Identifying Factors Associated with Health Problems of Tannery Workers, Savar, Dhaka

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Abstract

This research investigates the incidence and patterns of health problems experienced by tannery employees, as well as the associations between such problems and a variety of other variables. The cross-sectional study was conducted at three randomly selected tanneries of the BSCIC Tannery Industrial Estate in Savar. During in-person interviews, 203 workers were questioned using a questionnaire. Most respondents (84.2%) admitted that they had health problems caused by their jobs. Musculoskeletal disease (65.5%), gastrointestinal problems (38.9%), skin disease (37.9%), respiratory disease (26.6%), and eye disease (17.7%) were the significant causes of illness. Our research revealed that factors such as respondents' age (p value=.001), experience (p value<.000), working hours (p value=.005), mode of work (p value=.044), types of PPE (p value=.017), and awareness of toxic chemical rules (p value=.033) were significantly associated with health problems among tannery workers. A healthy tannery environment and enhanced medical facilities may improve their health.

I. Introduction

Government of Bangladesh has designated the leather and leather goods industry as a priority sector[1]. The entire export income for this sector in Fiscal year (FY) 2021 was $941.67 million. The government and sectoral entrepreneurs claim that leather and leather products account for 4% and 0.5%, respectively, of Bangladesh's overall exports. According to Export Promotion Bureau (EPB) data, leather exports were climbed by 33.29%, leather items by 33.34%, and leather footwear by 13.72% in the first quarter of FY 2022[2]. So this sector can play an important role in emerging the economy of Bangladesh.

Leather manufacture is one of the world's oldest trades, using a chemical process that converts animal hides into the far less perishable substance, leather. After the top layer of skin and any excess subcutaneous tissue have been removed, a chemical procedure commonly referred to as tanning is used to stabilize the dermal collagen fibers[3]. According to the European Commission, the tanning scheme comprises four phases: Beam house mechanism, wet finishing, dry finishing, and packaging[4].

Due to the use of numerous poisonous chemicals and hazardous working conditions, the leather sector is one of the riskiest in Bangladesh[5,6]. Workers in these occupations generally work in hazardous situations such as a poor work environment, a soiled working floor, chemicals, and interacting with machines and equipment. As a result of the risks in the tannery sector, workers are at risk of developing various health problems. According to previous studies, tannery workers face a double burden of health problems. Tannery workers are exposed to various chemicals and suffer from toxic effects of chemicals and wastes generated during the manufacturing process[7,8,9]. Moreover, inexperienced work and a lack of Personal protective equipment (PPE) practice endanger human health in the leather sector[10]. Additionally, different types of chemicals and raw materials that are highly contaminated with disease-causing organisms pose a constant risk of infection for the workforce[11,12]. In the majority of developing nations, occupational health and safety (OHAS) practices do not meet the norms. Developing nations frequently have fewer occupational health and safety programs and fewer or less designed and enforced rules and regulations than industrialized ones[13].

A cross-sectional study in India reported that leather tannery workers frequently complained of low-back pain (61.0%), dermatitis (31.0%), asthma (38.0%), and chronic bronchitis (14.0%) in the one year prior to the survey[12]. The prevalence of asthma among tannery workers was estimated at 5.3% in Pakistan[14], 3.0% in Istanbul[11], whereas it varied from 2.2% to 38.0% among leather tannery workers in India in older studies[15,16]. To present, the vast majority of research has shown that tannery workers who are exposed to chromium in the workplace are at a higher risk of developing dermatitis, respiratory illnesses, and ulcers[7,11,12,13].

According to a study of 179 tannery employees from six tanneries performed by the Society for Environment and Human Development (SEHD) of Bangladesh, 58% of

tannery workers suffered from gastrointestinal disorders, 31% from dermatological illnesses, 12% from hypertension, and 19% from jaundice[19]. Dalju, Innawu, et al. (2019) conducted a comparative cross-sectional study utilizing the stratified sampling approach, which found that the incidence of respiratory disorders was greater among exposed employees i.e. tannery workers than among unexposed workers (civil servants). The factors associated with respiratory symptoms included gender, job status, ventilation of working areas, lack of occupational health and safety training, and failure to use PPE[20].

Despite the findings of numerous surveys, only a small number of research have examined the relationship between inevitable occupational exposure and health issues among leather tannery employees. As far we know, no comprehensive occupational illness registry, long-term health assessment, health surveillance, other hazard assessment initiatives have been implemented for the tannery industry in Bangladesh. The aim of our study is to determine patterns of health problems of the tannery workers and find out the factors associated with those health problems, to understand the extent of awareness about occupational health risks involved in tannery occupation and adopted preventive measures by the tannery workers.

