Occupational Morbidities and their Association with Nutrition and Environmental Factors among Textile Workers of Desert Areas of Rajasthan, India

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Abstract: Occupational Morbidities and their Association with Nutrition and Environmental Factors among Textile Workers of Desert Areas of Rajasthan, India: Madhu B. SINGH, *et al.* Desert Medicine Research Centre (ICMR), India—In Rajasthan 21,000 workers are engaged in hand processing textile industries (process gray/raw cotton cloth). They are exposed to hazards of the textile industries besides the harsh conditions of the desert which contributes to adverse effects on their health. To explore the occupational health problems of the desert textile workers and their association with nutrition and environmental factors, investigations were carried-out in two districts, Jodhpur and Pali. Data on occupational disease conditions, environmental factors, nutritional deficiency signs and anemia were collected for a total of 1,240 individuals out of which 845 were textile workers and 395 were comparative group workers of the same age groups. The main disease conditions, i.e. aches (19.4%), respiratory (12.1%) and fever (7.7%), were higher in textile workers than the comparative group. Dyeing group workers suffered the most (25.5%) from aches, significantly higher than the comparative group (11.6%), may be due to a higher percentage of severe anemia, besides physical labour. Printing and bleaching group workers suffered from respiratory problems (15.5%) almost twice as much as the comparative group, possibly due to exposure to fumes of acids and use of chemical dyes. Housing conditions, personal hygiene and education showed negative associations with disease conditions but positive associations with anemia. The study revealed that in the textile industry, disease conditions vary with the categorization of work. The findings suggest the need for implementation of safety measures according to the type of work in textile industries, besides

extension of health and nutrition education and welfare programs.

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In developing countries, high prevalence of manual and heavy physical work combined with lack of general health and social protection warrant an urgent need to develop occupational health services¹⁾ giving due consideration to general health needs besides improvement of health and environment. The occupational health standards of workers and workplaces vary substantially according to the structure, level of industrialization, developmental status, climatic conditions and traditions of occupational health and safety. According to WHO 20 to 50 percent of workers are subjected to hazardous exposures in industrialized countries and the rate may be even higher in developing countries¹⁾.

In desert districts of Rajasthan, Pali, Jodhpur and Barmer, about 21,000 workers are engaged in various type of activities in hand processing textile industries. They process gray/raw cotton cloth through various stages such as caustisizing (continuous caustic padding: passing the gray/raw cotton cloth through caustic soda), bleaching, dyeing, printing and finishing (stentering: sizing of cloth for maintaining the width of cloth, felt finishing and packing). These workers are not only exposed to the harsh conditions of the desert but also to the hazards of the textile industries, both affecting their health adversely. The major health problems reported in the literature at international^{2–5)} and national^{6, 7)} levels are mainly respiratory and musculoskeletal pain, headache. Occupational health problems of workers of the desert areas of Rajasthan, exposed to hazards of the textile industry, have not yet been explored. The present study was conducted with the aim of exploring the occupational

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Figure Map of India and Rajasthan showing the location of textile industries in the present study.

health problems and their association, if any, with nutrition and environmental factors.

Subjects and Methods

Figure

The great Indian desert commonly called Thar, is spread over 285,680 km², between 22° 30' N and 32° 50' N and from 68° 05' E to 75° 45' E. Within India it forms a part of the country's north west arid zone in the states of Rajasthan (69%), Gujrat (21%) and Punjab and Haryana (10%). The desert is bordered by the irrigated plains of the river Indus in the West, the Aravalli hill ranges in the east, the Rann of Kutch in the South and the plains of Punjab and Haryana in the north and northeast. The greater part of desert remains arid to hyper arid throughout the year. The annual precipitation is low, ranging from less than 100 mm in the West to about 500 mm in the east. It is highly erratic. About 90% of rainfall is received in the months of July and August. Delayed onset and early withdrawal of the monsoon, the main source of rain is quite common. Summer temperature is high, reaching up to 50° C in May and June in some places. Dust storms are quite common with wind velocities above 50 kph. During the last century, the arid region experienced 47–62 percent droughts of varying intensities. The desert dwellers have for centuries lived under harsh conditions with a bare minimum of potable water fetched from far off places and stored as a precious treasure. Milk and milk products are usually available in plenty, but not drinking water. In years of good rainfall, ponds, underground tanks and sublets of ponds turn into water reservoirs, serving human and livestock requirements⁸⁾.

