

Eye Injuries among the Tannery Workers of Kanpur City, India

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Abstract

Occupational health hazards among the workers in the tannery industries are well known. However, a study on eye problems/injury among tannery workers is scanty. They are exposed to hazardous chemicals which is directly associated with their health. This study examined the prevalence of eye problems/injuries and their determinants among them. A total of 284 tannery and 289 non-tannery workers were interviewed during January-June 2015 from Kanpur using a three-stage sampling design. Bivariate and logistic regression analysis have been applied for data analysis. Results show that the prevalence of eye problems was higher among tannery workers than non-tannery workers. More than one-fifth (22.5%) of the tannery workers suffered from cloudy and blurry vision. The risk to them was significantly higher among those with eleven or more years of work experience (OR=3.32; $p<0.05$). They had exposure to dry finishing work (OR=2.65; $p<0.1$). Tannery workers' exposure to a moderate or high level of chemicals in the air (OR=2.08; $p<0.1$) resulting in eye injuries is higher than their counterparts elsewhere. In conclusion, they should be trained and self-motivated to use preventive measures to reduce chemical and dust exposure such as wearing protective glasses. Their ocular health must be monitored periodically for adequate and timely treatment. In this regard, health education and safety training are essential to prevent eye injuries.

Keywords: Dry finishing, eye problems, Kanpur, tannery workers.

I. Introduction

Eye-related issues are the most common and recurrent among the workers involved in manufacturing industries across the globe. Despite the higher incidence eye-related problems, that must have a high priority in the public health domain. However, it is still underestimated, or little concern is shown to critical eye-related problems (Courtin, et al., 2016). Its occurrence depends on the severity of the exposure that varies from one occupation to another occupation. Symptoms such as cloudy or blurry vision, vision problem with light (glare from bright light or halos around lights), red eyes, infection in eyes, conjunctivitis (a painful infection of the eyes which make them red and makes the eyelids swollen and sticky) and cataract are the most common eye-related issues among the workers engaged in different occupations.

Tanneries are a noteworthy industry group across the world, especially in developing countries. Simultaneously, when the world is undergoing rapid urbanization and industrialization, especially in developing countries, labour-oriented markets aim to alter automation and mechanization. Nevertheless, occupational hazards contribute to 2.3 per cent of disability-adjusted life year (DALY) lost among middle-income countries (Kumar et al., 2013; ILO, 2011). Eye injuries account for 3.3 per cent of all occupational injuries resulting in lost workdays in the private industry (Xiang, et al., 2005). However, most recent estimates for tannery workers from the Kanpur city reported that the prevalence of dry eye symptoms was 33.8 per cent, while that in the control group was 15.8 per cent (Gupta et al., 2014).

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The tanning industry is identified as the world's most toxic industry because of the extensive use of chemicals in different processes of production. Chrome, known for its cancer-causing risk, is used in huge amounts, as are acids, sodium and ammonium salts. Even in colouring, several chemical treatments are involved (Moktadir, et al., 2018). On the record, 69,000 tons of chrome salts are used annually in 1,600 Indian tanneries. But despite the dangers, workers can still be seen striving without adequate protective gear (Rastogi, et al., 2008). During the tanning process, workers are regularly exposed to heat, leather dust produced in buffering operations and many chemicals. All these factors cause dry eyes among tannery workers (Gupta et al., 2014).

Tannery workers work with toxic materials with little or no use of protective gear. Very few of them seem to use protective gear to safeguard themselves from the baleful effects. Evidence has shown that the use of appropriate eye protective gear and implementation eye protection policies in the workplace are effective in preventing work-related eye injuries (Gupta et al., 2014). While preventive measures and regulatory mechanisms are adhered as safety precautions in industrialized countries, they are still at a blossoming growth phase in many developing countries. Most of the production units fall under the non-organized sector, and effective safety practices are not often followed. The primary factors responsible for it include poor economic conditions, low worker education and inadequate knowledge regarding health and safety measures. Despite having many health issues among tannery workers, limited studies have been conducted to assess the prevalence and risk factors associated with eye injuries among them. With this background, the present research was conducted to estimate the prevalence and risk factors of eye-related problems involved in the tannery units in Kanpur.

II. Data and methods

Data for the present research was drawn from a cross-sectional household study of tannery and non-tannery workers in the Jajmau area of Kanpur during January-June 2015. The primary data was collected by the first author. For comparative purposes, a total of 284 tannery and 289 non-tannery workers were interviewed.

Studied Area

Kanpur ranks among the top ten industrial cities in India. Its Jajmau suburb is located near the southern bank of the river Ganga. Kanpur has conventionally been a manufacturing city and a major economic centre in the state. There are currently 402 registered leather tanneries in the eastern part of the city with an estimated 20,000 tannery workers (Rastogi, et al., 2008). More than 20,000 people worked in the leather industry, and a substantial proportion of tannery workers live in Jajmau.