II. Materials and Methods

Data collection and study design

We conducted a cross-sectional study in the BSCIC Tannery Industrial Estate in Savar, where primary data were collected through in-person interviews using a questionnaire. Respondent belong to one of three randomly selected tanneries, namely beam house, wet and dry sections of tanneries (both men and women). Note that by applying the Simple Random sampling approach, these tanneries were chosen. Moreover, the stratified random sampling process was adopted along with the proportional allocation procedure.

The sample size was determined using[19],

$$n = \frac{\frac{Z^2 PQ}{d^2}}{1 + \frac{1}{N}(\frac{Z^2 PQ}{d^2} - 1)}.$$

The population sizes respectively, 350, 132 and 107 of the three tanneries were obtained from the administrative offices of these tanneries. Assuming 5% significance level along with degree of precision, d =0.05, and the disease prevalence rate[7] P = 0.72, the sample size becomes 203. Again, applying the formula for stratum-specific sample size, $n_h = \frac{n}{N} N_h$ (for h^{th} strata, where h= 1, 2, 3)[19], the

sample sizes determined for each of the three tanneries were 121, 45, and 37.

Statistical methods

We have carried out univariate, bivariate and binary logistic regression analyses to reach the goals of this study. The statistical summaries of each of the variables were extracted through univariate analyses. Moreover, association between health problems (dependent variable) and independent variables (age, gender, education, smoking status, experience of job in year, working hours, Mode of work, protective equipment use, and awareness of toxic rules) were explored through Chi-square test and Fisher's exact test. Then Binary logistic regression model was fitted to the data considering the presence and absence of health problems.

In a logistic regression model we can measure the effect of each independent variable (both continuous or categorical) on a binary response variable. We calculate the quantity $\pi(x) = E(Y|x)$ to express the conditional mean of Y given x when logistic distribution is used. The particular form of the model we apply is,

$$\pi(x) = \frac{\exp(\beta_0 + \beta_1 x)}{1 + \exp(\beta_0 + \beta_1 x)}, \tag{1}$$

where β_0 and β_1 are model parameters. The range of $\pi(x)$ is between 0 and 1. We actually did not directly use model (1). We calculate a link function, which is also known as logit, g(x). It allows the outcome variable to be modelled as

$$g(x) = \ln(\frac{\pi(x)}{1 - \pi(x)}).$$

The quantity $\pi(x)/(1-\pi(x))$ is called odds and hence the logit is called log odds.

As in binary logistic regression the response variable is dichotomous, there can be two odds; one is Y=1 and other is Y=0. The ratio of these two odds is known as odds ratio. It is more convenient and meaningful to interpret the model results by odds ratio. That's the main reason in logistics regression it converts the estimated parameter into odds ratio to measure the effect of independent variables on response variable.

We apply multiple logistic regression analysis when there is a single binary response variable and more than one independent variables. The p-variate logistic regression model can be expressed as[20],

$$\pi(x) = \frac{\exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p)}{1 + \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p)},$$

where symbols represent their usual meaning in a logistic regression model.

III. Results

Socio-demographic characteristics of the study participants

According to the survey findings, of the 203 respondents, 172 (84.7%) are male and 31 (15.3%) are female. 39.4% of the 203 respondents were between the ages of 25 to 34. The age group 35-44 has the second greatest share (25.1%). The third and fourth biggest age groups are 45-54 and 15-24, with 19.2 and 12.8 percent, respectively. The age group 55-64 has the lowest proportion, 3.4. The majority of the 203 respondents identify as Muslims; the percentage for this group is 98%.

Our study found, 25.1% of respondents have not completed any form of formal education, 49.8% of respondents have completed their elementary school, and 25.1% of respondents had education up to secondary level. The majority of responders were married, accounting for 90.1% of the total. Additionally, the household income ranges from 1,500 to 30,000 tk. is significantly greater than most other percentages, coming in at 68.0 percent. The group with a total of 0-15000 tk. had a percentage of 18.2, making it the second-highest percentage. However, the rate for families with earnings greater than 30,000 tk is 13.8%, making this the lowest rate group. The vast majority of workers at the tannery are smokers (66.5% of them), and every single one of them is a man.

