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Occupational hand dermatitis web survey in a university hospital during COVID-19 pandemic: the SHIELD study

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Keywords: COVID-19; occupational hand dermatitis; healthcare workers; personal protective equipment; protective gloves; hand washing.

Abstract

Background: *Occupational hand dermatitis (OHD) is a skin disease occurring on employees' hands in certain jobs. Little is known about prevalence, incidence and characteristics of this adverse skin reaction and its associated risk factors during COVID-19 pandemic. To evaluate both prevalence and incidence of OHD and associated risk factors in Italian clinicians.* ***Methods:*** *A cross-sectional study was performed using a self-report questionnaire.* ***Results:*** *Two hundred and thirty clinicians responded to the survey and 82% of responders did not report previous OHD history before the COVID-19 pandemic. Daily use of gloves was reported by 80% of responders. OHD prevalence was 18%, while incidence was 80%. We found a protective effect on symptom occurrence for vinyl/nitrile gloves if the time with gloves was ≥ 6 hours per day.* ***Conclusions:*** *This survey reveals a high OHD incidence in an Italian population of clinicians. Furthermore, wearing vinyl/nitrile gloves for at least 6 hours a day had a protective effect on symptom onset.*

Introduction

A novel coronavirus named 2019-nCoV was discovered in December 2019 in Wuhan, China causing coronavirus disease 2019 (COVID-19), which spread rapidly throughout the country and the world (1,2). In this emergency, the simple act of hand washing, regardless of other medical interventions, is a cornerstone of behaviours to prevent the transmission of respiratory viruses (3). Furthermore, hand washing with an adequate antimicrobial product for at least 20 seconds can reduce the risk

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of transmission of viruses including SARS-CoV-2 (4). However, hand protection measures (gloves, alcoholic-based sanitizers, cream/moisturizers) can cause adverse skin reaction; occupational hand dermatitis (OHD) is common in health-care workers (HCWs), because of frequent hand hygiene and prolonged glove wearing. The first signs of OHD are red and scaly patches in the finger webs and on the knuckle area of the hands. Itchy blisters, painful cracks, and possibly infection are common, and eventually the skin becomes thickened.

In the pre-COVID era the prevalence of OHD among HWCs was around 20-50% in the United States (5), 31.5% in China (6) and 13% in the Netherlands (7), which increased significantly during the COVID-19 pandemic. One multicentre study from Wuhan, China, reported an OHD prevalence of 74.5% (6). A further Chinese study showed that the prevalence of skin injury, caused by enhanced infection-prevention measures, increased up to 97% among physicians and nurses who worked in tertiary hospitals during the pandemic (8). In the rest of the world, the prevalence of OHD was estimated to be 46.4% in a group of Saudi Arabian HCWs (9), 50.4% in a group of Turkish HCWs treating COVID-19 patients (10), and 76% in an Irish study (11). In a German survey, comparing the onset of OHD and associated symptoms between HCWs directly involved in intensive care and HCWs without direct contact to this patient cohort, in a single surgical clinic during the COVID-19 pandemic, the total prevalence was 90.4% (12).

Beiu et al. (4) reviewed the potential dermatological adverse effects that may arise due to frequent hand washing, as well as practical tips to prevent these uncomfortable skin reactions, which were preventable and manageable using appropriate skin care products and found that regular skin hydration is essential to prevent skin injuries derived from frequent washing. To date, no data on both prevalence and incidence of OHD in Italy is available. We aimed to study both prevalence and incidence of OHD (primary outcomes) among clinicians employed in a tertiary Italian Hospital. Furthermore, we assessed associations among skin damages and demographic, occupational and behavioral variables.

Methods

Study design, setting, and participants

This cross-sectional survey was carried out from September 7 to November 7, 2020. The prevalence of OHD-defined as a skin disease occurring on employees' hands in certain jobs-was evaluated at the beginning of the study (March 1, 2020). Incidence was estimated from data collected in the period from March 2, 2020 until the end of the study. All clinicians received an online survey via email to assess self-perceived adverse skin reactions. The e-mail contained a brief explanation of the study aims and an invitation to respond anonymously to a 10-item multiple choice questionnaire. After consenting to participate anonymously, the recipient answered the questionnaire.

