

Occupational Health Risk among Selected Cement Factory Workers in Dang District of Nepal

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ABSTRACT

Background: The health risks was reported in the cement industry in various study conducted in different settings. This study aimed to assess the occupational health risks among cement factory workers of Dang district of Nepal.

Methods: A cross-sectional study in 212 workers was conducted in Samrat Cement Company and Sonapur Minerals and Oils of Dang district in between July, 2019 to January 2020 using structured questionnaire. Proportionate stratified random sampling was used for participant selection. The collected information was entered in Statistical Package for Social Sciences (SPSS). Descriptive and inferential statistical analysis was performed.

Results: Of 212 workers, the respiratory and musculoskeletal health risks were reported by 13.2% and 22.2% of factory workers, respectively. About 29.2% were smokers. Two-third (66%) had poor knowledge of Occupational Health and Safety related questions and 17.9% had poor practice to prevent respiratory problems. Smokers ($p=0.004$) and access to safety measures ($p=0.008$) were significantly associated with respiratory problems. Educational status ($p=0.021$), work shift ($p=0.022$) and first aid availability ($p=0.009$) were statistically significant with musculoskeletal health risk.

Conclusion: Low occupational health risk and low knowledge was reported by cement factory workers. Special protection to workers above 40 years and declaring the cement factory as smoking restricted area could minimize respiratory risk. Access to and condition of safety devices need to be monitored by factory administration. Behavior change communication and safety orientation could help the workers use safety devices.

Keywords: Occupational health risk, respiratory health risk, musculoskeletal health risk, knowledge, practice, cement factory workers.

INTRODUCTION

Occupational health and safety promotes the health and well-being of workers through anticipation, recognition, evaluation and control of hazards arising in/from the workplace⁽¹⁾.

Occupation health protects, promotes the worker's health either by

preventing or controlling occupational accidents and diseases by reducing or eliminating factors or conditions hazardous to health and safety at work.⁽²⁾

In developing countries, though on an average, one-third of the lifetime of workers is spent in the workplace the working condition is very poor due to lack

of knowledge, attitude and behavior among employees, employers and regulating bodies⁽³⁾. Exposure to cement reveals the complaint of the respiratory tract in high frequency among loading workers with persistent cough 54% and breathlessness 47%⁽⁴⁾.

The common causes of accident in cement factories include; accident due to machinery, accident due to manual material handling, accident due to electricity, accident due to lack of PPE, accident due to occupational stress, accident due to lack of safety culture, fire, etc.⁽⁵⁾.

Emissions from cement industries are degrading human health by deteriorating air quality⁽⁶⁾. Human health is adversely affected by the emissions that occur from cement industries in a variety of ways, like itchy eyes, respiratory diseases like tuberculosis, chest discomfort, chronic bronchitis, asthma attacks, cardiovascular diseases and even premature death⁽⁷⁾. Likewise, cement exposure has a high risk of developing chronic respiratory symptoms and COPD⁽⁸⁾.

Worldwide, the problem of occupational safety can be observed. In the United Arab Emirates (UAE), although 74.5% had knowledge that dust exposure results in serious health hazards while only 28.8% used masks all the time during working hours⁽⁹⁾.

According to International Labor Organization (ILO) estimates, throughout the world, there are over 300 million work accidents (both fatal and non-fatal), about 160 million work disease cases every year and some 2.3 million persons die from work-related accidents and diseases⁽¹⁰⁾.

In Northwest Ethiopia workers working in night shifts were two times more likely to develop respiratory symptoms than do not work the night shift. Workers with service year more than 5 years had likely to develop respiratory symptoms. Training on occupational health and safety-related to dust health effects could reduce respiratory symptoms by 82%. Also, the occupational history of dust exposure is likely to develop

respiratory symptoms as per a study in Northwest Ethiopia⁽¹¹⁾.

OHS concept is still new in Nepal because of high illiteracy among workers, lack of awareness, the poor performance of the concerned government authorities in implementation. In Nepal, in some workplaces, personal protective equipment is found to be provided by management but due to no or low use of them, management did not provide such PPE later on. Lack of awareness and felt inconvenience by workers are the major cause of not using PPE⁽¹²⁾.

In Nepal, cement production is growing steadily over the past few years⁽¹³⁾. At present in Nepal, around 59 cement industries under the private sector and two governments owned cement industry have been registered in the department of the industry which are in operation⁽⁵⁾. National policy and legislation are not adequate in Nepal. Moreover, the working environment is not yet being labor-friendly⁽¹⁴⁾.

Study on Maruti cement factory workers reflected that 84% did not know cement factory policies, only 33% of workers had knowledge on all types of PPE measures and 39% of workers suffered from occupational illness⁽¹⁵⁾. Similarly, Udaypur cement factory workers reflected the high prevalence of respiratory problems. Health problems among workers included musculoskeletal pain(55.6%) followed by eye problems (33.2%). Similarly, 24.1% had at least one respiratory problem; chest pain and wheezing. Respiratory symptoms were found to be positively associated with low education, duration of work and smoking⁽¹⁶⁾.

Though there exists some research on occupational health in other settings but only few studies on occupational health in the cement factory came in attention in Nepal. This study hopes to raise and strengthen the discussion on worker's health and safety.

