



The Magnitude of Occupational Injury and Associated Factors among Factory Workers in Ethiopia; *The case of Mughher Cement Factory*

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Summary

BACK GROUND

Throughout the world, occupational exposure to cement dust and noise continue to cause serious public health hazard and one of the leading causes of disability and disease among workers.

OBJECTIVES

The study investigated the prevalence and associated factors of occupational injuries (injuries that occur at a person's workplace which can include exposure to chemicals or other substances) among cement factory workers in Mughher.

METHODOLOGY

The sampling frame was obtained from Mughher cement factory. An institution based cross sectional study was conducted using stratified random sampling. The data was collected, edited, entered in to a computer using Epi Info *version 3.5.0* then exported to SPSS *version 21* and cleaned. Bivariate analysis & multivariate analysis was done. All employees who were directly engaged in the production process within the study period & had been working for at least one year in the selected factory irrespective of gender were included

RESULTS

The prevalence of occupational injury in one year was 10.4%. In addition, 1356 working days were lost as a result of 52 work related injuries. Thirty seven (71.2%) employees were hospitalized, accounting for 51.4% hospitalization for more than 24 hours, 18(34.6%) were absent from work for 15-30 days. The significant contributing factor for occupational injuries was job category. Workers in the cement production were 74.7% less likely to experience occupational injury than workers in the clinker production [AOR= 0.25, C.I : (0.100-0.639)].

CONCLUSION AND RECOMMENDATION

Most of the world's work - related deaths, injuries and illnesses are preventable. The prevalence of occupational injury was high. Preventive measures like provision of adequate and quality safety materials timely and work place supervision should get focus.

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Introduction

According to Labor Proclamation No. 377/2003 of Ethiopia "Occupational accident" means any organic injury or functional disorder sustained by a worker as a result of any cause extraneous to the injured worker or any effort he/she makes during or in connection with the performance of his/her work and includes;

- (a) Any injury sustained by a worker while carrying out the employer's order, even away from the work place or outside his normal hours of work
- (b) Any injury sustained by a worker before or after work or during any interruption of work if he/she was present in the work place or the premises of the undertaking by reason of duties in connection with his/her work
- (c) Any injury sustained by a worker while he/she was preceding to or from place of work in a transport service vehicle provided by the undertaking which is available for the common use of its workers or in a vehicle hired and expressly destined by the undertaking for the same purpose
- (d) Any injury sustained by a worker as a result of an action of the employer or a third party during the performance of his/her work [1].

Occupational injuries are injuries that occur at the location of a person's employment which can include exposure to chemicals or other substances as well as any other accident. Occupational accidents, Work injury, Work-related injury, Work accidents, Work-related accidents are other names for occupational injuries [2].

The primary cause of Occupational Injuries while working at a workplace was as a result of exposure to deleterious agents usually toxins, gases, inhalants, etc. [3].

According to International Labor Organization (ILO), projections for the year 2000 based on 1998 statistics, there were 2 million work-related deaths annually worldwide. These accidents contributed to 19% of the ILO estimates that, a total cost of occupational accidents and work-related diseases were 4% of the gross national productions. Most of the world's work-related deaths, injuries and illnesses are preventable [4].

According to results from the Census of Fatal Occupational Injuries conducted by the U.S. Bureau of Labor Statistics, a preliminary total of 4,383 fatal work injuries were recorded in the United States in 2012 [5].

A report from Centers for Disease Control and Prevention (CDCP), 7.9 million non-fatal injuries to younger workers were treated in U.S. hospital emergency departments within 10 years [6].

A global burden of about 10.5 million DALYs was estimated due to both fatal and non-fatal occupational injuries [7].

In Ethiopia, an accident report by the Ministry of Labor and Social Affairs (MOLSA) collected from 66 establishments between 2008 and 2009, had a total of 1968 work accidents. 9 cases out of those, were fatal. Among the reported work accidents 56.05% occurred in the manufacturing industries.

In respect of the same report collected from 220 establishments in 2009/2010, there were 29 fatal and 6127 non-fatal work accidents reported in total.

Among the total sum, 41.64% occurred in the manufacturing industries. Similarly in an accident report by MOLSA taken from 248 establishments in 2010/2011 showed that there were 16 fatal and 6990 non-fatal work accidents. In the report 51.78% of them took place in agricultural, hunting, forestry and fishing sectors. Followed by 42.95% in the manufacturing industries [8].

Occupational injuries may occur in the production process of a cement factory as a result of unsafe working conditions, unsafe acts, personal failure and lack of awareness on both the side of employers and employees. The failure on the part of the management in realizing and applying properly guarded machines, proper illumination and ventilations, non-defective tools etc could be considered as some of the causes of Work Accidents.

Occupational injuries may result in loss of life, physical impairment, material damages and termination of employment that might claim very huge financial losses [8].

Personal status like; gender, age, Education, marital, job category, lack of experience, workplace supervision, job satisfaction working hours per week



health and safety training, alcohol use, sleeping disorder, manual handling of very heavy objects (>20 kg), need for visual concentration for the task, and maintenance of machine, job stress, non PPE use were factors associated with occupational injury in a study done in Ethiopia [9 -13].

Most of the world's work-related deaths, injuries and illnesses are preventable. Worldwide occupational exposure to cement dust and other hazards was the cause for skin allergies, eye irritation and other work related injuries [14].

Job category, work experience and use of personal protective equipments were the associated factors. Different investigations in Africa reported that, cement industry was responsible for many types of injuries like burns in different parts of the body, fractures, falling and responsible for hospitalization. The high cost for treatment and loss of productivity due to absentseem from workplace was another factor [15 - 16].