The study was conducted and described according to the STROBE checklist. The local Ethics Committee approved the SHIELD Study.

Questionnaire and Data Collection

The study used the commercially available online survey platform Microsoft Forms, which is included in the Hospital's Microsoft Office 365 package. Survey data were analyzed with the analytic tools within Microsoft Forms respectively Microsoft Excel. The questionnaire was firstly validated through the following procedure: 1) use of a structured Delphi Method to achieve mutual agreement among panel experts to identify questions, and 2) validation phase on the first 25 responders to analyze applicability and generalizability.

A reminder mail was sent after two weeks of the first communication. In addition to demographic information, self-perceived adverse skin reactions were recorded. Furthermore, the following variables were collected: known exposure to COVID-19 patients, duration with and types of gloves, frequency of hand washing, topical hand cream application after washing, previously allergological history and pre-existing hand dermatitis (HD). No incentives were offered to complete the survey.

Sample size

For the calculation of the sample size (i.e. the number of completed responses the research team

receives) 1) a population size of 1465 clinicians, 2) a margin of error of 5%, 3) a chosen sampling confidence level of 95% and 4) a response rate (i.e. the percentage of clinicians who actually complete the survey) of 50% was considered; a sample size of 305 subjects was estimated.

Statistical analysis

The effect of candidate predictors on the outcome of interest (having at least one symptom) was tested individually with Chi-squared test or Fisher's exact test, when appropriate. Covariates, resulting statistically significant at the univariate analysis, were used to estimate a logistic regression model through Akaike Information Criterion (AIC)-based stepwise model selection. Two versions of the model have been foreseen. In a first version of the model, all the covariates were considered as non-interacting. In the second version of the model, an interaction term was added between "time with gloves" and "type of gloves".

The receiver operating characteristic (ROC) curve was used to evaluate the performance of the model. A threshold of 0.05 on p-values was considered significant for statistical test. All statistical analysis was performed using R (version 3.4.4).

Results

Two hundred thirty clinicians responded to this survey. Table 1 summarizes the results of the questionnaire. Twenty (8.7%) clinicians were under 29 years old, 136 (59.1%) between 30 and 49 years, and the remaining 74 (32.2%) were at least 50 years old. No gender predominance was found: 123 (53.5%) clinicians were female.

The majority of responders (188, 82%) did not report a history of HD before the COVID-19 pandemic. Among the remaining responders, 17 (7%) suffered from irritative contact dermatitis, 4 (2%) reported a history of allergic contact dermatitis, 13 (6%) reported previous atopic dermatitis. Finally, 8 (3%) responders reported a history of unclassified eczema.

One hundred and seventy-three (75%) clinicians did not suffer from other allergic diseases. Daily use of gloves was reported by most responders: 121 (53%) clinicians reported wearing gloves for less than 6 hours per day, while, 63 (27%) clinicians wore gloves for at least 6 hours per day. There was no predominance of a specific glove type: 93 (40%) clinicians reported wearing latex gloves, while, 109 (47%) responders preferred vinyl/nitrile gloves. As expected, most clinicians (173, 75%) reported frequent daily hand washing at least 10 times a day. Very rare was the use of emollient cream applied after hand washing. In fact, only 16 (7%) responders reported the use of emollients.