MATERIALS AND METHODS

Study design and settings

A cross-sectional study was used to assess the occupational health risk among cement factory workers of Dang district within the duration of six months; 15th July, 2019 to 15th January 2020. The individual workers working in Samrat cement company private limited, Lamahi and Sonapur minerals and oil private limited, Tulsipur were the study unit.

Sample and sampling

Proportionate stratified random sampling method was chosen. Stratification was done based on the location of factories registered. Study sample was determined by Cochran formula with prevalence of 39% percent occupational health risk in Maruti cement factory⁽¹⁵⁾. Total sample of 212 was considered including 10% of non-response. Staff detail was obtained from the respected factory and random sampling was done using employee serial number and excel random selection procedure. All participants participated in the study. One observation per cement factory was conducted to assess workplace environment.

Data collection

A structured interview schedule in Nepali and Hindi language was used for face to face interview with factory workers. Also, observation of the cement factory environment was carried out by the observation checklist. No clinical tools were used for disease verification. Only the reported symptoms were considered for the disease. Workers with prior respiratory disease were also included in the study. The occupational health risk tool developed by Syed Sana and et.al 2013⁽¹⁷⁾ was used as a reference. Similarly, for knowledge and practice questions, reference of a tool developed by Jay Prakash Sah and et.al 2015⁽¹⁵⁾ was used. For the development of the workplace environment checklist, reference to workplace safety and prevention services⁽¹⁸⁾ was used.

The interview schedule was back-translated (English-Nepali-English/ English-Hindi-English) and modification was made accordingly as per the context. Pre-testing of the tools was carried out in Manakamana brick industry of Ghorahi, Dang in 10% of sample size and the improvement in tools was made accordingly.

Operational Definition

Under occupational health risk, the respiratory and musculoskeletal health problems were considered. Workers with at least anyone symptoms of the respiratory problem and musculoskeletal problem were considered having respiratory health risk and musculoskeletal health risk respectively. Knowledge and practice related questions were asked to participants and the relevant response was scored with 1 and irrelevant response with 0. Total knowledge score and practice score was converted to percentage and Bloom's cut off point (60 to 80 percent) was used to categorize knowledge into good, fair and poor⁽¹⁹⁾. The average value of the maximum possible score was taken as a cut off value for differentiating workplaces safe and risky.

Data procession and analysis

Statistical Package for the Social Sciences (SPSS) statistics software version 16 was applied for descriptive and inferential statistical analyses. Only descriptive analysis was conducted regarding workplace status. Univariate and multiple logistic regression models were used to determine the significance and the strength of association to identify the most important independent factors associated with occupational health risks (Yes Vs No). Those variables which showed association during univariate logistic regression were considered for multiple logistic regression.

The odds ratio (OR) and 95% confidence interval (CI) were reported while showing the association between outcome and independent variables. These results were considered significant at a 5 percent

level i.e. p-value (<0.05). During data coding in SPSS for analysis, outcome variable of interest i.e. occupational health risk was coded as 1 and no occupational health risk was coded as 0. Similarly, for independent variables, the reference category was coded as 0 and the comparing category was coded as 1.

Ethics statement

Approval for this study was obtained from the institutional review committee of Manmohan Memorial Institute of Health Sciences with registration number MMIHS-IRC 446. Similarly, approval for interviews

was obtained from the concerned factory's administration so that workers might feel free to express their views. Informed and written consent was taken before the interview. Participants were ensured of the confidentiality of their responses and were not lured to participate in the study. Workers' queries in the research area were clarified after interview.

RESULTS

Result part explains the collective findings of both factories. Factory wise characteristics have been displayed in respective tables.

Table 1: Socio-demographic characteristics

Socio-demographic characteristics	Both Factories(n=212) Number(Percentage)	Samrat Factory(n=72) Number(Percentage)	Sonapur Factory(n=140) Number(Percentage)
Age			
<=40	157(74.1)	54(75)	103(73.6)
>40	55(25.9)	18(25)	37(26.4)
Mean±SD;Min-Max	32.6±10.3;16-64	32.7±10.7;16-64	32.6±10.2;17-61
Gender			
Male	196(92.5)	71(98.6)	125(89.3)
Female	16(7.5)	1(1.4)	15(10.7)
Marital status			
Married	156(73.6)	53(73.6)	103(73.6)
Unmarried	56(26.4)	19(26.4)	37(26.4)
Ethnicity			
Upper caste group	76(35.8)	21(29.2)	55(39.3)
Disadvantaged janajatis	56(26.4)	14(19.4)	42(30)
Dalit	7(3.3)	2(2.8)	5(3.6)
Disadvantaged non-Dalit Terai	6(2.8)	3(4.2)	3(2.1)
Indian people	67(31.6)	32(44.4)	35(25)
Religion			
Hindu	200(94.3)	62(86.1)	138(98.6)
Muslim	10(4.7)	9(12.5)	1(0.7)
Buddhist	2(0.9)	1(1.4)	1(0.7)
Permanent residence			
Province 1	6(2.8)	1(1.4)	5(3.6)
Province 2	12(5.7)	2(2.8)	10(7.1)
Bagmati province	2(0.9)	1(1.4)	0
Province 5	102(48.1)	31(43.1)	71(50.7)
Karnali province	3(1.4)	1(1.4)	2(1.4)
Sudurpashchim province	21(9.9)	4(5.6)	17(12.1)
India	67(31.6)	32(44.4)	35(25)
Education			
No formal education	15(7.1)	6(8.3)	9(6.4)
Basic education	61(28.8)	17(23.6)	44(31.4)
Secondary education	103(48.6)	38(52.8)	65(46.4)
Higher education	33(15.6)	11(15.3)	22(15.7)
Yearly household income			
Enough for < 6 months	31(14.6)	13(18.1)	18(12.9)
Enough for 6 to 12 months	145(68.4)	35(48.6)	110(78.6)
Enough for ≥ 12 months	36(17)	24(33.3)	12(8.6)