Studies done in different parts of Ethiopia reported that, occupational injury was prevalent in different industries. Occupational injury caused many types of injuries, affected different parts of the body and it was the cause for hospitalization, loss of working days and death [10 - 13].

Studies done in different industries (even though being in different sectors they use similar machineries) in Ethiopia linked occupational injuries with the following; age, working hours in a week, health and safety training, alcohol consumption and sleep disorder, educational status, marital status, manual handling of heavy objects, maintenance of machines, work stress work experience, job category, work place supervision use of Personal protective equipment (PPE) [9 - 13].

While some of them reported that, Gender, educational level, monthly salary, job category, work experience, job satisfaction and use of PPE, age, gender employment pattern, work place supervision, health and safety training and sleep disorder were not associated with occupational injury [10 - 13].

Work, when well-adjusted and productive can be important in health promotion, e.g. partially disabled workers may be rehabilitated by undertaking tasks suited to their physical and mental limitations. This will, substantially increase their working capacity [17].

There was a great discrepancy in the studies explained earlier in relation to the associated factors of occupational injuries in different industry sectors. In addition there was no study carried out on the prevalence and associated factors of occupational injury in cement factory. Occupational health and safety affected not only the worker but also his/her family and significantly others and their communities.

There was rapid industrialization due to favorable investment policy. That might result in an increased number of industries and employment in Ethiopia, placing a greater number of people at risk from cement dust exposure and other hazards Therefore, it is important to know the prevalence and determinants of occupational injuries among cement factory workers.

Methodology

Study Area

According to the Ministry of Industry there were around 10 cement factories in Ethiopia. Muger Cement Enterprise was a state owned plant constructed in 1984. Muger Cement Enterprise's first production line was commissioned and officially inaugurated in 1984 with a capacity of 300,000 tons of clinker per annum. It is situated near Muger River, 90Km west of Addis Ababa.

The enterprise doubled its capacity to 600,000 tons per annum of clinker production in 1990 with the construction of a second plant. The 3rd line cement expansion project was commissioned in 2011. It was the largest cement producer in Ethiopia with a production capacity of 900,000 tones and a 35% market share and has a total workforce of over 1,500. Its head office was based just outside the capital and its quarrying sites were spread across the country.

Muger Enterprise produces two main products OPC (Ordinary Portland cement) and PPC (Poslana Portland cement). Sulphate resistance cement is sometimes produced on demand.

The firm produces about 60 million packaging sacs for its own consumption in Addis Ababa branch. Muger also extracts and sells natural resource minerals such as gypsum, limestone and silica to other manufacturing companies and farms. Muger uses an outdated production technology from Germany which has high energy consumption and dust emission [19].

There were around 1488 workers in Mughher cement Enterprise in all branches (Mugher, Addis Ababa, Derba, Tatek & Nazreth). Out of the 1488 workers, 955 were working on the cement production process which includes raw materials, clinker production, cement production and engineering processes. There were around 690 workers with greater than one year work experience in the production process of Mughher which was selected as a study area.

Study Design

An industry based cross sectional study complemented with observation checklist and record review was conducted.

Source Population

All workers in the production process of the cement factory. The production process consisted of four main sections;

- Clinker production
- Cement production
- Raw materials production and Preparation
- Engineering team because they were considered as exposed to occupational health and safety hazards that leads to occupational injury.

Study Population

All workers who were randomly selected from the production process of the cement factory.

Using PPS, Sample size=500

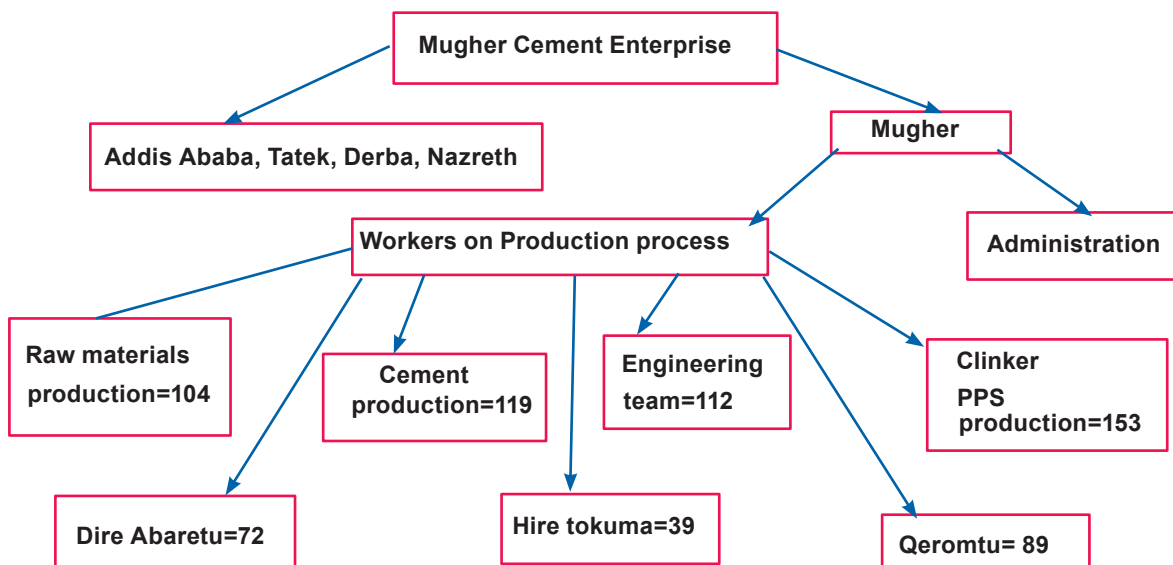


Figure 1: Schematic Presentation of Sampling Procedure in Mughher Cement Factory, Ethiopia, 2014.

