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Prevalence of Occupational Skin Diseases and its Predisposing Factors in Leather Tanning Workers of Southern India

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Abstract

Skin diseases are a major occupational health issue in tannery workers because of work related exposure to various toxic chemicals used in tanning process. In the present study, prevalence of various skin diseases and predisposing factors in tannery workers were investigated. A cross sectional study including 114 tannery workers (male-89; female-25) employed at different tanneries of Southern India was carried out. Face to face interview with pre-designed questionnaire and health examination was conducted. Skin samples obtained from the participants were subjected to microscopic examination and microbial culture for diagnosis of skin diseases. The prevalence of occupational skin disorders were 39% among the study participants. Contact dermatitis (16%), skin infections (16%), eczematous lesions (7%) and nail discoloration (1.75%) wereidentified. Skin infections of fungal origin were identified among 11.4% of subjects. The skin infections of fungi; tinea corporis, tineatinea cruris, tineatinea unguium, tineatinea versicolor, tineatinea pedis and Pityriosis versicolor were identified. Bacterial skin infections identified were associated with contact dermatitis. Lack of PPE usage was reported among 30% of workers. Hazardous working environment, chemical exposure, humidity and lack of PPEusage were significantly associated with increased skin disease incidence(p<0.05), indicating the major predisposing factorsfor Occupation skin diseases. The findings of the study emphasize that, workers in the pre-tanning section and tanning sections are more vulnerable to occupational skin diseases. Compliance to use of PPEs, engineering controls to reduce exposure, education, frequent health surveillance and early identification & treatment could mitigate the occupational skin diseases among tannery workers.



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Keywords

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Introduction

The leather tanning industry holds a prominent place in the Indian economy, providing job to 4.42 million people, mostly of lower socio-economic status. Women workers occupy 30% in this sector, among the states Tamil Nadu, the southern part of India holds the major leather production centers. The state of Tamil Nadu is accountable for 60-70% of leather production in India.¹ Tannerv industries are the most toxic in the world owing to intensive chemical usage. The tanning industries involved manual operations, viz; hide handling, soaking, un-hairing, trimming, tanning, dyeing and other finishing process.² Thus tannery workers exposed to deleterious agents such as acids (Formic acid, sulphuric acid) chromium sulphate, ammonium salts, sodium salts and dyes etc,.3 These chemicals are demonstrated as potential irritant and sensitizing agent among worker exposed for long duration.⁴ Chromium salts has potential ability to bind with skin proteins of tannery workers to produce complex antigens which lead to hypersensitivity reactions.⁵ Prevalence of occupational dermatitis has been reported among tannery workers in Asian countries.⁶

Occupational skin diseases (OSD) are emerging concern and frequently encounterednotifiable work related health issue. The worsening of preexisting skin disorders by work related exposures are considered as OSDs which account for 34% of work related diseases.⁷ OSD contributes to the compromised productivity, loss of work days, switch over to other jobs, affects life style, disablement and increased health expenditure among working population.^{8,9}The most important agents responsible for the OSD are chemical, biological, physicaland



Fig. 1: Evaluation of Occupational skin disease (OSD), diagnosis and preventive measures and (Source: Alfonso *et al.,* 201711; Febriana *et al.,* 201212)

mechanical factors.¹⁰ Occupational skin diseases are classified into contact dermatitis, allergic contact dermatitis, contact urticaria, skin cancers, skin infections, skin injuries, pigmentary disorders and miscellaneous types.¹¹ Employment in tanneries is probably associated with occupational dermatitis.12 The prevalence of contact dermatitis, urticaria and skin infection, hand eczema, atopic eczema, and bacterial infection were 8%, 7%, 5%, 3%, and 0.5% respectively in the workers of Khartoum tanning industry.13 The chemicals used to treat the animal hides have the indistinguishable affect on human skin that disturbs immunological barrier of skin anatomy,^{14,15} consequently it rendered to opportunistic skin infections to the sensitized population. Moist area of the body such as in between the toes, genital area, and underneath the breasts and skin folds are more susceptible to fungal infections.16

