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## Chapter

# Responsiveness of Occupational Health Risk and Preventive Measures Practice by the Workers Employed in Tannery Occupation in Kanpur, India

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## Abstract

Occupational health covers all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards. The objective of the study was to understand the extent of awareness about occupational health risks involved in tannery occupation and adopted preventive measures by the tannery workers of Kanpur, India. Information for the present research was strained from a cross-sectional household study of tannery workers in the Jajmau area of Kanpur. The survey was piloted through the period January–June 2015, and 284 samples were collected. The prevalence of awareness of tannery work is very hazardous in nature varies from 73–93% among the tannery workers. Tannery workers having a middle-school level of education were 3.01 times more likely to be aware of the hazards as compared to the illiterate workers. Tannery workers aged 36 and above were less likely to aware of a hazardous work environment. Further, tannery workers who belong to the younger cohort (16–24 years) reported a higher awareness of respiratory problems (38%), skin complaints (59%), and gastrointestinal issues (21%) than those aged 36 years and above. About one-third of Beam house workers (33%) and over a quarter (26%) of the wet finishing had moderate to high dermal contact with the chemicals. The study's outcomes give a clear indication of the effect of the workstation environment on the health status of workers and require the use of adequate measures to improve the facilities and thereby the health status of tannery workers.

**Keywords:** Occupational health risk, preventive measures, tannery workers, work environment, health hazard, qualitative measure

## 1. Introduction

The enormous burden of poor working conditions stated by several studies and with the latest estimates provided by the International Labour Organization (ILO) that somewhere 2.3 million working people around the world capitulate to

work-related accidents or diseases every year; this links to over 6000 deaths every single day. Worldwide, there are around 340 million occupational accidents and 160 million fatalities of work-related illnesses annually [1]. While improved and harmless workplaces can avoid at least 1.2 million deaths every year, according to 2018 world health organization (WHO) study [2]. Many casualties can be prevented through addressing significant health dangers, which is directly associated with the workplace, and the exposures such as stress, long working hours and shift work, prolonged sitting at work, work-related climate-sensitive diseases, such as heat and cold stress, as well as workplace air pollution [3–6].

Occupational health covers all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards. Depending on workplace conditions, there are several health risks: cancers, injuries/accidents, musculoskeletal disorders, respiratory problems, mental health disorders, skin ailments, infectious diseases, etc. Employment conditions in both formal and informal sectors are also significant factors: working hours, salary, and policies that cover such aspects as maternity leave, and provisions for protecting and promoting employee health [2]. Occupational health is a grave concern in developing countries, but there have been few studies of health issues faced by tannery workers because of which the problems are largely unknown. Further, the workers' health issues have not received sufficient attention from employers. The place and work environment are crucial influences on the extent of health risks faced by tannery workers. According to WHO, occupational health problems accounted for about 1.5 percent of the total burden of disease regarding disability adjusted life years (DALYs), particularly in occupational health, which included work-related injuries, and exposure to risks such as carcinogens, airborne particulates, ergonomic stressors, and noise [7].

Tannery workers are susceptible to multiple chemical and physical hazards in their work. Direct exposure to hazardous materials significantly increases health risks. The workers are exposed to chromium during the tanning process, leather dust, and various chemical agents. There are also ergonomic stressors that increase susceptibility to numerous health issues. Workers involved in multiple operations like material transfer, wet finishing, dry finishing, etc. are particularly vulnerable to harm. The risks associated with the tanning work is included in the proposed research paper examines the health hazards of tannery work Kanpur (India), and the preventive actions that are taken.

As mentioned earlier, there have been a limited number of studies of perceived health risks and preventive measures among tannery workers in the developing world. This research work investigates the work experience, working hours, type of job contract, and the type of work the tannery employees are usually engaged in. At the same time, it also examines their awareness of the hazardous work environment, the effect of exposure to chemicals, dangerous tissues involved in the tanning process. It also studies their perceptions of the effects of exposure to chemicals and contact with them, airborne dust, and ergonomic stressor. The objective of the study was to understand the extent of awareness about occupational health risks and adopted preventive measures during working hours among male tannery workers of Kanpur, India.

