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Original Article

Respiratory Health Problems Among the Ceramic Workers in Dhaka,

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Abstract :

Ceramic factory workers are potentially at risk to develop occupational respiratory diseases due to chronic inhalation of dust particles generated in the ceramic factory. A cross-sectional descriptive study was carried out to assess the respiratory and other health problems among the workers of Mirpur Ceramic Works Limited, Dhaka, Bangladesh during the period of April to June, 2011. Among 200 participants, 132 (66%) were males and 68 (34%) were females. Less than one-third of the workers were habituated to use personal protective equipments (PPE), while more than two-third were not habituated. Nearly half (45.5%) of the workers were suffering from at least one respiratory problem and of them 86.8% (P=0.001) had problems after joining the factory. Of the respiratory sufferers 27% had chronic bronchitis, 20% bronchial asthma, 1% pulmonary tuberculosis, and 0.5% had silicosis. A significant numbers (60.5%) of workers were suffering from other health problems along with or without respiratory problems, in terms of musculoskeletal pain, back pain, headache, dermatitis, anaemia and fever. The prevalence of respiratory problems was significantly higher among non-users of PPE than PPE users (P=0.006), and it was found to be higher with the increased of job duration. The study showed the notable higher prevalence of respiratory problems among the workers exposed to ceramic dust, although the other potential environmental confounding factors could not be ruled out in the analysis. Obligatory use of PPE by all workers and health education to increase awareness among the workers might have role to reduce the prevalence.

Key words : Respiratory problem, Ceramic dust, Ceramic workers, Bangladesh.

Introduction :

Air polluted by dust in workplace is associated with a wide variety of occupational respiratory diseases[1]. Ceramic factory workers exposed to dust particles generated in many phases of ceramic production are potentially at risk to develop occupational respiratory diseases[2]. Chronic inhalation exposure to ceramic dust has been elevated risk of pneumoconiosis, chronic bronchitis and ventilatory disorders among both male and female workers[3-5]. An extremely high prevalence of general respiratory symptoms among the ceramic workers was found in Brazil1. Silica dust is correlated with positive radiographic results for silicosis[3]. A significant reduction in Forced Vital Capacity (FVC) and Forced Expiratory Volume in the first second FEV1 has been documented among ceramic and pottery workers in Italy[6]. Respiratory disorders and abnormal spirometric findings were significantly higher in the tiles and ceramic factory workers group compared to controls in Iran[2]. While, in other study no significant reduction has been found in the parameters of lung function of both ceramic and pottery workers with less than 21 years of exposure history[7].

Ceramic dust generated by hot process in the ceramic factories, is typically of the submicron (1 micron = 1/25,000 of an inch) heavier and higher dense than dust particles of wood and plastic, almost invisible to the naked eye and easily inhaled. Many of ceramic products contain a small percentage of amorphous silica, however, not in sufficient quantity to produce free crystalline silica upon heating. Dusts are therefore considered of the inert (nuisance) type and would not be expected to cause permanent damage to tissues on inhalation unless the exposure is severe. Chronic exposure may produce radiopaque deposits in the pulmonary system with little or no parenchymal

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reactions. Some individuals may exhibit allergenic reactions ranging from asthmatic symptoms to benign pneumoconiosis[8]. Ceramic raw materials contain crystalline silica (cristobalite), which has been classified as carcinogenic to humans. After crystalline silica is exposed to temperature above 160^0F (87^0C) cristobalite and tridymite are formed. Removal of these products may generate respirable dust and airborne ceramic fibers. Organic binder will burn off during first heat up. Acrid smoke and irritating fumes may be released. Typical combustion products are carbon, carbon monoxide, and carbon dioxide[9].