Table 1 illustrates the sociodemographic characteristics of factory worker. Study showed the mean age of 212 factory workers as 32.67±10.35 years ranging from 16 to 64 years where almost three fourth (74.1%) of the workers were ≤ to 40 years. The majority (92.5%) were

male and 73.6% were married. A high number of upper caste ethnicity (35.8%) and the majority (94.3%) were Hindu. Almost half (48.1%) of the workers were from province 5 while 31.6% were from India. Only 7.1 percent had no formal education.

More than two third had household income enough for 6 to 12 months.

Table 2: Work nature related characteristics

Socio-demographic characteristics	Both Factory(n=212) Number(Percentage)	Samrat Factory(n=72) Number(Percentage)	Sonapur Factory(n=140) Number(Percentage)
Working industry			
Samrat cement industry	72(34)	72(100)	140(100)
Sonapur cement industry	140(66)	0	0
Working department			
Maintenance	48(22.6)	22(30.6)	26(18.6)
Cement mill	34(16)	8(11.1)	26(18.6)
Administration	25(11.8)	8(11.1)	17(12.1)
Security	21(9.9)	5(6.9)	16(11.4)
Transport	17(8)	3(4.2)	14(10)
Finance/ sales	16(7.5)	7(9.7)	9(6.4)
Production and quality control	13(6.1)	3(4.2)	10(7.1)
Environment	10(4.7)	0	10(7.1)
Electrical	10(4.7)	3(4.2)	7(5)
Loading/ unloading	9(4.2)	7(9.7)	2(1.4)
Engineering	8(3.8)	5(6.9)	3(2.1)
Health	1(0.5)	1(1.4)	0
Work tenure			
<=5 years	179(84.4)	65(90.3)	114(81.4)
>5 years	33(15.6)	7(9.7)	26(18.6)
Mean±SD;Min-Max	2.7±2.66;0.01-10	1.7±2.3;0.01-10	3.2±2.7;0.04-10
Work shift			
Day	161(75.9)	50(69.4)	111(79.3)
Night	33(24.1)	22(30.6)	29(20.7)
Previous occupation			
Farmer	50(23.6)	9(12.5)	41(29.3)
Unemployed	33(15.6)	4(5.6)	29(20.7)
Cement factory	31(14.6)	17(23.6)	14(10)
Technician	24(11.3)	13(18.1)	11(7.9)
Business	13(6.1)	3(4.2)	10(7.1)
Driver	13(6.1)	5(6.9)	8(5.7)
Foreign employment	13(6.1)	7(9.7)	6(4.3)
Government service	12(5.7)	6(8.3)	6(4.3)
Security guard	10(4.7)	2(2.8)	8(5.7)
Other factories	5(2.4)	2(2.8)	3(2.1)
Others*	8(3.8)	4(5.6)	4(2.9)

Others*: Teachers, hotel workers, microfinance and consultant

Table 3: Health risk in the factories

Health risk	Both Factories(n=212) Number(Percentage)	Samrat Factory(n=72) Number(Percentage)	Sonapur Factory(n=140) Number(Percentage)
Respiratory health risk	28(13.2)	8(11.1)	20(14.3)
Reported respiratory symptoms			
Shortness of breath	75.4%	87.5%	48.3%
Asthma	15.4%	12.5%	31.1%
Wheezing	6.2%	0	13.8%
Chest Injuries	1.5%	0	3.4%
Cough thick sputum with blood	1.5%	0	3.4%
Musculoskeletal health risk	47(22.2)	10(13.9)	37(26.4)
Musculoskeletal problems as per body parts			
Neck	31.9%	0	35.7%
Lower Back	19.1%	40%	16.7%
Wrist/ Hand	14.9%	0	16.7%
Upper Back	12.8%	20%	11.9%
Hip/ Thigh	10.6%	40%	7.1%
Elbow	6.4%	0	7.1%
Shoulder	4.3%	0	4.8%
Reported musculoskeletal health problems			
Difficult to bow down	30%	31.2%	29.5%
Tired body	15%	25%	11.4%
Heavy head	10%	6.2%	11.4%
Staggered in standing up	10%	12.5%	9.1%
Stiff/ awkward while moving	8.3%	6.2%	9.1%
Heavy feet	8.3%	12.5%	6.8%
Sleepy	5%	0	6.8%
Thirsty	5%	0	6.8%
Heavy eye	3.3%	6.2%	2.3%
Yawning	3.3%	0	4.5%
Tired talking	1.7%	0	2.3%

Work nature related characteristics of factory worker are explained in **table 2**. Study comprises two third (66%) workers from Sonapur cement industry while remaining from Samrat cement industry. Most of the workers were from maintenance department (22.6%) followed by a cement mill (16%), administration (11.8%), and others as displayed in table. More than three fourth (75.9) had day shift work and 84.4% had work tenure less than or equal to 5 years. The average duration of work tenure was 2.7 years with maximum tenure of 10 years. Most of the workers had farming (23.6%) as the previous occupation followed by a cement factory worker (14.6%).