## **2. Methods**

Information for the present research was strained from a cross-sectional household study of tannery workers in the Jajmau area of Kanpur, India. The survey was piloted through the period January–June 2015 and was a portion of a Ph.D.

database. All total of 284 tannery workers from the study area were questioned. Rigorous pre-testing was completed with the tannery workers of the Jajmau area for testing the internal uniformity of schedule. Beforehand starting the interviews, we have clarified the tenacity of the survey and requested to contribute to the study by giving the proper information. After that, face-to-face discussions were piloted among those who agreed to participate in the study by using a structured pre-tested questionnaire on the tannery workers.

## 2.1 Sampling design

This study has adopted a three-stage sampling design. At the first stage, seven localities in the Jajmau area, namely Tadbagiya, Kailash Nagar, J.K. colony, Asharfabad, Motinagar, Chabeelepurwa, and Budhiyaghat, were selected based on a higher concentration of leather tannery worker's population in these areas as reported by various stakeholders in the city. In the second stage, three out of the seven localities, namely Budhiyaghat, Tadbagiya, and Asharfabad, were selected by probability proportional to size (PPS) sampling technique after arranging them in increasing order of estimated number of HHs of leather tannery workers. Subsequently, a comprehensive household listing and mapping were completed in each of the three localities, and all the household were classified into three groups- *households having at least one tannery worker, irrespective of having or not having any non-tannery worker, households having non-tannery worker (s) and households having no worker*. The first two groups of households constituted two independent sampling frame in each of the three selected localities. While the third group of households was excluded from the study. Once the updated and comprehensive sampling frames were developed in each of the three areas included in the study, a circular systematic random sampling was used for the selection of households at the third and the last stage. In case, if more than one worker were in a household, the target respondent was selected using KISH table. In each of the three selected areas, 100 households were selected for each of the two categories i.e., a tannery as well as non-tannery workers, using a circular systematic random sampling procedure. Thus, a total of 600 HHs were selected for the interview, and a total of 284 HHs having at least tannery workers, and 289 HHs of non-tannery workers (s) were interviewed successively. In the paper, we have tried to understand the level of awareness among the leather tannery workers. Bivariate analysis and logistic regression analysis were performed.

Qualitative measurement of environmental exposures have been classified as follows: Chemicals in the air (no exposure, low exposure, moderate exposure, high exposure, 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, 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, spraying paint.

2Dermal exposure to chemicals (no exposure, moderate exposure, high exposure) was based on qualitative rating of exposure assessment as [0] No skin contact: no contact with agent. [1] Moderate exposure: infrequent skin contact with agent contact occurs during specific activities that are not part of the daily work routine. [2] High exposure: frequent skin contact with agent regular contact is unavoidable due to particular activities in daily work practice. 3Another important variable airborne dust (no exposure, low exposure, moderate exposure, high exposure, very high exposure) was based on qualitative rating of exposure assessment as [0] No exposure: clear visibility. [1] Low exposure: visibility more than 10 m. [2] Moderate exposure: visibility between 5 to 10 m. [3] High exposure: visibility between 1 to 5 m. [4] Very high exposure: visibility less than 1 m. 4Ergonomic stressors (no exposure, low exposure, moderate exposure, high exposure, very high exposure) was based on qualitative rating of exposure assessment as [0] No exposure: does not occur (< 10% of work time). [1] Low exposure: less than 25% of daily work time. [2] Moderate exposure: 25–49% of daily work time. [3] High exposure: 50–74% of daily work time. [4] Very high exposure: 75% or more of daily work time. Exposure of waste water of chromium (no exposure, moderate exposure, high exposure) was based on qualitative rating of exposure assessment as [0] No exposure: no contact with chromium water. [1] Moderate exposure: infrequent contact with chromium water. [2] High exposure: frequent contact with chromium water.

## 2.2 Data analysis

We begin with the descriptive analysis (frequency distribution) to present the sample. Further, cross-tabulation was done to study the association with the dependent variable and predictor variables included in the study. Adjusted odds ratio from the binary logistic regression was executed to determine the associated factors. Data were analyzed using STATA 14 software.

## 3. Results

### 3.1 Work related characteristics of tannery workers

The work-related characteristics of tannery workers are presented in **Table 1**. Tannery operations was categorized into four broad categories: Beam house work (8% of workers in a tannery unit), wet finishing (25%), dry finishing (50%), and miscellaneous work (17%).

