Determinants of Occupational Injury in Kombolcha Textile Factory, North-East Ethiopia

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Abstract

Background: Textile factory is among the most common manufacturing industries that has higher rate of work-related injuries. Knowing the associated factors of work-related injuries can be a critical step for improving the working condition of workers in the sector.

Objective: To assess the major determinants of occupational injury among workers in Kombolcha textile factory, North-East Ethiopia.

Methods: An institution-based cross-sectional study was conducted from April 1 to 15, 2013 on 455 randomly selected workers after stratification by working departments. The data was collected using a structured questionnaire through face-to-face interview by data collectors of 6 occupational health experts and 6 nurses.

Results: Working >48 hrs/wk (aOR: 2.71, 95% CI: 1.18–6.24), handling objects >20 kg (aOR: 2.35, 95% CI: 1.24–4.45), visual concentration (aOR: 3.10, 95% CI: 1.42–6.75), timely maintenance of machine (aOR: 1.80, 95% CI: 1.11–2.93), and sleep disorder (aOR: 2.95, 95% CI: 1.47–5.92) were significant factors for the occurrence of occupational injuries.

Conclusion: Many factors including working for a long time with accurate instruments and sleep disorders can cause occupational injury in textile industries.

Keywords: Occupational injuries; Behavior; Risk assessment; Accidents; Human engineering

Introduction

The function of occupational safety and health service at the workplace is to provide preventive measures and advisory roles and being responsible for assisting employers, workers and their representatives in establishing and maintaining a safe and healthy working environment including the adaptation of work to suit workers capabilities.

Working environment conditions are among the major factors that affect public health conditions, because many workers spend a large part of their time at work.

Textile factory is among the most common manufacturing industries that has a higher rate of work-related injuries; many hazards and risks to workers, ranging from exposure to noise and hazardous substances to manual handling and working with potentially dangerous machinery. Each processing stage—from the production of materials to the manufacturing, finishing,
coloring and packaging—poses risks for workers.\textsuperscript{3,4} There was a paucity of data in this regard in Ethiopia in general and in Kombolcha textile industry in particular. This study was therefore conducted to determine the major determinants of occupational injury among workers of Kombolcha textile industry.

**Materials and Methods**

**Setting**

An institutional-based cross-sectional study was conducted from April 1 to 15, 2013 to investigate the risk factors of occupational injury in Kombolcha textile factory. Kombolcha textile factory was established in 1986 in Amhara Regional State, South Wollo zone administration, Kombolcha town; the town is located 380 km far from Addis Ababa with a total of 1584 workers of whom 905 (58\%) are men and 679 (42\%) are women. It is engaged in the production of towels, bed sheets and home fabrics using cotton.

In the factory, there is an insurance mechanism for workers that may be injured during work. This encouraged the workers to report every accident they faced while working. All workers in the factory were considered as source population and workers who were directly engaged in the production process were considered as study population whereas administrative workers were excluded from the study assuming that they were not exposed to factors of occupational injuries.

**Sampling**

The minimum sample size was calculated using Open Epi ver 2.2 statistical software. Assuming a finite population, an expected prevalence of 50\%, 4\% acceptable margin of error, and 95\% confidence interval, we came to a minimum sample size of 413. We also considered other variables and came to lesser sample sizes.\textsuperscript{5} Taking into account a 10\% drop-out, we finally came to a sample size of 455.

Departments of Engineering, Processing/Garment, Weaving, and Spinning were selected as the major areas of the factory where workers have direct involvement in the production process. Assuming that work-related injury varies with the nature of the work, we used a stratified sampling technique based on the four departments. The study participants were allocated according to the proportion of workers load in each department. Finally, the study subjects were drawn by simple random sampling from each department using the random number generator of Open Epi ver 2.2 statistical software.

