Occupational Exposure to Domestic Waste and Oral Mucosal Lesions: a Cross-Sectional Study

Exposição Ocupacional a Resíduos Domésticos e Lesões de Mucosa Oral: Estudo Transversal

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Abstract

This study aimed to evaluate the occurrence of oral mucosal lesions (OML) in domestic waste collectors and their association with occupational exposure to domestic waste. This cross-sectional study included 295 adult men who worked in a waste management company: 129 men were exposed to domestic waste during their labor of waste collection, and 166 were not. The waste collectors used personal protective equipment. The lips, buccal mucosa and sulcus, gum, alveolar ridge, tongue, the floor of the mouth, and soft and hard palate were evaluated. The chi-square or Fisher's exact test assessed the variables associated with OML (P ≤ 0.05). Twenty-five OMLs were observed in 22 volunteers, 8 in the exposed and 17 in the non-exposed group. Actinic cheilitis in the lips and candidiasis were the most common lesions in both groups. OML was not associated with waste exposure (OR= 0.72, 95% CI = 0.29-1.77, P = 0.47). There was no association between domestic waste exposure and actinic cheilitis (OR = 0.70, 95% CI= 0.23-2.15, P = 0.37), candidiasis (OR = 0.42, 95% CI= 0.08-2.12, P = 0.24) or leukoplakia (OR = 0.99, 95% CI= 0.97-1.01, P = 0.32). Actinic cheilitis in the lips and candidiasis were the most common lesions in both exposed and non-exposed groups. Occupational exposure to domestic waste was not related to OML. Proper use of personal protective equipment may have prevented the development of OML in domestic waste collectors.

Keywords: Cross-Sectional Studies. Oral Mucosa. Epidemiology. Occupational Health. Waste Pickers.

Resumo

Este estudo teve como objetivo avaliar a ocorrência de lesões de mucosa oral (LMO) em coletores de lixo doméstico e sua associação com a exposição ocupacional a resíduos domésticos. Este estudo transversal incluiu 295 homens adultos que trabalhavam numa empresa de gestão de resíduos: 129 homens foram expostos a resíduos domésticos durante o seu trabalho de coleta de resíduos e 166 não. Os coletores de lixo usavam equipamentos de proteção individual. Foram avaliados lábios, mucosa bucal e vestículo, gengiva, rebordo alveolar, língua, assoalho da boca e palato mole e duro. O teste qui-quadrado ou exato de Fisher avaliou as variáveis associadas à LMO (P ≤ 0,05). Vinte e cinco LMO foram observadas em 22 voluntários, 8 no grupo exposto e 17 no grupo não exposto. Queilite actínica nos lábios e candidíase foram as lesões mais comuns em ambos os grupos. A LMO não foi associada à exposição a resíduos (OR = 0,72, IC 95% = 0,29-1,77, P = 0,47). Não houve associação entre exposição a resíduos domésticos e queilite actínica (OR = 0,70, IC 95% = 0,23-2,15, P = 0,37), candidíase (OR = 0,42, IC 95% = 0,08-2,12, P = 0,24) ou leucoplasia (OR = 0,99, IC 95% = 0,97-1,01, P = 0,32). A queilite actínica nos lábios e a candidíase foram as lesões mais comuns nos grupos expostos e não expostos. A exposição ocupacional a resíduos domésticos não esteve relacionada com LMO. O uso adequado de equipamentos de proteção individual pode ter evitado o desenvolvimento de LMO em coletores de lixo doméstico.

Palavras-chave: Estudos Transversais. Mucosa Oral. Epidemiologia. Saúde Ocupacional. Catadores.

1 Introduction

Waste management, encompassing the collection, transport, sorting, processing, and disposal of waste, is a significantsocial issue owing to its environmental impact and effects on human health. Waste collectors are particularly affected since they are exposed to various physical, ergonomic, chemical, biological, and psychosocial hazards in the workplace[1].