Only 13.2% of the factory workers reported respiratory risk. Among workers with respiratory health risk, shortness of breath (75.4%) was reported by large number of workers. Musculoskeletal health risk was reported by 22.2%. Musculoskeletal problems of neck (31.9%) was reported by highest number of workers while problem in different body parts included lower back (19.1%), wrist/ hand

(14.9%), upper back (12.8%), hip/ thigh (10.6%), elbow (6.4 percent) and shoulder (4.3 percent). Comparatively, occupational health risk was reported high in Sonapur cement factory. Details on health risk are shown in **table 3**.

Health and sanitation related characteristics are portrayed in **table 4** in detail. Among total factory workers, 29.2% had smoking habit. Nearly half of the workers (48.1%) used to check their health status half-yearly. Almost all workers (95.8%) had the availability of first aid services. Similarly, health insurance was available to 64.2% of workers. More than 95% of workers reported that the cement factory had installed pollution protective devices.

Hygiene and sanitation indicators were found to be good. Hand washing with soap and water, bathing and changing clothes after work was practiced by 92.5%, 84.4%, and 74.1% of workers' respectively. More than half (61.8%) of the respondents told the floor to be cemented followed by muddy (29.2%), leveled (8 percent) and graveled (0.9 percent).

Table 4: Health and sanitation related characteristics

Health and sanitation related characteristics	Both Factories(n=212) Number(Percentage)	Samrat Factory(n=72) Number(Percentage)	Sonapur Factory(n=140) Number(Percentage)
Smoking habit	62(29.2)	15(20.3)	47(33.6)
Health service seeking behavior			
Monthly	9(4.2)	0	9(6.4)
Half-yearly	102(48.1)	24(33.3)	78(55.7)
Yearly	101(47.6)	48(66.7)	53(37.9)
First aid within industry	203(95.8)	72(100)	131(93.6)
Insurance within industry	136(64.2)	57(79.2)	79(56.4)
Pollution protective device in industry	202(95.3)	72(100)	130(92.9)
Hand washing with soap & water	196(92.5)	70(97.2)	126(90)
Bath daily after work	179(84.4)	56(77.8)	123(87.9)
Change cloth daily after work	157(74.1)	46(63.9)	111(79.3)
Floor of industry			
Cemented	131(61.8)	48(66.7)	83(59.3)
Muddy	62(29.2)	21(29.2)	41(29.3)
Leveled	17(8)	1(1.4)	16(11.4)
Graveled	2(0.9)	2(2.8)	0

Knowledge related information illustrated in **table 5** shows one-third of the respondents (66%) had poor knowledge of OHS related questions. Respiratory disease was the highest reported disease (98.1%) caused by cement factory while 42% reported musculoskeletal disease. All the factory workers knew about the mask. More

than 80% of the workers knew the advantages of safety measures where disease prevention was reported by 86.3% and accident prevention by 83.5%. More than two-thirds (69.8%) of the workers knew insurance facilities within the factory. The majority (90.1%) had knowledge that compensation is provided for death while

45.8% knew about the compensation provided for disability.

Table 5: Knowledge related information

Knowledge related characteristics	Both Factories(n=212) Number(Percentage)	Samrat Factory(n=72) Number(Percentage)	Sonapur Factory(n=140) Number(Percentage)
Overall knowledge level (Blooms cut off)			
Good knowledge	4(1.9)	0	4(2.9)
Fair knowledge	68(32.1)	18(25)	50(35.7)
Poor knowledge	140(66)	54(75)	86(61.4)
Disease cement industry can cause (Multiple responses)			
Respiratory disease	208(98.1)	72(100)	136(97.1)
Irritation/ allergy	92(43.4)	38(52.8)	54(38.6)
Musculoskeletal disease	89(42)	32(44.4)	57(40.7)
High blood pressure	84(39.6)	28(38.9)	56(40)
Swelling of leg/ feet	40(18.9)	9(12.5)	31(22.1)
Heart attack/ failure	19(9)	4(5.6)	15(10.7)
Gastrointestinal disease	15(7.1)	2(2.8)	13(9.3)
Knowledge on PPE (Multiple responses)			
Mask	212(100)	72(100)	140(100)
Boot	184(86.8)	64(88.9)	120(85.7)
Gloves	159(75)	54(75)	105(75)
Goggles	131(61.8)	47(65.3)	84(60)
Apron	48(22.6)	12(16.7)	36(25.7)
Helmet	15(7.1)	11(15.3)	4(2.9)
Belt	2(0.9)	72(100)	2(1.4)
Advantage of safety measures (Multiple responses)			
Disease prevention	183(86.3)	71(98.6)	112(80)
Accident prevention	177(83.5)	49(68.1)	128(91.4)
Knowledge of insurance facility	148(69.8)	57(79.2)	91(65)
Knowledge of policies within the industry (Multiple responses)			
Health insurance related policy	109(51.4)	42(58.3)	67(47.9)
Salary related policy	95(44.8)	14(19.4)	81(57.9)
Leave related policy	92(43.4)	16(22.2)	76(54.3)
OHS related policy	68(32.1)	20(27.8)	48(34.3)
Work hour related policy	45(21.2)	10(13.9)	35(25)
Social security related policy	28(13.2)	5(6.9)	23(16.4)
Knowledge of compensation (Multiple responses)			
For death	191(90.1)	64(88.9)	127(90.7)
For disability	97(45.8)	41(56.9)	56(40)

Table 6 explains on source of safety information where more than three quarter (75.9%) got information through peers followed by television (61.3%), training/ orientation (59.9%), radio (55.2%) and newspaper (21.7%). More than one fourth

(29.7%) had not received training on OHS. Among training receiver (70.3%), majority (93.2%) got training on safety measures while 6.71 percent got training on near-miss accident/ hazard control.