**Variables**

Occupational injury was the dependent variable. The independent variables consisted of “socio-demographic factors” including age, sex, educational status, monthly income, marital status, employment pattern, and work experience; “work environment and ergonomic-related factors” including health and safety training, health and safety supervision, hours worked per week, working department, manual handling, visual concentration needed for the task, use of vibrating tools, safely guarding of machine, and timely maintenance; and “worker’s behavioral factors” including alcohol drinking, Qat (Khat or Kat) chewing, cigarette smoking, use of personal protective equipment, sleep disorder, and present job satisfaction.

**Definition of terms**

Terms were defined operationally for plausibility of the study in the following way:

Job satisfaction: Whether the worker was happy with the job that he/she had engaged currently with or not.\textsuperscript{6} Manual handling: If the task involves movement

\textbf{Khat, Kat or Qat (Catha edulis)} is an evergreen plant that is extensively cultivated in the highlands of Ethiopia and surrounding countries like Kenya and Yemen. It is a bushy plant whose leaves are the source of a naturally occurring amphetamine-like substance. It is highly abused for its stimulant properties. Stimulation is commonly obtained by chewing the leaves privately or in small social gatherings.

For more information on use of Qat by Yemeni women see www.theijoem.com/ijoem/index.php/ijoem/article/view/402
or support of any load by physical effort including lifting, putting down, pushing, pulling, carrying and moving; its creden
cence was based on the average weight of the object ("light" ≤5 kg, "medium" 6–10 kg, "heavy" 11–20 kg, "very heavy" >20 kg) and the amount of time workers spend in handling (<2 hrs, 2–4 hrs, >4 hrs). Occupational injury: Any physical injury condition sustained by worker in connection with the performance of his/her work but not includes work-related diseases that need exposure assessment or laboratory tests and medical examination. Personal protective equipment (PPE): Utilization of the worker-specialized clothing or equipment worn by employees for protection against health and safety hazards at the time of interview. PPE equipment is designed to protect many parts of the body, eg, eyes, head, face, hands, feet, and ears. Safety guarding of machine: the machine is safe if it safeguards workers from contacts with dangerous moving parts. Sleep disorder: The presence of sleeping problems when the worker is at work in the factory that occurred due to workers spending more than eight hours without shifting, working in evening, trying to work more than one task at a time, excessive heat at the work place, etc.

Data collection

The data was collected by six occupational health experts and six nurses using face-to face interview administered questionnaire with Amharic version developed from occupational health and safety guidelines, standards and other studies with little modification for the purpose of this study.

Before the actual data collection, a pre-test of the instrument was pursued and the procedure was conducted on 34 textile workers in Bahirdar textile industry, a different study setting. Improvement was done on the clarity of the questionnaire from the lessons learned during pretesting.

To avoid self-reporting bias, the data collectors have informed the following points to study participants:

- “Genuine information that respondents are going to provide will help policy makers to design strategy/give priority for prevention and control of occupational injuries to have healthy workforce.”
- “Participants will not get any direct benefit for being participated.”
- “The study has no any risk for the participant and interview also will be private to make safe participants from management-related problems.”
- “Participating or not in the interview was the full right of the participants and you can also stop from participation in the study at any time. Participants can skip question which they does not want to respond. Participants can ask any questions which was not clear for understanding.”

This study focused on work-related injuries in the past 12 months, which can also contribute the recall bias of the study.