Occupational variables of the study participants

According to the survey findings, 37.9% of workers have experience that is greater than 10 years, which is the highest rate. 30% of workers have been working in the tannery for 1-5 years, and that's the lowest of all. 104 out of 203 workers work in the tannery for 9–11 hours, with the highest percentage of 51.2. 30.5% of workers work 12–14 hours, which is the second highest figure. Only 18.2% of them work for 6–8 hours per day. A total of 42.4% of the respondents were employed in the beam house, 34.5% worked in the dry-finishing section, and the remaining respondents were employed in the wet-finishing section (23.1%).

In addition to this, it was discovered that 65% of the respondents had no training in any aspect of the tanning industry. Only 34.0% of workers do not use PPE, while the majority of workers (66%) do use PPE. There are about 24% of workers in the tanning industry who use full PPE in their workplace, and there are about 42% who use partial PPE. Despite receiving PPE from the tanneries, 95.1% of tannery employees do not utilize it because they are unaware of its benefits.

107 workers are aware of the harmful chemical laws; thus, 52.7% of workers are aware of these standards. As a result, 47.3% are unaware of the rules. The majority of respondents (88.7%) are aware that chemicals can have a negative impact on one's health. The vast majority of respondents (77.3% of them) do not have diabetes. According to our survey, 171 out of 203 workers are dealing with some kind of health problem, while the remaining 32 workers are completely free of any health concerns. Only 76 employees, or 37.4%, out of 203 workers receive any form of medical treatment. Moreover, the statistics show that 44.8% of employees get treatment supplements from the administration of the tanneries, despite becoming sick regularly owing to hazardous working conditions.
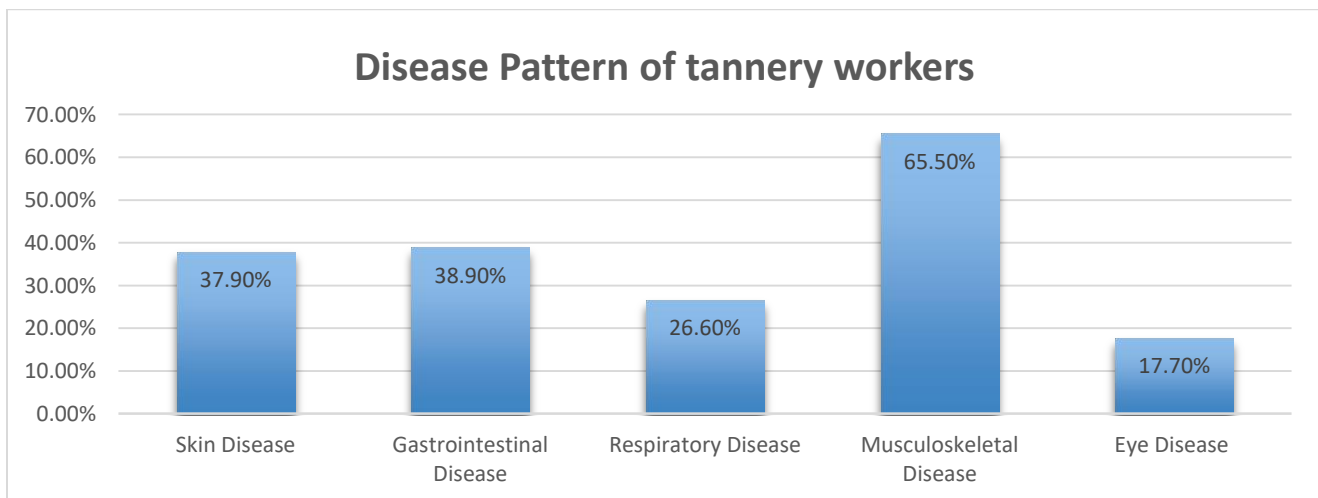

Fig. 1. Disease pattern of tannery workers

According to Figure 1, 65.5% of workers suffer from musculoskeletal disease, whereas 38.9% have gastrointestinal disorders. Other common health difficulties among tannery workers include skin disease (37.9%), respiratory disease (26.6%), and eye disease (17.7%).

Factors Associated with health problems of tannery workers

According to Table 1, the percentages of health problems among workers for the age range 15-24, 25-34, 35-44, and 45-54 were respectively 57.7%, 83.8%, 92.9%, and 92.3%. There is an association (p=.001) between the age of workers and their health problems. We can also see that as workers get older, they are more likely to fall ill.