Table 1. Results of survey. HE~: hand eczema. CD*: contact dermatitis

Items		N° of subjects	%
N° ofresponders		230	
Sex (Female)		123	53
Age groups (years)	≤29	20	9
	30-49	136	59
	≥50	74	32
Pre-existing HE~	No	188	82
	Yes	42	18
	Irritative CD *	17	7
	AllergicCD *	4	2
	Atopic dermatitis	13	6
	Unclassified eczema	8	3
History of other allergie disease	No	173	75
	Yes	57	25
Time with gloves	<6 hours/day	121	53
	≥6 hours/day	63	27
Type of used gloves	I.atex gloves	93	40
	Vinyl/ nitrile gloves	109	47
Frequency of hand washing	<10 times/ day	56	24
	≥10 times/ day	173	75
Topical hand emollient cream use after washing	No	213	93
	Yes	16	7

Concerning the primary outcomes, OHD prevalence among clinicians was 18% and incidence was 80%. Figure 1 describes the frequency of OHD symptoms reported by clinicians. Dryness, erythema, desquamation, fissuring and itching were the symptoms most commonly described by responders.

Table 2 shows the individual effect of candidate predictors on the outcome of interest "incidence". Age (p=0.029), sex (p=0.047), time with gloves (p=0.042)

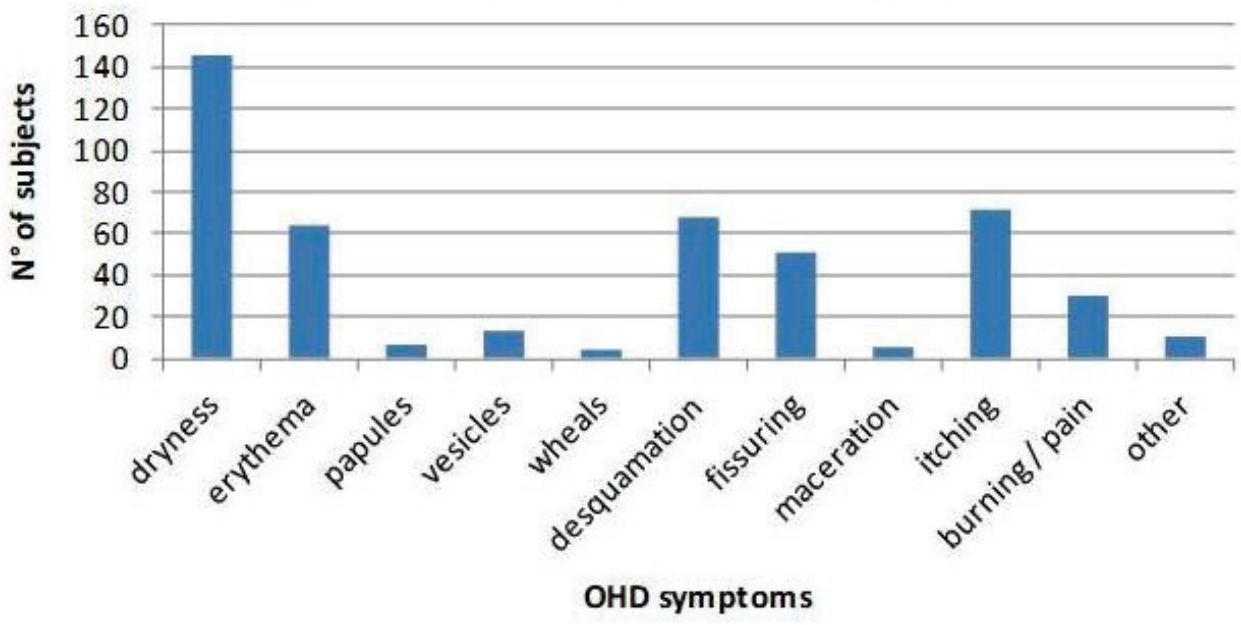

Figure 1. Frequency of OHD symptoms.

Table 2. Effect of candidate predictors on the outcome of interest "OHD incidence". •: The effect of candidate predictors on the outcome of interest "OHD incidence" (having at least 1 symptom among those shown in Figure 1) was tested individually with Fisher's exact test. HE[1]: hand eczema

Covariate		No OHD symptoms	OHD symptoms	p-value •
Age	≤ 29 years	6	14	0.029
	30-49 years	19	117	
	≥ 50 years	20	54	
Sex	Male	27	80	0.047
	Female	18	105	
Time with gloves	< 6 hours/day	20	101	0.042
	≥ 6 hours/day	9	54	
	No gloves	16	30	
Type of gloves	Latex	15	64	NS
	Vinyl / nitrile	10	81	
Frequency of hand washing	< 10 times/day	15	41	NS
	≥ 10 times/day	30	143	
Topical band cream appliance after washing	No	43	170	NS
	Yes	2	14	
Other pre-existing allergic diseases	No	34	138	NS
	Yes	10	47	
Pre-existing HE[1]	No	46	143	< 0.001
	Yes	0	42	

and pre-existing hand eczema (HE) (p<0.001) was individually associated to OHD incidence.