Table 6: Training and information source related knowledge

Training and information source related knowledge	Both Factories(n=212) Number(Percentage)	Samrat Factory(n=72) Number(Percentage)	Sonapur Factory(n=140) Number(Percentage)
Source of safety information (Multiple responses)			
Peers	161(75.9)	56(77.8)	105(75)
Television	130(61.3)	18(25)	112(80)
Training/ orientation	127(59.9)	57(79.2)	70(50)
Radio	117(55.2)	10(13.9)	107(76.4)
Newspaper	46(21.7)	10(13.9)	36(25.7)
Received training on OHS	149(70.3)	57(79.2)	92(65.7)
Training topic	(n=149)	(n=57)	(n=92)
Safety measures training	139(93.2)	56(98.2)	83(90.2)
Near miss accident/ hazard control	10(6.71)	1(1.8)	9(9.8)

Table 7 shows only 17.9% had poor practice to prevent respiratory problems while 41 percent had poor practice to

prevent musculoskeletal problems. The majority (87.7%) used PPE. Among PPE users, mask users (85.8%) were in high

numbers to prevent different health risk. Nearly three fourth (73.1%) used all required PPE. Among those who don't use

PPE, most of the workers (47.3%) replied no need followed by discomfort (43.8%) and not available (8.7 percent).

Table 7: Practice related information

Practice related characteristics	Both Factories (n=212) Number(Percentage)	Samrat Factory(n=72) Number(Percentage)	Sonapur Factory(n=140) Number(Percentage)
Practice to prevent respiratory problem (Blooms cut off)			
Good practice	59(27.8)	20(27.8)	39(27.9)
Fair practice	115(54.2)	44(61.1)	71(50.7)
Poor practice	38(17.9)	8(11.1)	30(21.4)
Practice to prevent MSD problem (Blooms cut off)			
Good practice	42(19.8)	15(20.8)	27(19.3)
Fair practice	83(39.2)	36(50)	47(33.6)
Poor practice	87(41)	21(29.2)	66(47.1)
PPE use	186(87.7)	71(98.6)	115(82.1)
PPE use by types (Multiple responses)			
Mask	182(85.8)	69(95.8)	113(80.7)
Boot	129(60.8)	52(72.2)	77(55)
Gloves	92(43.4)	26(36.1)	66(47.1)
Goggles	75(35.4)	28(38.9)	47(33.6)
Helmet	41(19.3)	27(37.5)	14(10)
Apron	24(11.3)	9(12.5)	15(10.7)
Belt	3(1.4)	1(1.4)	2(1.4)
Use of all required PPE	155(73.1)	54(75)	101(72.1)
Reason for not using all required PPE	(n=57)	(n=18)	(n=39)
Not necessary	27(47.3)	14(77.8)	13(33.3)
Discomfort	25(43.8)	3(16.7)	22(56.4)
Not available	5(8.7)	1(5.5)	4(10.3)

Table 8: Enabling and reinforcing factors for the practice of safety measures

Practice related characteristics	Both Factories(n=212) Number(Percentage)	Samrat Factory(n=72) Number(Percentage)	Sonapur Factory(n=140) Number(Percentage)
Accessibility of PPE	204(96.2)	72(100)	132(94.3)
If accessible, the timing of availability	(n=204)	(n=72)	(n=132)
As per requirement	174(85.3)	72(100)	102(77.2)
Half-yearly	15(7.3)	0	15(11.4)
Yearly	15(7.3)	0	15(11.4)
Condition of PPE			
Good	194(91.5)	70(97.2)	124(88.6)
Poor	18(8.5)	2(2.8)	16(11.4)
Compulsion on safety measures used in industry	180(84.9)	71(98.6)	109(77.9)
Monitoring of safety measures use in industry	184(86.8)	69(95.8)	115(82.1)
If yes, safety measures use monitoring schedule	(n=184)	(n=69)	(n=115)
Daily	172(93.4)	67(97.1)	105(91.3)
Weekly	9(4.8)	2(2.9)	7(6.1)
Monthly	3(1.6)	0	3(2.6)
Penalty for no PPE use	137(64.6)	64(88.9)	73(52.1)
Type of penalty	(n=137)	(n=64)	(n=73)
Warning	63(45.9)	24(37.5)	39(53.4)
Absent/ fine	55(40.1)	36(56.3)	19(26.1)
Counselling/ orientation	19(13.8)	4(6.2)	15(20.5)
Monitoring from the government side for safety use	106(50)	44(61.1)	62(44.3)

Enabling and reinforcing factors for the practice of safety measures is displayed in **table 8**. Of total factory workers, only 3.8 percent had no access to PPE. Among those who had access to PPE, 85.3% had access as per requirement while 7.3 percent had access in half yearly and yearly. Majority (91.5%) of the workers had PPE in good condition. The industry had made compulsion on the use of safety measures

which was reported by 84.9% of workers. Monitoring of safety measures used in industry from factory administration was reported by 86.8% where 93.4% reported daily monitoring while 4.8 percent and 1.6 percent reported weekly and monthly monitoring respectively. Almost two-third (64.6%) replied that there is a provision of penalty for no use of safety measures. Warning (45.9%), absent/ fine (40.1%) and

counselling/ orientation (13.8%) were the penalty applied for no use of safety measures. More than 40% told that, the penalty in the form of absent or fine. Half of the factory workers replied the practice of monitoring from government side for safety.