Inclusion Criteria

All employees who were directly engaged in the production process within the study period & who had been working at least for one year in the selected factory irrespective of gender were included in the study.

Exclusion Criteria

Workers less than 18 years old were excluded. Workers who were absent from work for more than 3 times of visit at the time of data collection were not included.

Sample Size Determination

The total sample size was calculated for each specific objective by using Epi Info *version 7* and considering different parameters, the largest sample size was taken. Considering 95% confidence level, 90% Power (1-β), odds ratio of 1.9 and adding 5% non-response rate, a sample size of 500 was calculated [16].

Sampling Procedures

Stratified random sampling was applied to get the desired sampling unit. It was stratified by job category. The calculated sample size was allocated to each stratum using probability proportional to size (PPS). The sampling frame was obtained from Mughher cement factory, Human resource management office. The study participants were selected using simple random sampling technique from the sampling frame using lottery method. (Figure.1)



4.7 Data Collection Procedures

Data was collected using pretested and structured *Amharic version* questionnaire via face to face interview of the study participants after getting ethical clearance from responsible bodies and informed verbal consent from study participants.

Before the actual data collection, the questionnaire was pretested in 5% (25 workers) outside the study area, in Addis Ababa (Ethiopian Iron and steel factory). Based on the pretest necessary modification was done on the questions and participants who were involved in the pretest were excluded from the actual data analysis. The questionnaire was prepared in English and translated to Amharic & later translated back to English. The questionnaire was adopted from previous researches [11].

The questionnaire focused on environmental variables, socio - demographic behavioral and occupational injury characteristics. Work place observation checklist, record reviews were done. Sick leaves were checked to supplement the quantitative data.

Data collection was administered by four persons, one who had a Bachelor's Degree and two supervisors with B.Sc degree in occupational health and MPH degree respectively after two-day training. In one case the selected respondents failed to turn up, the data collectors tried to visit three times with no success.

Study Variables

Dependent Variable: Occupational injury

Independent Variables:

1. Socio - demographic factors; gender, educational level, age, monthly salary, Service duration, job category.
2. Work environment factors; hours worked per week, workplace supervision, health and safety training.
3. Behavioral factors; alcohol use, chat chewing, sleep disorder, job satisfaction, and use of personal protective equipment.

Operational Definition

Occupational Injury-an injury sustained on worker in connection with the performance of his or her work in cement factory within one year that causes hospitalization, working days lost or disabilities and death as reported by the worker, confirming clinical records and sick leave.

Data Management

After the completion of data collection, the raw data was edited, entered into a computer using *Epi Info version 3.5.0* then exported to IBM SPSS *version 21*. Data was cleaned in *Epi Info version 3.5* as well as IBM SPSS *version 21* by running frequencies and cross tabulations. Preliminary frequencies were run to identify missing variables. Data was backed up by saving it in different folders in the computer, removable flash disk and email. Continuous variables were coded and some coded variables were recoded.

Data Analysis Procedures

Data was analyzed using IBM SPSS *version 21* and used to display percentages, graphs and tables. Descriptive statistics of the collected data was done for all variables in the study using standardized statistical parameters:

- a. Percentages
- b. Mean
- c. Standard deviations

Bivariate analysis (Cross tabulation and Chi Square, Crude OR with 95 % Confidence Interval) were done for the independent variables with the outcome variable to select candidate variables for the multivariate analysis (Adjusted OR). Variables which showed significant association with the outcome variable on the bivariate analysis were entered into multivariate logistic regression analysis to identify their independent effects on the outcome variable. 95% confidence interval and p-value <0.05 was used.

To avoid excessive numbers of variables and unstable estimates in the multivariate analysis variables reached a p-value less than 0.2. Variables which became significant and those variables that were considered as determinants were kept. Those which showed significant association in the bivariate and continued in the multivariate were the determinants of occupational injury. The overall effect of socio-demographic variables



on the occurrence of occupational injury was assessed in the first step.

In the second step of the analysis, the work environment variables were added, and their effect was assessed.

Behavioral factors were entered in the third step.

In the fourth step selected socio- demographic factors, work environment and behavioral factors together were assessed to see the overall effect on the occurrence of occupational injury.

Data Quality Assurance

Training of the data collection team with pretesting in 5% of the sample size before the actual survey was conducted for two days to ensure the possible quality of the data. Based on the pretest results, the questionnaire was additionally adjusted quantitatively, contextually and terminologically, administered on the study population.

Every day the completed questionnaires were handed to the supervisor on each day of data collection. The data collected in the cement factory was checked daily for completeness, clarity and logical consistency by the investigator and supervisor. Incorrectly filled or missed ones were sent back to data collectors for correction. Anything, which was unclear and ambiguous was corrected on the next day. Five percent of the samples were rechecked by the supervisors whether the interviewers had done their job correctly or not. Five percent of the collected data was entered twice by the investigators to verify whether the data was properly entered or not.

Ethical Consideration

The study was approved and a letter issued by Addis Ababa University, school of Public Health ethical clearance committee. Health ethical clearance committee submitted to the relevant and concerned bodies in the cement factory before starting the study.

The information sheet and consent forms were provided for respondents to read for those who can read and the interviewer read the consent form for those respondents who can't read. Finally the respondents were asked to consent for participation in the study.