Some of the questions asked were: 1) “Do you receive regular health and safety supervision?” with possible answers Yes/
No; 2) “Have you had an incident at work that resulted in injury to you in the last 12 months?” with possible answers Yes/No; 3) “If your answer is ‘yes,’ which part of the body was affected?” with possible answers “eye/tooth/hand/ear/knee/toe/fingers/head/upper arm/lower arm/upper leg/lower leg/back/chest;” 4) “Does your work involve manual handling activity (pulling, pushing, carrying, and lifting)?” with possible answers Yes/No; 5) “If ‘yes,’ on average how much weight do you handle per day?” with possible answers “light/medium/heavy/very heavy” (as defined above); 6) “On average, how much time did you spend on this work per day?” with possible answers “not more than 2 hrs/2–4 hrs/more than 4 hrs;” 7) “Did your work need visual concentration?” with possible answers Yes/No; 8) “If ‘yes,’ the visual demand of your task was...?” with possible answers “low” (almost no need to see fine details >50 cm/“high” (need to view fine details ≤50 cm); 9) “Do you use vibrating tools at your work place?” with possible answers Yes/No; 10) “If your answer is ‘yes,’ for how long per day?” with possible answers “not greater than 1 hr/2–4 hrs/greater than 4 hrs;” 11) “Do you have any sleep disorders?” with possible answers Yes/No; 12) “If ‘yes,’ what is the reason?” with possible answers “working more than 8 hrs without shifting working in evening/trying to do more than one task at a time/excessive heat/others;” 13) “Do you use any personal protective device while you are working?” with possible answers Yes/No; 14) “If ‘yes,’ what type?” with possible answers “glove/ear plug/respirators/helmet/overalls/goggles/face shield/boots/shoes/other;” 15) “Are machines always maintained immediately when old or unsafe?” with possible answers Yes/No.

Statistical analysis
The collected data was cleaned, entered and analyzed using SPSS® for Windows® version 20. Descriptive statistics, binary logistic and multivariable logistic regression analysis were applied to see the effect of predictor variables on the frequency of occupational injuries. In multivariable analysis, those variables with p value <0.30 in bivariate analysis were entered the model using “enter” or standard method to avoid unstable estimates due to excessive number of variables.

Ethical clearance was obtained from the ethical review board of University of Gondar. A supporting letter was obtained from South Wollo labor and social affairs department.

Result
Determinants of occupational injury
Socio-demographic factors
Among selected socio-demographic variables, educational status and marital status of workers showed statistically significant association with occupational injury when adjusted for all variables. Workers who had only 1–8 years of education were more likely to report work-related injury than those with more than nine years of education (aOR: 7.50, 95% CI: 4.44–12.74) (Table 1).

Working environment and ergonomic-related factors
Among the study participants 39 (8.6%) reported that they were at work for >48 hrs/wk; 326 (71.6%) of respondents had been regularly supervised at work about health and safety. Regarding safety and health training, 249 (54.7%) responded that they had not ever taken safety and health training. Participants were also asked about manual handling activities such as pulling, pushing, carrying, and lifting tasks, which may contribute for workplace accidents and musculoskeletal disorders. Of them,
227 (49.9%) responded that their jobs involve these activities. Of the participants, 265 (58.2%) and 283 (62.2%) worked with safely guarded and timely maintained machines, respectively (Table 2).

Among the work environment and ergonomic-related variables, hours worked per week, manual handling of very heavy objects (>20 kg), need for visual concentration for the task, and maintenance of machine showed significant association with work-related injury (Table 2). Workers who were used to work >48 hours per week were more likely to be injured than those spend 48 hours or less (aOR: 2.71, 95% CI: 1.18–6.24). Similarly, respondents

Table 1: Selected socio-demographic variables tested for any associations with occupational injury among respondents in Kombolcha textile Factory, April, 2013 (n=455).