Sample Size Estimation

The present study has collected the data of leather tannery workers who have at least one year of work experience in tannery work. The sample size was determined using the prevalence of morbidity (respiratory problems) found among them. According to a study conducted by epidemiologists on medical grounds, around 16.7 percent of workers had respiratory diseases (Rastogi et al., 2008). The total sample size for this study is determined using the following formula:

$$\text{Sample size } (n) = \frac{z^2 * p * q * (1 + R) * Deff}{d^2}$$

Where,

n=Sample size required

P= Prevalence of respiratory problems (16.7%) among leather tannery workers=0.17

q=1-p= 0.83

z= z value (1.96 at 5% level of significance)

Deff= Design effect (assumed to be 1.25)

R= Non-response rate (assumed to be 10%)

d = Margin of error (assumed to be 0.05)

Hence, $n=300$ (300 households of tannery workers and 300 households of non-tannery workers were selected from the same area for the study).

Sampling design

A three-stage sampling design was adopted for the study. Firstly, seven localities, i.e., Tadbagiya, Kailash Nagar, J.K. colony, Asharfabad, Motinagar, Chabeelepurwa, and Budhiyaghat, were designated based on a higher concentration of leather tannery worker's population in identified areas as stated by many stakeholders in Jajmau. In the second stage, three out of the seven localities, i.e., Budhiyaghat, Tadbagiya and Asharfabad, were designated using a probability proportional to size (PPS) sampling procedure. Once the updated and inclusive sampling frames were established in each of the three localities, a circular systematic random sampling was cast off to select households. In the end, in each of the three selected areas, 100 households were designated for each of the two groups, i.e., tannery and non-tannery workers, using a circular systematic random sampling technique. Thus, a total of 600 HHs were designated for the talk, and a total of 284 HHs of tannery workers and 289 HHs of non-tannery worker(s) were interviewed successively.

Pre-testing of the interview schedule

After finalizing the schedule, it was translated into the Hindi language. All the tools for the data collection were pre-tested in December 2014 during the pilot survey in the study area before starting the data collection. This pilot survey was completed to check the validity and reliability of and repo building in the study area. Tools were revised based on the feedback and experience of pre-testing of tools. Some of the questions were re-structured, re-sequenced, added and removed from the schedule to make it factual and standardized, which helped make the interviews process smoother.

Dependent variable

Cloudy and blurry vision among tannery workers in 12 months preceding the survey was the study's main dependent variable.

Independent variables

Respondent's age (16-24, 25-35 and 36 or more years); media exposure (low, medium, and high) was computed with the information in last one month, how often did one read /watch/listen the following- never or once a month or once a fortnight or once a week or daily? Newspaper, magazine, radio, television, and internet; work experience in the current tannery (up to five years, 6-10 years, 11 or more years); type of work (bean housework, wet finishing work, dry finishing work and miscellaneous work); type of job contract (temporary job vs. permanent job); symptoms such as cloudy or blurry vision, vision problem with light (glare from bright light or halos around lights), red eyes, infection in eyes, conjunctivitis and cataract were included in the study. Chemicals in the air (no exposure, low exposure, moderate exposure, high exposure, or very high exposure) was based on qualitative rating of exposure assessment as [0] No exposure: no contact with agent, agent is used in workplace but is very unlikely to result in exposure to workers involved. [1] Low exposure: infrequent contact with agent at low concentrations, agent is used in a closed/controlled system; there are no specific activities that enhance exposure; exposure takes place because of presence at the shop floor. [2] Moderate exposure: frequent contact with agent at low concentrations, agent is used throughout the closed/controlled process and exposure mainly occurs by passive contact; infrequent contact is needed with the agent. [3] High exposure: Frequent contact with agent at high concentrations, nature of the production process and associated manual activities makes regular contact necessary; agent causes exposure during manual activities and around particular sources such as presses and drums. [4] Very high exposure: Frequent contact with agent at very high

concentrations, agent is used in manual activities that introduce frequent peak exposures such as cleaning, opening a press and spraying paint.

Statistical analysis

Univariate and bivariate analysis was applied to understand the frequency distribution, proportions, and prevalence of study variables. Odds ratios were estimated using multivariate logistics regression analyses to accomplish the objective of the study. The logistic regression model considered the response variable cloudy and blurry vision (i.e., binary or 0-1). The adjusted odds ratio was estimated to get the risk factors associated with the response variable cloudy and blurry vision.

Ethical consent

This work is based on the Ph.D. work of the first author. We have received ethical clearance from the Student Research Ethics Committee of the International Institute for Population Sciences Mumbai. We have also obtained consent to participate from each of the respondents before starting the interview.

