
ORIGINAL ARTICLE**Occupational Health Hazards of Women Working in Brick Kiln and Construction Industry**

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Abstract:

Background: In brick kiln and construction industry the exposure to carbon monoxide and silica dust is the most common occupational hazard to the workers in these industries. A study on occupational health hazards of working women in these two unorganized sectors was undertaken by Lokmanya Medical Research Centre. **Objectives:** To study the effect of work site environment on the health of the women working in brick kiln and construction industry. An attempt was also made to study the seasonal changes in the concentration of carbon monoxide and dust at the worksite. **Material and Methods:** A cross-sectional study was conducted among the working women (age 18-40 years) at brick kilns and construction sites during summer and winter season. They were examined primarily to assess the effect of working environment on health. Gasteck Detector Pump of model 800 and air sampling instrument (SKC Air Check-52) were used to measure concentration of carbon monoxide and dust in the air respectively. **Results:** There were 66% of women who were in the age group of 18-40 years and most of them (94%) were married. At brick kiln sites, average CO exposure was 62.8 ppm and 55.5 ppm and average dust exposure was 146.1 mg/m³ and 91.4 mg/m³ in summer and winter season respectively. At construction sites, average dust exposure was 41.5 ppm and 90.8 ppm in summer and winter. **Conclusion:** Both exposure to CO and dust were more in summer than in winter in brick kiln industry whereas in construction industry the exposure to dust was more in winter season. A high level of morbidity in the form of headache, bodyache, problems with vision, cough and breathlessness were observed in both industries. It is strongly recommended to take pollution control measures.

Keywords: CSPro (Census and Survey Process), Exposure related symptoms (ERS), Occupational Health and Safety (OHS), General Medical symptoms (GRS), Work related symptoms (WRS)

Introduction

According to census 2011, women constitute 48.56% of the total population in India and 25.67% of female population is designated as workers. Almost 400 million people, more than 85% of the working population in India works in unorganized sector and out of these at least 120 million are women [1, 2].

Occupational health is defined by the International Labour Office (ILO) and the WHO, as 'the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations [3]. Construction site workers and brick kiln workers, are mostly 'periodic labour force'; and protecting their health at the work site may not be always on priority of the employer [4].

The study highlights on two unorganized sectors brick kiln and construction site of Pimpri Chinchwad Municipal Corporation (PCMC) concentrating on occupational health hazards of women working in those areas. Building and construction is a high-risk industry. The accident rate is very high when compared to other industries [5]. The frequent change of site and poor equipment supplied constitute some of the important factors producing difficulty for compliance of safety standards [6]. Construction workers drawn largely from immigrants and

members of other low- income groups face predictable occupational illness and injuries [7].

The work force in construction sector is most vulnerable because employment is temporary, employer and employee relationship is very fragile and most of the time short-lived. [8]. Occupational contact dermatitis is significant occupational hazard in some jobs like the construction industry. Reported prevalence of allergic contact dermatitis to chromate among this population usually is more than 10% [9]. The other area of research study was brick kiln because this is an important industry where a large proportion of periodic labour force is employed (approximately 10 million) [10]. Main environmental chemical hazards in brick kilns are gases like carbon monoxide (CO) and sulfur dioxide (SO₂) and silica dust [11]. Brick making involves crude techniques causing considerable worker drudgery. Brick workers, especially moulders are exposed to the sun for long hours. They are exposed to high concentration of dust while manual breaking of coal. There is also a risk of exposure to gas /dust (from bottom ash spread on the kiln) and open fire during manual coal feeding. The workers have to walk on hot surface (top of the furnace) while monitoring and regulating the fire.

Average value of particulate matter of size less than 10 microns and total suspended particles for the pre operation time has been 0.029 mg/m³ and 0.033 mg/m³ respectively, whereas, it could reach 0.050 mg/m³ and 0.056 mg/m³ respectively during the brick kiln operation time [12] Dust pollution is generated during removal and laying down of ash layer on the top of the kiln and also due to blowing of ash stacked on the top and sides of the kiln [13]. The incremental pollution of 40 mg/m³ due to the brick kilns, translates to an increase in 5,000 premature deaths annually in the Dhaka city [14].