We collected information on total work experience (in the present job and previous ones) in tanneries. Around 15 percent of the tannery workers surveyed were engaged in the occupation for more than 20 years, and about one-third of workers were involved for 20 years in the tannery occupation. Most of the workers (89%) were working as daily wage laborers, while only 11 percent were permanent employees. Over one-fourth (27%) worked for 11 to 12 hours a day, and 52 percent reported that they worked for all seven days in the week.

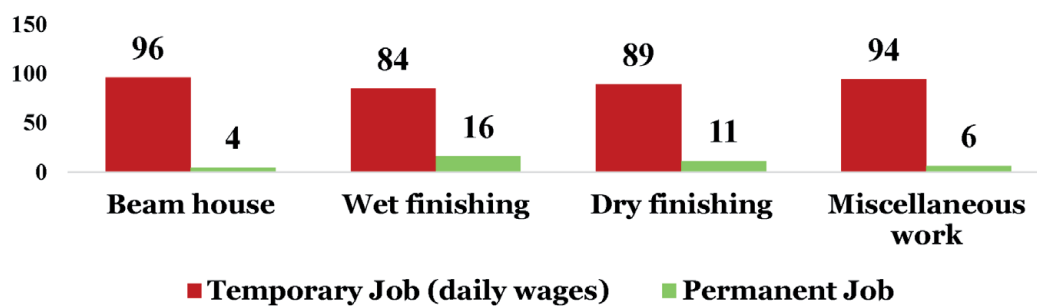
The nature of the work done is shown in **Figure 1**. For this study, the job contract was divided into two categories—temporary (daily wages) and permanent. Most workers were engaged in works on a temporary basis. In the beam house, where the work is particularly hazardous, 96 percent of the workers were employed temporarily, with permanent employees making up the remainder. The nature of the job contract was heavily skewed in the other sections also: wet finishing work (84% and 16 percent respectively of temporary and permanent workers), dry finishing (89% and 11%), and miscellaneous work (94% and 6%).

Variables	Percentage (%)	Number (N)
<b>Type of job within tannery occupation</b>		
Beam house	8.4	24
Wet finishing	24.5	70
Dry finishing	50.4	142
Miscellaneous	16.7	48
<b>Work experience in current tannery</b>		
Up to 5 years	34.3	96
6 to 10 years	33.5	96
11 to 20 years	22.4	64
20+ years	9.8	28
<b>Work experience in previous tannery</b>		
Up to 5 years	43.4	43
6 to 10 years	38.4	38
11 to 20 years	13.1	13
20+ years	5.1	5
<b>Type of job contract</b>		
Temporary job (daily wages)	89.2	253
Permanent job	10.8	31
<b>Working hours in day</b>		
7 to 8 hours	47.2	134
9 to 10 hours	25.5	73
11 to 12 hours	27.3	77
<b>Working days in a week</b>		
Six days in a week	48.3	137
Seven days in a week	51.7	147
<b>Total</b>	<b>100.0</b>	<b>284</b>

**Table 1.**  
 Work related characteristics of tannery workers.

### 3.2 Awareness about the exposure of hazardous chemicals and work environment

Workers' awareness of hazards involve in tannery operation is presented in **Table 2**. About 79 percent of the workers in the age group of 16–24 years agreed with the statement that “tannery work is very hazardous in nature” found to be highest. Awareness of the above statement varies from 73 to 93 percent for the educational attainment, religion, caste, media exposure, and standard of living index among the tannery workers. It was found that tannery workers having a middle-school level of education were 3.01 times more likely to be aware of the hazards as compared to the illiterate or less educated ones. Those with a comparatively higher standard of living were 2.08 times more likely to agree that “tannery work is very hazardous in nature” than those having a lower standard of living. Agreement with the statement that “tannery workers work in the very hazardous work environment” ranges from 55 to 79 percent for the predictors such as age,



**Figure 1.**

Percent distribution of job contract by their type of work they usually do in tannery reported by tannery workers.

education, religion, caste, media exposure, and standard of living index. Tannery workers aged 36 and above were 0.34 times, and those who had a medium level of media exposure were 0.58 times less likely to aware of a hazardous work environment. We also examined the perceptions about exposure to hazardous chemicals in tanning processes. The awareness varied between 40 and 69 percent according to selected background variables. Odds ratio show that workers having a middle level of education were 0.43 times, and those with a medium level of media exposure are 0.54 times less likely to aware of the exposure of hazardous chemicals used in the tanning process. We also tried to understand the awareness of exposure to hazardous tissues involved in the tanning process. It was found that awareness ranged from 40 to 65 percent, depending on age, education, religion, caste, media exposure, and standard of living index. The odds ratio shows that tannery workers aged 36 years and above were 0.44 times less likely to aware of the hazardous tissues involved in the tanning process.

