African Journal of Urology

ORIGINAL RESEARCH

Open Access

Prevalence of urinary symptoms and infections among traditional tannery workers in the Fez city of Morocco: case–control study

Arhoune Ilham[1,2*], Hoummani Hasnae[1,2], Arhoune Btissam[3], Belaroussi Leila[4,5], El Fakir Samira[5] and Achour Sanae[1,2]

Abstract

Background: Many work activities such as leather tanning include hazards to work. Among these, biological hazards are particularly important and pose a serious problem to human health and environment. The aims of this study were to estimate the prevalence of dysuria and urinary tract infections among tannery workers and to identify their risk factors.

Methods: This observational survey was conducted among 220 tannery workers and 220 age-matched control group from Fez city in Morocco. Reported urinary symptoms, demographic and professional information were obtained by a standardized questionnaire collected from participants and were then compared among the two groups. The logistic regression model was used to explore the interaction between variables with significant association.

Results: The most common symptoms reported by tannery workers and controls were dysuria (36.4% vs. 1.8%, $p < 0.001$), voiding frequency (15.5% vs. 0.9%, $p < 0.001$) and incontinence (3.2% vs. 0.5%, $p < 0.001$). A positive urinary culture was seen in 3.64% of the tannery workers but not in the controls (0%). *E-coli* was the only species. Multivariate logistic regression showed that exposure to biological hazards increased significantly the odds of dysuria by 6.76 times (CI 1.112–41.78; $p = 0.038$) but rather, low or normal weight was a protective factor of dysuria (OR 0.53; CI 0.249–0.950; $p = 0.035$).

Conclusion: Multiple working conditions including exposure to biological hazards may cause an increase in urogenital disorders in the tannery workers. A significantly higher prevalence of urinary symptoms among male workers demand serious attention and further investigation.

Keywords: Biological hazards, Dysuria, Tannery workers, Risk factors, Urinary tract infection

1 Background

Recently, infectious diseases including microorganisms have been identified as the most common occupational diseases [22]. In the tanning sector, the processing of animal hides requires significant water usage, causing a high humidity working environment, when combined with elevated temperature and low oxygen concentration, the high-humidity environment acts as a catalyst for

*Correspondence: ilham.arhoune@usmba.ac.ma; arhoune.ilham@gmail.com
[1] Laboratory of Biomedical and Translational Research, Faculty of Medicine, Sidi Mohammed Ben Abdellah University, KM 2.200 Road Sidi Hrazem, Post Office Box 1893, 30070 Fez, Morocco
Full list of author information is available at the end of the article

microbial growth [3, 11]. The raw skins containing carbohydrates, fats and proteins, as well as a high moisture content, provide an ideal medium for the rapid reproduction of microorganisms [18]. In addition to the working environment and raw skins, some tannery agents, such as oils, greases, pigeon dungs, and protein binders, also provide nutrients for microorganism propagation [8, 13]. An association between infectious diseases, humidity and temperature has been established because most of bacteria and fungi require specific environmental conditions to proliferate [19]. The most frequent bacteria isolated from hides and skins delivered directly to the tannery without prior treatment include: *Escherichia coli, Staphylococcus epidermidis, Morganella morganii, Proteus mirabilis, Proteus vulgaris, Bacillus anthracis, Bacillus subtilis, Pseudomonas aeruginosa, Lactobacillus Jensen and Bacillus mycoides* [3, 19]. The possibility of contracting urinary infection is a constant hazard for the tannery workers, because the animal skin and leather product contain many microorganisms that have been identified in urogenital diseases [20]. For example, *Escherichia coli* and *Enterobacter* species can cause urinary tract infection, wound infection and abscesses septicaemia.

Symptoms of urinary tract infection (UTI), particularly dysuria, become more prevalent in men with increasing age. Although many physicians equate dysuria with UTI, it is actually a symptom that has many potential causes. Any source of irritation or inflammation of the urinary tract, particularly the bladder, prostate or urethra, can cause dysuria [2, 9]. It is difficult to draw conclusions about causes from comparisons of symptoms. However, such comparisons are useful in describing the subjects-perceived problems, and within country analyses may help to improve methods for the study of urological conditions.