Bangladesh, being a low-labor-cost economy, offers to be a strategic partner in production and supply of ceramic products where more and more labor force is required. The labor force therefore, needs attention of their health and a proper working environment, where the workers and their families can enjoy the benefits of their efforts. Bangladesh had ten ceramic industries. Five of them are fairly large[10]. Since ceramic an important industrial sector, the health and health related factors of the ceramic workers should have been studied with special attention. But due to lack of proper diagnostic facility and occupational health services, the exact picture of the problems is not clear. The unhealthy and unsafe working condition, the critical deficit of safety knowledge, lack of training and skills and above all the apathy on the part of the management in the matter of safety standards are causing a lot of sufferings to the victims of respiratory problems and their families as well as a huge economic loss to the country. The issue of their work-related illness is also being neglected. Non recognition of diseases and non-reporting is the main reason for poor data on occupational diseases. In the early manifestation of the disease, the workers usually conceal their illness probable because they are afraid of losing job. Sometimes the ignorant workers do not count the mild symptoms at the onset of the disease. Concerned parties are showing an indifferent attitude towards this problem and there is no systemic reporting of the health problems or administrative database available in neither Bangladesh, nor a significant number of studies been conducted focusing this issue. There is no exact figure showing how many workers are suffering at present from respiratory health problems due to exposure of dust in their workplace. But there is no question that a large number of industrial workers have been suffering from pulmonary diseases like occupational asthma, pneumoconiosis, bronchitis, tuberculosis, silicosis, etc due to occupational exposure to dust[11].

Therefore, the aims of the study were: to assess the extent of respiratory symptoms/diseases due to exposure of dusts in the ceramic factory and to find out the magnitude of other health problems among the ceramic factory workers in Dhaka, Bangladesh.

Materials and Methods :

The study was a cross-sectional descriptive conducted during April- June, 2011 in Mirpur Ceramic Works Limited, one of the oldest ceramic factory located in Mirpur-12, Dhaka, Bangladesh, where more than 1000 workers work regularly. The factory was selected randomly among four big factories in Dhaka city. Based on eligibility criteria, among the 320 volunteer participants, 200 (62.5%) workers were recruited randomly for interviews. The eligibility criteria were set as: 1) workers with working history of at least one year and 2) none of the subjects would have past medical or family history of respiratory illnesses or any other chest operations or injuries. Data were collected through face-to-face interview of the participants with the help of pre-tested respiratory symptoms and socio-demographic questionnaires, and clinical examination through cheek list. Respiratory symptoms questionnaire was developed from the American Thoracic Society (ATS 1978)[12], was modified and adopted to this study after validated by local experts. The questionnaire was adapted to the local language using a forward- and back-translation procedure by a professional translator. The questionnaire was then pre-tested among 20 samples in a different factory in Dhaka city to ensure understandability, clarity of wording, and reliability. It was modified and finalized according to the feedback received from the pre-testing. The questionnaire was administered to the subjects by ten paramedic students of SPKS medical institute, Mirpur, Dhaka who had attended one-day training session including a role-play to demonstrate their proficiency. Peak expiratory flow rate (PEFR) of every worker was recorded by Wright Mini-Peak Flow Meter (Airmed; Clement Clarke International, London, UK). Chest X-ray P/A view and sputum for AFB of suspected workers with pulmonary tuberculosis and silicosis were done. Chronic bronchitis was defined as cough and sputum production for at least 3 months and in each of two consecutive years[13]. The study was conducted in accordance with the Helsinki Declaration of 1964 as revised in 2000[14]. Before collecting data, all participants gave written or thumb printed consent after being fully informed about the objectives of the study. The information was gathered anonymously and subjects were assured not to disclose any information without their prior permission. An ethical approval was found from the medical ethics committee of Bangladesh Medical Research Council before commencement of the study. Descriptive and statistical methods were used to analyze data. Chi-square test, Fisher exact test were used for analyzing the data with the help of SPSS version 14.0 for windows. A two-tailed p value <0.05 was considered as statistically significant.