Subjects and Data

In the desert parts of Rajasthan about 700 textile enterprises are situated in the Pali, Jodhpur and Barmer districts, and they engage nearly 21,000 workers in various activities such as dyeing, printing and bleaching. Only the first two districts were included in this study. WHO⁹⁾ criteria for random sampling were used in estimating the sample size on the basis of 10% prevalence of malnutrition and morbidity and 20% relative precision as observed in earlier studies (Moser and Kelton¹⁰⁾, Waterlow, *et al.*¹¹⁾ and Healy M.J.R.¹²⁾). The required sample size was estimated to be 864. For the comparative group, fifty percent of the required sample of textile workers, i.e. 430, were taken for comparison. The textile enterprises were selected using systematic sampling. The individuals were selected based on the Simple Random Sampling (SRS) technique from each textile enterprise. The comparative group were selected randomly by matching their age groups and smoking habits (interviewed in the beginning about age and smoking habits and then proceeded further), residing in 8 communities situated in the vicinity of the textile enterprises. The occupations of the comparative group were mainly service, gardeners, electricians, small shopkeepers, carpenters and tailors.

A total of 1,240 individuals were interviewed (mentioned below) out of which 845 were textile workers employed in 33 textile enterprises located in the Pali and Jodhpur districts and 395 were from the comparative group. Textile workers were working for 10 h only in one shift.

From each worker, information on socio-demographic, economic aspects, duration of exposure and smoking

habits was recorded in pre-structured schedules following the interview technique. For environmental factors, housing conditions and personal hygiene were recorded. In assessing housing conditions, 10 parameters were considered for the household of each worker: type of house, ventilation and light, no. of living rooms, cleanliness, animals kept in the house, kitchen, water supply and adequacy, disposal of refuse and waste water disposal, and after scoring the assessment was made as poor, fair and good. In personal cleanliness, 10 parameters were taken: bath, hair, dress, footwear, bowel habit, nail, face, hand washing before meals, hand washing type and louse infestation, and after scoring the grading was done. Workers who had worked in the textile industry for at least one year or more were included in the present study. Each worker was examined for present illnesses, dietary intake (24 h recall oral questionnaire method¹³⁾) and clinical examination for nutritional deficiency signs along with height and weight following WHO standard techniques¹³⁾. Haemoglobin estimation

was done by cynmethaemoglobin technique (filter paper method)¹⁴⁾. Ethical approval of the study was given by the ethical committee of the Desert Medicine Research Centre, Jodhpur.

Statistical Method

Chi-square test was applied among different work categories of textile workers and the comparative group to test the strength of associations in disease conditions. The proportion test was applied as per their feasibility for application¹⁵⁾ to identify significant differences between disease conditions, morbidity and environmental factors in textile workers.

Results

Table 1 shows the age and gender distribution of the workers. Textile hand processing work has been categorized into four groups: causticizing and bleaching, dyeing, printing and finishing. In the textile industry, 96.9 percent were male workers and the majority of them

Table 1. Age and gender distribution of workers and the comparative group according to type of textile work (N=845 & comparative group=395)

Age Group	Causticizing & Bleaching		Dyeing		Printing		Finishing		Total		Comparative group	
	M	F	M	F	M	F	M	F	M	F	M	F
<18	0	0	11	0	14	0	14	1	39	1	20	2
18–30	39	0	67	4	186	0	171	0	463	4	173	15
30–40	30	0	53	10	54	0	70	4	207	14	95	7
40–50	7	0	21	5	22	0	36	1	86	6	58	5
>50	1	0	8	1	2	0	13	0	24	1	19	1
Total	77	0	160	20	278	0	304	6	819	26	365	30