The awareness of potential health hazards involved in the tanning process by type of work is presented in **Table 3**. It is seen that 83 wet finishing and dry finishing (about 80%) workers were aware that the tannery work is hazardous. Similarly, 66 and 64 percent wet finishing and dry finishing workers engaged in tannery workers accepted that they worked in an unsafe work environment. Most of the workers (69%) in the wet finishing section reported that tannery workers were exposed to several hazardous chemicals during the tanning process, which was following by workers engaged in dry finishing (55%), Beam house work (50%), and workers engaged in miscellaneous work (49%). Around two-thirds of the workers involved in wet finishing were agreed that hazardous tissue engaged in the tanning process.

*Awareness about the health hazard due to work in tannery occupation.*

This research work examined awareness of health problems that may occur in tannery work. Various health issues like respiratory trouble, skin complaints, eye-related, and gastrointestinal issues were observed, which are presented in **Table 4**. Tannery workers who belong to the younger cohort (16–24 years) reported a higher awareness of respiratory problems (38%), skin complaints (59%), and gastrointestinal issues (21%) than those aged 36 years and above. There is an increasing awareness of educational attainment. Workers with high school education and more showed higher awareness of respiratory problems (52%), skin complaints (67%) in comparison to illiterate workers. Further, Hindu workers were more aware of respiratory problems (33%), skin complaints (55%), and gastrointestinal problems (16%) as compared to Muslim workers. Similarly, other caste group workers were also more aware of respiratory problems (29%), eye-related issues (46%), and the gastrointestinal problem (19%) compared to the schedule caste and other caste group workers.

Background Variables	Tannery work is very hazardous in nature		Tannery workers work in hazardous work environment		Tannery workers are exposed to many hazardous chemicals		Hazardous tissues involve in tanning process	
	Percent (%)	Odds CI	Percent (%)	Odds CI	Percent (%)	Odds CI	Percent (%)	Odds CI
<b>Age in years</b>								
16–24	79.3		79.3		68.9		65.5	
25–35	78.6	1.23 [0.42–3.65]	65.0	0.54 [0.20–1.49]	59.2	0.71 [0.28–1.78]	55.3	0.66 [0.27–1.62]
36+	74.3	0.89 [0.31–2.57]	55.2	0.34**[0.13–0.93]	52.6	0.55 [0.22–1.35]	46.0	0.44*[0.18–1.07]
<b>Education</b>								
Illiterate	73.8		59.3		57.7		50.8	
Up to primary	78.9	1.27 [0.52–3.12]	63.1	0.98 [0.46–2.10]	60.5	0.98 [0.46–2.09]	55.2	1.08 [0.51–2.28]
Middle school	88.0	3.01* [0.73–12.34]	60.0	0.94 [0.36–2.46]	40.0	0.43* [0.16–1.14]	40.0	0.66 [0.25–1.73]
High school & above	78.7	1.23 [0.40–3.79]	69.7	1.31 [0.49–3.49]	57.5	0.78 [0.30–2.00]	57.5	1.27 [0.50–3.23]
<b>Religion</b>								
Hindu	83.3		64.5		59.3		47.9	
Muslim	72.8	0.63 [0.31–1.26]	59.5	0.94 [0.53–1.66]	55.3	0.94 [0.53–1.66]	53.1	1.51 [0.86–2.66]
<b>Caste</b>								
Schedule caste	80.6		61.8		58.6		51.0	
Other backward class	65.3	0.41** [0.20–0.86]	59.6	0.80 [0.41–1.57]	63.4	1.14 [0.58–2.24]	61.5	1.31 [0.67–2.55]
Others	93.7	4.60 [0.56–37.80]	62.5	1.21[0.39–3.76]	50.0	0.84 [0.28–2.50]	50.0	0.92 [0.31–2.74]



