Work-related Respiratory Symptoms and Associated Factors among Cement Factory Workers in Rupandehi District, Nepal

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ABSTRACT

Background

Cement factory workers are exposed to cement dust at workplace. It leads to a greater prevalence of chronic respiratory signs and symptoms.

Objective

To identify the prevalence of Work-related respiratory symptoms, its association with various risk factors, and to assess the outcomes like hospitalization and sickness absenteeism.

Method

Cross-sectional study was conducted in the Argakhanchi Cement factory among 190 workers with minimum work experience of 1 year. Census method was used for data collection. To assess the respiratory symptoms, sputum samples were collected; smears prepared by pick and smear method, and later stained by Leishman and pap stain. Smears devoid of alveolar macrophages were considered unsatisfactory for evaluation.

Result

The mean age of respondents with standard deviation was 35.56±11.45 years. The prevalence of Work-related respiratory symptoms was 31.6%. Age, no. of years worked, working in the raw materials department, burner and clinker department, cleaning department and wearing mask were the significant risk factors. On cytological analysis of the sputum sample, mild inflammatory cell noticed in 71.6%, moderate inflammation in 23.7%, and dense inflammation in 4.2%. Fungal spores were seen in 3.7%, fungal pseudohyphae in 0.5%, and bacterial colonies in 27% of the sputum samples. Out of 190 participants, 8(4.2%) of them had to be hospitalized and 17(8.9%) were on sick leave due to respiratory symptoms.

Conclusion

Pre-employment and periodic medical examination, frequent work shift, training on occupational health and safety, use of appropriate personnel protective equipment is recommended to reduce respiratory symptoms.

KEY WORDS

Cement factory workers, Rupandehi district, Work-related respiratory symptoms

INTRODUCTION

Cement is manufactured through: mining, crushing and grinding of raw materials, blending and kiln burning, cement milling, and packaging.[1] During production, chronic exposure to cement dust leads to a greater prevalence of chronic respiratory symptoms and signs such as cough, sputum production, wheezing, dyspnea, and alteration of pulmonary function.[2-5]

In Nepal, high illiteracy, lack of awareness, poor performance among the workers and lack of implementation of Occupational Safety and Health (OSH) related policies have lead to work-related disease and disability.[6] As per International Labor Organization (ILO), an estimated 2.3 million workers die every year from occupational accidents which leads to high rate of sickness absenteeism and low productivity.[7] They are at high risk of work-related diseases which vary from minor injuries to cancers.[8,9] Work-related Respiratory symptoms (WRRS) were defined as workers who developed one or more symptom of cough, phlegm, wheezing, dyspnea, chest pain and chest tightness for at least three months in a year.[10]

Also, cement industries have no clear-cut plan and policy for occupational safety and health, so absenteeism of workers is high and productivity is low. In this regard, this study aims to identify the prevalence of WRRS, its association with various risk factors, and assess the outcomes like hospitalization and sickness absenteeism. This study will also help the healthcare professional, occupational health and safety professionals and stakeholders to know the various risk factors responsible for development of respiratory problems so that rules and regulations can be set up by addressing the issues through legal ways.

METHODS

The cross-sectional analytical study design was conducted in Argakhanchi Cement Pvt. Ltd. which is located in Siyari rural Municipality, Rupandehi district, Nepal. The study period was from May 2019 to July 2019. Workers with minimum work experience of 1 year involved in cement production processes were involved in the study. Census method was used for data collection.