The respondents were informed about the objective of the study. Confidentiality was maintained by omitting their names and personal identification,

never be used in connection with any information. Not to be revealed to anyone else except the principal investigator, his/her assistants and was kept locked with a key in the entire study period.

Privacy was maintained by organizing a quite place for interviewer and study participant to protect them involving other parties according to the choice of the respondent ensuring visual and auditory privacy throughout the data collection.

Study respondents had the right to participate or not. They could withdraw at any time of the study as they wish. There was no benefit the study participants could get in terms of monetary or other items. Fortunately, they will benefit in future if there will be a change of policy and strategies by considering this study. The unanimous benefit is to improve occupational safety, health and working environment services provided based on their answers to the questions. There was no risk to the study participants because of this study.

Results

A total of 498(99.6%) respondents were included in the study and interviewed on whether they had experienced work related injury in the last 12 months.

Socio-Demographic Characteristics of The Respondents

The 498 respondents had 484 males. The mean age (SD) 37.36 ± 10.32 years. About 89(17.9%) of the respondents were in the age group 26-30 years. The majority 422 (84.7 %) of study participants were Orthodox Christian religion followers.

About 189(38%) of the respondents had attended secondary school. In regards to marital status of the respondents, the majority 406 (81.5%) were married. Out of the 498 study participants, 354 (71.1%) were permanent employees while 144 (28.9%) were from Micro and Small Enterprises. One hundred and seventy six (35.3%) of the respondents were from clinker production.

165(33.1%) of the respondents had 1727-3684 monthly salary in birr. Most 261 (52.4%) of the respondents had working experience of five years or below (*Table 1*) next page.



Table 1: Socio-Demographic Characteristics of The Respondents, Mugher Cement Factory, Mugher, March, 2014 (N=498).

Variables	Frequency	Percentage (%)
Sex		
Female	14	2.8
Male	484	97.2
Age		
<21	13	2.6
21-25	64	12.9
26-30	89	17.9
31-35	67	13.5
36-40	75	15.1
41-45	67	13.5
46-50	67	13.5
51-55	36	7.2
>55	20	4.0
Religion		
Orthodox	422	84.7
Protestant	64	12.9
Others	12	2.4
Educational Status		
Primary school and below	199	40
Secondary school(9-12)	189	38
12+	110	22
Marital Status		
Married	406	81.5
Single	85	17.1
Others	7	1.4
Employment Pattern		
Permanent	354	71.1
Micro and small enterprise	144	28.9



cont: **Table 1:** Socio-Demographic Characteristics of The Respondents, Mughher Cement Factory, Mughher, March, 2014 (N=498).

Variables	Frequency	Percentage (%)
Job Category		
Clinker	176	35.3
Cement production	114	22.9
Raw material	127	25.5
Engineering	81	16.3
Service Duration		
<5	261	52.4
5-9	57	11.4
10-14	28	5.6
>=15	152	30.5
Monthly Salary in birr		
<1050	155	31.1
1050-1726	94	18.9
1727-3684	165	33.1
>3684	84	16.9

Occupational Injury Characteristics

A total of 63(12.7%) respondents were reported with occupational injuries during the last 12 months. Due to the definition of occupational injury in this study and after reviewing records the overall prevalence

within the last 12 months was 52(10.4%) and 48 (92.3%) of the injured respondents reported they had sustained occupational injury once. The two week prevalence was 3(0.6%). Out of this case, all reported that they had sustained occupational injury once (**Table 2**).

Table 2: Distribution of Occupational Injury in The Last 12 Months among Respondents in Mughher Cement Factory, March, 2014(N=498).

Variable	Frequency	Percentage (%)
Injury in the last 2 Weeks	3	0.6
Injury in the last 12 Months		
Yes	52	10.4
No	446	89.6
No. of occurrence(n=52)		
Once	48	92.3
More than once	4	7.7



Hands were the body part with the highest frequency of occupational injuries 11 (21.2%), Lower Leg 10 (19.2%), Finger 9 (17.3%) and Eye 7(13.5%)

were other sites frequently affected. The most types of injuries reported were cuts 10(19.2%), burn 10(19.2%), abrasions 7(13.5%) & eye injury 7(13.5%) (**Table 3**).

Table 3: .Distribution of Occupational Injury by Part of The Body Affected and Type of Injury, Muger Cement Factory, March, 2014 (N=52).

Variables	Frequency	Percentage (%)
Part of the body affected		
Hand	11	21.2
Lower Leg	10	19.2
Finger	9	17.3
Eye	7	13.5
Back	6	11.5
Upper Leg	5	9.6
Others*	13	25
Type of Injury		
Burn	10	19.2
Cut	10	19.2
Abrasion	7	13.5
Puncture	7	13.5
Eye injury	7	13.5
Fracture	6	11.5
Others **	8	15.3

***Others** = Tooth=2, Ear=2, Knee=2, Toe=2, Head=1, Lower arm=2, Chest=2

****Others** - Dislocation=4, Ear injury=2, Amputation=2

In this study the most common agent stated as cause was machinery 25 (48.1%), splintering objects 10 (19.2%) and falls 10 (19.2%) followed by hot substances 9(17.3%). Thirteen (25%) of the occupational injuries

occurred on Tuesdays and Wednesdays 13(25%). Followed by Mondays 9(17.3%). The most 17(32.7%) common time of injury was in the afternoons followed by mornings 16(30.8%) (**Table 4**).



Table 4: Distribution of Occupational Injuries in The Last 12 Months by Cause of Injury, Day of Injury and Time of Injury among 52 Injured Respondents, Muger Cement Factory, March, 2014 (N=52).