| Variable                      | Occupational Injury | Crude OR (95% CI) | Adjusted OR (95% CI) |
|-------------------------------|---------------------|-------------------|----------------------|
|                               | Yes     | No               |                     |                      |
| Sex                           |          |                  |                      |                      |
| Male                          | 120     | 201              | 1.07 (0.70–1.63)    |                      |
| Female                        | 48      | 86               | 1.00                |                      |
| Age*                          |          |                  |                      |                      |
| 14–29 yrs                     | 16      | 38               | 0.69 (0.37–1.28)    | 0.48 (0.16–1.44)     |
| ≥30 yrs                       | 152     | 249              | 1.00                | 1.00                 |
| Level of education*           |          |                  |                      |                      |
| 1–8 yrs                       | 121     | 89               | 5.73 (3.76–8.71)    | 7.50 (4.44–12.74)    |
| ≥9 yrs                        | 47      | 198              | 1.00                | 1.00                 |
| Marital status*               |          |                  |                      |                      |
| Never married                 | 29      | 38               | 1.37 (0.81–2.31)    | 2.21 (1.10–4.43)     |
| Ever married                  | 139     | 249              | 1.00                | 1.00                 |
| Employment pattern            |          |                  |                      |                      |
| Temporary                     | 26      | 37               | 1.24 (0.72–2.13)    |                      |
| Permanent                     | 142     | 250              | 1.00                |                      |
| Monthly income                |          |                  |                      |                      |
| ≤ ETB 1092 (US$ 56.2)         | 119     | 135              | 2.73 (1.82–4.10)    | 1.36 (0.50–3.70)     |
| > ETB 1092 (US$ 56.2)         | 49      | 152              | 1.00                | 1.00                 |
| Working experience            |          |                  |                      |                      |
| ≤5 yrs                        | 31      | 39               | 1.44 (0.86–2.41)    |                      |
| >5 yrs                        | 137     | 248              | 1.00                |                      |

*Variables with p<0.3 in the bivariate analysis.
**Table 2:** Working environment and ergonomic-related factors tested for any associations with occupational injury among workers in Kombolcha textile factory, April, 2013 (n=455).

| Variable                        | Occupational Injury | Crude OR (95% CI) | Adjusted OR (95% CI) |
|---------------------------------|---------------------|-------------------|----------------------|
|                                 |                     |                   |                      |
|                                 | Yes                 | No                |                      |
| **Hours worked per week***      |                     |                   |                      |
| ≤48 hrs                         | 149                 | 267               | 1.00                 | 1.00                 |
| >48 hrs                         | 19                  | 20                | 1.70 (0.88–3.29)     | 2.71 (1.18–6.24)     |
| **Safety supervision**          |                     |                   |                      |
| Yes                             | 123                 | 203               | 1.00                 | 1.00                 |
| No                              | 45                  | 84                | 0.88 (0.58–1.35)     |                      |
| **Safety training***            |                     |                   |                      |
| Yes                             | 65                  | 141               | 1.00                 | 1.00                 |
| No                              | 103                 | 146               | 1.53 (1.04–2.25)     | 0.62 (0.29–1.34)     |
| **Working department**          |                     |                   |                      |
| Engineering                     | 12                  | 30                | 1.00                 | 1.00                 |
| Processing/garment              | 33                  | 84                | 0.98 (0.45–2.15)     |                      |
| Weaving                         | 54                  | 74                | 1.82 (0.86–3.88)     |                      |
| Spinning                        | 69                  | 99                | 1.74 (0.83–3.64)     |                      |
| **Manual handling***            |                     |                   |                      |
| No                              | 77                  | 151               | 1.00                 | 1.00                 |
| Light (≤5 kg)                   | 1                   | 38                | 0.05 (0.007–0.38)    | 0.03 (0.004–1.03)    |
| Medium (6–10 kg)                | 16                  | 27                | 1.16 (0.59–2.29)     | 1.02 (0.45–2.34)     |
| Heavy (11–20 kg)                | 30                  | 30                | 1.96 (1.10–3.49)     | 1.13 (0.51–2.51)     |
| Very heavy (>20 kg)             | 44                  | 41                | 2.11 (1.27–3.50)     | 2.35 (1.24–4.45)     |
| **Time spend on handling***     |                     |                   |                      |
| <2 hrs                          | 14                  | 49                | 1.00                 | 1.00                 |
| 2–4 hrs                         | 15                  | 11                | 4.77 (1.79–12.70)    | 1.87 (0.59–5.89)     |
| >4 hrs                          | 62                  | 76                | 2.86 (1.44–5.65)     | 1.58 (0.54–4.67)     |
| **Need for visual concentration*** |                   |                   |                      |
| Yes                             | 153                 | 237               | 2.15 (1.17–3.97)     | 3.10 (1.42–6.75)     |
| No                              | 15                  | 50                | 1.00                 | 1.00                 |
who were handled >20 kg were more than 2-times more likely to be injured compared to those who were not engaged in manual handling.