Fungal skin infections are usually caused by dermatophytes, non-dermatophytic moulds and commensal yeasts.17 Particularly the fungal skin lesions may widespread if left untreated, therefore to treat the fungal skin infections effectively, appropriate laboratory diagnosis is essential for the differentiation of dermatophytosis from other nonmycotic dermatitis.18 The inappropriate treatment for tinea infections may progress to chronic, recurrent and multisite infection.9,19 Occupational illness is less likely to be reported in developing countries due to inadequate surveillance programmes.²⁰ There are only limited studies on prevalence of infectious skin diseases among the tannery workers, especially of fungal dermatitis. Therefore, the present study designed to investigate the prevalence of occupational dermatitis, associated skin infections and the risk factors responsible for Occupational skin diseases among the tannery workers.

Materials and Methods Study Design and Questionnaire

A cross sectional study was conducted to assess the prevalence of occupationalskin diseases among tannery workers. The study was conducted at Southern region of India, included 114 tannery workers (male, n=86; female n=25) with similar socioeconomic strata. Those workers worked in different leather tanning sections, namely pretanning section (preparatory), tanning section and post tanning section (finishing) were the study subjects. Institutional ethics committee approval was obtained prior to initiation of the study. A face to face vernacular language (English and Tamil) questionnaire was administered to collect the personal history, personal hygiene practices, socioeconomic status, occupational details, occupational practices specifically related to skin diseases using Nordic Occupational skin disease questionnaire.²¹

Medical Examination

The clinical examination was conducted to identify the clinical signs and symptoms of contact dermatitis, eczematous lesions, hives, psoriasis, acne, contact allergies, fungal infections (e.g., athlete's foot, ringworm), bacterial skin infections (with abscesses or exudates), history of atopy or psoriasis, and other skin manifestations. The skin samples were obtained only from the subjectsprovided their consent. Two portions of skin samples were collected from the subjects with skin infection and other skin disorders. From the two portions samples, one portion of sample was examined microscopically with specific staining method and another portion of each sample was cultured onto appropriate medium. The infected skin site was cleaned with 70% alcohol to eliminate the contamination and the skin scales were flaked into sterile petri-plate by using blunt edge sterile surgical blade. Skin scrapings from erythematous lesions and margins of infected skin lesions were aseptically collected. Sterile skin swab moistened with saline was used to collect scanty skin sample and infected lesions.

Sample Collection and Microscopic Observation

A total of 27 skin scrapings and 20 skin swabs were collected from workers. Skin scales collected from workers were subjected to microscopic examination using 10% potassium hydroxide (KOH). Skin scales were taken in a clean and sterile glass slide, and then drop of KOH solution was added onto it. A cover glass placed on the drop and slide was passed three times in a flame to accelerate the dissolving keratin and after a period of 10 minutes, then the cover glass was gently pressed. The presence of fungal elements was examined microscopically under 10X (low) and 40X (high) power objectives.

Microbial Culture

Isolation of fungi and bacteria was carried out according to Standard Operating Procedure mentioned inTextbook of Diagnostic Microbiology.22 Samples were cultured by inoculating the scraping pieces over the agar plates. For fungal isolation, the samples were inoculated into Sabouraud's dextrose agar (SDA) containing cycloheximide and chloramphenicol.²³ Culture plates were examined for fungal growth. The fungal genus was identified by macroscopic character of culture, microscopic examination of isolates and biochemical characters,22 for macroscopic character colony texture, rate of growth and pigmentation production of the front and the reverse side of the culture plates were observed. Microscopic identification of mould isolates was carried out using lactophenol cotton blue (LPCB). Bacterial culture was performed using Blood agar (BA) (contained 5% sheep blood) and MacConkey. Smear study, cultural characteristics and biochemical assays were performed to identify the infectious agent from the culture growth.

Chi-square test was used to find the significant association between skin diseases prevalence and other variables. The p-values p<0.05 was regarded as statistically significant.

