	Urban Low	Rural
a) Colds				
SO_2	0 – 50	0.1	3.6*	3.0
	51 – 100	3.0	9.1	1.5
	7 –100	19.2**	10.3	1.5
b) Intermittent cough				
	0 - 50	0.3	3.4*	1.6
	51 - 100	1.6	7.4	1.9
	7 - 100	14.7**	7.4	0.9
c) Chronic Cough				
	0 - 50	0.1	4.3*	1.1
	51 - 100	2.3	8.6	0.9
	7 - 100	12.0**	9.9	0.9
d) Dyspnoea				
	0 - 50	0.1	0.2*	0.2
	51 - 100	0.2	0.4	0.1
	7 - 100	2.1**	0.8	0.1

* Throshold below 50 ug/m^3 SO_2
** Threshold below 10 $ug/^3$ SO_2

TABLE - 12
Nutritional analyses and correlation with clinical abnornalities

	High		Medium		Low		Rural	
No. Studied %	635	(63)	705	(63)	617	(62)	758	(75)
Mean calorie + SD	1772	+488	1509	+438	1659	+414	1 3	6 3
+406								
a) Nutrition groups, %	M	F	M	F	M	F	M	F
(i) Inadequate protein & calorie (<80%)	5	10	7	17	4	11	32	32
(ii) Adequate protein & inadequate calorie	43	34	43	33	48	41	28	13
(iii) Adequate calorie (<30 gm) and poor protein	2	5	5	7	3	6	12	17
(iv) Adequate calorie + protein	50	51	46	43	45	42	28	33
b) Clinical abnermalities, %								
(i) Inadequate calorie & protein		38		31		13		18
(ii) Inadequate protein only	33	30	10	7				
(iii) Inadequate protein only	23	28	21	23				
(iv) Adequate (both)	28	27	15	15				

times cough and colds; in rural area the defaulting group was less abnormal. Considering age, abnormal symptom frequency was higher at young (0.9 years) ages but more so at older (above 44 years) ages. The age related regression is of small significance **(Table 13)**. But sex relations even poorer; in urban areas males and in rural area females were wears. For smoking particularly in rural area the relation was stronger and significant. For occupation the relatioship was significant but not as strong. There was no significant relation to housing, sanitation, income, a weak relation to fuel (particularly where ambient pollution was low) and a significant relationship with duration of residence. The relationship to nutrition is significant. In contrast as soon in **Table 13** air pollutants and mostly in a strong manner.

Table 14 shows the trend in long function over 3 years. There were more subjects with obstruction (Low FEV1/FEC) in highly polluted area. though rural subjects had low function initially their yearly declines were smaller. The cause for the initial low function in rural community some to be nutrition, it appears that they maintain it better till the age of 50. All urban communities seem to show high rates of yearly decline at the existing levels of pollution, suggesting an offect even in the low area.

Thus, the analyses indicate that environmental pollution is a major casual factor in respiratory and other health morbidity in an Indian metropolitan city. Other factors have a small role. The results also suggest that SO_2 threshold may be around 50 μ/m^3 and prevailing SPM levels in all areas seem to add. to this effect. The role of smoking may not be as large in India as claimed in western literature (Finkler) particularly in more polluted areas. The factor of fuel stressed by others (comstock, 1995) has been found to be more important in

TABLE - 14
Yearly lung function trends in regular study population over 3 years

High	**Medium**		**Low**		**Rural**			
	R	**S**	**R**	**S**	**R**	**S**		
	M	F	M	F	M	F	M	F
a) FVC, ml.								
15 - 19 yr.	-20	-10	-6	-76	-9	-48	+68	+50
20 - 25 yr.	-92	-38	-97	-63	-48	-99	+50	-61
26 - 30 yr.	-108	-73	-170	-68	-182	-85	-39	-74
31 - 40 yr.	-143	-21	-87	-120	-147	+106	-148	-50
41 - 44yr.	-142	-43	-175	-114	-192	-85	-204	-260
45 - 50 yr.	-140	-87	-141	-104	-181	-90	-18	+15
51 - 55 yr.	-201	-101	-94	-45	-107	-55	-129	-72
> 55	+172	-32	-176	-205	-182	-92	-173	-58
b) FEV1, ml								
All adults	-229	-29	-62	-201	-383	-319	-17	-21
20 - 25 yr.	-42	-20	-7	-13	-59	-56	-27	-20
31 - 40 yr.	-34	+11	-59	-91	-45	-58	-23	-36
41 - 44 yr.	-70	-8	-92	-52	-95	-60	-123	-58
51 - 55 yr.	-111	-84	-71	-4	-80	-91	+29	-35
c) Those with low (<80%) FEV1/FVC%	26.7	14.7	16.5	10.6	16.4	10.6	11.5	4 . 3

M : Male, F: Female

rural area. Thus with rapid urbanization and industrialization the technically trained and productive population is paying a price in large impairment of health. Due to basic factor of poor nutrition this is particularly unfavourable. While developing further industrial base, perhaps the administrative planners would consider the role of human safety and maintenance of well being of its citizens, with a higher priority.

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