Background Variables	Tannery work is very hazardous in nature		Tannery workers work in hazardous work environment		Tannery workers are exposed to many hazardous chemicals		Hazardous tissues involve in tanning process	
	Percent (%)	Odds CI	Percent (%)	Odds CI	Percent (%)	Odds CI	Percent (%)	Odds CI
<b>Media exposure</b>								
Low	76.9		64.6		61.5		53.8	
Medium	74.6	0.74 [0.35–1.59]	55.8	0.58* [0.30–1.11]	52.1	0.54* [0.28–1.03]	47.1	0.59 [0.31–1.12]
High	79.0	0.64 [0.22–1.77]	67.9	0.66 [0.28–1.57]	60.4	0.83 [0.35–1.97]	56.7	0.79 [0.34–1.85]
<b>Standard of living index</b>								
Low	73.8		56.0		52.3		46.7	
Medium	75.2	1.17 [0.58–2.39]	60.6	1.34 [0.73–2.49]	56.1	1.18 [0.64–2.18]	50.5	1.07 [0.58–1.98]
High	80.6	2.08* [0.92–4.72]	68.1	1.94* [0.98–3.81]	62.5	1.46 [0.75–2.83]	57.9	1.42 [0.74–2.75]
<b>Total</b>	<b>76.0</b>		<b>61.0</b>		<b>57.0</b>		<b>51.0</b>	

\* $p < 0.1$ .  
 \*\* $p < 0.05$ .

**Table 2.**  
 Awareness among the tannery workers about the involvement of hazards in tannery work by some selected background characteristics.

Statements	Beam house	Wet finishing	Dry finishing	Miscellaneous	Overall	(N)
<b>Tannery work is very hazardous in nature</b>						
Agree	62.5	82.9	80.4	61.7	51.4	217
Disagree	37.5	17.1	19.6	38.3	48.6	67
<b>Tannery workers work in hazardous work environment</b>						
Agree	58.3	65.7	63.6	48.9	56.7	174
Disagree	41.7	34.3	36.4	51.1	43.3	110
<b>Tannery workers are exposed to many hazardous chemicals</b>						
Agree	50.0	68.6	54.6	48.9	61.3	161
Disagree	50.0	31.4	45.5	51.1	38.7	123
<b>Hazardous tissues involve in tanning process</b>						
Agree	41.7	58.6	50.3	48.9	76.4	146
Disagree	58.3	41.4	49.7	51.1	23.6	138
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>284</b>

**Table 3.** Awareness about the health hazard involved in tanning process by their type of work they usually do in tannery.

### 3.3. Qualitative measure of environmental exposure by type of work

The chemicals used in tanning processes are not consumed but discharged into the environment as effluents. Effluents contain organic matter, chromium, sulphides, and solid waste. Qualitative assessment of exposure at the workplace may be a useful tool for evaluating hazardous working conditions. **Table 5** presents qualitative measures of environmental exposure by different work categories. The results show that more than half (54%) of the workers engaged in beam housework followed by wet finishing (44%) and miscellaneous work (43%) had moderate to high exposure to chemicals. About one-third of Beamhouse workers (33%) and over a quarter (26%) of the wet finishing had moderate to high dermal contact with the chemicals. Further, 63 percent of the workers engaged in Beamhouse work, 51 percent doing miscellaneous work, 47 percent in wet finishing, and 36% in dry finishing reported exposure to dust. Furthermore, 50 percent of the beam house workers, 43 percent workers in wet finishing, 34 percent in miscellaneous work, and 30 percent in dry finishing had moderate to high exposure to ergonomic stressors.

### 3.4 Preventive measure and experiencing the different working condition

The preventive and safety measures appropriate for the work are presented in **Table 6**. The highest use of gloves and masks is seen in Beamhouse work (12 & 13% respectively), wet finishing (10 & 16%), miscellaneous (9 & 17%), and dry finishing (6.3 and 9%). Most tannery workers (69–92%), temporary as well as permanent, reported that they were involved in loading and unloading of raw hides manually in tannery premises. Only a small proportion (4.3–10%) used trolleys for loading and unloading. A substantial proportion of tannery workers had high exposure to humidity (69–88%), heat (69–84%), noise (78–87%). Additionally, most (51–63%) had become accustomed to the smell of hide. Most tannery workers also reported that exhaust fans (88–99%).