Table 1 shows that the health problem rate for employees is 65.6% among those who have worked for 1-5 years. It goes up to 93.8% among those who have worked for 6-10 years. Then this rate becomes 90.9% among those who have worked for 11 years or more. There is a significant association (p <.001) between experience and health problems. We can see that as their experience grows, their health problems increase. Then after some years, their body becomes immune, and their disease rate decreases little. There is a significant relationship (p=.005) between workers' working hours (per day) and their health problems. Workers who work 6-8 hours a day have a disease rate of 67.6%, while those who work 9-11 hours have a disease rate of 85.6%, and those who work 12-14 hours a day have a disease rate of 91.9%. It has been observed that workers who work long hours every day are more likely to become ill. According to Table 1, there is a significant association (p=.044) between their mode of work and health problems. A higher proportion of workers in wet finishing (91.5%), dry finishing (75.7%), and beam house (87.3%) have diseases. The percentage is highest in the wet finishing sector because the workers are exposed to dangerous chemicals. The workers who wear PPE (p=.0017) correctly have a lower incidence of illness. But it is not possible for this to be true for those who only use some of the recommended precautions. As we can see, the health problem rate among workers who do not use PPE is 87%, whereas among those who do use it is 71.4%. Ultimately, it may be concluded that PPE effectively protects people against chemical and other hazards. There is a significant association (p=.033) between awareness of the rules of using toxic chemicals and health problems. While analyzing the association, it led us to a result that was not expected. Of the individuals who were aware of the rules, 89.7% of people among them were suffering from health issues. In contrast, 78.1% of workers had health problems and were unaware of those rules. We know that people who work in the wet-finishing area have to deal with more chemicals than those who work in the dry finishing area or the beam house. People who dealt with chemicals were aware of the rules. This may lead us to this situation.

Binary Logistic Regression Analysis

To discover which variables best explain and predict workers' health issues, all significant variables in the bivariate analysis were incorporated into the model.

From Table 2, it is revealed that the factor mode of work has an association with health issues. Here we consider the dry finishing section as a reference category. The likelihood of experiencing health issues was higher for beam-house and wet-finishing section employees. Workers in the wet finishing section have a 7.885 times higher chance of suffering from diseases, whereas workers in the beam-house area are 3.474 times more likely to suffer from various health problems. Workers in the wet finishing department have a greater risk of contracting infections because of their exposure to hazardous chemicals.

Additionally, there is a strong relationship between working hours and health issues. As a reference range, we took 12–14 hours into account. The odds ratios for employees working 6 to 8 hours and 9 to 11 hours are 0.149 and 0.514, respectively. This means that if a worker works 6–8 hours instead of more than 11 hours, their chance of experiencing health issues lowers by 85.1%. Furthermore, if a worker works 9–11 hours rather than 12–14 hours, their likelihood of having disease drops to 48.6%.

The reference category for examining the relationship between types of PPE usage and health problems is considered to be not using any protective equipment. There is a 0.295 odds ratio in favor of wearing complete PPE. This indicates that utilizing a full PPE set (mask, boot, gloves, and goggles) instead of not using any protective equipment reduces the chance of developing a disease by 70.5%. Hence, wearing PPE greatly reduces the risk of exposure to numerous toxic substances and also aids in preventing many diseases.

Table 1. Association of health problems of tannery workers with different risk factors (Cross table)