**Behavioral factors**

Of studied participants 31 (6.8%) were cigarette smoker, 51 (11.2%) used to drink alcohol, and 120 (26.4%) used to chew Qat. Almost 70 (15.4%) of the respondents had sleep disorder at their workplace and the reasons for the disorder were mentioned as working in evening by 41 (59%) participants, excessive heat by 30 (43%), and doing more than one task at a time 18 (26%). The majority of the respondents (n=317, 69.7%) were satisfied by their current job (Table 3).

The use of PPE in the factory was not quite similar among workers even though there was PPE delivered to workers in the industry. The majority of the respondents (n=359, 78.9%) were used PPE at the time of data collection and answered they used PPE at their workplace frequently, whereas 96 (21.1%) were not used any types of PPE; they answered they did not use PPE frequently. Most of the reasons for not using PPE included they were not comfortable to use by 50 (52.1%) participants, lack of provision by 44 (45.8%), and perception of decreased work performance by 38 (39.6%). Among users, respirators (n=208, 57.9%), ear plug (n=170, 47.4%), glove (n=145, 40.4%), and goggles (n=141, 39.3%) were commonly used PPE.

Among behavioral factors entered in the final step of the analysis, only sleep

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**Table 2**: Working environment and ergonomic-related factors tested for any associations with occupational injury among workers in Kombolcha textile factory, April, 2013 (n=455).

| Variable                        | Occupational Injury | Crude OR (95% CI) | Adjusted OR (95% CI) |
|---------------------------------|---------------------|-------------------|----------------------|
|                                 | Yes     | No     |                   |                      |
| Use of vibrating tools          |         |        |                   |                      |
| Yes                             | 57      | 109    | 0.84 (0.58–1.25)  |                      |
| No                              | 111     | 178    | 1.00               |                      |
| Time spend                      |         |        |                   |                      |
| ≤1 hr                           | 8       | 20     | 1.00               |                      |
| 2–4 hrs                         | 13      | 13     | 2.50 (0.81–7.69)  |                      |
| >4 hrs                          | 36      | 76     | 1.18 (0.48–2.99)  |                      |
| Safely guarded machines*        |         |        |                   |                      |
| Yes                             | 84      | 181    | 1.00               |                      |
| No                              | 84      | 106    | 1.71 (1.16–2.51)  | 1.57 (0.58–4.30)     |
| Maintenance of machine*         |         |        |                   |                      |
| Yes                             | 87      | 196    | 1.00               | 1.00                 |
| No                              | 81      | 91     | 2.00 (1.35–2.97)  | 1.80 (1.11–2.93)     |

*Variables with p<0.3 in the bivariate analysis.
disorder remained significant. Workers who had sleep disorder in their workplace were almost 3-times more likely to report work-related injuries than their counterparts (Table 3). Chewing Qat and using PPE although showed significant associations with occupational injuries in bivariate analysis, lost their significant effects in the final step of multivariable analysis (Table 3).

In summary, a stable model that could explain the occurrence of work-related injury among workers in the textile factory needs to consider their educational level, marital status, hours worked per week, handling very heavy object, visual demand of the task, maintenance of machine, and sleep disorder.

**Discussion**

So far several variables have been identified to be related to the occurrence, severity, and types of work-related injuries; they included socio-demographic factors, working environment factors, workers' be-

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**Table 3:** Behavioral variables tested for any associations with occupational injury among workers in Kombolcha textile factory, April, 2013 (n=455).