Therefore, information on biological hazards related to urinary tracts in tannery workers has not been widely researched, which justifies this study and demonstrates its importance. Therefore, this study was designed to estimate the prevalence of urinary symptoms and urinary tract infection in tannery workers and to identify associated factors.

2 Methods
2.1 Study design and participants
This case–control study was conducted in traditional tanneries of Fez city in Morocco from September 2017 to March 2018. It has included 220 male tannery workers aged ≥ 18 years having at least one year of work experience, and 220 age-matched male subject (control group). The selection of the control group was collected randomly from different activities (textile workers, administrative personnel and sellers in the informal sectors).

2.2 Data collection
For each participant, demographic data including age, education level, marital status and smoking habits were investigated. Other occupational conditions including duration of work, exposure to biological hazards (raw skins and pigeon dungs that may be contaminated with a variety of bacteria, molds, virus, yeasts and various diseases), working environment: humid area (tasks in the basins) and dry place (tasks far from the basins) were collected from the tannery workers by a questionnaire-based interview. Participant tanners were also asked to determine the status of the use of Personal Protective Equipment (PPE) regarding boots and gloves. In addition, Urinary Tract symptoms (UTS) and related hygienic conditions were also collected including a total of 7 questions (increased daytime frequency, nocturia, urgency, incontinence, dysuria, frequency of toilet break access and use tissue/water after toilet). The personal medical history including blood pressure (BP) and body mass index (BMI) of participants were measured following standard procedures. This index classifies the nutritional status of the subject into four categories: underweight < 18.5 kg/m^2, normal 18.5–24.9 kg/m^2, overweight 25.0–29.9 kg/m^2 and obese ≥ 30 kg/m^2.

2.3 Sample collection
The participants were asked to provide a fresh 10 ml spot urine sample in the morning of a normal working day. The urine cytology was quantitatively performed using the Sysmex UF-1000i urinary system (TOA Medical Electronics, Kobe, Japan) to estimate white blood cell (WBC) count, red blood cell (RBC) count and bacteria. All urine samples were examined on the same day as the urine samples were delivered.

2.4 Microbiological analysis
Urines were cultured and incubated at 37 °C for 24 h. Presumptive Enterobacteriaceae (oxidase-negative, facultative aerobic, Gram-negative rods) were identified by using the API 20E system (bioMérieux, Marcy-l'Étoile, France) and confirmed by method automated on Phoenix. Antimicrobial susceptibility was determined as recommended by the French Society of Microbiology (SFM, 2013).

UCBE interpretation was performed according to the guidelines mentioned in the medical microbiology guidelines (REMIC) [15]. More than 10^4 cells/ml was considered as abnormal value for the number of average RBC and WBC in the urine.

A participant was diagnosed as having a UTI if they had clinical symptoms of UTI and the urinalysis showed bacteria (bacteriuria). Significant bacteriuria was defined

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as $\geq 10^3$ colony-forming units (CFUs)/ml of a single bacterial species in a freshly voided sample of urine as mentioned in the 2015 French guidelines [5].

2.5 Data analysis

The descriptive statistics technique was used for the description of demographic variables. The prevalence of urinary symptoms and UTI were reported. The Chi-square test was used to establish the possible associations between the presence of dysuria, demographic and occupational parameters. Parameters with $p < 0.05$ were considered statistically significant. The binary logistic regression model was used as a multivariate analysis to determine the factors related to dysuria. Data analysis was performed using the statistical software package SPSS 17.0.

3 Results

3.1 General characteristics, prevalence of urinary symptoms and hygienic conditions among tannery workers and control group

Data collection in the current study was completed from 220 tannery workers and 220 control group. Demographic, clinical history and occupational characteristics of the two groups are presented in Table 1. Results showed that more than half of tannery workers (52.7%) were between 40 and 60 years of age, 28.2% were relatively young and 84.5% were married. Then, they were likely to be more sexually active. No significant difference was found between tannery workers and controls with respect to age, smoking habit and marital status. Smoking was slightly more frequent in tannery workers than the control group (29.1% vs. 20.9%, p = 0.61). Primary school was the most prevalent education level in tannery workers (49.5%) compared to control group (28.2%). For occupational parameters, the majority of tannery workers (72.3%) were involved in a humid area in these tanneries. Moreover, 73.6% of them were exposed to various biological hazards and 69.5% of them they did not use any type of professional protective equipment.