Table 2. Morbidity profile of textile workers in different types of work

Total workers: 845			Sick: 447 (52.9%)									
Comparative group: 395			Sick: 183 (46.3%)									
Type of Morbidity	Bleaching		Dyeing		Printing		Finishing		Total		Comparative group	
	No	%	No.	%	No.	%	No.	%	No.	%	No.	%
Aches	12	15.6	46	25.5**	52	18.7**	54	17.4*	164	19.4	46	11.6
Respiratory	11	14.3*	21	11.7	44	15.8**	26	8.4	102	12.1	31	7.8
Fever	7	9.1	12	6.7	25	8.9*	21	6.8	65	7.7	19	4.8
Gastric Problem	6	7.8	11	6.1	30	10.8	22	7.1	69	8.2	32	8.1
Skin	3	3.9	11	6.1	7	2.5	14	4.5	35	4.1	19	4.8
General Weakness	2	2.6	4	2.2	13	4.7	11	3.5	30	3.6	13	3.3
Eye	2	2.6	3	1.7	2	0.7	6	1.9	13	1.5	11	2.8
Urinary Tract Infection	1	1.3	5	2.8	3	1.1	2	0.6	11	1.3	5	1.3
Ear	—	—	3	1.7	1	0.3	—	—	4	0.5	4	1.0
Others	3	3.9	9	1.1	3	3.9	18	2.1	33	3.9	20	5.1

** $p < 0.01$ (Textile workers group v/s comparative group), * $p < 0.05$ (Textile workers group v/s comparative group)

Table 3. Distribution of textile workers and comparative group according to anemia

		Textile workers: 765						Comparative group: 350					
Hb Grades		Caust.& Bleach		Dyeing		Printing		Finishing		Total		Comparative group	
gm/dl	Gender	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Normal	M	26	38.2	42	35.0	70	29.4	105	34.6	243	33.2	138	42.7
=>13	F	—	—	13	68.4	—	—	3	50.0	16	64.0	12	44.4
	T	26	38.2	55	39.6	70	29.4	108	34.6	259	34.2	150	42.8
Mild	M	32	47.1	32	26.7	137	57.6	108	35.6	309	42.2	127	39.3
10-<13	F	—	—	5	26.3	—	—	2	33.3	7	28.0	11	40.7
	T	32	47.1	37	26.6	137	57.6**	110	35.3	316	41.7	138	39.4
Moderate	M	8	11.8	34	28.3	27	11.3	85	27.8	154	21.0	55	17.0
7-<10	F	—	—	1	5.2	—	—	—	—	1	4.0	3	11.1
	T	8	11.8	35	25.2	27	11.3	85	27.2	155	20.5	58	16.6
Severe	M	2	2.9	12	10.0	4	1.7	8	2.6	26	3.6	3	0.9
<7	F	—	—	—	—	—	—	1	16.7	1	4.0	1	3.7
	T	2	2.9	12	8.6	4	1.7	9	2.9	27	3.6	4	1.1

** $p<0.01$ (Textile workers group v/s comparative group), * $p<0.05$ (Textile workers group v/s comparative group)

Table 4. Mean and standard deviation of haemoglobin in textile workers and comparative group

		Textile Workers:765			Controls: 350		
Hb Grades		Caust. & Bleach		Dyeing	Printing	Finishing	Comparative group
gm/dl	Gender	Mean $\pm$ SD		Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD
Normal=	M	15.1 $\pm$ 1.57		16.1 $\pm$ 1.92	14.8 $\pm$ 1.74	15.8 $\pm$ 2.13	14.1 $\pm$ 1.03
>13	F	—		15.9 $\pm$ 1.79	—	16.0 $\pm$ 2.23	14.8 $\pm$ 1.21
Mild	M	11.5 $\pm$ 0.88		11.3 $\pm$ 0.97	11.6 $\pm$ 0.86	11.5 $\pm$ 0.83	11.3 $\pm$ 0.77
10-<13	F	—		11.5 $\pm$ 1.14	—	11.7 $\pm$ 0.07	11.5 $\pm$ 0.76
Moderate	M	8.4 $\pm$ 0.89		8.5 $\pm$ 0.86	9.1 $\pm$ 0.76	8.6 $\pm$ 0.93	8.8 $\pm$ 0.80
7-<10	F	—		7.5 $\pm$ 0.0	—	—	8.9 $\pm$ 0.93
Severe	M	5.5 $\pm$ 0.56		5.6 $\pm$ 0.77	5.9 $\pm$ 0.79	5.4 $\pm$ 0.81	5.5 $\pm$ 1.22
<7	F	—		—	—	6.2 $\pm$ 0.00	6.9 $\pm$ 0.00