| Variable               | Occupational Injury | Crude OR (95% CI) | Adjusted OR (95% CI) |
|------------------------|---------------------|-------------------|----------------------|
|                        | Yes | No   |                  |                      |
| Cigarette smoking      |     |      |                  |                      |
| Yes                    | 14  | 17   | 1.44 (0.69–3.01) |                      |
| No                     | 154 | 270  | 1.00              |                      |
| Drinking alcohol       |     |      |                  |                      |
| Yes                    | 19  | 32   | 1.02 (0.56–1.86) |                      |
| No                     | 149 | 255  | 1.00              |                      |
| Chewing Qat*           |     |      |                  |                      |
| Yes                    | 56  | 67   | 1.64 (1.08–2.50) | 0.72 (0.39–1.23)    |
| No                     | 112 | 220  | 1.00              | 1.00                 |
| Sleep disorder*        |     |      |                  |                      |
| Yes                    | 38  | 32   | 2.33 (1.39–3.90) | 2.95 (1.47–5.92)    |
| No                     | 130 | 255  | 1.00              | 1.00                 |
| Job satisfaction       |     |      |                  |                      |
| Yes                    | 117 | 200  | 1.00              |                      |
| No                     | 51  | 87   | 1.02 (0.66–1.52) |                      |
| Use of PPE*            |     |      |                  |                      |
| Yes                    | 115 | 244  | 1.00              | 1.00                 |
| No                     | 53  | 43   | 2.62 (1.65–4.14) | 1.40 (0.83–2.37)    |

*Variables with p<0.3 in the bivariate analysis
behavior, and ergonomic-related factors as the most common possible risk factors for workers to be injured in workplace.6-10

In this study, level of education was significantly associated with the frequency of occupational injury. Though this is consistent with a study done in Brazil,11 it is inconsistent with studies conducted in Ethiopia6-8. This could be explained by the fact that work processes in this factory need professional experts while others might need daily laborers to manage the factory tasks. The marital status of workers was also significantly associated with occupational injury in this study, which is not consistent with studies from Ethiopia6-8. This could be explained by the fact that in the current study most of the workers (n=388, 85.3%) were still in marriage that makes them to take care of themselves from injury because of their family.

Regarding the work environment factors, we found that hours worked per week was significantly associated with occupational injury, which is in agreement with other studies conducted in Ethiopia and India.6,8,12 With regard to ergonomic-related factors, visual concentration of the task was significantly associated with occupational injury. This is because if the worker is given too much information he becomes confused, makes mistakes, or becomes panic to process, may commit error and become injured. Another explanation may be if the worker concentrates for a long period there may be eye strain and he loses his concentration with consequent injury. Manual handling of heavy object more than 20 kg was also significantly associated with occupational injury. This may be due to too heavy or bulky load that exposes workers to repetitive and forceful exertion bending, stretching, and awkward postures, which produce increased pressure on the support structures. When these situations combined with other environmental stressors, ie, excessive heat, noise, and the like, will aggravate the impact. Maintenance of machine was another factor that was significantly associated with magnitude of occupational injury in our study. This might be due to the fact that if the machine is not maintained there may be splinters from the machine's body, which cause serious injury. However, if it is maintained, it makes the operator's task possible and reasonable by reducing the physical and mental strain, and leaves him free to devote his attention to those factors in his work.

Literature published from other countries,12,13 stated that ergonomic-related factors are predictors for occupational injuries. However, there is no study showing these relations in Ethiopia for comparison.

From the studied behavioral factors, only sleep disorder was associated with work-related injury in our study. This is consistent with studies performed in Ethiopia, but not for alcohol consumption,8 job dissatisfaction,6,8 smoking,7 and use of PPE8. This might be attributed to the fact that workers may not want to express these personal behaviors at the time of data collection.

Integrated safety works on occupational injury should be done by considering the factors indicated to enhance public health in the industry.

Conflicts of Interest: None declared.

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A Yemeni man chewing Qat (also known as Khat, or Kat). Qat (Catha edulis) is an evergreen plant that is extensively cultivated in the highlands of Ethiopia and surrounding countries like Kenya and Yemen. It is a bushy plant whose leaves are the source of a naturally occurring amphetamine-like substance. It is highly abused for its stimulant properties. Stimulation is commonly obtained by chewing the leaves. For more information on use of Qat among Yemeni women see page 109. (Photo from Wikimedia Commons).