Results :

Of the 200 workers recruited in the study, 132 (66%) were males and 68 (34%) were females. More than half (53.0%) of the participants were belonged to the age group 14-30 years. Service length of the majority workers was 1-10 years. Less than one-third of the workers were habituated to use personal protective equipments (PPE), while more than two-thirds were not habituated. About half of the participants had respiratory problems. The mean peak expiratory flow rate (331.87 Liter/minute) was markedly reduced among the workers with respiratory problems. The socio-demographic and other characteristics are summarized in the (Table I.)

Table I: Socio-demographic and other characteristics of the participants

Characteristic	No. of respondents	Percent
Sex		
Male	132	66.0
Female	68	34.0
Religion		
Muslim	175	87.5
Hindu	25	12.5
Marital Status		
Single [a]	24	12.0
Married	176	88.0
Age in years		
14-30	106	53.0
31-50	63	31.5
≥"51	31	15.5
Length of Service in Years		
1-10	123	61.5
11-20	62	31.0
21	15	7.5
Education		
No education	90	45.0
Primary	88	44.0
Secondary and above	22	11.0
Monthly income in BDT		
< 1000	19	9.5
1001-3000	165	82.5
≥ 3001	16	8.0
Smoking habit		
No	113	56.5
Yes	87	43.5
Use of PPE [b]		
No	136	68.0
Yes	64	32.0
Respiratory problem		
Absent	109	54.5
Present	91	45.5
Mean PEFR[c]		
Without respiratory problem	516.24 Liter/minute	
With respiratory problem	331.87 Liter/minute	

a Single includes never married, separated, or widowed
b PPE: Personal Protective Equipment
c PEFR: Peak Expiratory Flow Rate

When we considered a single respiratory problem the prevalence of chronic bronchitis, asthma, tuberculosis, and silicosis were 27.0%, 20.0%, 1.0%, and 0.5%, respectively. Prevalence of different types of respiratory problems is shown in the (Table II.)

Table II: Prevalence of different types of respiratory problems among the workers.

Respiratory problems	Yes (%)	No (%)
Chronic bronchitis	54 (27.0)	146 (73.0)
Asthma	40 (20.0)	160 (80.0)
Tuberculosis	2 (1.0)	198 (99.0)
Silicosis	1 (0.5)	199 (99.5)

Table III shows that of the total workers worked in the excavation section majority (63.3%) had respiratory problems followed by dice press clean section (58.8%) and TD section (57.1%).

Table III: Prevalence of respiratory problems among the workers in different section of the factory.

Name of factory section	Respiratory problem	
	Yes (%) (n = 91)	No (%) (n = 109)
Quartz press (n=51)	24 (47.1)	27(52.9)
Quartz press clean (n=19)	9 (47.4)	10(52.6)
Dice press (n=50)	15 (30.0)	35(70.0)
Dice press clean (n=17)	10 (58.8)	7(41.2)
BG press/Bush (n=42)	21 (50.0)	21(50.0)
Excavation (n=11)	7 (63.6)	4(3 6.4)
TD (n=7)	4 (57.1)	3(42.9)
Workshop (n=3)	1 (33.3)	2 (66.7)

Table IV indicates that prevalence of respiratory problem was significantly higher among the non-users of PPE and it was significantly higher after joining the factory (78.0%; p = 0.006 and 86.8%; p = 0.001, respectively).

Table IV: Relation of respiratory problem with PPE use and timing of problem

Variable	Respiratory problem (n = 91)	p-value
PPE use		0.006
No	71 (78.0)	
Yes	20 (22.0)	
Starting of problem		0.001
Before joining the factory	12 (13.2)	
After joining the factory	79 (86.8)	

Prevalence of respiratory problem was found to be higher with the increased of job duration. The worker, who worked for ≥ 21 years had highest (73.3%) prevalence of respiratory problem (Table V).