Results

Demographic Characteristics and personal habits Demographic characteristics of the workers are presented in Table 1. The mean age of workers was 43.8±10.4 years, ranges from 16 to 68 years. Of the study subjects 26% of them were illiterate, about 45.6% of workers had only primary education, higher secondary education completed by 26.3% workers and only 1.8% of them were graduated. Almost majority of the workers had lowermonthly income varying from Rs.5000 to 8000/- and most of them were temporary employees (95.6%) for several years. Of the study subjects tobacco chewing habits observed among 9.6% subjects, smoking habits reported by 24.6% subjects and alcohol consumption were reported by 36.8% subjects.

Statistical Analysis

The resultswere statistically analyzed using SPSS version 26. Descriptive statistics was performed.

Va	riables		Tannery workers (n=114)
Ag	je (Years)	Mean ± SD	43.8±10.4
		Range	18-68
Ge	ender	Male	89 (78)
		Female	25 (21.9)
Ma	arital status	Married	103 (90.3)
		Unmarried	11 (9.6)
Ed	lucation	Illiterate	30 (26.3)
		Primary	52 (45.6)
		Higher Secondary	30 (26.3)
		Graduate	2 (1.8)
Mo	onthly income	<5000	6 (5.2)
		5000-8000	91 (79.8)
		>8000	17 (14.9)
Jo	b description	Temporary	109 (95.6)
		Permanent	5 (4.3)
То	bacco Chewing	Chewer	11 (9.6)
-		Non-chewer	103 (90.3)
Sn	noking	Smoker	28 (24.6)
		Non-smoker	86 (75.4)
Alc	cohol consumption	Alcoholic	42 (36.8)
		Non-alcoholic	72 (63.1)

Table 1: Demographic and occupational details of Tannery workers

* Parenthesis indicates percentage (%)

Occupational Details

The occupational details of the workers represented in the table 2. According to the working departments of workers, they were proportioned into three groups, about 47.3% of subjects worked in preparatory or pre-tanning process (involved in sorting, curing, storage of hides, soaking, un-hairing, liming, deliming, bating, pickilng and beam house process), 30% of them worked in tanning department (involved in tanning, sammying, and shaving process) and 22% of them involved in post-tanning department (fat liquoring, drying, dyeing and finishing process). The mean work experience of workers was 15.46±10.4 years, ranges from 1 to 36 years. The working hours of the subjects were ranges from 42 to 56 hours/ week.

Vari	iables	Pre tanning (n=54)	Tanning (n=34)	Post tanning (n=26)	Total subjects (n=114)
Worker working section		54 (47.3)	34 (29.8)	26 (22.8)	114 (100)
a)	42-48 hours	16 (29.6)	29 (85.2)	0	51 (44.7)
b)	≥48 hours	38 (70.3)	5 (14.7)	26 (100)	63 (55.2)
Ŵoi	rk experience		· · /		
a)	1-15 Years	32 (59.2)	19 (35.1)	16 (61.5)	67 (58.7)
b)	15-30 years	19 (35.1)	12 (22.2)	9 (34.6)	40 (35)
c)	> 30 years	3 (5.5)	3 (8.8)	1 (3.8)	7 (6.1)
PPE	Eusage				
a)	PPE users	43 (83.3)	25 (73.5)	21 (80)	79 (60.5)
b)	Non users	11 (16.6)	9 (26.4)	15 (57.6)	35 (30.7)
c)	Gloves users	43 (83.3)	25 (73.5)	3 (11.5)	71 (62.2)
d)	Apron users	38 (70.3)	25 (73.5)	2 (7.6)	63 (55.2)
e)	Safety boots users	43 (83.3)	25 (73.5)	1 (3.8)	69 (60.5)
d)	Goggles users	0	0	0	0
e)	Mask users	2 (3.7)	3 (8.8)	0	5 (4.3)
Rea	son for not wearing PPE				
a)	Not provided	5 (9.2)	3 (8.8)	7 (26.9)	19 (16.6)
b)	Discomfort while use	2 (3.7)	2 (5.8)	2 (7.6)	11 (9.6)
c)	Allergic to PPE	1 (1.8)	1 (2.9)	0	4 (3.5)
d)	Not able to afford PPE	3 (5.5)	3 (8.8)	6 (23)	19 (16.6)
Handling of chemicals					
a)	Yes	13 (24)	10 (29.4)	3 (11.5)	26 (22.8)
b)	No	41(75.9	24 (70.5)	23 (88.4)	88 (77.1)
Type of exposure					
a)	Chemicals	19 (35.1)	12 (35.2)	2 (7.6)	33 (28.9)
b)	Dust	17 (31.4)	3 (8.8)	21 (80)	38 (33.3)
c)	Humidity	24 (44.4)	27 (79.4)	4 (15.3)	55 (48.2)
Wearing same clothes		4 (7.4)	0	4 (15.3)	8 (7)
repetitively at work					