Work-related Respiratory symptoms were defined as workers who developed one or more symptoms of cough, phlegm, wheezing, dyspnea, chest pain, and chest tightness during the last 3 months in a year.[10]

To assess the respiratory symptoms, relevant clinical history was taken, and a sputum sample was collected for cytological examination. Sputum samples were collected after the workers were advised to clear the nasal passage, rinse the mouth with water, and discard the material before collecting the specimen. Sputum was obtained from spontaneous deep cough into a wide-mouth container with fixative (95% Ethyl Alcohol). The samples were then transported to the cytopathology laboratory of Lumbini Medical College Teaching Hospital, Palpa and smears were prepared by pick and smear method, which were later stained by Leishman and Pap stain for cytological evaluation. Each sputum specimen was assessed for the presence of macrophages, inflammation, atypical/malignant cells, and the presence of bacterial or fungal organisms. Smears devoid of alveolar macrophages were considered unsatisfactory for evaluation. Permission to conduct this study was taken from Argakhanchi Cement Private limited and written consent was obtained from each participant.

Out of 220 sputum samples collected only 190 samples fulfilled the satisfactory criteria so; only 190 samples were analyzed for the study. That Sputum cytology which showed any abnormal finding, workers were notified for further treatment of the condition.

All the collected data were entered in Microsoft Excel 2007 and the data were analyzed by using the statistical package for social sciences, SPSS 20.0 version and the level of significance was set at 5%. The proposal was ethically approved by the Institutional Review Committee (IRC) of Lumbini Medical College (IRC-LMC 02-C/019).

RESULTS

The mean age of the respondents with standard deviation was 35.56±11.45 years (Range: 18 to 65 years). The mean duration of work in the factory with standard deviation was 3.58±2.78 years. The minimum duration of work was 1 year and a maximum of 10 years. Similarly, the mean duration of a working hour per day with a standard deviation was 11.05±1.68 hours. The minimum working hour was 8 and a maximum of 12 hours.

Out of 190 participants, 93.7% were male, 21.6% were illiterate, and the majority of them were having a secondary level of education (36.8%). The majority of them were Hindu (95.3%) by religion. Most of the workers were married (78.9%). Almost 36.3% of the workers were Janajati followed by Brahmin (32.1%). Twenty-seven percent of the workers used to smoke a cigarette. Likewise, 60% of workers consumed alcohol.

Similarly, 8.4% were involved in the raw material production department, 11.6% in the burner and clinker department, 12.6% in the cement milling and packing department, 12.1% in the cleaning department, 12.1% in the loading and unloading department, 2.6% were security guard, 14.7% were the driver and 25.8% as a mechanical worker (Table 1).

The prevalence of work-related respiratory symptoms was 31.6% (CI-0.25-0.38). Among various respiratory symptoms, chronic cough (18.9%) was the most common followed by chronic chest pain (13.2%), chronic shortness of breath (8.9%), chronic wheeze (4.2%), and chronic cough with thick sputum (3.2%) (Table 2).

Table 1. Socio-demographic profile of the participants (N=190)

Variables		Frequency	Percent
Gender	Male	178	93.7
	Female	12	6.3
Education	Illiterate	41	21.6
	Primary	39	20.5
	Secondary	70	36.8
	Higher Secondary and above	39	21.1
Marital status	Married	150	78.9
	Unmarried	40	21.1
Ethnicity	Brahmin	61	32.1
	Chetteri	13	6.8
	Janajati	69	36.3
	Dalit	28	14.7
	Others	19	10.0
Working Department	Raw material production	16	8.4
	Burner and clinker department	22	11.6
	Cement mill and packing department	24	12.6
	Cleaners	23	12.1
	Loading and unloading	23	12.1
	Security guard	5	2.6
	Driver	28	14.7
	Mechanical	49	25.8

Table 2. Prevalence of work related respiratory symptoms among Cement factory workers (N=190)

Work-related respiratory symptoms	Frequency(n)	Percent (%)
Chronic cough	36	18.9
Chronic shortness of breath	17	8.9
Chronic chest pain	25	13.2
Chronic wheeze	8	4.2
Cough with thick sputum	6	3.2

The most common health problems complained by the workers were skin problems (24.2%) followed by eye problems (21.6%), weight loss (10.0%), high blood pressure (7.4%), and diabetes (5.3%).

Out of 190 workers, the majority of them use a mask (71.6%) as personnel protective equipment (PPE). Only 4.7% of them use goggles while none of them use respirators. Almost 14% use helmets as a PPE. Only 10.5% of them had taken training on occupational safety and health.

