

Epidemiological studies on bicycle manufacturing industrial workers

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(Received: April 27, 2005 ; Revised received: November 11, 2005 ; Accepted: February 28, 2006)

Abstract: Studies involving health status of bicycle manufacturing industrial workers exposed to chemicals and unexposed workers of the same industry, who formed control were conducted at Sonapat in Haryana State, India. Negligence of industrial hygiene and personal protection affected the health of exposed workers adversely. Epidemiological spectrum of exposed subjects showed much variation from control. Some unique disorders, such as nail impairments, nasal septum perforation and metal fume fever were observed in exposed workers against their absence in unexposed workers. Data showed occurrence of following diseases in the order of asthma>skin disorders>allergic disorders>bronchitis>all other respiratory diseases>nail disorders and acute pharyngitis>pulmonary tuberculosis and loss of smell and hearing>nasal septum perforation showing high risk factor for 'all other respiratory diseases' and skin disorders. Importance of occupational health surveillance has been highlighted.

Key words: Bicycle manufacturing industrial workers, Industrial hygiene, Epidemiological spectrum, Occupational health surveillance
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Introduction

Apart from polluting the environment, industries pose risk to human health. In addition to the factors that influence the health of the general population, the health of industrial workers may also be influenced by conditions prevailing in their work place. Occupational health represents a dynamic equilibrium between the industrial worker and his occupational environment. By "occupational environment" is meant the sum of external conditions and influences which prevail at the place of work which have a bearing on the health of working population. All occupational environments have a certain degree of work related hazards and each working environment is unique in the nature and degree of hazards it poses to workers. One of the important interactions in a working environment is between man and chemical agents. There is hardly any industry which does not make use of chemicals. Hazardous processes expose workers to toxic substances which results in the risk of morbidity. Rao and Lundgren (1955) were the first to draw attention in India to the prevalence of it due to machine oil, rubber, x-rays, caustic alkalies and lime. Statistics now show that nearly 75 percent of occupational cancers are related to skin Dickel *et al.* (2003). Exposure to asphyxiating gases is another common hazard in industries (Govt. of India, 1965; Lindberg and Hedenstierna, 1983; Drozdov, 1984).

Unfortunately, in India occupational health is not treated with the gravity it deserves. Risk assessment procedures are yet to be adopted for environmental regulation in the country (Balakrishnan, 1998). Often the standards are based on data on population elsewhere in the world. Only few attempts have been made on epidemiological index of poor occupational environment (Backyavathy *et al.*, 1986; Gandhi and Sharma, 1999; Rastogi and Rastogi, 1999; Tseng, 2007). Beyond doubt, bicycle

manufacturing industry located at Sonapat has benefited the local male inhabitants by providing them employment. But because of wide use of chemicals in electroplating and heat treatment processes in the industry, there is always a danger of workers getting exposed of them. Chemicals come out in the occupational environment from different uses in the form of dust or mist and act in three ways on the human body: (a) local action, (b) inhalation and (c) ingestion. Conventional risk assessment generally deals with a single chemical exposure, but workers are almost never exposed to only a single chemical. In fact, there is often a continuous chronic exposure to mixed chemicals. Combination of various factors influence the health of workers and thereby produce illness. The effects produced depend upon the duration and quantum of exposures, and individual susceptibility. Therefore, an attempt has been made to document the impact of chemicals on health of workers of industry through health surveillance.

Materials and Methods

50 workers employed in electroplating and heat treatment plants were selected randomly as subjects for epidemiological studies. As control, 50 workers of the same industry who were not exposed to chemicals were selected. The selected workers were interviewed on a survey performa which was divided into two sections. General section included age, type of employment, duration of employment, nature of job, liking for assignment, personal and industrial hygiene, and dietary habits. In the health/epidemiological status section questions were related to persistent, frequently or occasionally occurring symptoms with specific emphasis on skin, nails, irritation/allergy, asthma, other respiratory problems, lung diseases, cancer and tuberculosis, nasal septum perforation and mucosa ulceration, loss of smell and hearing and any other clinically diagnosed disease. Relative



Table - 1: Occurrence of various diseases among experimental and control groups of workers