Table 2: Occupational details of study subjetcs

*Parenthesis indicates percentage (%)

Use of Personal Protective Equipments (PPE's) were reported among 60.5% of subjects and 29.8% of workers did not use any kind of PPE's, further non-

glove users 27.8% and non-apron users 54% were noted. Usage of face mask at work was noted only among 4.3% subjects. The study subjects stated that

discomfort while wear, allergic to PPEs, not offered PPEs by industry, and not able to afford PPEs by self, were the reasons for lackof PPEs use at work. As alternatefor PPEs,workers were reported to be covering the body by self-designed impermeable protectivematerials such as polythene cover and rubber sheets.

Exposure Assessment

Direct handling of chemicals and exposure to chemicals was reported among 33% subjects, exposure to dust 36% and experience of high

humidity at workplace was reported among 48% (Table 2). The major chemicals reported to be directly handled by the workers were ammonium sulphide, ammonium chloride, sodium chloride, sodium sulphide, sodium metabisulphide, formic acid, sulphuric acid, and chrome sulphatein tanning and in pre-tanning sections (table 5). These chemicals are classified as potential irritant and sensitizing agent to skin and eyes is given in the table 3. These indicate that the workers in pre-tanning and tanning departments are exposed to those chemicals constantly at work.

Dept	Chemicals used	Application	Health effects
Pre- tanning sections	Sodium sulphide	To destroy the hair on hides	May cause sensitization. Can severely irritate and burn the skin and eves
	Sodium hydrosulphide	Destroys the hair on hides or skins	Contact can severely irritate and burn the skin and eyes
	Sodium hydoxide	Used in liming process to remove protiens blistering	Skin irritant: Contact can cause pain, redness, burns, and
	Ammonium sulphate	Used to remove alkaline chemicals form skin dermatitis	Prolonged skin contact may cause skin irritation and/or
	Ammonium chloride	Used in deliming process skin and eves	Contact can severely irritate the
	Sodium metabisulphite	Act as whitening agent in deliming process	Cause skin and eye irritation
	Formic acid	Penetrate into hide and acidify to prepare for tanning process inflammation	Contact can cause pain, burns and ulcers. Eye contact causes pain, watering eyes, and
	Sulphuric acid Sodium formate	To reduce the pH level and acidify the hide Facilitate chromium compound perforation into	Contact can cause pain, redness, burns, and blistering. Contact can cause skin and eye irritation
Tanning section	Chromium sulphate	Penetrates into the collagen matrix during tanning and that stabilize the skin structure	May cause skin allergy, if allergy develops, can cause itching and skin rash.
	Aldehydes	Aldehydes are tanning agents used to make wet white	Irritation of the eyes and skin
Post- tanning section	Dyes	Dyes are used to give the leather a desired color sores, itching, and burning.	Contact with skin may cause irritation including redness,
	Epoxy resins	Facilitate high chemical resistance and low water absorption.	Contact cause skin irritation

Table 3: List of chemical used by workers and the effect on skin

Sources:https://sites.google.com/site/isttschool/useful-information/chemicals-used-in-leather-processing24; http://www.cdc.gov/ niosh/programs.html25



a) Contact dermatitis



b) Allergic dermatitis with infection



c) Nail discoloration



d) Seborrheic Psoriasis



e) SeborrheicEczema



f) Contact allergic dermatitis

Fig. 2: Illustration of occupational dermatitis in tannery workers (e-f)



a) Pityriasis versicolor



b) Multi site infection



c) Tinea corporis



Fig. 3: Illustration of fungal dermatitis in tannery workers (a-d)

Skin Disease Pattern

The medical examination among workers explored about 45.6% (n=54) of the study subjects were suffer from skin disorders (Table 4). Skin disorders, *viz;* Contact dermatitis, allergic dermatitis, seborroheic eczema, seborroheic psoriasis and skin infections were identified among the subjects (Figue 2 &3). The diagnostic pattern to confirm the work related skin diseases (39%; n=44)) among tannery workers is given in figure 4.