Brick kiln sector in Chennai shows long working days, child labour [15].

They are also exposed to high concentrations of respirable suspended particulate matters (RSPM), during monitoring and regulating the fire.

Transportation of red bricks is done by head load. Generally 9 to 12 bricks are carried at a time as head load. Carrying head loads on a regular basis causes health problems, especially in women. In Pimpri Chinchwad Municipal Corporation (PCMC) area, children accompany their parents to the work place instead of attending school leading to child labour, school dropout, poor living condition like lack of sanitation, traditional practices of cooking (Chula), etc. Hence this study was planned with an objective to correlate working environment and medical symptoms of women working in un-organized sector.

Material and Methods

A cross-sectional study was conducted at two types of unorganized sectors brick kilns and construction sites during summer and winter season in Pimpri Chinchwad Municipal Corporation (PCMC) area of Pune District during 2008- 2010. The exposure to gases at work place was measured by gas detector tubes of lowest range of United phosphorous company and Gasteck Detector Pump of model 800[16]. This sophisticated instrument is capable of measuring concentrations in the range of threshold limit values. Sampling was done at different working spots and time intervals [17]. Sampling of air for gases and dust measurement was done in summer and winter season for three consecutive days. On every day two samples of gases and dust each were collected. First sample was collected close to the brick kiln/construction site and second sample was collected at a distance of 35-40 feet away from the charged brick kiln/construction site to assess daily variation of gases and dust. (Fig. 1)