Table 2 shows that the tannery workers had a higher prevalence of many urinary symptoms and related work conditions, except for nocturia which was significantly higher in the control group.

In particular, tannery workers had a significantly higher prevalence of dysuria compared to controls (36.4% vs. 1.8%, $p < 0.001$). No significant difference was found in the prevalence of urinary incontinence between the two groups. In terms of toilet access and hygiene measures, about half of tannery workers (49.1%) and 40.4% of comparison group require 3 or more toilet breaks in a day. Moreover, very few of them reported they did not use tissue/water after using a toilet.

Table 1 Comparison of general characteristics between tannery workers and control group

Characteristics of the study population	Tannery workers n = 220 (%)	Control group n = 220 (%)	*p*-value
Age (years)			
18–40	62 (28.2)	84 (38.2)	0.063
41–60	116 (52.7)	105 (47.7)	
> 60	42 (19.1)	31 (14.1)	
BMI (Kg/m²)			
Underweight-normal	117 (62.2)	93 (52.5)	**0.039**
Overweight-obesity	71 (37.8)	84 (47.5)	
Educational level			
Illiterate	74 (33.6)	53 (24.1)	**0.018**
Literate	146 (66.4)	167 (75.9)	
Marital status			
Unmarried	34 (15.5)	29 (13.2)	0.230
Married	186 (84.5)	191 (86.8)	
Smoking			
Yes	64 (29.1)	46 (20.9)	0.610
No	156 (70.9)	174 (79.1)	
Biological hazards exposure			
Yes	162 (73.6)	–	–
No	58 (26.4)	–	
PPE use			
Yes	56 (25.5)	–	–
No	153 (69.5)	–	
Working area		–	
Humid area	159 (72.3)	–	–
Dry place	61 (27.7)	–	
History of clinical conditions			
Diabetes	11 (5.0)	21 (9.5)	**0.049**
High blood pressure (HBP)	34 (15.5)	20 (9.1)	**0.029**

PPE personal protective equipment

3.2 UCBE results

The results of UCBE are displayed in Table 3. A significant number of tannery workers had $\geq 10^4$ RBCs (hematuria) and $\geq 10^4$ WBCs (leucocyturia) in their urine, where the number of hematuria and leucocyturia in tannery workers was higher than those of the control group (22.7% vs. 1.8%, $p < 0.001$ and 10.9% vs. 1.8%, $p < 0.001$; respectively). Urinary tract infection was detected among 8 (3.64%) of the tannery workers but not in the controls (0%).

E. coli was the unique species isolated from the tannery workers having a positive culture. Chi-square-test results of urinary parameters showed significant differences between the tannery workers and controls, which indicates that tannery workers had a higher risk of urinary system abnormalities than those of the controls

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Table 2 Prevalence and comparison of urine analysis results among the two groups

Parameters	Tannery workers (n = 220), n (%)	Control group (n = 220), n (%)	p-value
RBC			
(Cells/ml)			
> 10^4	50 (22.7)	4 (1.8)	< 0.001
≤ 10^4	170 (77.3)	216 (98.2)	
WBC			
(Cells/ml)			
≥ 10^4	24 (10.9)	4 (1.8)	< 0.001
< 10^4	196 (89.1)	216 (98.2)	
Bacteria			
CFU/ml			
≥ 10^3	8 (3.64)	0 (0)	< 0.001
< 10^3	212 (96.36)	220 (100)	

Bold text indicates a statistically significant difference with a *p*-value less than 0.05

RBC red blood cells, *WBC* white blood cells

Table 3 Prevalence of urinary symptoms and hygienic conditions for tannery workers and control group

Urinary symptoms[a]	Tannery workers n (%)	Control group n (%)	p-value
Dysuria	80 (36.4)	4 (1.8)	< 0.001
Incontinence	18 (8.2)	16 (7.3)	0.430
Nocturia (≥ 3 time/night)	15 (6.8)	38 (17.3)	0.001
Toilet break access (time/day)			0.021
0	0 (0)	6 (2.7)	
1–2	112 (50.9)	125 (56.8)	
3	59 (26.8)	54 (24.5)	
≥ 4	49 (22.3)	35 (15.9)	
Use tissue/water after toilet			0.002
Yes	194 (88.2)	211(95.9)	
No	26 (11.8)	9 (4.1)	

[a] Subjects may have more than one urinary symptom

(Table 3). Multivariate logistic regression of urinary tract confirmed by bacteriological examination, socio-demographic and occupational factors showed no association in tannery workers and controls ($p > 0.05$).