III. Results

Symptoms of eye related problems among tannery and non-tannery workers

Data on ocular problems (problems in vision) experienced by the tannery and non-tannery workers in the last 12 months preceding the survey are presented in Table 1. More than one-fifth of tannery workers (23%) experienced blurry vision, while 15 percent of non-tannery workers reported the same. More than 26 tannery workers and 11 percent of non-tannery workers had low tolerance to bright light or seeing halos.

Table 1: Ocular problems in the last 12 months preceding the survey reported by tannery and non-tannery workers in Kanpur, 2015

	Tannery workers		Non-tannery workers		Overall	
	Percent	Number	Percent	Number	Percent	Number
Has a doctor ever told you that you have ocular problems in the last one year						
Yes	7.0	20	5.9	17	6.5	37
No	93.0	264	94.1	272	93.5	536
Have you experienced cloudy or blurry vision in last one year						
Yes	22.5	64	14.9	43	18.7	107
No	77.5	220	85.1	246	81.3	466
Have you experienced vision problems with light such as glare from bright light or halos around lights in the last 12 months						
Yes	25.7	73	11.1	32	18.3	105
No	74.3	211	88.9	257	81.7	468
Total	100.0	284	100.0	289	100.0	573

Besides, the study has collected information on some of the other eye-related problems with the frequency of their occurrence (often, sometimes, never) and the results are presented in Table 2. About 3 percent of the tannery workers reported having red eyes more often and 31 percent occasionally had red eyes. Seventeen percent of the tannery workers and 8 percent of the non-tannery workers reported having eye infections. Further, 5 percent of the tannery workers had conjunctivitis symptoms more often.

Table 2: Percentage distribution of the tannery and non-tannery workers having eye-related problems in last one year preceding the survey

Eye-related problems	Tannery workers				Non-tannery workers			
	Often	Some-times	Never	(N)	Often	Some-times	Never	(N)
Red eyes	2.8	31.0	66.2	284	1.0	30.5	68.5	289
Infection in eyes	1.8	16.5	81.7	284	0.7	8.0	91.4	289
Problem in vision	6.7	19.0	74.3	284	3.5	16.3	80.3	289
Conjunctivitis	4.6	9.5	85.9	284	2.1	4.2	93.8	289
Other problems	0.4	6.3	93.3	284	0.4	2.4	97.2	289

Prevalence and odds ratios were estimated using multivariate logistic regression of cloudy and blurred vision as experienced by the tannery workers in the last 12 months preceding the survey. The results are presented in Table 3. Problems with the eyes are common among tannery workers due to their exposure to leather dust and chemical agents. The results show that a little less than one-third (30%) of the older workers (age 36 years and above) had experienced cloudy and blurred vision. The odds ratio shows that a tannery worker of 36 years and above was 5.3 times more likely to experience cloudy and blurry vision, but the result was not statistically significant. Around one-fourth of the illiterate workers and those with a medium level of exposure to the mass media reported that they experienced a cloudy and blurry vision. Tannery workers with six to ten years' experience and those having worked for more than 11 years and above in the current job were 2.5 ($p < 0.1$) times and 3.3 ($p < 0.05$) times more likely to experience cloudy and blurry vision as compared with those who worked for five years or less. Over one-fourth and over one-fifth of the workers (27% and 21%) engaged in wet and dry finishing respectively and workers engaged in dry finishing were 2.8 ($p < 0.1$) times more likely to have blurry vision in the last 12 months preceding the survey. Significant results of the odds ratio show that tannery workers with moderate/high exposure to chemicals in the air were 2.1 ($p < 0.1$) times more likely to experience cloudy and blurry vision.

IV. Discussion

Ocular trauma is the most common cause of visual morbidity, a significant proportion of the workplace (Shashikala, et al., 2013). Ocular problems are largely preventable with the use of protective eyewear and strict compliance. The tannery industry accounts for many accidents. Although identifying hazards before commencing tannery work is widely employed to prevent accidents, it fails because of insufficient safety experience. The tannery worker faces various environmental and workplace hazards that pose risks of eye damage from accidents involving harmful chemicals and equipment, and exposure to wind, dust, and colours.

Eye safety risks are well-known among industrial and agricultural occupations, yet little is identified about the prevalence of eye problems among tannery workers. There are very few studies conducted among tannery workers in India and worldwide concerning eye injuries and safety measures (Kundu et al., 2017; Ranjan et al., 2016; Gupta et al., 2014). One such study has documented the low awareness among tannery workers about safety measures for eye injuries. The common understanding of safety measures and the low frequency of their daily usage is a matter of concern. There is a higher level of eye problems among tannery workers than non-tannery workers. Eye-related issues may be attributed to varying factors such as low educational level, lack of proper training, background experience and failure to implement regulatory policies on safety precautions by the authorities. Tannery workers generally work in an environment with a high exposure to chemicals and toxic agents which might become a reason for life-threatening diseases.