After the AIC-based selection, the logistic regression model included the following variables: age, sex, time with gloves and pre-existing HE (Figure 2). Overall classification performance of the model was: AUC = 0.79 (95% CI: 0.63-0.75), sensitivity = 0.6811, specificity = 0.7556, positive predictive value (PPV) = 0.9197 and negative predictive value (NPV) = 0.3656 (Figure 2).

The second version of the model, after the AIC-based selection, included the following variables: age, sex, time with gloves, type of gloves, pre-existing HE, interaction term between time with gloves and type of gloves (Figure 3). The effect of the last interaction term had a protective effect on symptom occurrence for type of gloves equal to vinyl/nitrile if the time with gloves is ≥ 6 hours per day, showing a log odd of -2.21 and a p-value of 0.0339. The overall classification performance of the second model was: AUC = 0.79 (95% CI: 0.64-0.77), sensitivity = 0.6968, specificity = 0.7586, PPV = 0.9391 and NPV = 0.3188 (Figure 3).

Figure 2: OHD incidence

	Log Odd	SE~	p-value*
Age [30-49 years]	1.4386	0.6000	0.0165
Age [≥ 50 years]	0.5759	0.6072	NS
Male gender	-0.6872	0.3716	NS
Time with gloves ≥ 6 hours	0.1874	0.4599	NS
No gloves	-1.3540	0.4514	0.0027
Pre-existing HE‡	17.5895	929.6995	NS

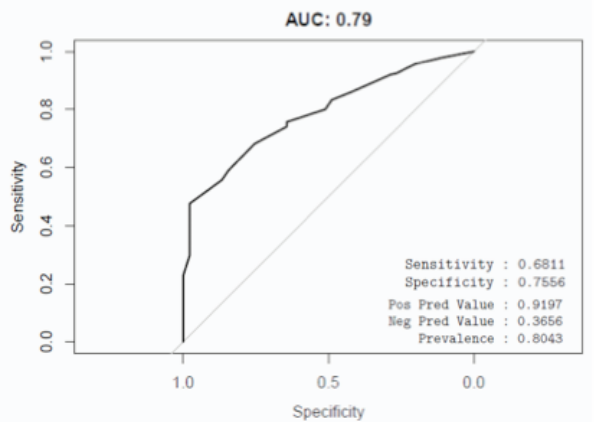

Figure 2. OHD incidence: logistic regression model through AIC-based stepwise model selection with covariates which resulted statistically significant at the univariate analysis. All covariates were considered as non-interacting. *: A threshold of 0.05 on p-values was considered significant for statistical test. SE~: Standard Error. HE‡: hand eczema

	Log Odd	SE~	p-value*
Age [30-49 years]	1.6094	0.6990	0.0213
Age [≥ 50 years]	0.5123	0.6880	NS
Male gender	-1.0438	0.4697	0.0262
Time with gloves ≥ 6 hours	1.3348	0.7332	NS
No gloves	0.0897	1.0916	NS
Vinyl / nitrile gloves	1.0009	0.5844	NS
Pre-existing HE‡	17.2889	1056.4360	NS
Time with gloves ≥ 6 hours + No gloves	-1.6949	1.6069	NS
Time with gloves ≥ 6 hours + Vinyl / nitrile gloves	-2.2107	1.0420	0.0339