Work-related respiratory symptoms were higher in > 35 years old workers and the association was also statistically significant (COR-1.82, CI-0.98-3.39). The prevalence of WRSS was high in those workers who worked for > 10 hours per day though there was no any significant association. The workers who had worked for more than 3 years had almost 4 times higher risk of getting work-related respiratory symptoms than those who worked for ≤ 3 years (COR-3.80, CI-1.99-7.22). Cigarette smoking did not show any association with WRRS. Chewing tobacco seems to be a protective factor and the association was also statistically significant. Among occupational factors, wearing of masks was associated with increased risk of WRRS (COR-3.55, CI-1.55-8.13) and wearing helmet and taking training on occupational health and safety did not show a significant association with respiratory symptoms (Table 3).

Table 3. Association between Work-related Respiratory Symptoms and socio-demographic and occupational factors (N=190)

Variables		Work related respiratory symptoms			
		Yes n (%)	No n (%)	COR(95%CI)	P-value
Age(yrs)	>35	31(39.2%)	48(60.8%)	1.82(0.98-3.39)	0.05
	≤35	29(26.1%)	82(73.9%)		
Worked duration per day/ hours	>10	48(33.6%)	95(66.4%)	1.47(0.07-3.09)	0.303
	≤10	12(25.5%)	35(74.5%)		
No. of years worked	>3	35(50.0%)	35(50.0%)	3.80(1.99-7.22)	0.000
	≤3	25(20.8%)	95(79.2%)		
Smoking Cigarette	Yes	14(27.5%)	37(72.5%)	0.76(0.37-1.55)	0.458
	No	46(33.1%)	93(66.9%)		
Chewing tobacco	Yes	29(25.2%)	86(74.8%)	0.47(0.25-0.89)	0.019
	No	31(41.3%)	44(58.7%)		
Wearing Mask during work	Yes	52(38.2)	84(61.8)	3.55(1.55-8.13)	0.001
	No	8(14.8)	46(85.2)		
Wearing Helmet	Yes	4(15.4)	22(84.6)	0.35(0.11-1.06)	0.055
	No	56(34.1)	108(65.9)		
Training taken on occupational health and safety	Yes	7(35.0%)	13(65.0%)	1.18(0.44-3.14)	0.727
	No	53(31.2%)	117(68.8%)		

COR- Crude Odds Ratio, CI- Confidence Interval

The odds of developing work-related respiratory symptoms were more in the workers working in the raw material production department, burner and clinker department, and cleaning department in comparison to those who worked as a mechanical worker.

Those who worked in the raw material production department, burner and clinker department, and cleaning department had 7, 8 and 7 times more risk for development of WRRS respectively and the association was also statistically significant (Table 4).

Table 4. Association between Work-related respiratory Symptoms and working department (N=190)

	Work related respiratory symptoms			
Working Department	Yes n (%)	No n (%)	COR (95%CI)	P-value
Raw material production	9(56.2%)	7(43.8%)	7.71 (2.16-27.50)	0.000
Burner and clinker department	13(59.1%)	9(40.9%)	8.66 (2.69-27.84)	0.000
Cement mill and packing	6(25.0)	18(75.0)	2.00 (0.58-6.97)	0.260
Cleaners	13(56.5)	10(43.5)	7.80 (2.47-24.60)	0.000
Loading and unloading	5(21.7)	18(78.3)	1.66 (0.46-5.95)	0.428
Security guard	1(20.0)	4(80.0)	1.50 (0.14-15.46)	0.731
Driver	6(21.4)	22(78.6)	1.63 (0.48-5.46)	0.420
Mechanical	7(14.3)	42(85.7)	1(Reference)	

Sputum cytology

On sputum cytology, mild inflammation was seen in 71.6% of the total sputum samples, whereas, moderate and dense inflammation was seen in 23.7% and 4.2% respectively. Only 1.05% of the sputum showed the presence of reactive changes associated with inflammation. Fungal spores were seen in 3.68%, fungal pseudohyphae in 0.52%, and bacterial colonies in 27% of the sputum samples. Only 0.52% of the cases showed the presence of red blood cells among all sputum samples (fig. 1).