Occupational exposure to waste has been related with respiratory, gastrointestinal, dermatological and musculoskeletal disorders, as well as hearing loss, and viral infections[1-3]. Adverse oral health effects have also been related, including tooth damage, dental caries, toothache, and damage to the buccal mucosa cell[4-6]. Continuous exposure to domestic waste has been linked to pyknosis and karyolysis of buccal mucosa cells, which are associated to the development of many oral mucosal lesions (OMLs), including oral cancer and premalignant oral diseases such as leukoplakia, oral lichen planus, oral submucous fibrosis, and erythroplakia[7]. Pyknosis and karyolysis are metanuclear alterations indicative of cytotoxicity used for evaluating cytogenetic damage[8]. These processes represent the final stages of cell death . Pyknosis involves the shrinkage of the cell nucleus, while karyolysis refers to the dissolution of nuclear chromatin[9]. Nonetheless, the association between occupational exposure to domestic waste on OMLs remains undetermined.

Domestic waste collectors are exposed to many different

types of waste. In Brazil, domestic waste can include organic waste (kitchen waste, vegetables, flowers, leaves, and fruits), toxic waste (old medicines, paints, chemicals, bulbs, spray cans, fertilizer and pesticide containers, batteries, and shoe polish) and other chemicals, recyclable items (paper, glass, metals, plastics), and cloth soiled with body fluids and feces[10]. Moreover these workers are also exposed to intense sunlight throughout the year, particularly in the Northeast region of Brazil, where this study was developed, where ultraviolet radiationlevels arehigh and show minimal seasonal variation.

Considering that mutagenic and cytotoxic factors induced by waste exposure can lead to genomic instability and cytotoxic damage in oral mucosa cells[5,12], we hypothesized that domestic waste collectors may exhibit a higher prevalence of OMLs, and that such lesions areassociated with their occupational exposure to domestic waste. Therefore, this study aimed to investigated the occurrence of OML in domestic waste collectors and explore the potential association between these lesions and their occupational exposure to domestic waste.

2 Material and Methods

The research wascarried out following The Code of Ethics of the World Medical Association and was approved by the Institutional Research Ethics Committee (protocol 1.023.054). All participants received detailed explanations about the study and signed a consent form.

This cross-sectional investigation used a convenience sample of 295 adult male individuals employed by the the waste management company responsible for the daily collection and transport to a landfill site of domestic waste from private homes from most of the city (Revita Engenharia Sustentável, Salvador, Brazil). Direct contact with domestic waste served as the exposure factor, while the presence of OML was the outcome of interest.. Among the participants, 129men were directly exposed to domestic waste during labor, and 166 did not. Employees with direct contact with the waste were exposed for 8 hours/day, five days/week, during waste collection activities Unexposed subjects worked as drivers, mechanics, technicians, and managers.

The independent variables were sociodemographic (age, income, education level), environmental (smoking and drinking habits) and labor (position held, employment time, shift work) factors, and a previous diagnosis of diabetes.

The inclusion criteria were: individuals aged ≥ 18 years and male gender. Workers with uncontrolled systemic diseases, including severe metabolic disease, cardiopulmonary failure, active infection, and radiation therapy or chemotherapy for cancer treatment were excluded. Women represented a small proportion of employees. Then they were excluded from the study

A single trained dentist collected the data between September 2016 and March 2017. Initially, in-person interviews were conducted using a structured form to gather the data position held, sociodemographic, environmental, and labor factors and systemic health.

Clinical examinations were performed at the company headquarters under natural light, with subjects seated on regular chairs. The examination of theo ral mucosa followed the criteria outlined by the World Health Organization [13]. It involved a systematic evaluation of of various oral structures, including the lips, labial mucosa and sulcus, commissures, buccal mucosa and sulcus, gingiva and alveolar ridge, tongue, the floor of the mouth, and soft and hard palate. Parameters such as color, texture, and any abnormalities were evaluated. Whenever an OML was found, its location, clinical diagnosis, and clinical description were recorded.

A stepwise protocol was used to diagnose OMLs, including clinical examination by the field examiners, review of clinical records and photographs by an experienced pathologist, and referral of cases to the stomatology service of UFBA for further clinical assessment, treatment, and biopsy whenever indicated.

