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Warm-water immersion foot among car wash workers

Pés de imersão em água morna entre trabalhadores de lavagem de automóveis

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ABSTRACT | Background: Warm-water immersion foot (WWIF) is associated with prolonged contact with water at high temperature. Car wash workers are frequently exposed to humidity, however, there are not studies targeting diseases affecting this category of employees. **Objective:** To investigate the frequency of WWIF among car wash workers. **Methods:** The study was carried out in 2013 at a car wash service in Jundiaí, São Paulo, Brazil. A group of 30 workers was subjected to clinical interview and dermatological examination. Statistical tests were performed to assess the association between WWIF and independent variables. **Results:** All the participants were male, their average age was 23 years old, and the most (60%) had worked at the investigated company for more than one year. Sixty percent of the participants exhibited lesions compatible with WWIF. Age and length of work at the company were associated with the assessed outcome. The participants were frequently and permanently exposed to humidity along the working day without wearing impermeable clothes. **Conclusion:** Most participants exhibited WWIF; the ones over 30 years old and having worked less than 1 year at the investigated company exhibited higher odds of WWIF due to occupational exposure to humidity.

Keywords | immersion foot; humidity; dermatitis, occupational.

RESUMO | Introdução: O quadro clínico de pés de imersão em água morna (PIAM) está relacionado ao contato prolongado com água em temperaturas elevadas. Uma categoria profissional com possibilidade de exposição frequente à umidade é a dos prestadores de serviço de lavagem de automóveis (lava a jato). Não foram encontrados estudos científicos sobre doenças que acometam os trabalhadores dessa área. **Objetivo:** Avaliar a frequência de quadros de PIAM entre trabalhadores de um lava a jato. **Métodos:** O estudo foi realizado em um lava a jato na cidade de Jundiaí (SP), em 2013. Um grupo de 30 trabalhadores foi submetido a anamnese e exame físico dermatológico. Foram realizados testes estatísticos para avaliar associação entre quadros de PIAM e variáveis independentes. **Resultados:** Todos os participantes eram do sexo masculino, com idade média de 23 anos, e a maioria (60%) trabalhava na empresa há mais de um ano. Sessenta por cento dos participantes apresentaram lesões compatíveis com PIAM. A faixa etária e o tempo de trabalho estiveram associados ao quadro. Havia exposição frequente e permanente à umidade durante o trabalho, sem uso de vestuário impermeável. **Conclusão:** A maioria dos trabalhadores que fizeram parte da pesquisa tinha diagnóstico de PIAM; os com idade superior a 30 anos e que trabalhavam há menos de 1 ano na função tiveram maior probabilidade de apresentar o quadro clínico por exposição ocupacional à umidade.

Palavras-chave | pé de imersão; umidade; dermatose ocupacional.

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INTRODUCTION

Occupational dermatoses involve any change in the mucous membranes, skin and adnexa caused, conditioned, sustained or aggravated by agents used at work or present in the work environment. The direct causes of occupational dermatoses are environmental physical, chemical and biological agents. Exposure to these agents has effects on the skin, causing dermatosis or aggravating a preexisting disease[1,2].

Prolonged contact with water causes different forms of dermatitis, including hand eczema among workers exposed to wet work[3]. In turn, superficial mycoses are the conditions that most commonly affect the lower limbs. However, continuous and excessive contact with water might also cause a disorder known as immersion foot or trench foot. The latter is a dermatosis that results from prolonged exposure to physical agents such as dampness and cold, and was first described among soldiers in World War I (1914-1918)[4].

A similar condition was identified during the Vietnam War (1955-1975) which was named tropical immersion foot. Soldiers exhibited erythema, painful swelling and increased sensitivity of the foot skin. This disorder was associated with prolonged contact with water (>72 hours) at high temperature (22–32ºC). Anatomical-pathological examination evidenced maceration of the stratum corneum, chronic inflammation and vasculitis of the upper dermis[5].

Warm-water-immersion foot (WWIF) is a syndrome characterized by painful, white, wrinkled soles due to hyperhydration of the plantar stratum corneum. Anatomical-pathological examination evidenced maceration of the stratum corneum, chronic inflammation and vasculitis of the upper dermis[5].

WWIF is scarcely described in the scientific literature. Car wash workers represent an occupational category likely to be frequently exposed to wet conditions. The vehicle market exhibited over 100% increase from 2001 and 2012 in Brazil[6]. As a consequence, also the demand for services such as car washing increased. This situation notwithstanding, we were not able to locate any scientific study on diseases affecting car wash workers exposed to occupational hazards.