Variables	Frequency	Percentage (%)
Cause of Injury		
Machinery	25	48.1
Splintering objects	10	19.2
Falls	10	19.2
Hot substances	9	17.3
Hit by falling objects	9	17.3
Day of Injury		
Monday	9	17.3
Tuesday	13	25
Wednesday	13	25
Thursday	7	13.5
Friday	3	5.8
Saturday	3	5.8
Sunday	6	11.5
Time of Injury		
Morning	16	30.8
Afternoon	17	32.7
Evening	14	26.9
Mid night	5	9.6

*Others:- Lifting heavy objects = 4, Fire = 2, Electricity = 1, Hand tools = 1, Collision with objects = 1

Severity of Occupational Injuries

Out of the 52 injured respondents, 37(71.2%) were hospitalized, for more than 24 hours accounting for 51.4%. 18(34.6%) were absent from work for 15-30 days There was one report with disability (total

disability was 10% from the whole man) resulted in lumbar contusion and mild difficulty of walking which was decided by medical board of St.Paul hospital. In addition, 1356 working days were lost as result of 52 occupational injuries (**Table 5**).



Table 5: Severity of Occupational Injuries as Reported by The Respondents and Confirmed by The Investigator, Mughher Cement Factory, March, 2014(N=52).

Hospitalization		
Yes	37	71.2
No	15	28.8
How long(n=37)		
Less than 24 hours	18	48.6
More than 24 hours	19	51.4
Working days lost		
<2	3	5.8
2-6	12	23.1
7-14	12	23.1
15-30	18	34.6
>30	7	13.5

Work Environment Characteristics

Four hundred eighty three (97%) respondents worked more than 48 hours per week. Two hundred fifteen (43.2%) of the respondents reported that their

workplaces were not supervised regularly. Majority (60.6 %) of the respondents were not taken any health and safety training (Table 6).

Table 6: Work Environment Characteristics of Respondents in Mughher Cement Factory, March, 2014(N=498).

Variables	Frequency	Percentage (%)
Working Hour in a Week		
<=48	15	3.0
>48	483	97.0
Supervision		
Yes	283	56.8
No	215	43.2
Safety Training		
Yes	196	39.4
No	302	60.6



Behavioral Characteristics

Three hundred and ten (310 (62.2%) with 25(5%) of the respondents consumed alcohol and chewed *Khat* respectively. *Tela* was consumed by many of 231(46.4%). The majority 298(59.8%) consumed occasionally. About 57 (11.4%) of the respondents reported that, they had sleep disorder. The majority 442 (88.8%) of the respondents were satisfied by their current job. 488 (98.0%) of the respondents were using

their personal protective equipment at their workplace, while 10 (2.0%) were not used any type of personal of protective equipment. Glove was used by majority of the respondents ,464(93.2%).

All of the study participants were interviewed for not using protective equipment and their most frequent reasons were; lack of personal protective equipment 359 (72.1%), and not comfortable to use them 53 (10.6%) (**Table 7**).

Table 7: Behavioral Characteristics of Respondents in Muger Cement Factory, March, 2014(N=498).

Variables	Frequency	Percentage (%)
Alcohol		
Yes	310	62.2
No	188	37.8
How Often		
1-3 Days in a week	12	2.4
Occasionally	298	59.8
Khat		
Yes	25	5.0
No	473	95.0
How Often		
Every day	2	0.4
1-3 Days in a week	5	1.0
Occasionally	18	3.6
Sleeping Disorder		
Yes	57	11.4
No	441	88.6



Cont. **Table 7:** Behavioral Characteristics of Respondents in Mughher Cement Factory, March, 2014(N=498).

Variables	Frequency	Percentage (%)
Job Satisfaction		
Yes	442	88.8
No	56	11.2
Use of PPE		
Yes	488	98.0
No	10	2.0
Type of PPE		
<i>Glove</i>	464	93.2
<i>Ear plug</i>	253	50.8
<i>Respirators</i>	270	54.2
<i>Helmet</i>	352	70.7
<i>Overalls</i>	397	79.7
<i>Goggles</i>	150	30.1
<i>Face shield</i>	69	13.9
<i>Boots</i>	304	61.0
Reasons For Not Using		
<i>Lack of PPE</i>	359	72.1
<i>Lack of safety and health education</i>	4	0.8
<i>Not comfortable to use</i>	53	10.6
<i>Decrease work performance</i>	5	1.0
Others		
<i>It lacks Quality</i>	5	1.0
<i>Not needed</i>	15	3.0
<i>Not timely</i>	4	0.8



Workers Health Information on Illness Symptoms

Eighty four(16.9%) of the respondents reported that, they were exposed to eye irritation 15 days prior to the data collection, followed by skin allergy 51(10.2%). General weakness 34(6.8%), Wheezing 18(3.6%), Coughing for more than 3 weeks 6(1.2%) and a Cough with sputum 1(0.2%) were also reported.

Work Environment Observation

According to the observation workers around the kiln were exposed to heat, noise and splintering objects that pass through the conveyer belt without cover .Workers in cement packing were exposed to excessive dust, radiation and there was no adequate light. Some of the control rooms and cement packing room were not properly ventilated; some of the ventilators were not functional at the time of data collection. There was dust in the raw mill when the electro filter (conditioning tower) was not functioning. It could pollute the environment by changing its direction to different areas, sometimes it also goes to residential area of the workers.