Association of occupational health risk with different variables is explained in **table 9** where none of the socio-demographic variables showed a statistically significant association with respiratory

health risk while residence ($p=0.018$, $COR=0.37$, 95% CI: 0.16-0.84), educational status ($p=0.024$, $COR=3.43$, 95% CI: 1.18-10.03) and work shift ($p=0.011$, $COR=2.49$, 95% CI: 1.23-5.01) had statistically significant association with musculoskeletal health risk. Workers age more than 40 years had 2.05 times high risk of respiratory risk while 1.89 times high risk of musculoskeletal risk.

Table 9: Association between health risk and socio demographic characteristics

Socio demographic characteristics	Respiratory health risk			Musculoskeletal health risk		
	p-value	COR	95% CI	p-value	COR	95% CI
Age						
>40	0.088	2.05	0.21-1.11	0.072	1.89	0.94-3.80
<=40		Ref			Ref	
Gender						
Male	0.407	2.39	0.30-18.88	0.777	0.84	0.26-2.75
Female		Ref			Ref	
Marital status						
Married	0.522	1.36	0.52-3.57	0.204	Ref	
Unmarried		Ref			0.59	0.27-1.33
Ethnic group						
Other castes	0.661	1.20	0.51-2.82	0.958	0.98	0.50-1.93
Upper caste		Ref			Ref	
Religion						
Other	0.716	1.33	0.27-6.45	0.810	1.18	0.31-4.55
Hindu		Ref			Ref	
Permanent Residence						
Native		Ref		0.018	Ref	
Non-native	0.214	0.55	0.21-1.42		0.37	0.16-0.84
Educational status						
No formal education	0.449	0.45	0.05-3.56	0.024	3.43	1.18-10.03
Formal education		Ref			Ref	
Working nature						
Admin/Table Worker		Ref		0.781	Ref	
Field level Worker	0.920	1.04	0.46-2.32		1.16	0.41-3.27
Tenure						
>5 years	0.146	2.02	0.78-5.24	0.444	1.39	0.59-3.24
<=5 years		Ref			Ref	
Work shift						
Night	0.727	0.84	0.32-2.20	0.011	2.49	1.23-5.01
Day		Ref			Ref	
Previous occupation						
With dust exposure	0.535	1.28	0.58-2.85	NA	NA	NA
Without dust exposure		Ref				
HH yearly income						
Enough < 6 months	0.532	0.66	0.18-2.36	0.384	0.64	0.23-1.76
Enough > 6 months		Ref			Ref	

NA: Not Applicable

Table 10 shows statistically significant association of respiratory health risk with smoking habit ($p=0.003$, $COR=3.36$, 95% CI: 1.49-7.58) and access to safety measures ($p=0.006$, $COR=0.13$, 95% CI: 0.03-0.56). Smokers had more than three times the chance of respiratory risk compared to a non-smoker. Similarly,

workers with access to safety measures were 87% protective to respiratory health risk. Musculoskeletal health risk was statistically significantly associated with availability of first aid services ($p=0.001$, $COR=0.07$, 95% CI: 0.01-0.35). Workers with access to first aid service were 93% protective to musculoskeletal health risk.

Table 10: Association between health risk and health related characteristics

Health related characteristics	Respiratory health risk			Musculoskeletal health risk		
	p-value	COR	95% CI	p-value	COR	95% CI
Smoking habit						
Yes	0.003*	3.36	1.49-7.58	NA	NA	NA
No		Ref				
Health check-up						
Within a year	0.078	2.11	0.90-4.91	0.429	1.30	0.68-2.50
Yearly		Ref			Ref	
Health service within factory						
Available	0.970	1.01	0.38-2.68	0.130	0.57	0.27-1.18
Not available		Ref			Ref	
First aid available						
Yes	0.850	1.22	0.14-10.20	0.001	0.07	0.01-0.35
No		Ref			Ref	
Received insurance						
Yes	0.094	2.25	0.87-5.82	0.279	0.69	0.36-1.35
No		Ref			Ref	
Received OHS training						
Yes	0.457	0.72	0.31-1.68	0.147	0.60	0.31-1.19
No		Ref			Ref	
Knowledge on OHS						
Good	0.524	1.30	0.33-1.73	0.303	0.69	0.34-1.40
Poor		Ref			Ref	
Access to safety measure						
Yes	0.006*	0.13	0.03-0.56	0.070	0.27	0.07-1.11
No		Ref			Ref	
Practice of safety measures						
Yes	0.120	0.44	0.16-1.23	0.108	0.49	0.20-1.18
No		Ref			Ref	
Mask use						
Yes	0.084	0.42	0.16-1.12	NA	NA	NA
No		Ref				
Condition of safety measures						
Good	0.066	0.35	0.11-1.07	0.082	0.41	0.15-1.12
Poor		Ref			Ref	

NA: Not Applicable

Multiple logistic regression analysis is depicted in **table 11**. Variables that showed statistically significant relationship in univariate logistic regression were considered for multiple logistic regression. Smoking and access to safety measures showed statistically significant relationship with respiratory health risk. Similarly, residence, educational status and work shift showed statistically significant relationship with musculoskeletal health risk.