3.3 Association between socio-demographic parameters, work conditions and the presence of dysuria in tannery workers

The results of the association between socio-demographic characteristics, work conditions and the presence

of dysuria in tannery workers, are indexed in Table 4 and considered as candidate variables to the multivariate analysis. In terms of age, workers being more than 40 years showed more urinary symptoms than young ones. However, the Chi-square test shows no significant relationship between age and dysuria ($p = 0.27$). A statistically significant relationship was established between BMI and dysuria ($p = 0.018$). Moreover, the educational level, marital status, smoking habits and diabetes do not affect the reported dysuria in tannery workers. The statistically significant predictors of dysuria were biological hazards exposure ($p = 0.003$) and working area ($p = 0.017$). Since the tannery workers had direct exposure to biological hazards without appropriate PPE,

Table 4 Association between dysuria in tannery workers, demographic and professional characteristics

Variables	PS+	PS−	p-value
Age (years)			0.270
≤ 40	25 (40.3)	37 (59.7)	
> 40	55 (34.8)	103 (65.2)	
BMI (Kg/m^2)			**0.018**
Low-normal	53 (42.7)	71 (53.3)	
Overweight-obesity	27 (28.1)	69 (71.9)	
Educational level			0.230
Illiterate	24 (32.4)	50 (67.6)	
Literate	56 (38.4)	90 (61.6)	
Marital status			0.491
Unmarried	10 (34.5)	19 (65.5)	
Married	70 (36.6)	121 (63.4)	
Smoking			0.350
Yes	25 (39.1)	39 (60.9)	
No	55 (35.3)	101 (64.7)	
Biological hazards exposure			**0.003**
Yes	68 (42.0)	94 (58.0)	**0.003**
No	12 (20.7)	46 (79.3)	
PPE uses			0.425
Yes	4 (44.4)	5 (44.6)	
No	76 (36.0)	135 (64.0)	
Working area			**0.017**
Humid area	65 (40.89)	94 (59.11)	
Dry place	15 (24.59)	46 (75.41)	
Diabetes			
Yes	3 (27.3)	8 (72.7)	0.381
No	77 (36.8)	132 (63.2)	
High blood pressure (HBP)			**0.027**
Yes	7 (20.6)	27 (79.4)	
No	73 (39.2)	113 (60.8)	

Bold text indicates a statistically significant difference with a *p*-value less than 0.05

PS+, presence of dysuria

the Chi-square test shows no significant relationship between the use of PPE and the onset of the reported dysuria ($p = 0.425$). Workers who have high blood pressure (HBP) are not the most affected by dysuria symptom. In spite of this, Chi-square test represents a statistically significant relationship between the presence of HBP and reported dysuria ($p = 0.027$).

3.4 Multivariate logistic regression analysis of factors associated with dysuria in tannery workers, demographic characteristics and work conditions

The logistic regression model was used to explore the interaction between variables with significant association with dysuria symptom in the Chi-square test already done (Table 5). In this step, a logistic regression model has been conducted to explore the interaction between parameters with a significant association with dysuria in the Chi-square test already done. The OR brut and OR adjusted have been compared to each selected variable. Results showed that exposure to biological hazards was the major risk factor that increased 6 times or more the risk of developing dysuria with (ORa = 6.76, CI = 1.107–41.349, $p = 0.038$). In contrast, having low or normal weight (BMI < 25 kg/m2) was an independent protective factor of dysuria after adjusting which had an adjusted OR of 0.53 and a 95% CI of 0.249–0.950 ($p = 0.035$).