That would cause many health problems and it was a recipe for wastage of raw materials up to 9 tons per hour creating economical loss. We did not confirm enough safety precautions. There were some directives and fire extinguishers in most of the work areas but the instructions were written in English which all workers could not read. Some of the permanent workers who used necessary PPEs complained that, they lacked standards and were not provided timely.

For example safety shoes provided could not prevent their feet where there was a risk of injuries from hot substances. Workers from the micro and small enterprises were not provided PPE by the organization, they bought by themselves.

There was an occupational health and safety officer but there was no adequate supervision from our observation. Training was given for some of the workers.

There were two cafeterias near to the plant and used by many people which could cause a health hazard.

First Aid facilities were available but not functional in their workplace, despite the fact that, there was a health center in the compound.

Socio-Demographic Factors

Educational level, job category, and monthly salary were identified as the major socio-demographic determinants of occupational injury. Educational level was statistically significant in this study. When we compared workers who attended primary school and those below with workers who attended higher education, the difference was statistically significant. Workers who attended primary school were 2.44 times more likely to report occupational injuries than workers who attended 12 and above [OR = 2.44, CI : 1.084 - 5.508].

Occupational injury was statistically associated with Job category. Workers who were working in cement production, raw materials preparation and production respectively were 69% and 73% less likely to report occupational injury than clinker production.

Monthly salary was also another variable that showed association with prevalence of occupational injury. Workers who were paid less during the interview were more likely to report occupational injury [OR=2.24, CI: 1.062 - 4.727] compared to those who were paid relatively higher.

However, in this study occupational injury was not associated with sex, age, religion, marital status and service duration of the respondents (*Table 8*).

Table 8: Crude Statistics of Socio Demographic Factors of Occupational Injuries in Mughar Cement Factory, Mughar, March, 2014.

Variables	Injury		P-value	COR(95%CI)
	Yes (%)	No (%)		
Sex				
Female	2(14.3)	12 (85.7)	0.635	1.45(0.315-6.65)
Male	50(10.3)	434 (89.7)		1.00



Table 8: Crude Statistics of Socio-Demographic Factors of Occupational Injuries in Mughher Cement Factory, Mughher, March, 2014.

Variables	Injury		P-value	COR(95%CI)
	Yes (%)	No (%)		
Age				
<=30	18(10.8)	148 (89.2)	0.836	1.06 (0.582-1.951)
>30	34(10.2)	298 (89.8)		1.00
Religion				
Orthodox	46(89.1)	376 (10.9)	0.432	1.43 (0.587-3.469)
Others	6(92.1)	70 (7.9)		1.00
Educational Level				
Primary and below	32(16.1)	167 (83.9)	0.031	2.44 (1.084-5.508)
Secondary	12(6.3)	177 (93.7)	0.758	0.86 (0.342-2.185)
12+	8(7.3)	102(92.7)		1.00
Marital status				
Married	46(11.3)	360 (88.7)	0.179	1.83 (0.758-4.427)
Others	6(6.5)	86 (93.5)		1.00
Employment Pattern				
Permanent	32(9.0)	322 (91.0)	0.111	0.62(0.340-1.118)
Micro & small enterprise	20(13.9)	124 (86.1)		1.00
Job Category				
Clinker	31(17.6)	145 (82.4)	0.000	1.00
Cement production	7(6.1)	107 (93.9)	0.007	0.30(0.130-0.721)
Raw material	7(5.5)	120 (94.5)	0.003	0.27(0.116-0.642)
Engineering	7(8.6)	74 (91.4)	0.065	0.44(0.186-1.053)
Service Duration				
<=5	26(10.0)	235 (90.0)	0.713	0.90(0.505-1.595)
>=6	26(11.0)	211 (89.0)	0.000	1.00
Monthly Salary in Birr				
<1400	25(15.0)	142 (85.0)	0.034	2.24(1.062-4.727)
1400-3045	16(8.9)	164 (91.1)	0.596	1.24(0.558-2.764)
>3045	11(7.3)	11140 (92.7)	0.000	1.00

Work Environment Factors

Hours worked per week, workplace supervision, health and safety training showed no association with the prevalence of occupational injuries (*Table 9*).

Table 9: Crude Statistics Work Environment Factors of Occupational Injuries in Mugher Cement Factory, Mugher, March, 2014.

Variables	Injury		P-value	COR(95%CI)
	Yes (%)	No (%)		
Working Hour in a Week				
<=48	1 (6.7)	14 (93.3)	0.631	0.60 (0.078-4.697)
>48	51 (10.6)	432 (89.4)		1.00
Supervision				
Yes	34 (12.0)	249 (88.0)	0.190	1.49(0.819- 2.726)
No	18 (8.4)	197 (91.6)		1.00
Safety Training				
Yes	17 (8.7)	179 (91.3)	0.300	0.73 (0.394-1.333)
No	35 (11.6)	267 (88.4)		1.00

Behavioral factors

Alcohol use, *khat* chewing, sleeping disorder, job satisfaction and use of personal protective equipments did not show significant association (*Table 10*).



Table 10: Crude Statistics of Behavioral Factors of Occupational Injuries in Mugher Cement Factory, Mugher, 2014.