Contact dermatitis (15.7%), skin infections (16%), eczematous lesions (6.1%), and nail discoloration (1.7%) were identified as work related skin diseases. The frequency of skin morbidity was found to be high among the workers of pre-tanning and tanning departments. Pickling, liming, and tanning are the major activities that have been reported to be worsen the skin conditions among workers. Sickness absenteeism reported among 32% of workers due to skin disease burden.

The other health complications of musculoskeletal disorder (32%), joint pain (30%) and eye complaints (8%) were also recorded among workers while performing work.

Skin Infections

Fungal skin infections were identified among 11.4% subjects. The skin infections of; tineatinea corporis, tineatinea cruris, tineatinea unguium, tineatinea versicolor, tineatinea pedis and Pityriosis versicolor were identified. The fungal genera of dermatophytes; *Trychophyton* spp, *Microsporum* spp, *Malassezia* spp

and non-dermatophtyic fungi; *Candida* spp, *Fusarium* spp, *Curvularia* spp and *Aspergillus* spp skin infections were identified. Bacterial skin infections were identified among 5.3% of study subjects. Skin infections of *Staphylococcus aureus* and *Klebsiella*

pneumonia were identified. Bacterial skin infections identified were associated with contact dermatitis. Chronic andrecurrent skin infections were identified among 9.6% (n=11) of study subjects.

Variables	Pre tanning (n=54)	Tanning (n=34)	Post tanning (n=26)	Total subjects (n=114)
Skin diseases prevalence	34 (62.9)	14 (41.1)	4 (15.3)	52 (45.6)
Types of skin disorders				
a) Fungal dermatitis	8 (14.8)	4 (11.7)	1 (3.8)	13 (11.4)
 Bacterial skin infections 	3 (5.5)	3 (8.8)	0	6 (5.2)
c) Contact dermatitis	11 (18.4)	5 (14.7)	2 (7.6)	18 (15.7)
d) Eczematous lesions	7 (7.4)	1 (5.5)	0	8 (6.1)
e) Others	5 (1.8)	1 (2.9)	1 (3.8)	7 (3.5)
History of skin disorder				
a) Recent skin disease	8 (14.8)	3 (8.8)	2 (7.6)	13 (11.4)
b) Within the past 3 months	11 (20.3)	4 (11.7)	1 (3.8)	16 (14.0)
c) Between 3-12 months	6 (11.1)	2 (5.8)	1 (3.8)	9 (7.8)
d) More than 12 months	7 (12.9)	3 (8.8)	0	10 (8.7)
e) Only of past history	2 (3.7)	2 (2.9)	0	4 (3.5)
Seasonal effects in Skin disorder				
a) No seasonal variation	4 (7.4)	4 (11.7)	0	8 (7.0)
b) Summer	28 (51.8)	9 (26.4)	4 (15.3)	41 (36)
c) Winter	2 (3.7)	1(2.9)	-	3 (2.6)
d) Rainy	-	-	-	-
Major activity worsen skin condition				
a) Liming and pickling	19 (35.1)	0	0	19 (16.6)
b) Tanning	0	14 (41.1)	0	14 (12.2)
c) Dye spray	0	0	2 (7.6)	2 (1.7)
d) Other activities	15 (27.7)	0	2 (7.6)	17 (14.9)
Severity of skin disease				
a) Manageable	8 (14.8)	2 (5.8)	1 (3.8)	8 (7)
b) Awful	17 (31.4)	5 (14.7)	2 (7.6)	23 (20.1)
c) Extremely awful	9 (16.6)	7 (20.5)	1 (3.8)	14 (12.2)
Musculoskeletal disorder	27 (50)	6 (17.6)	3 (11.5)	36 (31.5)
Joint pain	22 (40.7)	7 (20.5)	5 (19.2)	34 (29.8)
Eye irritation	5 (9.2)	3 (5.5)	1 (3.8)	9 (7.8)
Sickness absenteeism	18 (33.3)	16 (47.0)	1 (3.8)	37 (32.4)