The respiratory health risk was found to be associated with smoking (AOR= 3.40, p=0.004, 95% CI: 1.47-7.85). Smokers were more than 2 times at risk of respiratory problems compared to non- smokers. Likewise, respiratory risk and access to safety measures were statistically significant (AOR=0.12, p=0.008, 95% CI: 0.02-0.58). Those workers who had access to safety measures had 88% less chance to develop respiratory problems.

Table 11: Multiple logistic regression analysis

Health related characteristics	Respiratory health risk			Health related characteristics	Musculoskeletal health risk		
	AOR	p-value	CI		AOR	p-value	CI
Smoking				Permanent Residence			
No	Ref			Native	Ref		
Yes	3.40	0.004*	1.47-7.85	Non-native	0.44	0.061	0.19-1.04
Access to safety measures				Educational status			
No	Ref			No formal education	3.77	0.021	1.22-11.69
Yes	0.12	0.008*	0.02-0.58	Formal education	Ref		
				Work shift			
				Night	2.44	0.022	1.14-5.22
				Day	Ref		
				First aid available			
				Yes	0.11	0.009	0.02-0.58
				No	Ref		

The musculoskeletal health risk was found to be associated with educational status (AOR=3.77, p=0.021, 95% CI: 1.22-11.69), work shift (AOR=2.44, p=0.022, 95% CI: 1.14-5.22) and first aid service availability (AOR=0.11, p=0.009, 95% CI: 0.02-0.58). Workers with no formal education and day-time work shift were 3.77 and 2.44 times at risk to musculoskeletal health risk. Similarly, workers with access to first aid services were 89% protective to musculoskeletal health risk.

Table 12 shows both cement factories had safe workplace environment. Of the total 36 workplace environment related indicators, Sonapur cement factory (91.67%) had more positive indicators compared to the Samrat cement factory (86.11%).

Table 12: Factory workplace environment status

Cement factory	Workplace indicator (n=2; indicators=36)		Workplace status
	Positive n(%)	Negative n(%)	
Samrat	31(86.11)	5(13.89)	Safe
Sonapur	33(91.67)	3(8.33)	Safe

n(%): Number(Percentage)

DISCUSSION

Present study showed 13.2% of workers have respiratory risk while a similar study conducted in Maruti cement factory, Siraha and Udaypur cement factory showed 39% and 24.1% workers respectively were suffering from any illness^(15,16). But, finding of the Dejen cement factory showed higher prevalence (62.9%)⁽²⁰⁾. This might be due to high PPE use (87.7%), strict monitoring regarding use of safety measures (86.8%), provision of safety training (70.3%), etc.

As per the present study, 75.4% have shortness of breath, 15.4% have asthma, 6.2 percent have wheezing, 1.5 percent have chest injuries and 1.5 percent have a cough which is lower than the Dejen cement factory as shortness of breath (38.6%), wheezing (36.9%), chest pain (21%) and 24.5% had a cough⁽²⁰⁾. Study of Udaypur cement factory showed chronic cough was present in 3.4 percent, 9.2 percent had wheezing and asthma in 2 percent of

workers⁽¹⁶⁾. Similarly, 54% had wheezing as respiratory symptoms in the study conducted in Pakistan⁽²³⁾. Comparatively low respiratory symptom was observed in the present study which might be due to high PPE use and installation of pollution control devices.

The current study report MSD among 22.2% of worker which is consistent with Portland cement factory where only 18.8% of workers had musculoskeletal health risk⁽²⁴⁾. MSD might be high in this study since it is neglected as it does not cause serious effect at initial stage and is not taken as a disease. So, most of them might not get treated on time.

In this study MSD was found in neck (31.9%), shoulder (4.3 percent), upper back (12.8%), elbow (6.4 percent), lower back (19.2%), wrist/ hand (14.9%), Hip/ thigh (10.6%). Musculoskeletal problem was observed to be high among cement factory workers as per study carried out by IOS Press and the authors i.e. in neck (36%), shoulder (30%), upper back (15%), elbow (17%), low back (31%), Wrist/ hands (17%), Hips/ thighs (14%)⁽²⁵⁾.

But comparatively less musculoskeletal health risk was observed in the study conducted among workers of construction industries in Chennai metropolitan city. Musculoskeletal health problems included problems in neck (9.7 percent), shoulder (10.4%), upper back (7.8 percent), elbow (7.8 percent), lower back problems (20.8%), wrist problem (11%) and hips/ thigh (6.5 percent)⁽²⁶⁾.

As per this study, 29.2% worker smoke cigarette while higher number of Udaypur cement factory workers, Qassim cement factory workers a, South Indian cement factory workers and Dejen cement factory workers i.e. 33.2%, 46%, 59.1% and 11.6% currently were smoker respectively^(16, 21, 22, 20).