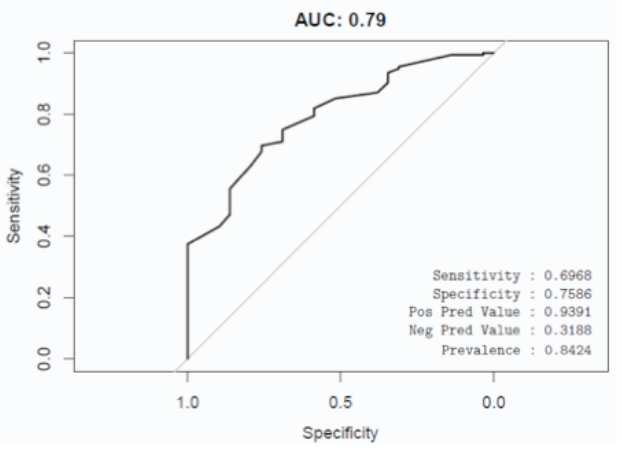

Figure 3. OHD incidence. Logistic regression model through AIC-based stepwise model selection with covariates which resulted statistically significant at the univariate analysis with the addition of an interaction term between "time with gloves" and "type of gloves". *: A threshold of 0.05 on p-values was considered significant for statistical test. SE~: Standard Error. HE‡: hand eczema

Discussion

To our knowledge, this is the first study that explores both prevalence and incidence of OHD among clinicians in an Italian tertiary hospital during the COVID-19 pandemic. We found a high incidence of OHD among clinicians (80%). Furthermore, a not negligible prevalence was observed (18%).

In literature, growing evidence demonstrate the impact of PPEs on the health of the skin, particularly on hands of frontline HCWs. In fact, after the first evidence of a very high prevalence of skin damages by Lan et al. in March 2020 (8), the subsequent reports, from different countries around the world, have confirmed a high prevalence of OHD ranging from 46.4% in a Saudi Arabia experience to 97% in a Chinese group of HCWs (6,8-13). Curiously, our data showed a prevalence (18%) lower than before mentioned published reports (6,8-13). On the other hand, we highlighted, for the first time, a high incidence of OHD (80%) in Italian clinicians during the COVID-19 pandemic. Studies reporting incidence data are limited (14-23) and results differed by study design, type of skin disease, and occupationally exposed populations.

Recently, Larese et al. systematically reviewed studies on incidence of contact dermatitis in HCWs highlighting the dearth of high-quality data and the possible underestimation of disease burden in the pre-COVID-19 era (24). In our study, age, sex, time with gloves and pre-existing HE were individually associated to OHD incidence. Therefore, we focused on these covariates in order to define a logistic regression model through AIC-based stepwise model selection. If all the covariates were considered as non-interacting, age between 30 and 49 years and wearing gloves could be considered risk factors for OHD with a prediction model characterized by a good performance (AUC = 0.79, PPV = 0.9197).

Since type of gloves and time with gloves are closely related from a clinical point of view, we eviscerated the impact of this interaction on OHD incidence through the before detailed second prediction model. Hence, we showed, for the first time, a protective effect on symptom occurrence for vinyl/nitrile gloves if the time with gloves was ≥ 6 hours per day (log odd of -2.21, p-value = 0.0339).

Our study has some limitations. First, only clinicians were invited to respond to the survey. Furthermore, the number of responders was limited. Out of 1465 clinicians invited, only 230 agreed to answer the questionnaire. Finally, this was a survey not supported by medical evaluation with allergological diagnostics of the new self-reported cases.

Conclusions

In conclusion, our study shows, for the first time, a high incidence of OHD in a population of Italian clinicians. Importantly, wearing vinyl/nitrile gloves for at least 6 hours a day has a protective effect on the onset of symptoms. Future studies are needed to investigate optimal strategies to reduce the risk of occupational hand dermatitis in all frontline healthcare workers.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of Fondazione Policlinico Universitario A. Gemelli IRCCS in Rome, Italy (ID 3274; Prot. N. 0025420/20).

Informed Consent Statement: Patient consent was waived due to data were collected anonymously.

Conflict of interest: No potential conflict of interest relevant to this article was reported by the authors

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