Name of disease	Experimental group					% occurrence of disease	Control group		Relative* risk
	Number of workers effected						Number of workers affected	Number of occurrence of disease	
	PRW	PO	S	T	Total				
Skin disorder	14	3	-	1	18	36	2	4	9.00
Allergic disorder	10	1	1	1	13	26	4	8	3.25
Nail disorder	5	1	-	1	7	14	Nil	-	-
Nasal septum perforation	2	-	-	-	2	4	Nil	-	-
Asthma	18	2	2	1	23	46	9	18	2.50
Bronchitis	8	2	-	1	11	22	3	6	3.66
All other resp. disorder	5	2	1	2	10	20	1	2	10.00
Acute pharyngitis	3	-	3	1	7	14	13	26	0.54
Pulmonary tuberculosis	5	-	-	-	5	10	1	2	5.00
Loss of smell and hearing	2	1	1	1	5	10	2	4	2.50

PRW = Piece rate worker; PO = Plant operator; S = Supervisor; T = Technician

* Relative risks for nail disorders and nasal septum perforation not calculated as there are no cases in controls

risk (RR) factor for various disorders was obtained using the formula given by Hogue *et al.* (1983).

$$RR = \frac{\text{Incidence among exposed}}{\text{Incidence among non-exposed}}$$

Results and Discussion

Present study portrays the realities and insights obtained during the survey. In electroplating and heat treatment processes various chemicals particularly chromium (as chromic acid), nickel (as nickel bridges, NiSO₄ and NiCl₂) and cyanide (as sodium cyanide) are used. Most of the electroplaters do not follow safety measures, unmindful of the serious consequences on health. Handling of chemicals is not done in the prescribed manner. Personal

safety equipments like rubber gloves and boots, helmets, face shields/chemicals goggles, mist respirator and ear muffs are not worn in required places during their work exposure. Such negligence of industrial hygiene and personal protection affects the health of workers adversely. In the present study, nature of symptoms or health complaints by exposed subjects may be attributed to some systemic disorder due to chemical intoxication including chromium, nickel and cyanide.

Experimental group (32 piece rate makers, 9 plant operators, 5 supervisors and 4 technicians) with an average age of 31±11 yr (range 21 to 49 yrs) exposure of 8 to 29 yr, majority with normal feeding habits and disliking for the demand of job, showed alarming frequency of psychosomatic disorders/diseases (vide material and method) compared to that in control group (Fig. 1) of almost similar age 34 ± 13 yr (range 22 to 56 years), having

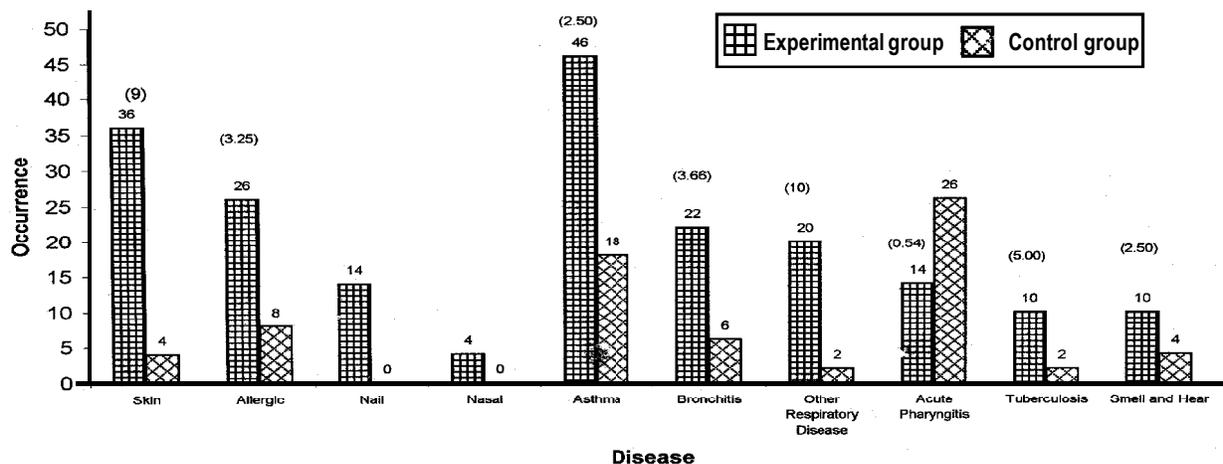


Fig. 1: Relative occurrence of various diseases between experimental and control groups