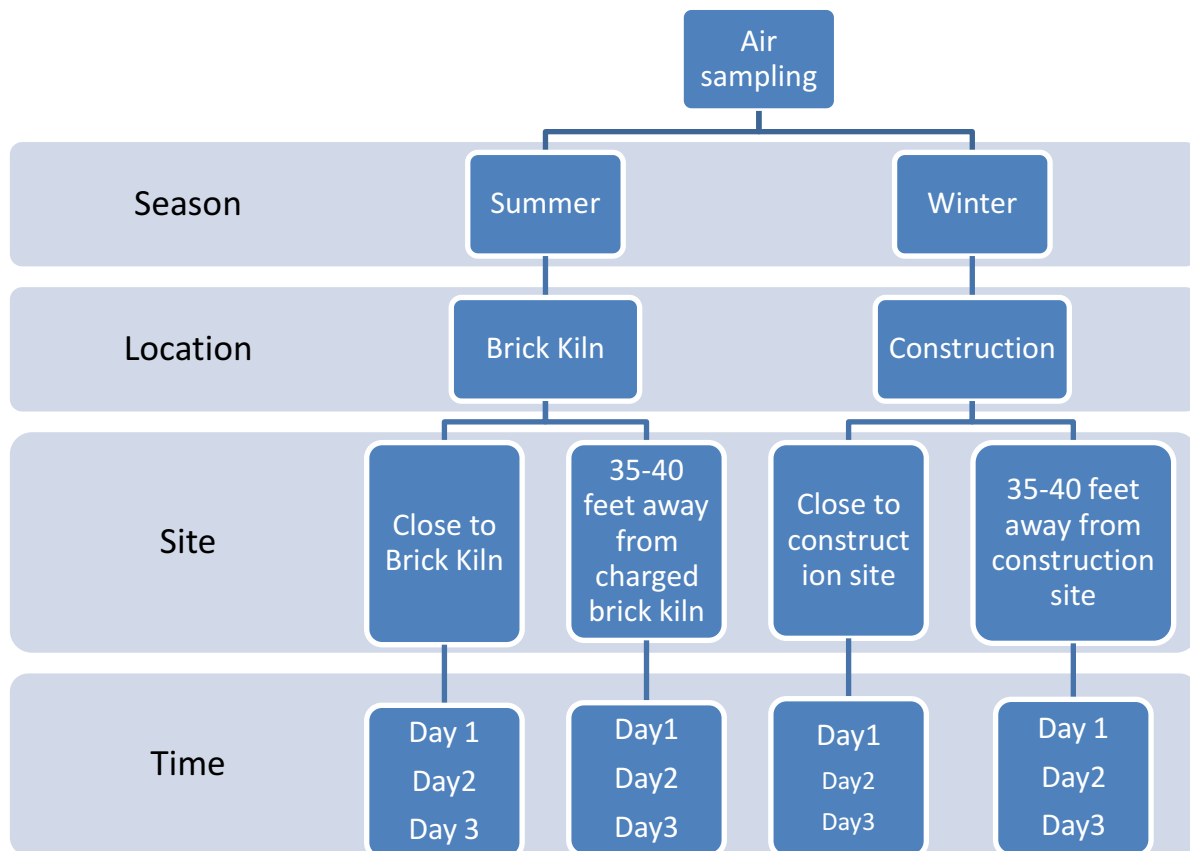


Fig. 1: Air sampling strategy

Carbon monoxide exposure was more than permissible level while exposures of other gases like sulfur dioxide (SO₂), nitrogen oxide (NO) and nitrogen dioxide (NO₂) were found negligible. Hence statistical tests were applied for exposure of CO and dust only. Silica dust concentration was measured gravimetrically at 6 working spots selected at brick kiln and construction sites with an air sampling instrument (SKC Air Check-52) [18]. In PCMC area total 24 brick kilns and 41 constructions sites were surveyed of which 6 brick kilns and 6 construction sites were selected randomly for the study. The brick kiln sites covered were Bodkewadi Phata, Dange Chowk, Chikhali, Wakad, Man, and Hinjewadi. The construction sites covered were Kala Khadak, Wakad, Chikhli, Nigdi, Kharadi and Chakan.

Inclusion Criteria: All the women working on these selected sites who were present on the day of study and who were willing to participate in the study.

All the women working at the selected sites were willing to participate in the study and none of them refused.

A total of 103 working women were included in the study of whom 40 were brick kiln workers and 63 were construction site workers. A written informed consent was taken from each woman prior to enrollment in the study. A pretested questionnaire was administered to these women to collect data related to socio-demographic and health issues. Databases were developed in Census and Survey Processing System (CSPRO) and Microsoft Excel. Data analysis was done in

Statistical Package for Social Sciences (SPSS) 11.5 using Chi-square and Proportion tests. Institutional ethics committee had reviewed and approved the study.

Results and Discussion

Socio-demographic Characteristics of the Respondents

Socio-Demographic information like age, marital status and work experience in brick kiln and construction industry were collected from women respondents. There were 66% of women who were in the age group of 18-40 years and most of them (94%) were married. It was observed that 37% women were addicted to tobacco either chewing or ash (Mishri). (Table 1)

Table 1: Personal History of the Respondents (N=103)

Characteristics	Group	Number of Respondents
		(Column %)
Age (in years)	<18	6 (6)
	18 to 25	44(43)
	26 to 30	18(17)
	31 to 40	10(10)
	41 and above	25(24)
Marital Status	Married	97(94)
	Unmarried	6(6)
Living space at home is comfortable	No	71(69)
	Yes	32(31)
Addiction	Mishri (Tobacco Ash)	24(23)
	Tobacco Chewing	14(14)

Table 2: Occupational History of the Respondents

Duration of work (in years)	Number of Respondents (Column %)	Type of site	
		Brick Klin (Column %)	Construction (Column %)
	N		
< 1yr	27(26)	4(10)	23(37)
1 to 5 yrs	53(52)	26(65)	27(43)
> 5 yrs	23(22)	10(25)	13(20)
Total	103(100)	40(100)	63(100)

The duration of work of these brick kiln and construction site is given in (Table 2). The percentage of women who were working since less than a year was 10% in brick kilns workers and 37% in construction industry workers.