This study reflects that 66% of workers have poor knowledge on occupational health and safety. Similar finding was seen in the study of Anand Sundarar in India which showed 64.6% had

poor knowledge⁽²¹⁾. In the Maruti cement factory, 98% had knowledge of the benefits of PPE while in this study 86% and 83.5% told disease prevention and accident prevention as benefits of PPE. Similarly, 90% of workers have received training while only 70.3% received training on occupational health and safety in the present study⁽¹⁵⁾.

Among total study participants, 87.7% use PPE in this study while only 79% used in Udaypur cement factory⁽¹⁶⁾ and 31.2% used in cement factory of Ethiopia⁽²⁰⁾, 96% used in Maruti cement factory⁽¹⁵⁾ and 99% of the workers used PPE as per the study of Aliae Mohamed Hussain⁽²⁷⁾. Of the total PPE user in the current study, 85.8% use mask, 60.8% use boot, 43.4% use gloves, 11.3% use apron, 35.4% use goggles. Among total PPE users in the Udaypur cement factory, 80.3% used mask, 30.2% used boot, 26.8% used gloves, 18.6% used apron, and 12.2% used goggles⁽¹⁶⁾.

In the study conducted by Anand Sundarraaj⁽²¹⁾, reasons for no use of PPE were not availability (30.8%), not necessary (21.9%) and uncomfortable (47%) while in this study, the reasons are not availability (8.7 percent), not necessary (47.3%) and uncomfortable (43.8%).

This study reflects that the risk of respiratory diseases is reduced by 28% among OHS training receiver. A similar study in Northwest Ethiopia reflected that training on occupational health and safety-related to dust, health effect reduced respiratory symptoms by 82% (AOR=0.18 95% CI: 0.09-0.36)⁽¹¹⁾. The association might have been affected because one-fourth of the respondent does not use all required safety measures (26.9%).

Statistically, the significant relationship is obtained between respiratory risk and smoking where smokers have more than three times higher risk compared to non-smokers (AOR= 3.40, p=0.004, 95% CI: 1.47-7.85) in this study which is in line to the study of Dejen cement factory where smokers developed respiratory symptoms

5.38 times more likely (AOR=5.38, 95% CI: 1.42, 20.39) than non-smokers⁽²⁰⁾.

This study reflects that there is 1.28 times high chance of respiratory risk among workers with previous occupation with dust exposure while in cement factory workers of Northwest Ethiopia, the occupational history of dust exposure was likely to develop respiratory symptoms (AOR=2.94, 95% CI: 1.13-7.63)⁽¹¹⁾. Workers aged > 40 years were two times more likely to develop respiratory risk in this study which coincides with a similar finding in the study of Dejel cement factory where ≥ 45 years were four times more likely to develop respiratory symptoms⁽²⁰⁾.

Education (p=0.449), work tenure (0.146), age (0.088), gender (0.407), work shift (0.727), are not found to be significantly associated while smoking is significantly associated with respiratory disease (p=0.020) in this study. Study in Udaypur cement factory showed significant association among respiratory symptoms and education (0.009), duration of work (<0.001), smoking (<0.001) while age (0.856), gender (0.929), work shift (0.19) were not significantly associated⁽¹⁶⁾.

Present study revealed that no statistical association was observed among musculoskeletal health risk and age (p=0.072), and job tenure (p=0.444). Study in Iranian Zinc Industry, showed association of MSD and age (<0.001) and job tenure (<0.001)⁽²⁸⁾. Similarly, the study conducted in India showed workers working more than 11 years had 2.77 times more risk (AOR=2.77, CI: 1.12-6.83)⁽²⁶⁾. This might be affected due to small sample size where workers working more than 5 years cover only 15.6% of total sample.

This study shows that workers above 40 years has 1.89 times risk of musculoskeletal problems which is consistent with the study conducted in India where workers aged 41 years and above had 2.72 times more risk of musculoskeletal morbidities (AOR=2.72, CI: 0.99-7.47). Gender had no significant association with MSD where males were 7 percent protective

compared to females in the study of India which is consistent with the present findings where male were 16% protective to musculoskeletal problems⁽²⁶⁾.

In the univariate logistic analysis, some cell frequencies are very low which might have affected the relationship. Though the confidence interval is uni-directional in multiple logistic regression the range is a little bit large. Despite all this information, smoking and access to safety measures are found to be a predictor of respiratory health risk. Similarly, educational status, work shift and first aid availability were found to be the predictors of musculoskeletal health risk.

CONCLUSION

Occupational health risk was reported less compared to similar study carried out in Nepal although the risk is still high. Musculoskeletal health risk was reported to be high by both cement factory workers. Special protection/ care needs to be provided to workers above 40 years of age since risk increases as per age. Field level workers, with special focus, need to be fully equipped with necessary safety measures to prevent health risk. Cement factories could be declared as the smoking restricted area. Behavior change communication related to OHS could be adopted to ensure workers' compliance with safety devices which improves knowledge level and ultimately healthy practice will be achieved. Routine health examination could help workers identify health issues timely to prevent complications. The government should strictly execute protocol and standards to monitor OHS.

AUTHOR CONTRIBUTIONS

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DISCLOSURE STATEMENT

The authors declare no possible conflicts of interest.

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