Background Variables	Respiratory Problems		Skin Complaints		Eye related problems		Gastrointestinal problems	
	Percent (%)	Chi-square	Percent (%)	Chi-square	Percent (%)	Chi-square	Percent (%)	Chi-square
<b>Age in years</b>								
16–24	37.9	$\chi^2 = 4.56$ $p < 0.335$	58.6	$\chi^2 = 1.76$ $p < 0.780$	24.1	$\chi^2 = 13.89$ $p < 0.008$	20.6	$\chi^2 = 2.19$ $p < 0.700$
25–35	25.2		53.4		34.9		13.5	
36+	23.6		53.9		38.1		12.5	
<b>Education</b>								
Illiterate	19.2	$\chi^2 = 19.48$ $p < 0.003$	54.5	$\chi^2 = 8.46$ $p < 0.206$	37.4	$\chi^2 = 4.47$ $p < 0.613$	11.7	$\chi^2 = 11.86$ $p < 0.065$
Up to primary	23.6		39.4		31.5		7.8	
Middle school	40.0		56.0		36.0		24.0	
High school & above	51.5		66.6		27.2		21.2	
<b>Religion</b>								
Hindu	33.3	$\chi^2 = 18.91$ $p < 0.000$	55.2	$\chi^2 = 1.14$ $p < 0.566$	22.9	$\chi^2 = 10.71$ $p < 0.005$	15.6	$\chi^2 = 1.11$ $p < 0.575$
Muslim	21.8		53.7		42.0		12.7	
<b>Caste</b>								
Schedule caste	22.5	$\chi^2 = 26.26$ $p < 0.000$	54.3	$\chi^2 = 7.65$ $p < 0.265$	34.4	$\chi^2 = 22.02$ $p < 0.001$	10.2	$\chi^2 = 24.80$ $p < 0.000$
Other backward class	28.8		57.6		46.1		19.2	
Others	12.5		62.5		6.25		0.0	
<b>Media exposure</b>								
Low	36.9	$\chi^2 = 23.45$ $p < 0.000$	61.5	$\chi^2 = 5.48$ $p < 0.241$	35.3	$\chi^2 = 6.67$ $p < 0.154$	21.5	$\chi^2 = 14.24$ $p < 0.007$
Medium	13.0		51.4		39.8		6.5	
High	38.2		53.0		28.4		19.7	

Background Variables	Respiratory Problems		Skin Complaints		Eye related problems		Gastrointestinal problems	
	Percent (%)	Chi-square	Percent (%)	Chi-square	Percent (%)	Chi-square	Percent (%)	Chi-square
<b>Standard of living index</b>								
Low	28.0	$\chi^2 = 5.47$ $p < 0.242$	50.4	$\chi^2 = 3.47$ $p < 0.483$	28.9	$\chi^2 = 5.16$ $p < 0.271$	14.9	$\chi^2 = 9.34$ $p < 0.053$
Medium	20.2		53.9		41.5		11.2	
High	28.4		59.0		37.5		14.7	
<b>Total</b>	<b>25.7</b>		<b>54.2</b>		<b>35.5</b>		<b>13.7</b>	

**Table 4.**  
 Percent distribution of tannery workers who were aware about the health problems involve in tannery work.

	Beam house	Wet finishing	Dry finishing	Miscellaneous work	Chi-square	N
<b>Chemicals in the Air<sup>1</sup></b>						
No exposure	25.0	24.3	30.1	17.0	$\chi^2 = 8.09$ $p < 0.231$	74
Low exposure	20.8	31.4	37.1	40.4		99
Moderate/ High exposure	54.2	44.3	32.8	42.6		111
<b>Dermal exposure to chemicals<sup>2</sup></b>						
No exposure	33.3	24.3	32.2	17.0	$\chi^2 = 16.43$ $p < 0.012$	79
Low exposure	33.3	50.0	49.0	74.5		148
Moderate/ High exposure	33.4	25.7	18.8	8.5		57
<b>Airborne dust<sup>3</sup></b>						
No exposure	25.0	21.4	34.3	17.0	$\chi^2 = 12.28$ $p < 0.056$	78
Low exposure	12.5	31.4	29.3	31.9		82
Moderate/ High exposure	62.5	47.2	36.4	51.1		124
<b>Ergonomic stressors<sup>4</sup></b>						
No exposure	20.8	18.6	37.1	19.2	$\chi^2 = 14.15$ $p < 0.028$	80
Low exposure	29.2	38.6	32.8	46.8		103
Moderate/ High exposure	50.0	42.8	30.1	34.0		101
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>		<b>284</b>

<sup>1</sup>Chemicals in the air (no exposure, low exposure, moderate exposure, high exposure, 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, 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, spraying paint.