Two hundred and ninety-eight workers were included in the statistical analysis, after excluding cases with missing data. The presence of oral lesions was the dependent variable. The independent variables were categorized as follows: age, ≤ 37 years or ≥ 38 years (38–61) based on the median age; education level, ≥ 9 years of schooling (complete elementary and middle school) or < 9 years of schooling [14]; economic status, monthly income $\leq$ US\$250.00 (the Brazilian minimum wage) or $>$ US\$250.00; duration of employment time, ≤ 4 years or > 4 years based on the median. The labor shift was categorized as day shift or night shift. Subjects were also classified as alcohol–dependent (according to an alcohol use disorder identification test [AUDIT] score ≥ 8) or non-dependent [15], as current non–smoker or smoker, and as diabetic or non-diabetic

Missing data were omitted from the statistical analysis. Descriptive analysis was conducted, computing frequencies for the categorical variables. The chi-square ($n > 5$) or Fisher ($n \leq 5$) test was employed to evaluate the associations between the presence of OML (the dependent variable) and the independent variables and between the most prevalent OML and domestic waste exposure. The odds ratios (OR) and 95% confidence intervals (CI) were calculated. A P-value < 0.05 was considered statistically significant. Data were analyzed using the SPSS 15.0 program (SPSS Inc., Chicago, IL, USA).

3 Results and Discussion

The sociodemographic analysis showed that most participants were ≤ 37 years old, had ≥ 9 years of schooling, and had an income of ≤ 250 US\$/month. Regarding occupational features, 44% reported direct exposure to domestic waste, while 49% had been employed at the company for 5 to 30 years, and 23% worked at night. Furthermore, 46 % of the individuals showed alcohol dependence, and 17% reported a smoking habit. Additionally, 2% of the volunteers had diabetes (Table 1).

Table 1 - Characteristics of the sample and analysis of the association between oral mucosal lesions and the independent variables (N = 295)

Variables	Oral Mucosal Lesion					
	Total	Yes	N	OR	95% CI	p
			n(%)			
Sociodemographic						
Age				1.66	0.69-4.01	0.26[a]
≤ 37 years	155 (52.5%)	9 (40.9%)	146 (53.5%)			
≥ 38 years	140 (47.5%)	13 (59.1%)	127 (46.5%)			
Education level (years of school)				1.59	0.65-3.85	0.21[a]
< 9	92 (31.2%)	9 (40.9%)	83 (30.4%)			
≥ 9	203 (68.8%)	13 (59.1%)	190 (69.6%)			
Monthly income (US$)				1.28	0.53-3.10	0.37[a]
< 250.00	157 (53.4%)	13 (59.1%)	144 (52.9%)			
≥ 250.00	137 (46.6%)	9 (50.9%)	128 (47.1%)			
Occupational factors						
Exposure to waste				0.72	0.29-1.77	0.47[a]
No	166 (56.3%)	14 (63.6%)	152 55.7%)			
Yes	129 (43.7.%)	8 (36.4%)	121 (44.3%)			
Duration of employment				0.85	0.36-2.04	0.44[a]
≤ 4 years	150 (50.8%)	12 (54.5%)	138 (50.5%)			
5-30 years	145 (49.2%)	10 (45.5%)	135 (49.5%)			
Work time				0.71	0.23-2.18	0.38[a]
Day	226 (76.6%)	18 (81.8%)	208 (76.2%)			
Night	69 (23.4%)	4 (18.2%)	65 (23.8%)			
Environmental factors						
Alcohol addiction				0.66	0.27-1.62	0.24[a]
No	160 (54.2%)	14 (63.6%)	146 (53.5%)			
Yes	135 (45.8%)	8 (36.4%)	127 (46.5%)			
Smoking habit				1.07	0.35-3.30	0.55[b]
No	244 (82.7%)	18 (81.8%)	226 (82.8%)			
Yes	51 (17.3%)	4 (18.2%)	47 (17.2%)			
Diabetes				2.55	0.28-22.86	0.37[a]
No	289 (98.0%)	21 (95.5%)	268 (98.2%)			
Yes	6 (2.0%)	1 (4.5%)	5 (1.8%)			

[a] Chi-squared test; [b] Fisher's exact test (used when $N ≤ 5$); CI, confidence interval; OR, odds ratio; n, number of subjects with the condition.
Source: research data.

Twenty-five OMLs were diagnosed in 22 volunteers (prevalence = 8.5%), 8 in the waste exposed (prevalence = 6.2%) and 17 in the non-exposed group (prevalence = 10.2%) (Table 2). The most frequently encountered OMLs were actinic cheilitis affectingthe lips (5 cases in the exposed and 9 cases in the non-exposed group) and candidiasis (2 cases in the exposed and 6 cases in the non-exposed group). In the non-exposed group, one volunteer showed both actinic cheilitis and candidiasis, and other had candidiasis and leukoplakia. Leukoplakia and nicotinic stomatitis were detected in one non-exposed and one exposed individual, respectively. The most commonly affected areas were the lips (actinic cheilitis) and tongue dorsum.