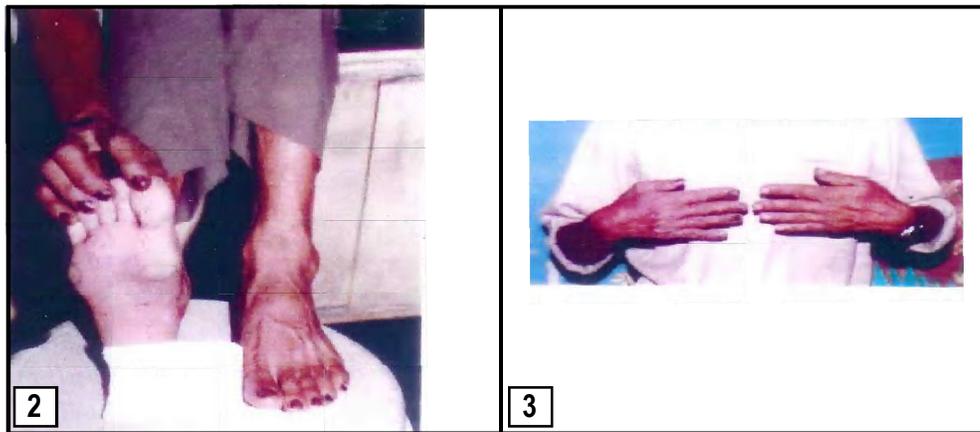


Fig. 2 and 3: Chromium causes skin and nail disorders in exposed workers

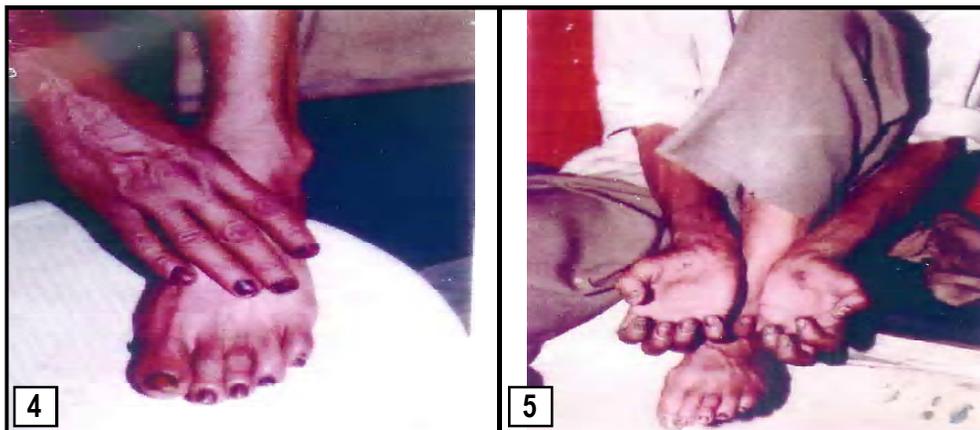


Fig. 4 and 5: Electroplaters suffering from nail disorders

normal feeding habits and fairly satisfied with nature of job. From Table 1 it is evident that physical disorders are quite diverse. Among various sub-occupational groups, piece rate workers had more susceptibility for diseases than plant operators, supervisors and technicians which may be attributed to the duration of exposure and nature of activities. The workload dramatically changes the inhaled volume of air and for many chemicals the amount absorbed is directly related to the amount inhaled. Further, piece rate workers not only inhaled the metal mist but also were in direct contact with chemicals while carrying out their job work. A grim fact is that, work related skin disorders were very common. The experimental group showed nine fold increase in skin impairments, mild to acute (Fig. 2, 3), as compared to control group. Unprotected exposure to toxic chemicals over a period of years has been identified as a cause of a range of skin disorders in workers exposed to chemicals making their hands, arms and face red and swollen with intense itching and discomfort. In addition to these, the study also reveals dermal ulcers. Initially these ulcers develop as painless papulae generally on the hands, forearms and feet and later penetrate deep into tissues and may reach underlying bones (ILO, 1983). Piece rate workers were so addicted to their skin disorders that they left caring for their cure. An increase in occurrence of dermatitis was observed in group who shared longer occupational exposure.