Therefore, the aim of the present study was to investigate the occurrence of WWIF and associated factors among the employees of a car wash company.

METHODS

The present cross-sectional analytical study was conducted with 30 employees allocated to the operational area of a car wash in the city of Jundiaí, São Paulo, Brazil, in 2013. The participants were interviewed to collect data including age and length of work in current position. We also performed visual inspection of their full skin area including description and location of eventual skin lesions. No other tests were performed.

To investigate the participants' working conditions, we qualitatively described their exposure to wet work and the state of the clothing and footwear worn during the working hours. The environmental temperature was measured with digital thermos hygrometer HT-208. The water temperature was measured with Oregon Scientific THWR800 thermometer.

χ^2 and Fisher's exact tests were performed to investigate the presence of statistically significant difference for age and length of work in current position among the participants with skin lesions due to excessive exposure to wet conditions/water. Statistical significance was defined as $p<0.05$.

The study was approved by the human research ethics committee of Holy House of Mercy Brotherhood of São Paulo (CAEE 09166912.2.0000.5479/2012).

RESULTS

The analyzed company provides car cleaning, lubrication and polishing services. The employees allocated to the operational area worked 44 hours a week distributed across six days and two shifts, 8:00 to 16:20 and 10:00 to 18:20, respectively, having a 1-hour break for lunch. Overtime work was frequent. The average number of cars washed was 35 a day on weekdays and 60 on weekends.

The work routine began by compressed air cleaning with a professional vacuum cleaner. Next the cars were washed, either on the outside only or inside and outside. The cars were then dried just with a clean piece of cloth. The final step involved application of polishing cream, silicone shampoo, degreasing agents, car wax, instant cleaner, revitalizing and hydrating agents for leather seats, fragranced liquid silicone and car air freshener.

The employer provided inadequate clothing/uniforms made of non-impermeable common cotton. In addition, the clothes were in a poor state of preservation and cleanliness; most were dirty, torn and continuously wet. Neither footwear was impermeable, and was in a dramatically poor state of preservation. As a fact, the shoes were often soaked with water, to the point the employees preferred to wear their own sneakers of their own at work. As a result, the employees were exposed to wet conditions all across the working hours, even while not performing actual work and during lunch breaks.

Car washing resulted in frequent exposure to wet conditions, changes in the environmental temperature (outdoor work) and non-ionizing solar radiation. We measured the effective environmental temperature, as well as the temperature of the water used for car washing, which was 25ºC in both cases.

All 30 participants were male, with average age 23 years old (standard deviation: ±10) ranging from 17 to 53 years old. About 40% of the sample had worked for the current employer for less than 1 year.

Physical examination showed that 18 participants (60%) exhibited lesions on one or both feet characterized by swelling, maceration, cracks and paleness (Figures 1 to 4). The lesions affected the soles (89%) more frequently than the palms (11%). Some participants reported pain, and a fetid odor emanating from the affected areas was indicative of secondary infection.

Variables age range and length of work in current position exhibited statistical difference. The odds for occurrence of skin lesions were higher for employees 30 years old or older and the ones having worked in the current position for less than 1 year (Table 1).

DISCUSSION

Wet work is characterized by activities involving frequent immersion of the hands in water, frequent or intensive hand washing or frequent use of impermeable gloves. Workers exposed to wet work might develop hand eczema and contact dermatitis[3]. In the present study dermatosis was detected among employees exposed to wet work. Signs included foot injuries and swelling, wrinkling of soles and local cracks, therefore, similar to the ones characteristic of the immersion foot syndrome, for which dampness is a relevant trigger.

The swelling and corrosion derived from prolonged foot exposure to the water used for car washing have particular characteristics. According to criteria formulated by Allen and Taplin[5], the participants in the present study were exposed to working conditions favorable to the development of dermatosis, to wit, prolonged contact with water (44 hours per week) at high temperature (22 to 32ºC) having the feet occluded through the use of shoes. The plantar location of lesions and lack of systemic symptoms are indicative of WWIF[5].

While the literature only comprises reports of cases of immersion foot resulting from exposure to water at low temperature[4,7], in the present study we found lesions derived from exposure to water at room temperature. The most common mechanism for the development of immersion foot is the continued wearing of wet socks and/or footwear[7]. Water at room temperature accumulated inside the non-impermeable shoes worn by the participants all along the working hours, which characterizes strong, frequent and

Figure 1. Pale, wrinkled and swollen toes on the plantar area, patient 1.

permanent exposure. In addition, microtrauma caused by friction upon walking increased the odds for lesions to become worse and favored the occurrence of secondary infection.

Figure 2. Edema, maceration and cracks on the plantar area, patient 2.