(55.3%) belonged to the 18 to 30 yr of age group. Illiteracy was 21.0 percent. Most textile workers (92.6%) belonged to the Hindu religion. The majority of textile workers (76.4%) had monthly incomes less than Rupees 3000. Nearly 85.0% of textile workers were living in poor or fair housing conditions. Regarding their smoking habits, 51.4 percent were found to smoke various types of tobacco, such as Beeri (25.0%), Gutka (30.1%), and Zarda (37.7%). Beeri is dried tobacco leaf fragments rolled in tendu leaf (Botanical name: *Diospyros melanoxylon*). Gutka are flakes of tobacco mixed with betel nut pieces. Zarda is powdered tobacco.

Sickness at the time of survey was higher among the textile workers (52.9%) than the comparative group (46.3%). The main morbidities reported at the time of the survey among textile workers were aches (body ache,

backache and headache, 19.4 percent), respiratory (12.1%) and fever (7.7%). These percentages were higher than the comparative group, 11.6 percent, 7.8 percent and 4.8 percent, respectively (Table 2). Other disease conditions such as general weakness, urinary tract infection (UTI), etc. were comparable in both the groups. Among the textile workers, gastric problems, respiratory, fever and general weakness were higher in the group engaged in printing work, followed by bleaching, finishing and dyeing, whereas, aches and skin problems were higher in the dyeing group.

Anemia was higher among textile workers (66.0%) than in the comparative group (57.2%). Textile workers falling in the moderate anemia category (7–10 gm/dl) were higher (20.5%) than that of the comparative group (16.6%). The dyeing group workers were found to suffer

Table 5. Prevalence of nutritional deficiency signs in textile workers and comparative group

Nutritional deficiency signs	Textile workers		Comparative group	
	No	%	No	%
Protein calorie malnutrition signs				
Dispigmentation of hair	10	1.2	3	0.7
Dryness of hair	3	0.4	1	0.2
Sparseness hair	2	0.2	—	—
Total	15	1.8	4	0.9
Vitamin A deficiency				
Night blindness	—	—	—	—
Bitot spot	17	2.0	—	—
Xerosis	1	0.1	1	0.1
Total	18	2.1	1	0.2
Vitamin B complex deficiency				
Angular stomatitis	11	1.3	—	—
Cheliosis	17	2.0	2	0.5
Glossitis	6	0.7	4	1.0
Total	34	4.0	6	1.5
Gums bleeding	130	15.4	47	11.9
Swollen red papillae	6	0.7	1	0.2
Teeth caries	206	24.4	95	24.0
Mottled enamel	93	11.0	20	5.1
Teeth caries & mottled enamel	54	6.4	29	7.3
Thyroid	2	0.2	—	—

Table 6. Means and standard deviation of nutrients in textile workers with RDA, ICMR

Mean ± SD	Calories (Kcal/d.)	Proteins (g/d)	Fats (g/d)	Iron (mg/d)	Calcium (mg/d)	Vitamin A(mcg/d)
Textile Workers	2284.6 ± 235.29	75.1 ± 7.89	34.8 ± 2.96	37.9 ± 4.66	498.9 ± 33.36	1371.9 ± 101.91
RDA*, ICMR	2875	60	20	28	400	2400

*Recommended dietary allowances, Indian Council of Medical Research.

most from severe anemia (8.6%) as shown in Tables 3 and 4.