The percentage of females who reported farming as their previous work was 48%, labour work 2%, service 2%, house work 21% and only 27% professed the same work. It was noted that 90% women workers were untrained. Most of the women (80%) said that they worked extra 1-5 hours per week. About half of the women from construction industry worked extra than women from brick kiln industry.

Exposure to Occupational Hazards

Two main chemical hazards in the brick kiln sites were silica dust and carbon monoxide (CO) due to coal burning and cement dust at construction sites above permissible level may be hazardous to health (Table 3).

summer than winter (p-value ≤ 0.001).

At construction sites, average dust exposure was 41.5 ppm and 90.8 ppm in summer and winter. In winter dust exposure was very high at construction sites than summer (p-value < 0.001).

This difference can be explained by the fact that most of the brick kilns prefer functioning in summer for production of better quality bricks where as there is no such seasonal preference is observed in case of construction industry.

Exposure to Carbon Monoxide (CO) and Dust at Brick Klin

Carbon monoxide (CO) exposure while charging the furnace with burning coal was found to be on the higher side. Average CO exposure was observed to be 100 ppm in summer and 81 ppm in winter season on 1st day of charged brick kiln. On 2nd and 3rd day of charged brick kiln CO reduced to 70 ppm and 45 ppm respectively in summer season. The carbon monoxide exposure was also

Table 3: Season Wise Distribution of Exposures at Brick Kiln and Construction Site

Exposures	Season	N	Mean \pm S.D	t value	P value
Brick Kiln - Carbon monoxide	Summer	15	62.8 \pm 3.10	3.672	0.001
	Winter	25	55.5 \pm 7.26		
Brick Kiln - Brick dust	Summer	15	146.1 \pm 64.03	4.004	< 0.001
	Winter	25	91.4 \pm 19.50		
Construction site - Cement dust	Summer	20	41.5 \pm 7.91	-3.863	< 0.001
	Winter	43	90.8 \pm 56.67		

At brick kiln sites, average CO exposure was 62.8 ppm and 55.5 ppm and average dust exposure was 146.1 mg/m³ and 91.4 mg/m³ in summer and winter season respectively. Both of these CO and dust exposures were significantly higher in

measured in winter season on 2nd and 3rd day of charged the brick kiln which was found to be 61 ppm and 38 ppm respectively. Thus CO exposure was more during summer than winter season. (Fig 2)