Table V: Association between job duration and respiratory problem

Job duration	Respiratory problem	
	Yes (n = 91)	No (n = 109)
1-10 years	11 (36.6)	78 (63.4)
11-20 years	35 (56.5)	27 (43.5)
≥21 years	45 (73.3)	4 (26.7)

Discussion :

The study documented higher prevalence (45.5%) of respiratory problems among the ceramic workers i.e. Bronchitis, Bronchial Asthma, Pulmonary Tuberculosis, and Silicosis, which supports the other study[15]. One worker of silicosis along with pulmonary tuberculosis was found in excavation section who exposed to dust for 22 years. The possible reasons of respiratory problems are, more than two-thirds of the workers (68.0%) do not use PPE during work time, which facilitates the inhalation of dust particles. Moreover, more than half (51.6%) of the workers who suffered from respiratory symptoms were smokers. Cigarette smoking exerts an important influence on the response of lungs to other inhaled materials. Several studies have reported that tobacco use or smoking was associated with obstructive airways disease and overall respiratory symptoms[16-18].The reasons for highest prevalence of bronchitis might be due to constant exposure to ceramic dusts. In the industry dusts are used as raw materials, dusts, also released into the atmosphere during excavating, crushing, grinding, abrading and loading operations. Dusts particles smaller than 5 microns are directly inhaled into the lungs and are retained there. This fraction of dusts is causing respiratory problems.

The study also showed a considerable numbers of workers were suffering from other health problems i.e. occupational dermatitis, musculoskeletal pain, back pain, headache, anaemia, fever etc. These are mostly due to direct contact of hands and feet with soil and clay, heavy weight lifting, noise etc. The occurrence of respiratory problems and other health problems were found to be highest 63.6% and 72.7% respectively in excavation section, which is the dusty section and the PPE use in this section was only 26.4% eventually, the workers inhaled soil dust and clay dust easily. Moreover, they were used to carry heavy weight during work time. This is why the workers in this section were more sufferers.

The study revealed that the oldest group had highest prevalence of respiratory problems, similarly the workers who had been working for longer period were highest (73.3%) sufferers of respiratory problems. Long term inhalation exposure to dust during production of ceramic has been associated with elevated risk of pneumoconiosis, chronic bronchitis and ventilatory disorders among both male and female workers[5,19-20]. Furthermore, only 13.2% workers were suffering from respiratory problems before joining the factory, while 86.8% were suffering from respiratory problems after joining the factory. Therefore, it can be interpreted that older age, longer duration of service and dusty working environment are important risk factors for developing respiratory problems.

Our study also documented that only 32.0% workers were using PPE. Of them only 22.0% were suffering from respiratory problems. On the other hand, 78.0% of workers who did not use the PPE, were suffering from respiratory problems. Hence PPE has been shown to play a significant role in the prevention of respiratory problems.

Our findings should be viewed in the context of several limitations. First, the study was unable to measure indoor emissions, indoor concentrations, and amount of dust exposed by individual. Second, because of constraints of time and budget, the sample size was relatively small, so the results cannot be generalized to the whole country. Third, this study did not ascertain the outdoor concentrations of pollutants, which trigger the respiratory problems of workers. Fourth, we could not measure lung function tests except PEFR. Fifth, due to the cross-sectional nature of the study, it was impossible to interpret properly the causal relations of the involvements. Finally, the other potential confounding was not adjusted. However, the study represents the first study to understand the impact of ceramic dust on workers' respiratory health in Bangladesh. Further more extensive studies should be conducted including other lung function tests, personal monitoring for airborne inhalable and respirable dust and analyzing the chemical composition of silica phases and SiO2 contents of dust samples by X-ray diffraction (XRD) and X-ray fluorescence (XRF).

Conclusion :

This study comes to the conclusion in brief with the finalization of importance for occupational safety and health for the workers who are at risks. Provision of obligatory use of PPE for the workers should be administered by the factory authority to prevent inhalation of dust during work time. Health education to increase awareness about hazards of dust among the workers might have role to reduce this problem.