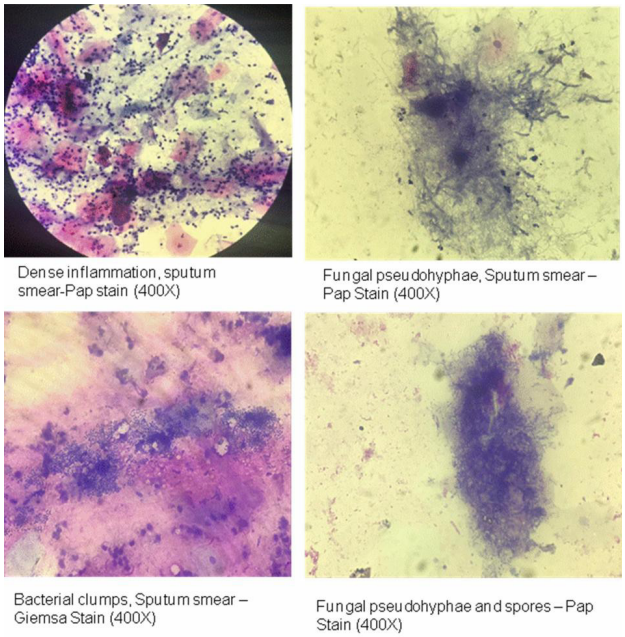

Figure 1. Cytological Analysis of Sputum sample

Outcomes of Work-related Respiratory Symptoms

Hospitalization and sickness absenteeism due to WRRS were used as an outcome variable. Out of 190 participants, 8(4.2%) (CI-1.93-1.98) of them had to be hospitalized and 17(8.9%) (CI-1.87-1.95) were on sick leave due to WRRS during last 6 months which is shown in the figure 2.

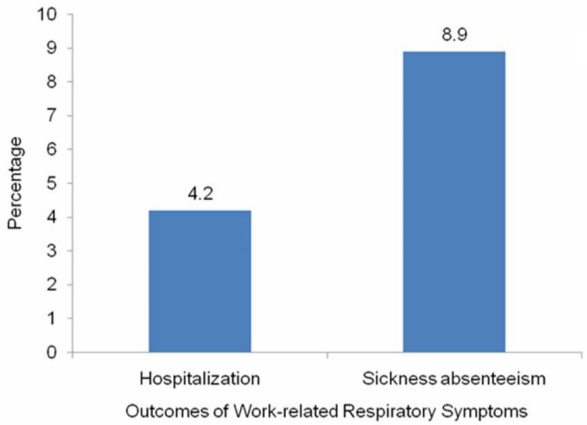

Figure 2. Percentage distribution of outcomes of Work-related Respiratory Symptoms

DISCUSSION

The prevalence of work-related respiratory symptoms in this study was 31.6% with the most common symptoms being chronic cough (18.9%), followed by chronic chest pain (13.2%). A similar study conducted in Ethiopia in 2015 among 404 cement factory workers showed that the prevalence of chronic respiratory symptoms was 62.9% with the most common symptoms being chronic cough 24.5%.[11] In 2018, another study done in cement factory worker in West-Nigeria showed the prevalence of respiratory symptoms among the exposed group as 71.4% for cough, 45.7% for phlegm, 67.1% for wheeze, 38.6% for breathlessness, and 48.6% for chest tightness.[12] From these studies, it showed that chronic cough was the most common symptoms because exposure to dust is unavoidable in a cement factory and there is no proper rules and regulation regarding occupational health and safety especially in developing countries. The prevalence of WRRS was higher than our study which could be due to more sample size, exposure to cement dust, lack of health and safety training on respiratory health, and working without additional preventive measures. Also, the production of dust and smoke in various occupational and industrial sectors increases the risk of developing respiratory diseases.[13]