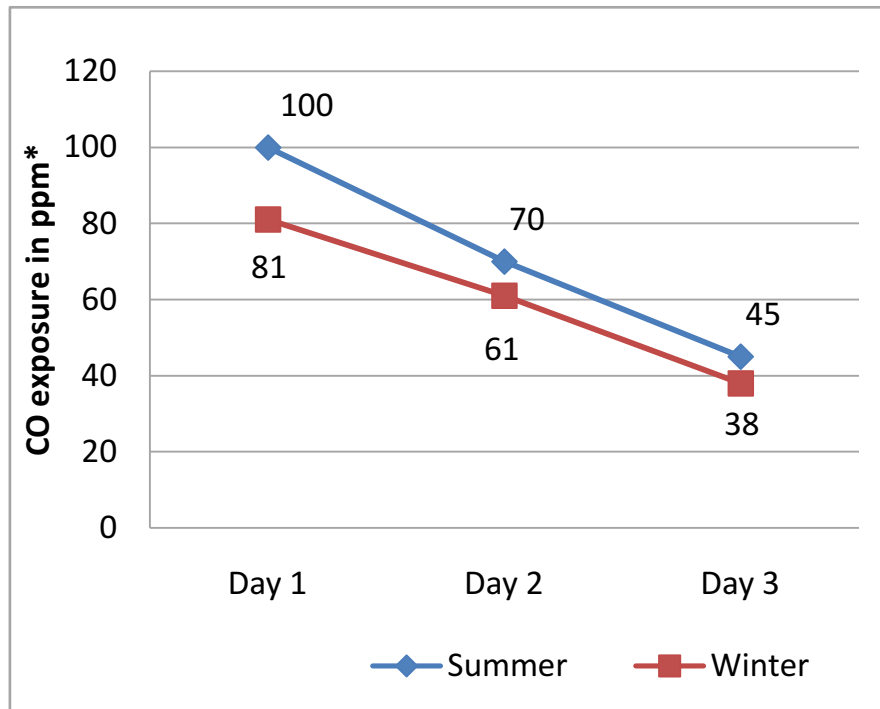


Fig 2: Season Wise Distribution of CO Exposure at Brick Kiln Sites
ppm* - parts per million

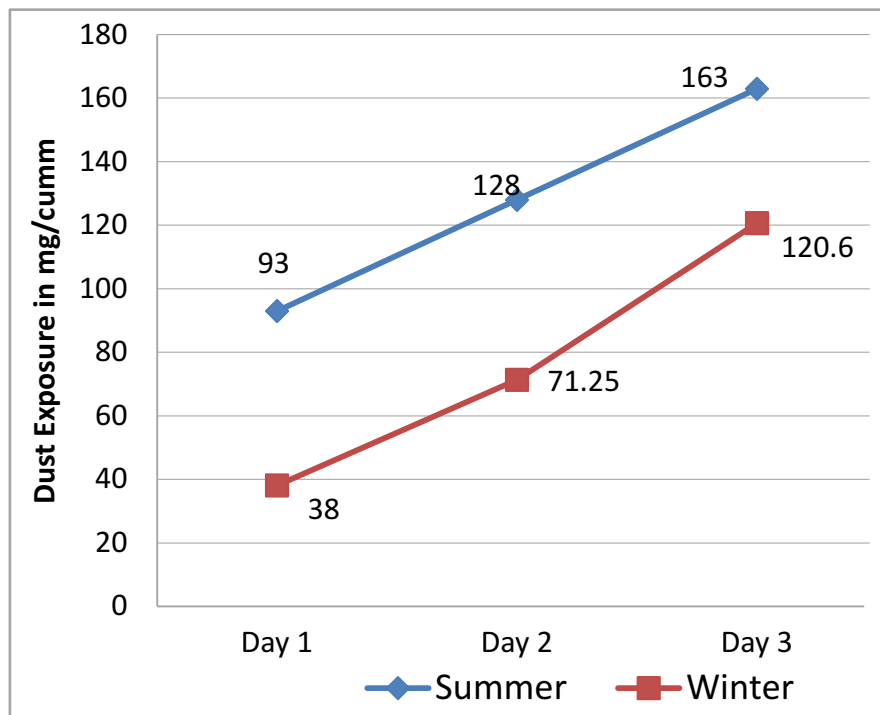


Fig 3: Season Wise Distribution of Dust Exposure at Brick Kiln Sites

Dust spraying operation at brick kilns causes silica dust exposure. Average dust exposure on 1st day of charged brick kiln was observed to be 93 mg/m³ in summer and 38 mg/m³ in winter season. This exposure increased to 128 mg/m³; 71.25 mg/m³ on 2nd day ; while 163 mg/m³ and 120.6 mg/m³ on 3rd day during summer and winter season respectively. Thus, dust exposure was more in summer as compared to winter season (Fig 3). Similar findings were observed in a study conducted in Lucknow city and the suspended particulate matter level (which included dust) was found to be much higher (93.3mg/m³) than the prescribed limit. The workers engaged in this study were at risk from dust and heat related diseases [19].

It was also observed that CO exposure was more on 1st day, it decreased and on 2nd and 3rd day onwards, while dust exposure increased on 2nd and 3rd day onwards. This put women continuously to CO or dust exposure throughout the period of charged brick kiln.