Regarding nutritional deficiency signs, protein calorie malnutrition, vitamin A, B complex and C deficiencies were higher among textile workers (1.8, 2.1, 4.0 & 16.1%) than in the comparative group workers (0.9, 0.2, 1.5 & 12.1%). The dietary analysis revealed that the diet of textile workers was deficient in calories (20.5%) and Vitamin A (42.9%) in comparison to recommended dietary allowances (RDA), Indian Council of Medical Research (ICMR)¹⁶⁾. This may be responsible for vitamin A deficiency and protein calorie malnutrition (PCM) (Tables 5 and 6).

Anthropometrically, body mass index was calculated in order to observe the extant of malnutrition according to WHO categories. Among textile workers, 43.8% suffered from chronic energy malnutrition, significantly

higher than in the comparative group (38.2%). Marginal and moderate thinness were higher among the workers engaged in the dyeing work followed by finishing and printing work, and were least observed in the causticizing and bleaching work.

In textile workers, overall morbidity has also been correlated with the environmental factors, housing conditions and personal hygiene, education, income and anemia. Overall morbidity was significantly higher ($p < 0.01$) in textile workers suffering from anemia (71.3%) compared to those without anemia (28.7%). In good housing conditions, overall morbidity (15.0%) was significantly ($p < 0.01$) lower than poor and fair conditions (85.0%). Similar results were found with personal hygiene: morbidity declined with good hygiene (4.5%) and was high in poor and fair conditions (95.5%). Education and income also showed a negative association

with morbidity: 5.7 percent in high education (secondary and above) and 79.6% in low education (primary level) with 90.6 percent in the lower income group (monthly income less than Rupees 3000) and 9.4 percent in the higher income group (monthly income more than Rupees 3000).

Discussion

The most frequent complaints reported by textile workers were aches and respiratory disorders. Respiratory disorders may be due to the dusty work environment. An earlier study⁴⁾ conducted at the Bahir Dar Textile Mills also reported the most frequent complaints reported by the workers within a period of one month were symptoms related to the respiratory system. In others studies, also, the major health problems associated with cotton dust were respiratory problems including byssinosis, cough, bronchitis and bronchial asthma^{2, 3)}. Other disease conditions related to working in textile mills which have been reported are musculoskeletal pains, headache, easy fatigue and changes in blood pressure^{2, 17)}. These conditions were also observed in the present study: textile workers suffered from aches (body ache, backache, headache) almost twice as much as the comparative group indicating textile workers are highly exposed to physical labour which affects their musculoskeletal systems.

Dyeing group workers suffered the most from aches at a significantly higher rate ($p < 0.01$) than the comparative group. This may be due to their higher rates of severe anemia in addition to physical labour, indicating association of morbidities not only with occupation but also with anemia. The WHO¹⁸⁾ stressed that disease prevention through prompt attention to nutrition and to various aspects of environmental health should be priority research. In a study¹⁹⁾ on adults of the Raika community (OBC) of Jodhpur district, prevalence of severe anemia was observed to be high, 3.4 percent. Diseases and malnutrition are closely linked. Malnourished populations are more susceptible to most infections and severity of illness worsens the mortality rates (WHO^{20, 21)}).

Printing and bleaching group workers were suffering from respiratory problems (15.5%) almost twice as much as that of the comparative group ($p < 0.01$), which may be due to greater exposure to acid fumes and use of chemical dyes, as reported earlier⁶⁾. Skin complaints were observed to be higher in the dyeing group, though statistically insignificant, which may be due to not using safety gloves, aprons, etc. while working.

Disease/morbidity showed a negative association with housing conditions, personal hygiene, education and income, but was positive with anemia. Nearly 85.0% of textile workers were living in poor or fair housing conditions. Many textile workers were also residing in industry compounds thereby experiencing environmental

pollution during their off-work hours, further enhancing their disease profile.

This study suggests the need for implementation of protective measures such as installation of hoods, dust filters, ventilators, general cleanliness and other safety measures such as use of gloves on hands and shoes on feet, aprons, masks, etc. so as to reduce the risks of respiratory problems. Efforts should be made to implement safety measures according to the type of work in textile industry. For example, printing and bleaching group workers were suffering more from respiratory problems, and dyeing and printing workers were suffering more from musculoskeletal pains as working conditions vary with the category of work. In addition to this, health and nutrition education and welfare programs should be organized for textile workers.

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