4 Discussion

The present study reports an important health issue on urinary disorders among workers from traditional leather tanneries as well as compares these disorders with the control group. In terms of toilet access and hygiene measures, about half of tannery workers require 3 or more toilet breaks and the majority of them use tissue/water after toilet. More than two thirds of tanners do not use any type of PPE. However, they reported that the use of PPE was impractical due to the high humidity in Moroccan artisanal tanneries, especially in summer. The high rate of low educational level as one of the factor limited knowledge about the existing health hazards and safety risks at work. Thus, they are at increased risk of contaminants from all possible routes including the oral, inhalation, ocular and dermal.

Regarding voiding problems, the results of our study showed a significant difference urinary tract symptoms (UTS) for voiding problems including dysuria and urinary frequency between the tannery workers and control group. It is true that UTS are not specific and can be increased by factors unrelated to prostatic conditions, fluid intake, including diet and alcohol intake [1, 23, 26]. The finding may sound alarming because many of them report that they suffer from burning urination and uncontrollable urine loss during work. Out of 111 (55%) tannery workers with urinary symptoms, 3.67% had significant bacteriuria as confirmed by bacteriological examination. In comparison with symptomatic controls (1.8%), no bacteriuria were identified (0%). *E. coli* was the only specie isolated among tannery workers having positive culture. Some infectious diseases such as UTI caused by *E. coli* are common in the general population, which complicates the attribution to the workplace [14]. According to the Biological Agent Biodefense Category listed in the World Health Organization (WHO) and the National Institute of Health (NIH), *E. coli* is a pathogen that does not constitute a serious hazard to the community or to the environment [25]. On the other hand, Chinese Laboratory Biosafety Categorization has classified *E. coli* as a pathogenic agent that can spread easily

Table 5 Comparison between ORb and ORa calculated by binary logistic regression for tannery workers

Paramètre	OR_b	CI (95%)	*p*	OR_a	CI (95%)	*p*
BMI (Kg/m^2)						
≤ 25	0.524	(0.297–0.927)	**0.018**	0.533	(0.249–0.950)	**0.035***
> 25	1			1		
Humid area						
Yes	2.121	(1.366–5.268)	**0.003**	0.360	(0.063–2.075)	0.253
No	1			1		
Biological hazards exposure						
Yes	2.773	(1.093–1.547)	**0.017**	6.76	(1.107–4.349)	**0.038***
No	1			1		
HBP						
Yes	0.401	(0.166–0.969)	**0.027**	0.421	(0.168–1.050)	0.064
No	1			1		

Bold text indicates a statistically significant difference with a *p*-value less than 0.05

OR_b, odds ratio brut; OR_a, odds ratio adjusted; CI, confidence interval

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between people, directly or indirectly, and can cause serious human disease [25]. In the general population, there are several causes of culture-negative urinary tract symptoms including antibiotics in urine, urinary tract malignancy, idiopathic interstitial cystitis, mycobacterial infection, Schistosoma haematobium, fungal infection, viral infection, inflammation or fastidious organisms [10]. A major factors that impact UTI incidence in our study includes poor hygienic conditions, working in a humid area and exposure to biological hazard especially, in the traditional working environment. In agreement with our study, poor sanitation, hygienic measures have a major influence on *E. coli* species [28]. However, protection strategies, as well as monitoring, are recommended for this community.

Urinalysis is a useful tool to identify not only infection, but also blood counts. In the current study, the hematuria was significantly prevalent in the tannery population compared to the control group (22.9% vs. 1.9%, $p < 10^{-3}$). The prevalence of hematuria found in our control group (1.9%) was lower than that reported in large previous screening studies among the general population which varied from 9 to 18% [12, 17, 21], particularly in the male population presenting to a health fair (8.6%) [6]. The multivariate analysis of factors associated with hematuria was conducted and showed no increased risk in the tanners' population. Previous risk factors identified of urinary tract malignancy diagnosed following hematuria were age, smoking, the presence of gross hematuria and positive cytology [4, 17]. Moreover, diabetes and proteinuria were also associated with hematuria in another research [6].

The prevalence of leucocyturia (WBC > 10^4), in the present study, was significantly higher in the tannery workers compared to that of the control group (10.9% vs. 1.8%, $p < 10^{-3}$). It was reported that the leukocyturia could suggest sterile pyuria and cannot reflect the possibility of bacteriuria. However, main Clinical Associations including acute or chronic interstitial nephritis, proliferative glomerulonephritis and urological disorders were reported [24]. In such cases, the correct interpretation of the urinary findings requires adequate clinical information and possibly renal biopsy.