Respiratory system is one of the target site for the toxicity of gaseous form of several metals and other chemicals. Number of epidemiological studies (Amelle, 1983; Friberg *et al.*, 1986) have shown that acute and chronic exposure to metals causes a variety of disorders. No wonder the present study demonstrates that the cases of respiratory diseases such as asthma, bronchitis and other respiratory diseases in workers exposed to mist of chemicals are quite high. Many other studies have also reported pulmonary disorders in industrial workers exposed to chromium and nickel over a prolonged period of time (Bock and Yeung, 1982; Finkel *et al.*, 1983; Chan-Yeung and Lam, 1986). According to Malo *et al.* (1982), Novey *et al.* (1983) and Davies (1986) asthmatic reactions to these metals result from an immunoglobulin E induced response. The above view also explains the greater incidence of asthmatic cases (46%) in exposed workers than control group (18%) in the present study. Further, "metal fume fever" which is grouped in all other respiratory diseases, a strange but frequent feature following exposure to high concentration of metal fumes was observed in present study only in exposed workers. This condition is an influenza or malaria like reaction consisting of fever, chills and malaise and classically little or no x-ray or functional abnormalities. Similar fever was observed in cadmium exposed workers by Johnson and Kilburn (1983).

Nail impairments which coincide with negligence of industrial hygiene and personal protection were also not found in control subjects but occurred high frequency and mild to acute in severity in experimental group (Fig. 4, 5). Similarly, nasal ulceration and septum perforation showed 4% occurrence in experimental group as against nil in control group. Present findings corroborate the report of Williams (2000) that nasal membrane inflammation, ulceration and development of permanent perforation of the nasal septum in chromeplaters is associated to inhalation of hexavalent chromic acid mist. It is also possible that workers inadvertently contaminate their own nose through direct contact of chromic acid on fingers with the mucosa. Low hygiene standards and nose picking have been reported as common within the industry probably due to the irritating nature of the hexavalent chromic acid mist. Psychological disturbance associated with body image could also be noticed in the suffering workers. Although no lung cancer has been reported in the present study during study period, epidemiological studies have shown that industrial workers exposed to chromium and nickel have a higher incidence of respiratory cancer than does the unexposed population (Grandjean *et al.*, 1988; Ronco *et al.*, 1988). Unfortunately, symptoms of metal poisoning come to the light at a later stage only.

Pulmonary tuberculosis was on the rise in experimental group than control. It is well known that various environmental agents including nickel alter the immune system and as a consequence, play an important role in health deterioration (Smialowicz *et al.*, 1984; Davies, 1986; Bhatt, 2005). According to David *et al.* (2000), immunosuppression is expected to promote infectious disease incidence and morbidity. Thus, while infectious diseases in industrial workers are not usually considered as environmental diseases, they often are directly related to environmental factors that suppress functioning of the immune system. Therefore, increase in pulmonary tuberculosis cases in the present study may be attributed to the suppressed immunity due to occupational environmental stress. On the other hand exposed workers demonstrated hypersensitiveness to chemicals also manifested as skin rash and asthma which may be attributed to the aberrant immune potential of environmental pollutants. Higher degree of loss of smell and hearing cases in exposed workers may also be due to adverse effects of occupational pollutants. Earlier, decrease or loss of smell and taste due to chromium was reported by Mancuso (1951). Converse to all above impairments, acute pharyngitis was more frequent and showed relatively a higher percentage in controls than experimental subjects. This situation is being related to the general foul environment of the town. Occurrence of pharyngitis may be due to inhalation of air pollutants not specifically related to BMI as a number of industries are located in Sonapat town.

Thus, it is evident that occupational environment morbidity symptoms were either higher than control or exclusively appeared in exposed group. Present health surveillance may be useful and supportive by providing some information on occupational chemical hazards under Indian weather and living conditions which is of extreme importance in estimating the magnitude of the health problem for preserving national health.

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