<sup>2</sup>Dermal exposure to chemicals (no exposure, moderate exposure, high exposure) was based on qualitative rating of exposure assessment as [0] No skin contact: no contact with agent. [1] Moderate exposure: infrequent skin contact with agent contact occurs during specific activities that are not part of the daily work routine. [2] High exposure: frequent skin contact with agent regular contact is unavoidable due to particular activities in daily work practice.

<sup>3</sup>Another important variable airborne dust (no exposure, low exposure, moderate exposure, high exposure, very high exposure) was based on qualitative rating of exposure assessment as [0] No exposure: clear visibility. [1] Low exposure: visibility more than 10 m. [2] Moderate exposure: visibility between 5 to 10 m. [3] High exposure: visibility between 1 to 5 m. [4] Very high exposure: visibility less than 1 m.

<sup>4</sup>Ergonomic stressors (no exposure, low exposure, moderate exposure, high exposure, very high exposure) was based on qualitative rating of exposure assessment as [0] No exposure: does not occur (< 10% of work time). [1] Low exposure: less than 25% of daily work time. [2] Moderate exposure: 25–49% of daily work time. [3] High exposure: 50–74% of daily work time. [4] Very high exposure: 75% or more of daily work time. Exposure of waste water of chromium (no exposure, moderate exposure, high exposure) was based on qualitative rating of exposure assessment as [0] No exposure: no contact with chromium water. [1] Moderate exposure: infrequent contact with chromium water. [2] High exposure: frequent contact with chromium water.

**Table 5.**  
Qualitative measures of environmental exposure by their type of work among the tannery workers.

Variables	Beam house	Wet finishing	Dry finishing	Miscellaneous work	Overall	Number (N)
<b>Use of glove</b>						
Often	12.5	10.0	6.3	8.5	8.1	23
Sometimes	41.7	50.0	51.7	42.6	48.9	139
Never	45.8	40.0	42.0	48.9	43.0	122
<b>Use of mask</b>						
Often	12.5	15.7	9.0	17.0	12.3	35
Sometimes	29.2	48.6	49.0	42.6	46.1	131
Never	58.3	35.7	42.0	40.4	41.6	118
<b>Involved in loading and unloading of raw hides manually</b>						
Yes	91.7	90.0	69.2	87.2	79.2	225
No	8.3	10.0	30.8	12.8	20.8	59
<b>Involved in loading and unloading of raw hides by trolley</b>						
Yes	8.3	8.6	9.8	4.3	8.5	24
No	91.7	91.4	90.2	95.7	91.5	260
<b>Feeling humidity in tannery premises</b>						
Yes	87.5	84.3	68.5	72.3	74.7	212
No	12.5	15.7	31.5	27.7	25.3	72
<b>Feeling heat in tannery premises</b>						
Yes	79.2	84.3	69.2	80.8	75.7	215
No	20.8	15.7	30.8	19.2	24.3	69
<b>Feeling extreme noise in tannery premises</b>						
Yes	83.3	87.1	78.3	85.1	82.0	233
No	16.7	12.9	21.7	14.9	18.0	51
<b>Comfortable with smell of hides</b>						
Yes	62.5	51.4	54.6	53.2	54.2	154
No	37.5	48.6	45.5	46.8	45.8	130
<b>Exhaustive fan</b>						
Yes	87.5	98.6	96.5	95.7	96.3	273
No	12.5	1.4	3.5	4.3	3.7	11
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>284</b>

**Table 6.**  
*Percentage of tannery workers who use preventive measures and experienced different environmental conditions in tannery premises by their type of work.*

## 4. Discussion

The results from this study of male tannery workers revealed that the workers were exposed to chemicals, leather dust, which contains chromium, and physical hazards. A substantial proportion of the tannery workers reported awareness of the health risks of the various tanning processes. The physical and cognitive

difficulty levels of the job in tanneries were like previous studies [8–10]. It is essential to mention here that there are very few studies conducted on tannery workers in the Indian context.