Several studies have demonstrated that voiding symptoms among men increase significantly with age and functional disability [16, 21]. Other factors have been implicated in the dysuria progression including metabolic disorders [7]. Data from previous studies highlight an association between high blood pressure, high BMI, diabetes and urinary disorders including dysuria [7, 23, 27]. In the present study, the risk to develop dysuria was associated with different factors such as BMI and high blood pressure but not necessarily age. Thus, multiple

working conditions were also found to be correlated with increased risk of dysuria including working area and exposure to biological hazards. These factors are significant in bivariate analysis. The choice of the symptom 'dysuria' for logistic regression was due to the elevated rate of this symptom compared to others reported in the current study. The multivariate logistic regression analysis of factors associated with reported dysuria symptom investigates that exposure to biological hazards increased significantly the odds of dysuria by 6.76 times. However, having low or normal weight (BMI < 25 kg/m^2) was an independent protective factor of dysuria. In fact, it is difficult to draw a firm conclusion about causes from observational comparisons of symptoms. Nevertheless, such comparisons are useful in describing the workers-perceived problems in the traditional work environment, to prevent various complications and improve working conditions.

In this context, a significantly higher prevalence of urinary symptoms among male workers demands a serious attention and further investigation. The low number of occupational diseases linked to biological agents should not lead to an underestimation of biological risks, but should be used as a basis for a decision to reduce the number of occupational risks. Since the exposure of traditional tannery workers to biological agents cannot be avoided, it will be reduced by the establishment of occupational health program based on the development of inter-enterprise medical service (pre-employment and periodic), the organization of medical surveillance program and provision of information/training about hazards and risks in the workplace.

5 Conclusion
The present study suggests that multiple working conditions, including humid area and exposure to biological hazards, may cause an increase in the urinary tracts in the tannery workers. A significantly higher prevalence of urinary symptoms among male workers demands serious attention and further investigation. In order to prevent health issues among the tannery workers, we suggest that medical observation, including pre-employment and periodic medical controls, should be performed.

Authors' contributions
AI conceived and designed the analysis, collected the data, contributed data or analysis tools, performed the analysis, and wrote the paper. HH conceived and designed the analysis and collected the data. AB performed the analysis and critical revision of the article. BL collected the data and critically revised

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the article. ES conceived and designed the analysis, contributed data or analysis tools and performed the analysis. AS conceived and designed the analysis, critically revised the article, and was involved in the final approval of the revision to be published. All authors have read and approved the manuscript.

Availability of data and materials
Not applicable.

Declarations

Ethics approval and consent to participate
The current survey was designed in accordance with legal requirements and the Declaration of Helsinki and was approved by the Joint Research Ethics Committee of Medical School and university Hospital Hassan II of Fez, Morocco (Number 29/16)". People who accepted to participate in the study were requested to provide written informed consent. The UCBE analysis results were interpreted and delivered to the subjects confidentially.

Consent for publication
Not applicable.

Competing interests
The authors have no conflicts of interest to declare.

Author details
[1]Laboratory of Biomedical and Translational Research, Faculty of Medicine, Sidi Mohammed Ben Abdellah University, KM 2.200 Road Sidi Hrazem, Post Office Box 1893, 30070 Fez, Morocco. [2]Pharmaco-Toxicology Service of CHU Hassan II, Avenue Hassan II, PO Box: 1835, 30050 Fes, Morocco. [3]Laboratory of Microbiology and Molecular Biology, Faculty of Medicine and Pharmacy, Sidi Mohammed Ben Abdellah University, KM 2.200 Road Sidi Hrazem, Post Office Box 1893, 30070 Fez, Morocco. [4]Occupational Health Service of CHU Hassan II, Avenue Hassan II, PO Box: 1835, 30050 Fes, Morocco. [5]Laboratory of Epidemiology Clinical Research and Community Health, Faculty of Medicine, Sidi Mohammed Ben Abdellah University, KM 2.200 Road Sidi Hrazem, Post Office Box 1893, 30070 Fez, Morocco.

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