Table 4: Skin disease profile of the study subjects according to their working section

*Parenthesis indicates percentage (%)

The severe skin symptoms of itching, burning sensation, rashes, peeling skin, dry skin, scaling skin and skin lesions were experienced by the subjects. The most affected body sites by the skin disorders

are in the order of hand > legs > hip & thigh > groin > foot & toes > face > chest and neck (Figure 5). It was informed by these workers that during summer season the skin infection exacerbate (36%).



Fig. 4: Diagnosis of Occupational skin disease in tanners



Fig. 5: Body proportions affected by skin disorder among the tanners

Predisposing Factors for Skin Diseases

Chi square test was performed to find the association between skin diseases incidence and the variables of worker's working section, chemical exposure, dust exposure, humidity, PPE usage, personal habits (tobacco chewing, smoking & alcohol intake), age, monthly income and with work experience (Table 5). The characteristics of working sections, chemical exposure, humidity and lack of PPEs usage were strongly associated with high incident of skin disorders among subjects (p<0.05).

Variables	Skin disorder n=52 (%)	p-value	
Working section	Pre-Tanning	34 (65)	
Working section	Tanning	14 (26.9)	0.010*
	Post Tanning	1 (7 9)	0.010
Δαρ	<30	15 (28 8)	0 266
/ ige	<u>_</u> 00 <40	21 (40.3)	0.200
	≥40	18 (34 6)	
Gender	Male	42 (80 7)	0 406
0.0.100	Female	10 (19.2)	000
Monthly income	<5000	2 (3.8)	0.835
······································	5000-8000	39 (75)	
	>8000	8 (15.3)	
Tobacco chewing habit	Yes	6(11.5)	0.248
3	No	46 (88.4)	
Smoking habit	Yes	11 (21.1)	0.515
C C	No	41 (78.8)	
Alcohol consumption	Yes	18 (34.6)	
·	No	34 (65.3)	0.700
PPE Usage	Yes	47 (90.3)	0.018*
-	No	5 (9.6)	
Taking bath after work	Yes	48 (92.3)	0.496
	No	4 (7.6)	
Hand wash	Yes	50 (96)	0.871
	No	2 (4)	
Chemical contact	Yes	28 (53.8)	0.001*
	No	24 (46.1)	
Dust exposure	Yes	23 (40.3)	0.143
	No	29 (59.6)	
Humidity	Yes	39 (75)	0.001*
	No	13 (25)	
Work experience	1-15	26 (55.4)	0.s774
	16-30	18 (34.6)	
	>30	8 (15.3)	
Sickness absenteeism	Yes	33 (63.4)	0.010*
	No	19 (36.5)	

Table 5: Predisposing factors of skin disorders among the tannery workers

* p value < 0.05

Discussion

Occupational contact dermatitis (OCD) has a significant impact on quality of life, work activity impairment, sickness absenteeism and economic recession.²⁶ Present study demonstrated occupational skin diseases prevalence among tannery workers in the study area, which was consistent with the findings

of similar studies.^{13,27-29} Likewise, a high prevalence of dermatitis was reported among Kenyan tannery workers.³⁰ Dermatophytosis, urticaria, Candidiasis, eczematous lesions and folliculitis were reported among Bangladeshi tannery workers.²⁸ A study among tannery workers of Indonesia leather processing industries showed a prevalence of 7.4% Occupational skin diseases.¹² Dermatological symptoms of skin rashes, itching and papules were reported among Indian leather tannery workers.^{27,31} Similarly high prevalence of occupational dermatitis was reported among Bangladesh and Sudan tannery workers (67.4%).^{5,13}