A study conducted of tannery workers in the industrial area on migrant workers showed that around 46.7 percent had eye problems (Hasan et al., 2016). In contrast, a little over a quarter of tannery workers under study experienced vision problems with light, whereas non-tannery workers where only around one-tenth showed similar problems. Moreover, another study in Erode district asserted that 5.1 percent and 2.9 percent respondents suffered from blindness and night blindness

respectively (Arjunan, 2015). Eye problems among tannery workers are common because of their exposure to airborne particles and other chemical agents.

Table 3: Odds ratio showing the risk factor of cloudy and blurry vision among tannery workers (12 months preceding the survey) in Kanpur, 2015

Independent variables	Percent	Number	O.R.	C.I.
Age in years				
16-24®	3.5	29		
25-35	17.5	103	2.95	[0.35-25.21]
36+	29.6	152	5.32	[0.62-45.27]
Education				
Illiterate®	26.7	188		
Up to primary	13.2	38	0.57	[0.19-1.65]
Middle school	20	25	1.41	[0.41-4.78]
High school & above	9.1	33	0.55	[0.13-2.36]
Media exposure				
Low exposure	23.1	65		
Medium exposure	26.8	138	0.96	[0.44-2.08]
High exposure	14.8	81	0.84	[0.28-2.47]
Work experience in current tannery				
Up to 5 years®	9.2	98		
6 to 10 years	25.5	94	2.54*	[1.05-6.17]
11 & above years	33.7	92	3.32**	[1.37-8.02]
Type of work				
Beam housework®	16.7	24		
Wet finishing work	27.1	70	2.79	[0.78-9.98]
Dry finishing work	21	143	2.65*	[0.77-9.12]
Miscellaneous work	23.4	47	2.13	[0.56-8.19]
Type of job contract				
Temporary job (daily wages) ®	22.9	253		
Permanent job	19.4	31	0.86	[0.28-2.63]
Chemicals in the air				
No exposure®	16.2	74		
Low exposure	14.1	99	1.04	[0.34-3.15]
Moderate/high exposure	34.2	111	2.08*	[0.49-8.77]
Airborne dust				
No exposure®	18	78		
Low exposure	13.4	82	0.70	[0.22-2.21]
Moderate/high exposure	31.5	124	1.03	[0.26-4.07]
Total	22.5	284		

Note: ® Reference category; ***P<0.01, **P<0.05, *P<0.1.

Leather tanning involves several steps involving chemical agents. Wet finishing leads to more workers reporting blurred vision than dry finishing and other beam work. Similarly, workers having long-standing careers in the field of tanning are at a greater risk of developing eye problems than those with less than five years of experience. A study conducted by Gupta et al. 2014 in Kanpur has asserted that eye problems among tannery workers increase with age and years of work experience (Gupta et al., 2014). Another important finding of the study was that the prevalence of eye problems was higher among temporary workers than permanent workers. Temporary workers have worse working conditions than permanent workers. Most of them lack the minimum statutory and social security benefits and are paid below the minimum wages.

The type of tannery work is significantly associated with the cloudy and blurry vision. It is because more hazardous chemicals are used in the dry finishing work than other tannery work. The

risk of eye problems is higher among those who reported moderate/ high exposure to chemicals in the air. Dust produced by various processes is from rotating drums, buffing, and shaving. This dust can affect human health, leading to the respiratory problem of chronic bronchitis among tannery workers (Arjunan, 2015). Similarly, lime and leather dust in the drum section is eroding and can give rise to irritation in the eye and may lead to corneal ulceration and resultant complications (Kashyap, et al., 2021). Moreover, the tanned waste contains thiol proteins - the decomposition and degradation of this waste lead to hydrogen sulphide release. Even small amounts of hydrogen sulphide can cause eye irritation, sore throat, headache, and giddiness (Raidas, 2007).

V. Conclusion

Occupational eye-related complaints are a significant source of concern among tannery workers. This study highlights the need to develop policies to protect employees from this health hazard and the urgent need to organize these small industries under the non-organized sector. Furthermore, targeting people most at risk such as older people, increasing staff preparation, providing appropriate eye protective equipment, and creating safety culture can minimize occupational eye-related complaints. The employer must play a crucial role by giving explicit instructions to tannery workers to take preventive measures to reduce the chemical and dust exposure such as wearing protective glasses. Besides, their ocular health should be supervised intermittently for adequate and timely treatment. In this regard, health education and safety training are essential for preventing eye injuries.

Limitations of the study

Information collected through a cross-sectional survey may have underestimated the accurate prevalence of eye injuries. The self-reported eye-injury results could be prejudiced due to subjectivity in responses as the severity was not quantified. Recall prejudice may also have influenced the anticipated prevalence of eye injuries.

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