Figure 3. Paleness, swelling and wrinkling of the medial margin of the foot, patient 3.

In the present study, association was found between age and occurrence of WWIF. The literature on indirect causes or predisposing factors for occupational dermatoses indicates that lesions occur more commonly among younger workers, for having less experience and the fact that the stratum corneum has not thickened yet[1]. Considering that

Figure 4. Paleness, maceration, cracks and swelling affecting the first toe, patient 4.

Table 1. Distribution of participants according to presence or not of skin lesions per age range and length of work in current position, Jundiaí, 2013 (n=30).

	Yes (n=18) (%)	No (n=12) (%)	p value
Age range (years)			
<30	9(45)	11(55)	0.02
≥30	9(90)	1(10)	
Length of work (years)			
<1	11(92)	1(8)	<0.01
≥1	7(39)	11(61)	

also variable length of work in the current position was associated with occurrence of WWIF, one might infer that permanent and chronic exposure to wet work overlaps factor age as concerns the pathogenic mechanism of this condition.

The harmful effects of immersion or prolonged contact with water are a target for close surveillance among several occupational categories[3,8]. However, the usual idea that lesions in the hands or feet are a part of the normal life of employees who perform wet work might lead to underreporting occurrences and neglect protective measure. Therefore, investment is needed in educational actions aiming at divulgating the effects of excessive exposure to wet work on the health of workers.

The cases reported here indicate non-compliance with the Brazilian legislation. According to the Brazilian Labor Ministry Regulatory Standard no. 15, appendix #10, activities or operations involving excessive dampness and likely to harm the health of workers are rated insalubrious[9]. Therefore measures to detect risk, assess exposure and protection should be implemented to minimize the occurrence of skin lesions among exposed workers.

Its results notwithstanding, the present study has some limitations. The sample comprised all the employees of the investigated company. We sought to minimize measurement bias by setting objective criteria for the determination of the outcome, i.e., occurrence of occupational dermatosis. Several confounding or mediator variables were not assessed, which limits the understanding of the disease process. However, occurrence of cases and the possible causal link found are relevant findings as concerns the implementation of preventive measures targeting this particular work environment.

CONCLUSION

Cases of dermatosis compatible with foot immersion were detected among the employees of the investigated car wash. Statistically significant association was found between skin lesions and age and length of work in the current position. There are sufficient reasons to posit a causal link between occurrence of lesions and occupational exposure to wet conditions.

Divulgation of information on the targeted dermatosis might improve its identification by physicians and make workers become aware of its occupational nature. In the presence of working conditions presenting high risk for similar cases, health care and safety professionals should promote preventive measures to improve the quality of work life.

REFERENCES

1. Alchorne AOA, Alchorne MMA, Silva MM. Dermatoses Ocupacionais. Anais Bras Dermatol. 2010;85(2):137-47. 2. Ali SA. Dermatoses Ocupacionais. São Paulo: Fundacentro; 2010.
3. Antonov D, Scliemann S, Elsner P, John SM. Wet work and occlusion. In: Rustemeyer T, Elsner P, John SM, Maibach HI. Kanerva's Occupational Dermatology. 2nd ed. Berlin: Springer Berlin Heidelberg; 2012. p. 839-46.
4. Olson Z, Kman N. Immersion foot: a case report. J Emerg Med. 2015;49(2):e45-8.
5. Allen AM, Taplin D. Tropical immersion foot. The Lancet. 1973;24(7839):1185-9.
6. Observatório das Metrópoles. Instituto Nacional de Ciência e Tecnologia. Evolução da frota de automóveis e motos no Brasil 2001-2012 (Relatório 2013). Rio de Janeiro: INCT Observatório das Metrópoles; 2013 [cited Jan 8, 2017]. Available from: http://www.observatoriodasmetropoles.net/download/auto_motos2013.pdf
7. Cappaert TA, Stone JA, Castellani JW, Krause BA, Smith D, Stephens BA. National Athletic Trainers' Association position statement: environmental cold injuries. J Athl Train. 2008 Oct-Dec;43(6):640-58.
8. Chow S, Westfried M, Lynfield Y. Immersion Foot: An Occupational Disease. Cutis. 1980;25(6):662.
9. Brasil. Ministério do Trabalho e Emprego. Anexo 10: Umidade. Norma Regulamentadora 15: Atividades e operações insalubres. Portaria MTE n.º 3.214, de 8 de junho de 1978. 1978 [cited Jan 8, 2017]. Available from: http://trabalho.gov.br/images/Documentos/SST/NR/NR15/NR15-ANEXO10.pdf

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