Table 2 - Prevalence of the OML and the association of exposure to waste with actinic cheilitis, candidiasis and leukoplakia (N = 295)

Lesions	Exposure to waste					
	n (%)	Yes	No	OR	95% CI	p
			n (%)			
Actinic cheilitis	14 (4.8)	5 (3.9)	9 (5.4)	0.70	0.23-2.15	0.37
Candidiasis	08 (2.7)	2 (1.6)	6 (3.6)	0.42	0.08-2.12	0.24
Leukoplasia	02 (0.7)	0	2 (1.2)	0.99	0.97-1.01	0.32
Nicotinic stomatitis	01 (0.3)	1 (0.8)	0	-	-	-
Total	25 (8.5)	8 (6.2)	17 (10.2)			

n, number of subjects with the condition; 95% CI, confidence interval; OR, odds ratio.
Source: research data.

The prevalence of actinic cheilitis, a condition resulting from chronic and excessive exposure to the ultraviolet radiation of sunlight, is an important finding because of the malignant potential of this lesion[16]. Actinic cheilitis ranks among the most common precancerous oral lesion. The prevalence of 3.9% found among waste collectors can be attributed to their daily and long-term exposure to radiation. Actinic cheilitis prevalence ranges from 16% to 40% among outdoor workers and 0.2 to 0.5% among other groups. Global prevalence is between 0.5% and 2%[17]. Moreover, in our study, all cases of actinic cheilitis were located on the lower lip, in line with previous findings[18]. The most common clinical presentation of actinic cheilitis is pale, scaly lips displaying a dry area of varied thickness and associated erythema. In advanced stages, leukoplakia and erythroplakia areas may appear, potentially accompanied by chronic ulcerations and erosions[18].

Although oral candidiasis was not associated with exposure to domestic waste in this study, it's worth noting that occupational exposure to microorganisms and viruses may lead to dysbiosis of the oral microbiome. This dysbiosis can promote the overgrowth of *Candida* species , which are the most common etiologic factor of fungal infections. *Candida albicans* is the primary causative agent of oral candidiasis, the second most prevalent OML found here. Candidiasis is an opportunistic infection that manifests as white patches on the tongue, throat, and other mouth areas[19]. Daily oral hygiene that involves cleaning the teeth, oral cavity, tongue, and dentures is recommended to treat uncomplicated oral candidiasis[20].

In this study, OML was not associated with direct occupational contact with domestic waste (OR= 0.72, 95% CI = 0.29-1.77, P = 0.47) or any other investigated factor (p ≥ 0.21) (Table 1). Furthermore, no association was found between domestic waste exposure and actinic cheilitis (OR = 0.70, 95% CI= 0.23-2.15, P = 0.37), candidiasis (OR = 0.42, 95% CI= 0.08-2.12, P = 0.24), or leukoplakia (OR = 0.99, 95% CI= 0.97-1.01, P = 0.32) (Table 2). Therefore, the present hypothesis was not confirmed. To our knowledge, this relationship had not been previously investigated. Waste collectors are exposed daily to various occupational hazards, including infectious pathogens and toxic substances, which could increase the risk for OMLs [4]. However, the workers evaluated in the current study used personal protective equipment during their work, which may have contributed to our findings.

The assessment of a convenience sample from a single company may have resulted in a limited representation of the at-risk population. Consequently, other groups of waste management workers should be investigated. In addition, since the physical examination was conducted at the company, subjects with negative self-perception of their oral health might have refused to participate to avoid personal exposure. Moreover, this study evaluated exposure and outcomes simultaneously, rendering causal inference impossible.

The results of this study can indeed be utilized to develop an oral health program aimed at improving overall health among waste workers. The oral health program should be based on preventive measures, educating and instructing waste workers to protect their lips during the day. Furthermore, workers should receive information about the most common predisposing factors for candidiasis: poor oral hygiene, smoking, and the consumption of tobacco and alcohol [20].

4 Conclusion

Occupational exposure to domestic waste was not associated with OML in the present population. However, the most prevalent lesions observed were actinic cheilitis and oral candidiasis. To ensure the well-being of workers exposed to domestic waste, it is crucial to emphasize the proper use of personal protective equipment, such as gloves and masks, sunlight protection, and preventive dental measures are essential..

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