Variables	Injury		P-value	COR(95%CI)
	Yes (%)	No (%)		
Alcohol Use				
Yes	33 (10.6)	277 (89.4)	0.849	1.06 (0.584-1.923)
No	19 (10.1)	169 (89.9)		1.00
Khat				
Yes	1 (4.0)	24 (96.0)	0.302	0.35 (0.046-2.603)
No	51 (10.8)	422 (89.2)		1.00
Sleeping Disorder				
Yes	8 (14.0)	49 (86.0)	0.348	1.47 (0.656-3.310)
No	44 (10.0)	397 (90.0)		1.00
Job Satisfaction				
Yes	47 (10.6)	395 (89.4)	0.695	1.21 (0.461-3.192)
No	5 (8.9)	51 (91.1)		1.00
Use of PPE				
Yes	49 (10.0)	439 (90.0)	0.057	0.26 (0.065-1.040)
No	3 (30.0)	7 (70.0)		1.00

Multivariate Logistic Regression Analysis

The overall effect of socio-demographic variables on the occurrence of occupational injury was assessed in the first step. In the second step of the analysis, the work environment variables were added, and their effect was also assessed. Behavioral factors were entered in the third step. In the fourth step selected socio-demographic factors, work environment and behavioral factors together was assessed to see the overall effect on the occurrence of occupational injury.

Among the mentioned socio-demographic variables computed in the first step; job categories

in cement production and raw material remained significant. Workers in the Cement production were 74.3% less likely to experience occupational injuries than workers in Clinker production [OR = 0.26, CI : 0.105 - 0.628]. Workers in the raw material production had 75.2% less than lower odds of having occupational injuries than workers in the Clinker production [OR=0.25 ,CI:0.102-0.607].

From work environment variables analyzed hours worked per week, supervision of workplace health measures and safety training was not statistically significant.

From the behavioral factors use of PPE was found to be significant. Workers who used PPE were



0.24 less likely to experience occupational injury than those who did not use PPE [OR = 0.24, CI ; (0.058 - 0.973)].

From the variables computed in the fourth step only job category was found to be significant. Workers in the Cement production were 74.7% less likely to

experience occupational injury than workers in Clinker production [OR= 0.25, CI :(0.100-0.639)]. Workers in the raw materials production had 73.6 % less likelihood to experience occupational injuries than workers in the Clinker production [OR= 0.26, CI :(0.107 - 0.653)] (*Table 11*).

Table 11: Multivariate Logistic Regression Analysis of The Relative Effect Of Socio - Demographic, Work Environme and Behavioral Factors on The Prevalence of Occupational Injuries in Mugher Cement Factory, Mugher, March, 2014.

Variables	Injury		COR(95%CI)	AOR(95%CI)
	Yes	No		
Educational Level				
Primary and below	32	167	2.44 (1.084-5.508)	3.03 (0.754-12.152)
Secondary	12	177	0.86(0.342-2.185)	1.10 (0.317-3.838)
12+	8	102	1.00	1.00
Marital Status				
Married	46	360	1.83(0.758-4.427)	1.80 (0.686-4.739)
Others	6	86	1.00	1.00
Employment Pattern				
Permanent	32	322	0.62 (0.340-1.118)	0.63 (0.143-2.778)
Micro & small enterprise	20	124	1.00	1.00
Job category				
Clinker	31	145	1.00	1.00
Cement production	7	107	0.30 (0.130-0.721)	0.25(0.100-0.639)
Raw material	7	120	0.27 (0.116-0.642)	0.26(0.107-0.653)
Engineering	7	74	0.44 (0.186-1.053)	0.80 (0.247-2.639)
Service Duration				
<=5	26	235	0.90 (0.505-1.595)	0.47(0.183-1.204)
>=6	26	211	1.00	1.00
Monthly Salary in Birr				
<1400	25	142	2.24 (1.062-4.727)	1.17 (0.248-5.483)



Table 11: Multivariate Logistic Regression Analysis of The Relative Effect of Socio-Demographic, Work Environment and Behavioral Factors on The Prevalence of Occupational Injuries in Muger Cement Factory, Muger, March, 2014.

Variables	Injury		COR(95%CI)	AOR(95%CI)
	Yes	No		
Educational Level				
1400-3045	16	164	1.24(0.558-2.764)	0.87 (0.305-2.457)
>3045	11	140	1.00	1.00
Working Hour in a Week				
<=48	1	14	0.60 (0.078-4.697)	0.91(0.102-8.225)
>48	51	432	1.00	1.00
Supervision				
Yes	34	249	1.49 (0.819- 2.726)	1.27 (0.649-2.484)
No	18	197	1.00	1.00
Safety Training				
Yes	17	179	0.73 (0.394-1.333)	0.97(0.451-2.088)
No	35	267	1.00	1.00
Alcohol Use				
Yes	33	277	1.06 (0.584-1.923)	0.90 (0.471-1.736)
No	19	169	1.00	1.00
Chat				
Yes	1	24	0.35 (0.046-2.603)	0.36 (0.042-3.042)
No	51	422	1.00	1.00
Sleeping Disorder				
Yes	8	49	1.47 (0.656-3.310)	1.98 (0.813-4.828)
No	44	397	1.00	1.00
Job Satisfaction				
Yes	47	395	1.21 (0.461-3.192)	0.76 (0.262-2.223)
No	5	51	1.00	1.00
Use of PPE				
Yes	49	439	0.26 (0.065-1.040)	0.44 (0.092-2.086)
No	3	7	1.00	1.00



Discussion

The 12 months prevalence was 52(10.4%) and 48 (92.3%) of the injured respondents confirmed they had sustained occupational injury once. The two week prevalence was 3(0.6%). In that case, all reported that they had sustained occupational injury once. The overall prevalence was relatively low compared with other studies [10, 11, 13, 18].