The results of our study validate the need for further efforts to minimize hazardous occupational health risks among tannery workers. However, findings depict tannery workers aged 36 years & above are less likely to be aware of the hazardous work environment, and malignant tissues involved in the tanning process, lack of protective equipment and safety devices showed a significant double risk for occupational health and injuries [11–14]. **Previous findings** agree with a study on salt workers found that there is a considerable gap between their knowledge and practices, along with protective measures [15]. Furthermore, a study conducted on chronic conditions, workplace safety, and job demands in Colorado revealed that non-provision of workplace safety led to employees' chronic health conditions and contributed to absenteeism and poor job performance. It also influences the physical and cognitive difficulties of the workers associated with the work [16]. Other factors also significantly affect the perceptions of health risks: age, education, religion, caste, media exposure, and standard of living index. Workers reported that they are aware that they have the chance of getting respiratory problems, skin complaints, eye-related, and gastrointestinal problems from the tannery. A substantial proportion of workers experienced severe conditions, such as humidity (69–88% of those surveyed), heat (69–84%), noise (78–87%); they had also got used to the smell of hides (51–63%). Comparable outcomes found by a study led in some developing countries concentrating on the upshot of work-related acquaintance to noise and heat on the health of the workers. Results portray that those who worked in the foundry had high thermal stress, high noise levels, high visual defects, high muscle cramps problem, high visual disability and describe non-use of protective equipment and poor occupational hygiene and safety measures were also affected the health problem among workers [17–20]. Our study recommended that leather dust exposure be reduced by providing gloves and masks and by installing a hood duct to provide better ventilation and removal of leather dust from the work area as also recommended by previous researches [21].

This research also suggested risks should be assessed for their potential consequences on health. Liquid effluents contain organic matter, chromium, sulfides, and solid wastes. A qualitative assessment of exposure showed that moderate to high exposure to chemicals and also contacted them. It has been reported from the literature that the workers on exposure to leather dust, which contains chromium in the protein-bound form, exhibited a higher mean concentration of urinary and blood chromium [8]. The workers engaged in beam housework, miscellaneous work, wet finishing, and dry finishing also reported moderate to high exposure to dust and ergonomic stressors. The use of safety gear was the highest in beam housework, followed by wet finishing, miscellaneous work, and dry finishing. This study also recognized a lack of awareness of the health risks in tannery operations and shortcomings in the use of preventive measures. Employers must raise awareness of health risks and ensure compliance with safety measures. But at the same time, qualitative results of focused group discussion with workers from small scale industries in Tanzania show high levels (>90%) of self-reported exposure to health problems, and low use of protective measures [22]. In continuation of the previous findings, a case study of electroplating sector workers in the United Kingdom showed that the employees had sound knowledge of the hazardous nature of chemicals used at the workplace [23].

An intervention study focused on prevention of work-related skin problems assessed the occupational health and safety among wet workers. The study found significant behavior change and fewer skin problems among workers in the intervention group as compared to the control group. The intervention was successful in enhancing knowledge and changing behavior [24]. Literature suggests most workers had an essential awareness of the existence of occupational health and safety legislation, but they were unaware of their legal responsibilities. They were found to have minimal occupational and safety training [25–29].

## **5. Conclusion**

The findings of this study reveal that the tannery workers work in a very hazardous work environment and susceptible to health risks. Although, tannery workers are less aware of the health hazard involved in the tanning process and even not aware of the exposure to hazardous chemicals at the work place. Evidence from the qualitative measures of environmental exposure pointed out that they work in different activities at the tannery and having different exposures. Further, the study findings reveal that tannery workers are not utilizing the appropriate preventive measures as per the protocol. The outcomes of the study give a clear indication of the effect of the workstation environment on the health status of workers and require the use of adequate measures to improve the facilities and thereby the health status of tannery workers.

## **Declarations**

### **Ethics approval and consent to participate**

We have received ethical approval from the board. The Student Research Ethics Committee approved the study of the International Institute for Population Sciences Mumbai, India. We have also obtained consent to participate from each of the respondents before starting the interview. The confidentiality of information has been maintained.

### **Consent for publication**

Not applicable.

### **Availability of supporting data**

This research is based on primary data.

### **Funding**

Not received any funding.

### **Authors' contributions**

GCK developed the questionnaire, collected the data, contributed in acquisition of data. SKS PC conceived and designed the experiments. GCK PC analyzed the data. GCK PC wrote the manuscript. SKS critically revised the draft.



## Abbreviations

ILO	International Labour Organization
WHO	World Health Organizations
DALY	disability adjusted life years
PPS	probability proportional to size
OR	odds ratio
CI	confidence interval

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