References :

1. Edilaura NR, Regina MVGS, Clovis B. Respiratory symptoms as health status indicators in workers at ceramics manufacturing facilities. J Bras Pneumol. 2011; 37:36-45.
2. Faezeh D, Saber M, Zargham S, Mirsaeed A. Respiratory Complaints and Spirometric Parameters in Tile and Ceramic Factory Workers. Tanaffos. 2009; 8:19-25.
3. Forastiere F, Goldsmith DF, Sperati A, Rapiti E, MiceliM, Cavariani F, Perucci CA. Silicosis and lung function decrements among female ceramic workers in Italy. Am J Epidemiol. 2002; 156:851-56.
4. Gielec L, Izycki J, Wozniak H. Evaluation of long- term occupational exposure to dust and its effecton health during production of ceramic tiles. Med Pr. 1992; 43:25-33.
5. Artamonova VG, Kuznetsov NF, Kadyskina AM. Functional indicators of individual sensitivity to silicate dust in workers of ceramic tile and claydite industry. Med Tr Prom Ekol. 1993; 10:10-12.
6. Masoud N, Zadeh JH, Fakoorziba M R. Respiratory Toxicity of Raw Materials Usedin Ceramic Production. Industrial Health. 2009; 47:64-69.
7. Bahrami AR, Mahjub H. Comparative study of lung function in Iranian factory workers exposed to silica dust. East Meditter Health J. 2003; 9:390-98.
8. Hnizdo E, Sluis-Cremer G. Risk of silicosis in a cohort of white South African gold miners. Am J Ind Med. 1993; 24:447-57.
9. Cnachoti N. Medical records: pneumoconiosis. J Med Assoc Thai. 1954; 12:369-80.
10. Banglapedia, National Encyclopedia of Bangladesh; www.banglapedia.org/HT/C_0071.HTM
11. Haque, AQM. Lecture, Occupational safety and health scope and strategy, Workshop on Occupational Safety and Health. NIPSOM, Dhaka-1212. 2007 March 11-15.
12. Ferris BG. Epidemiology Standardization Project. Part 2 of 2. Am Rev Respir Dis. 1978; 118:1-120.
13. GOLD-Global Initiative for Chronic Obstructive Lung Disease [homepage on the Internet]. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease. http://www.goldcopd.org/ (Accessed 15 June 2011).
14. World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. Adopted by the 18th General Assembly, Helsinki, Finland, June 1964, and amended by the 52nd WMA General Assembly, Edinburgh, Scotland, October 2000. http://www.wma.net/e/policy/ b3.htm
15. Tae Seok KIM, Hyoung-Ah KIM, Yong HEO, Yonggyu PARK, Chung-YillPARK and Young-Man ROH. Level of Silica in the Respirable Dust Inhaled by Dental Technicians with Demonstration of Respiratory Symptoms. Industrial Health. 2002; 40:260-65.
16. Cetinkaya F, Gu¨lmez I, Aydin T, Oztu¨rk Y, Ozesmi M, Demir R. Prevalence of chronic bronchitis and associated risk factors in a rural area of Kayseri, Central Anatolia, Turkey. Monaldi Arch Chest Dis. 2000; 55:189-93.
17. Dennis RJ, Maldonado D, Norman S, Baena E, Martinez G. Wood smoke exposure and risk for obstructive airways disease among women. Chest. 1996; 109:115-9.
18. Behera D, Jindal SK. Respiratory symptoms in Indian women using domestic cooking fuels. Chest. 1991; 100:385-8.
19. Forastiere F, Goldsmith DF, Sperati A, Rapiti E, Miceli M, Cavariani F, Perucci CA () Silicosis and lung function decrements among female ceramic workers in Italy. Am J Epidemiol. 2002; 156:851-56.
20. Gielec L, Izycki J, Wozniak H. Evaluation of long- term occupational exposure to dust and its effect on health during production of ceramic tiles. Med Pr. 1992; 43:25-33.