A study conducted in brick kilns in Thailand revealed that individual air pollutants varied significantly during the operation time of brick kiln. Average emission factors per 1,000 bricks were 6.35-12.3 kg of carbon monoxide, 0.52-5.9

kg of sulphur dioxide and 0.64-1.4 kg of particulate matter. [20]

Exposure of Cement Dust at construction site

During summer and winter season, samples of cement dust during different activities like Plastering; filtering/ carrying of small size sand; and mixing of sand/ stone in a mixture were taken at construction sites.

Average dust exposure was observed to be 75 mg/m³ and 337.5 mg/m³ during plastering activity; 25 mg/m³ and 237.5 mg/m³ during filtering/ carrying of small size sand; and 37.5 mg/m³ and 83.33 mg/m³ during mixing of sand/ stone in a mixture in summer and winter season respectively. Dust exposure was more in winter season at construction sites (Fig 4).

84% women reported significant dust exposure at construction site and 43% of workers reported exposure to fire/ heat at brick kiln sites. About half of women reported significant exposure to noise at construction sites.

All women reported exposure to dust which was significantly more in winter at work place. At the construction sites dust exposure was significantly more, while 70% women said that fumes/ gases exposure was more at brick kiln sites. Also it was observed that as the period of working in these two

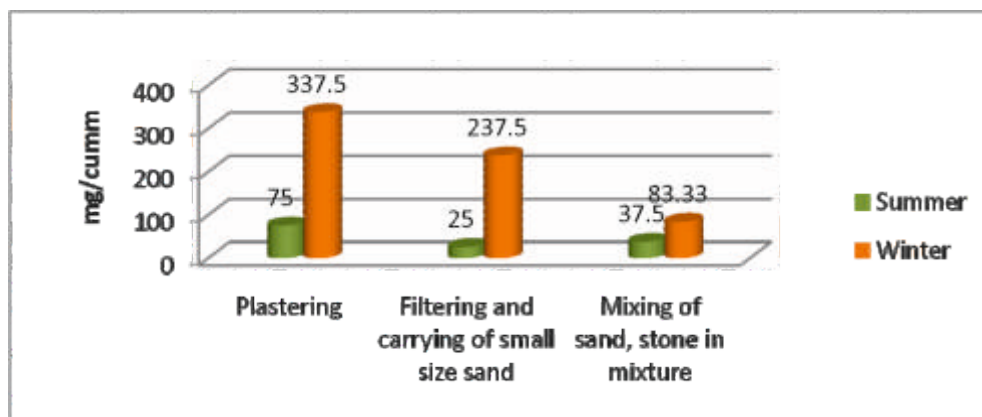


Fig. 4: Season Wise Distribution of Dust Exposure at Construction Sites mg/m³

industries increased, women were exposed more to fumes/gases and dust at their work place.

Exposure to accidents was reported to be as low as 3% in these industries. 8% women reported falls. 40% women at brick kiln sites said that they felt stressed/ tensed at work place so they could not cope up with routine work at home.

Health Assessment of the Respondents

It was observed that one third of the women were having hypertension. No subject had family history of tuberculosis. 3% brick kiln workers and 3% construction workers had family-history of bronchial asthma.

Past history of disease of the respondents

Past history of bronchial asthma (2%), trauma (2%), upper respiratory tract infection (3%), and musculoskeletal deformities (3%) were reported by construction site workers.

In case of brick kiln workers 23% of them gave past history of musculoskeletal deformity, 3% had skin diseases and 5% had upper respiratory tract

infection.

Recent medical problems

The percentage of women who were complaining of backache was 52% and headache 50%; 25% were having problems in vision and burning sensations in hand and feet; and few of them also complained of cough (18%), breathlessness (14%) and tremors in fingers of hands and legs (12%), etc (Fig. 5).

A study conducted among school going children in Kathmandu revealed that statistically significant high odds ratios for respiratory problems like tonsillitis (4.17 95% CI 2.05, 8.45) and acute pharyngitis (4.08 95% CI 2.01, 8.33) were observed among the students attending the school in the vicinity of the brick kilns sites as compared to the students attending the school away from the brick kilns sites [12].