The present study reported high prevalence of occupational dermatitis (38%) among tannery workers than several other studies of Indonesia, Kenya, Argentina, Korea and two Indian studies.^{12,27,31-33} The differences in the working conditions and the sampling size may also affect the prevalence rate reported among the tanners.¹² In present study chronic and recurrent skin disorder was found among 10% of workers. Prolonged period of exposure to allergens or irritants associated with recurrent occupational dermatitis.34 This study also found severe skin complications among the workers, which was similarly reported in other studies as occupational aggravate.^{5,13,35} The severity varies on individual physical characteristics including allergen sensitivity, immune capacity and exposure duration to the contaminants.³⁶ Occupational factors may play a synergistic role with pre-existing predisposition to allergy.37

In present study the major chemicals reported to be handled by workers in pre-tanning and tanning process aredemonstratedas potential irritant and sensitizer.4 Chromium sulphate, N-diphenylguanidine, benzidine and sodium metabisulfite were demonstrated as sensitizing agent to the exposed workers.12 Chromium induced hyper-pigmentation of skin was reported by Al-Hossain et al.,38 A study found chromate as frequent allergen to tannery workers that increased serum immunoglobulin E (IgE) level.39 Workers are exposed to the chemicals while loading, unloading, handling and discarding. The possible exposure routes are inhalation, ingestion and skin absorption. The exposure to chemical agents pose occupational hazard to the workers engaged in these environment, if failed to adopt appropriate personal protective equipments (PPEs).

Present study found 30% of the study subjects did not use any kind of PPE's atwork, it has been stated that workers who wore gloves were less likely to develop skin diseases compared to those did not wear gloves.⁴⁰ A significant association between lack of PPE use and increased incidents of skin disorder was demonstrated in present study (p<0.05). This finding was concordant with the findings of Hasan *et al.*,⁵ In the study area the workers substitutethe unavailability of PPEs with self-designed impermeable protective equipments such as plastic covers and rubber covers. These indicate inappropriate safety practice at workplace, which increase the chances of hazard exposure. The rubber gloves used as personal protective equipment can cause leukoderma as reported by Raidas *et al.*,⁴¹ In developing countries like India the awareness level about health risk and PPE use at workplace are short due to inadequate training.

In the present fungal dermatitis was identified among 11.4% subjects. Few studies reported dermatophytosis among tannery on dermatological examination.^{12,28} Present study identified the causative fungal agents in the view of appropriate treatment. The improper treatment for tinea infections may progress to chronic, recurrent, recalcitrant and multisite infection.¹⁹ The fungal skin lesions may widespread and may impact on social, psychological, and occupational health effects, and the quality of life.42 Bacterial skin infections were associated with contact dermatitis in present study. The important predisposing factor for fungal skin infection was wet and humid working conditions. The work environment of pre-tanning and tanning sections were recorded with hot and high humid conditions.12

Present study found that OSD was prevalent among the workers involved in pre-tanning and tanning process. These emphasize the workers in pre-tanning sections and tanning sections are prone to health issues due to work place exposure. Occupational skin diseases were high among beam house workers compared with other leather processing departments. During beam house activities the handling of wet hides with bare hand exposed to sulfuric acid, a strongly corrosive agent may cause permanent damage to skin.33 Workers with occupational skin diseases (OSD) were significantly correlated with hazardous risk factors of chemicals contact, inhalation of dust, smoke or vapor, fumes, low and high temperature and humidity.43

Occupational skin diseases among work population are easily treatable and can be preventable, if appropriate preventive measures, workplace improvement and prior training on employment are effectively implemented.

Conclusion

Occupational skin disorders were found to be prevalent among tannery workers. They were followed and treated efficiently. This study also demonstrates the burden of skin disease among tannery workers and its impact on quality of their normal life. Identification of fungal skin infectionsis crucial to prevent chronic and recurrent infections. The study finding emphasizes that pre-tanning section and tanning sections were more susceptible to occupational skin diseases. This working environment serves as a predisposing factor for skin disease morbidity. Obligate use of PPE, workplace improvement, education and frequent surveillance programmes, early identification and treatment could minimize the Occupational skin diseases burden in tannery workers.

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Conflict of Interest

The authors declare that they have no competing interests

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