Out of the total 52 injured respondents, 37(71.2%) were hospitalized, accounting for 51.4% hospitalization of more than 24 hours. 18(34.6%) were absent from work for 15-30 days. There was one report with disability thus (total disability was 10% from the whole man) and resulted in lumbar contusion with mild difficulties in walking that was decided by medical board of St. Paul Hospital.

In addition, 1356 working days were lost as a result of 52 occupational injuries. Hospitalization and working days lost can result to;

1. increase in medical cost
2. compensation cost
3. absenteeism
4. loss of working capacity which adversely affects productivity of the employees as well as the employer so we can see it economically.

Work that resulted in production loss, disregard the safety and health of workers, cannot be the basis of a sustainable development.

In a study done in Afar, 70 (11.0%) workers were hospitalized. In regard to the length of hospitalization, 7(10.0%) stayed for 1 day, 25(35.7%) stayed between 24 hours and 4 days, 25 (35.7%) took 5-10 days and 13 (18.6%) were admitted for more than 10 days. One death was also reported due to severe head injury while working in the ginning section in the previous 12 months.

A total of 6153 work days were lost among 634 injured respondents [10]. A study done in Kombolcha textile factory revealed that 73(43.45%) were hospitalized where 67% of the hospitalization was for more than 24 hours. 137 working days were lost as result of work related injuries in the previous 12 months [18].

Fifty five 55(17.1%) were hospitalized, accounting for 40% hospitalization more than 24 hours. One

hundred and three 103(53.9%) were absent from work for more than 4 days. In addition, 191 working days were lost as result of 322 work related injuries. There were 2 reported deaths as result of work related injuries in a study done in North Gondar [11].

Hands were the body part with the highest frequency of occupational injuries 11 (21.2%), Lower Leg 10 (19.2%), Finger 9 (17.3%) and Eye 7(13.5%) were other sites frequently affected. The possible explanation was due to more involvement in work which had direct exposure to machines, hot materials and could be affected more by injuries. Non-use of PPE could also be the reason. This was consistent with a study done in Kombolcha and North Gondar inconsistent with a study done in Bangladesh, Afar and Addis Ababa this might be due to the use of adequate PPE as it was in this study [10, 11, 13, 15, 18].

The most types of injuries reported were cuts 10(19.2%), burn 10(19.2%), abrasions 7(13.5%) and eye injury 7(13.5%). This was inconsistent with the findings in Ethiopia which could be due to the difference in the nature of work and type of machineries used in those different industries not similar.

The study's most common agent stated as cause of occupational injuries was machinery 25 (48.1%), Splintering objects 10 (19.2%) and Falls 10 (19.2%) followed by hot substances 9(17.3%). This could be due to presence of unguarded machine parts and non-use of PPE.

That was in agreement with [11, 18] and inconsistent with [10] and can be explained by the difference in materials they used for work. Thirteen 13(25%) of the occupational injuries occurred on Tuesday and Wednesday 13(25%) followed by Monday 9(17.3%). The most 17(32.7%) common time of injuries was in the afternoon followed by morning 16(30.8%).

That was inconsistent with [11] the reason could be the difference in work shifts. There were three working shifts with 8 working hours interval in the cement factory. The possible explanation for the high frequency of injuries in the afternoon could be due to speeding up of the production by the second round shift workers to meet the target before it becomes dark.

In this study Eighty four 84(16.9%) of the respondents reported that, they were exposed to eye



irritation 15 days prior to the data collection followed by skin allergy 51(10.2%). Findings from India [14] and Cairo [16] reported similarly.

Use of Personal Protective Equipments (PPE) as found to be significant when the effect of behavioral factors on occupational injury detected alone. Workers who used PPE were 0.238 less likely to experience occupational injury than who did not use PPE [AOR=0.24, CI ;(0.058-0.973)], but did not show significant association when socio-demographic and work environment factors were added.

Even though use of PPE did not show in the bivariate and multivariate analysis when added with the other factors in this study 72.1% of the workers confirmed lack of PPE, despite not provided timely and not meet high quality standards. The workers who reported as they use PPE did not use all types of PPE, only use of some types PPE cannot prevent from occupational injury.

From the variables computed in the multivariate analysis job category was found to be significant which was consistent with a study done in North Gondar. This can be explained by the work environment in clinker production is very hazardous, most of the workers in clinker production are from micro and small enterprises from which they are not provided adequate and quality PPE, lack of safety and health training and lack of regular workplace supervision [11].

Some studies revealed that increasing educational levels had been associated with decreasing work related injuries. This may be explained that education is likely to enhance workers health and safety practice that prevent them from work-related injuries.

Apparently, in this study educational level was not associated with occurrence of work-related injuries. This could be explained as education only cannot eliminate injury when the level of hazards are high and when the use of adequate PPE and safe work organization are limited.

However, in this study occupational injury was not associated with marital status, employment pattern, service duration, monthly salary, hours worked per week, workplace supervision, health and safety training, alcohol use, *Khat* chewing, sleeping disorder, job satisfaction and use of PPE for the respondents.

This study was not free of limitations. Since the study was a one year cross sectional study. The possibility of recall bias may result in under reporting and misreporting of events. Moreover, lack of studies with similar methodology and similar topic particularly in Ethiopia context made difficulty in comparing results.

Conclusion and Recommendations

The prevalence of occupational injury was 10.4%. Job category increased the risk of work related injuries. Taking modifiable and preventable factors that affect occupational injury occurrence into consideration, the following recommendations are forwarded to Muger cement factory based on the findings of the study. Provision, supervision of adequate and high quality safety materials timely and their appropriate use. Besides, regular work place supervision should get focus.

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Conflict of Interest

The authors declare that they have no competing interest.

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