Age, no. of years worked, working in the raw materials department, burner and clinker department, cleaning department and wearing a mask were the significant risk factors for respiratory symptoms in this study. Those working in the cement mill and packing department, loading and unloading department, working as a security guard, driver, those wearing helmets, taking training on occupational health and safety were not associated with WRRS. Cigarette smoking and chewing tobacco seems to be a protective factors which might be due to small frequency of cigarette smoking and chewing tobacco. A similar study conducted among cement factory workers in 2015 showed that sex, age, level of education, those working in cement

mill, burner, and clinker department, taking training on occupational health and safety, smoking cigarettes were contributing factors for chronic respiratory symptoms.[11] Likewise, another study done in 2019 among 86 cement workers from the different departments showed that age, smoking, high exposure to dust, and high eosinophil count were the predictors of chronic respiratory symptoms.[14] In the present study wearing a mask was a significant risk factors for respiratory symptoms, the finding is consistent with the another study done in Tanzania.[3] It might be due to use of face mask after the development of respiratory symptoms to reduce the aggravation of this symptoms. It could also be due to use of poor quality PPE without additional measures to reduce dust exposure. From these studies, it can be concluded that as the age and working years increases, there is more exposure to cement dust and more risk of respiratory symptoms. So, workplace environment, occupational safety practice, and provision of respiratory protective equipment play important role in the development of WRRS.

The most common health problems complained by the workers were skin problems (24.2%) followed by eye problems (21.6%), weight loss (10.0%), high blood pressure (7.4%, and diabetes (5.3%). A similar study done in 2018 among workers exposed to cement dust showed that 2% had a history of skin allergy and 22% were suffering from other complications like hypertension, diabetes, and back pain.[15] Both study finding showed the common type of health problems which could be due to exposure to high concentrations of irritant cement dust, long duration of working hours and other behavioral (smoking, alcohol consumption) and lifestyle-related factors.

In the current study, out of 190 sputum samples collected a mild inflammatory cell noticed in 71.6%, moderate inflammation in 23.7%, and dense inflammation in 4.2%. Only 1.05% of the sputum showed the presence of reactive changes associated with inflammation. Fungal spores were seen in 3.68%, fungal pseudohyphae in 0.52%, and bacterial colonies in 27% of the sputum samples. Only 0.52% of the cases showed the presence of red blood cells among all sputum samples. A similar study done among cement workers to see the effect of exposure to cement dust, a sputum sample was assayed for cytological analysis. It was observed that the majority of the subject (70%) showed severe inflammation.[15] Both these studies did not notice other types of alterations like metaplasia and dysplasia. Another study was made to investigate the risk of respiratory epithelium regarding occupational exposure to cement dust. The result of the study reported that atypia (dysplasia), squamous metaplasia, acute inflammatory infiltrated cells, and chronic inflammatory infiltrated cells were detected in cement workers.[16] These findings concluded that cement particle exposure or inhalation causes accumulation in the lungs and causes epithelial damage and inflammation. In present study out of 190 participants, 8 of them had to be hospitalized and 17 of them were on sick leave due to WRRS during last 6 months. It represents the workers health status which carries an economic burden and loss of productivity. It also increased the workload of other employees and leads to dissatisfaction in the workplace.

The main limitation of this study is the single study site (Arghakhachi Cement private limited only). The findings of this study would be made more generalize if we could do study in other sites also.

CONCLUSION

The prevalence of work-related respiratory symptoms was high among the cement factory workers as exposure to cement dust is unavoidable. Age, no. of years worked, working in the raw materials department, burner and clinker department, cleaning department and wearing mask were the significant risk factors for development of WRRS. So, pre-employment and periodic medical surveillance, frequent work shift from high to low exposure areas, training on occupational health and safety, use of appropriate personnel protective equipment is advised to reduce work-related respiratory symptoms in cement factory workers.

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