During winter season the percentage of women complaining of backache increased significantly to 60% which was 37% in winter irrespective of

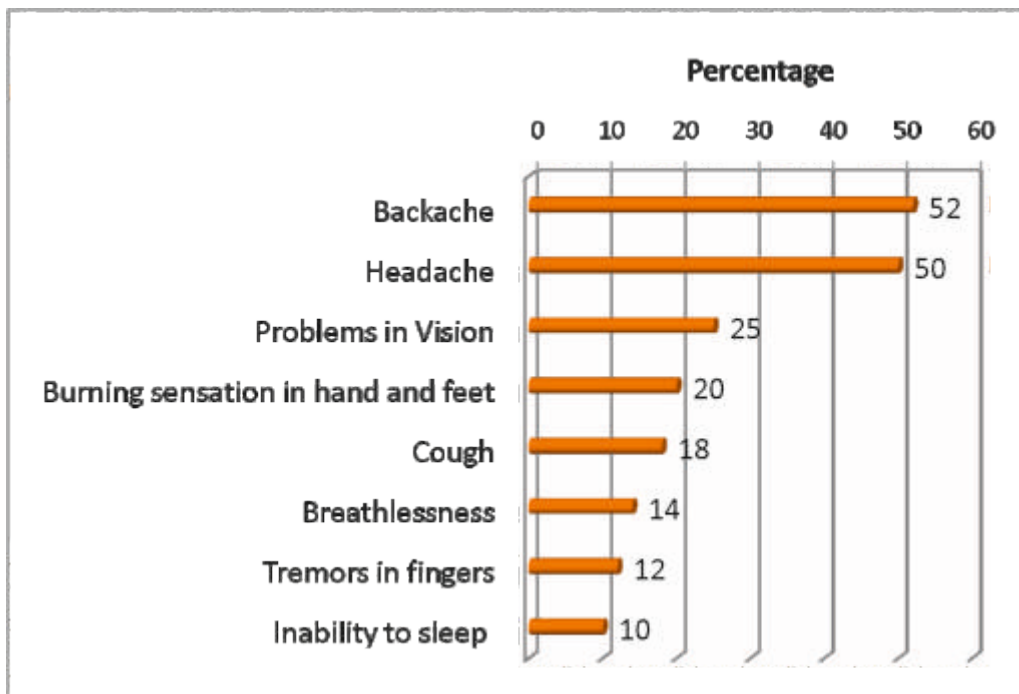


Fig 5: Types of Symptom Wise Distribution of Respondents

their type of work. The women working in brick kiln (63%) complained of headache more frequently as compared to those in construction industry (41%). This can be explained by the fact that brick kiln workers are exposed to gases like carbon monoxide which causes headache. The percentage of women having problems in vision was more in brick kiln (48%) as compared to those in construction industry. In brick kiln workers the percentage of women suffering from cough and breathlessness was 18% and 20% respectively; where as it was 19% (cough) and 10% (breathlessness) among construction site workers. Skin problems were reported by 5% of brick kiln workers and 3% of construction workers. Nutritional anemia was detected in 30% of brick kiln workers and 32% of construction site workers.

A study conducted in Vietnam had identified respiratory illness, noise, heat, lack of head protection (injury) and dust exposure as important hazards at the brick-manufacturing sites [21].

The percentage of women working at a construction site who reported that they were provided with any safety measures at work place was 17% and where as it was just 5% in case of brick kiln female workers.

Conclusion

Both CO exposure and dust exposure were significantly higher in summer than in winter (p-value 0.001).

Headache, bodyache, problems in vision, cough and breathlessness were the common complaints reported. It is strongly recommended that steps should be taken to reduce exposure by increasing the distance of brick kiln furnace by 200 feet from residential area so that exposure to various gases, fumes and dust can be controlled among most of the workers who prefer to reside in the vicinity of brick kilns. Installation of proper chimneys can also be helpful in reducing the exposure to fumes and gases. It is emphasized that capacity building; regular ambulatory health services, empowerment and social insurance can empower women.

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