| Characteristics | Health Problem | | Total (n=203) | Test of Significance p-value |
	Yes(n=172)	No(n=31)		
Gender				
Male	148(86%)	24(14%)	172(84.7%)	p=.110 (Fisher's exact test)
Female	23(74.2%)	8(25.8%)	31(15.3%)	
Age (in years)				
15-24	15(57.7%)	11(42.3%)	26(12.8%)	
25-34	67(83.8%)	13(16.3%)	80(39.4%)	χ^2=18.145 p=.001
35-44	47(92.2%)	4(7.8%)	51(25.1%)	
45-54	36(92.3%)	3(7.7%)	39(19.2%)	
55-64	6(85.7%)	1(14.3%)	7(3.4%)	
Education				
Illiterate	38(74.5%)	23(25.5%)	51(25.1%)	χ^2=5.440 p=.066
Primary	90(89.1%)	11(10.9%)	101(49.8%)	
Secondary	43(84.3%)	8(15.7%)	51(25.1%)	
Experience (in years)				
1-5	40(65.6%)	21(34.4%)	61(30%)	χ^2=23.102 p<.000
6-10	61(93.8%)	4(6.2%)	65(32%)	
>11	70(90.9%)	7(9.1%)	77(37.9%)	
Working hours (per day)				
6-8	25(67.6%)	12(32.4%)	37(18.2%)	χ^2=10.651 p=.005
9-11	89(85.6%)	15(14.4%)	104(51.2%)	
12-14	57(91.9%)	5(8.1%)	62(30.5%)	
Mode of work				
Beam house	75(87.2%)	11(12.8%)	86(42.4%)	χ^2=6.263 p=.044
Wet finishing	43(91.5%)	4(8.5%)	47(23.2%)	
Dry finishing	53(75.7%)	17(24.3%)	70(34.5%)	
Using PPE				
Yes	111(82.8%)	23(17.2%)	134(66%)	χ^2=.582 p=.544
No	60(87%)	9(13%)	69(34%)	
Types of PPE				
Full PPE	35(71.4%)	14(28.6%)	49(24.1%)	χ^2=8.152 p=.017
Partial PPE	76(89.4%)	9(10.6%)	85(41.9%)	
No PPE	60(87%)	9(13%)	69(34%)	
Aware of rules				
Yes	96(89.7%)	11(10.3%)	107(52.7%)	χ^2=5.123 p=.033
No	75(78.1%)	21(21.9%)	96(47.3%)	

While analyzing the association between workers' awareness of toxic rules and their risk of developing diseases, an unexpected outcome was discovered. Those who were aware of the guidelines for using chemicals are 2.181 times more likely to suffer from various health issues than workers who were not. This situation arises because employees who handle chemicals, particularly those in the wet-finishing area, are aware of the restrictions regarding

poisonous substances, in contrast to those who work in the beam-house and the dry-finishing section. Workers in the wet finishing section have a considerable risk of disease development since they are constantly exposed to harmful chemicals. Moreover, while analyzing the association between the experience of workers in tannery and health issues, it is found that employees who worked for 1 to 5 years had a lower risk of developing diseases compared to those who worked for more than ten years. However, workers working 6-10 years had a higher risk of having various diseases compared to those working more than ten years. Workers' progressive adaptation to their environment and immunity-building led to this unexpected outcome.

Table 2. Parameter estimates (binary logistic regression) on risk variables and health problems among tannery workers

Variables	Estimate	OR	95% Confidence Interval (for OR)	P-value
Age				
15-24	-1.191	0.304	0.019-4.757	0.396
25-34	-0.542	0.581	0.046-7.343	0.675
35-44	0.769	2.158	0.165-28.177	0.557
45-54	0.772	2.165	0.155-30.244	0.566
55-64 (Ref)		1		
Working hours (daily)				
6-8 hours	-1.903	0.149	0.036-.620	0.009*
9-11 hours	-0.665	0.514	0.155-1.703	0.277
12-14 hours (Ref)		1		
Experience (years)				
1-5 years	-0.423	0.655	0.151-2.849	0.573
6-10 years	0.59	1.805	0.378-8.607	0.459
> 10 years (Ref)		1		
Mode of Work				
Beam-house	1.245	3.474	1.129-10.690	0.030*
Wet finishing	2.065	7.885	1.702-36.525	0.008*
Dry finishing(Ref)		1		
Awareness of Toxic Rules				
Yes	0.78	2.181	0.766-6.212	0.144
No (Ref)		1		
Types of PPE usage				
Full PPE	-1.22	0.295	0.080-1.091	0.067
Partial PPE	-0.045	0.956	0.299-3.056	0.939
No PPE (Ref)		1		

*P-value<0.05

IV. Discussion and Conclusion

This study explores the incidence and patterns of health problems reported by employees of tanneries, as well as the associations between these problems and a wide range of other factors. The findings of this study showed tannery workers had a significantly higher incidence of musculoskeletal diseases, whereas only a tiny minority of workers experienced eye problems. The driving elements behind health problems were direct exposure to harmful chemicals, dust, and gas produced by various chemicals, a lack of safety precautions, and ignorance of the proper use of PPE.

The following factors have been found to be significantly associated with health problems: workers' age, years of experience in the tannery, daily working hours, mode of work, types of PPE used, and knowledge of the rules for using toxic chemicals.

Implementing proper training, upgrading healthcare access, and ensuring adequate PPE for workers can improve the situation at BSCIC Tannery Industrial Estate in Savar. Therefore, the government and tannery owners may follow the findings of this research to ensure a safe and healthy life for tannery workers.

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