

**An update on the prevalence and risk exposures associated with hand  
eczema in Danish hospital employees  
-A cross-sectional questionnaire-based study**

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## ABSTRACT

**Background** Hand eczema (HE) is common in healthcare workers (HCWs). During the last decade, new recommendations support increased use of alcohol-based hand rub (ABHR) to partially replace hand washings. Although this is expected to lower the HE prevalence, newer data is lacking.

**Objectives** To assess current one-year prevalence of HE in HCWs. Moreover, to investigate exposures and the extent of subjective discomfort to hand washings and ABHR.

**Methods** A digital questionnaire was sent to 4876 HCWs in April-May 2020.

**Results** Out of 2125 respondents (1779 women, 346 men), 14.7% reported HE within the last year. In total, 9.1% reported >20 hand washings and 76.0% reported ABHR use >20 times/shift. HE was significantly associated with hand washings (adjusted OR 1.73 (95%CI 1.26-2.36)) and glove use on wet skin (adjusted OR 1.99 (1.27-3.12)). Subjective discomfort was reported significantly more often to ABHR than to hand washing ( $P<.001$ ), and significantly more often in HCWs with HE than without HE ( $P<.001$ ).

**Conclusions** The current one-year HE prevalence in HCWs of 14.7% was lower than previously reported Scandinavian data. HE was related to frequent hand washings, as previously reported, and to glove use on wet skin, which is a possible risk factor for HE that should be further explored.

**Key words:** Hand eczema, epidemiology, risk factors, wet work

## 1. INTRODUCTION

Hand eczema (HE) is a common skin disease in health care workers (HCWs), and a challenge since the disease may lead to impaired quality of life, sickness absence and job-change <sup>1,2</sup>. In 2009, Ibler et al. reported a one-year HE prevalence of 21% in Danish HCWs <sup>3</sup>, and in 2014 the same high prevalence of 21% was reported in a comparable study of Swedish HCWs <sup>4</sup>. Wet work is considered a major risk factor for HE in the healthcare sector <sup>5</sup>. There is from previous studies a thorough understanding of the exposure-response relationship between hand washings, glove use and HE, respectively, while alcohol-based hand rub (ABHR) is generally considered harmless to the skin barrier <sup>4,6–10</sup>. In the last decade, recommendations for HCW regarding hand hygiene have been to use ABHR instead of hand washings when the hands are not visibly dirty <sup>11,12</sup>. However, new data reflecting the current exposures is lacking. In addition, recent data indicates that the skin barrier is affected negatively when ABHR is applied on wet skin as compared to application on dry skin<sup>13</sup>; likewise it has been discussed that the irritant effect of gloves may be intensified if the gloves are worn on wet skin <sup>14</sup>. Hence, more detailed information on wet work exposures may lead to a better understanding of the harmful effects on the skin, and thus a more focused prevention.

ABHR is known to cause subjective discomfort such as pain and stinging, in particular when applied on broken skin <sup>15</sup>. However, the prevalence of ABHR-related compared to hand washing-related subjective discomfort in HCWs, and whether it may influence the behavior with regards to their use are sparsely investigated.

In this study, we aim to map the current prevalence of HE in HCWs. Furthermore, we aim to explore wet work exposures and the extent of subjective discomfort in relation to ABHR and hand washings in HCWs with and without HE.

## 2. METHODS AND MATERIALS

### **2.1 Study population**

The questionnaire was sent digitally to all nurses, auxiliary nurses, physicians and a mixed group of biotechnicians, mid wives and physiotherapists employed at clinical departments at hospitals in Greater Copenhagen area. The e-mail addresses of the invited HCWs were provided by the Dept. of Human Resources, Capital Region.

## **2.2 The questionnaire**

The questionnaire was distributed between 28<sup>th</sup> April 2020 to 26<sup>th</sup> May 2020 by the Dept. of Human Resources, Capital Region, using Plan2learn. Two digital reminders were sent after one and two weeks, respectively. Information on the questionnaire was announced on the intranet of the respective hospitals.

The questionnaire was based on validated questions from the Nordic Occupational Skin Questionnaire (NOSQ-2002)<sup>16</sup>, and questions developed by the research group (see Supplementary Materials). The questionnaire was pre-tested by colleagues and hereafter validated by conducting cognitive interviews with 15 HCWs of different professions (i.e. nurses, physicians and auxiliary nurses)<sup>17,18</sup>. None of the questions in the questionnaire were mandatory.

## **2.3 Variables**

The one-year HE prevalence was based on validated questions ('Have you had HE during the past year' and 'Do you have HE today')<sup>19</sup>. Traditional risk factors (hand washings, use of gloves and use of ABHR) were registered, as well as some hitherto unexplored exposures (ABHR and gloves applied on wet skin, respectively). Wet skin is defined as skin that is moist or wet. Glove use and non-occupational wet work ("To which extend do you have wet hands during your spare time on a usual day?") were based on 8-hour workday and 8-hour spare time, respectively.

Confounders considered in this study were age, sex, non-occupational wet work, atopic dermatitis ('Have you ever had childhood eczema'), obesity (defined as body mass index (BMI) >30), tobacco smoking, children <4 years in the household and perceived stress. Subjective discomfort to hand washings and ABHR was evaluated by explorative multiple-choice questions ('How does it feel on your skin when you wash your hands' and 'How does it feel on your skin when you apply ABHR').

## **2.4 Statistical analysis**

Statistical analyses were performed in the statistical software R (version 4.0.1). Two-sided *P*-values <.05 were considered statistically significant. Since the study was explorative, a formal sample size calculation was not performed.

Descriptive statistics were used for characterization of the study population. Chi-square test and Fisher exact test were used to analyze associations between HCWs with HE within the last year, no HE within the last year and HCWs without HE, and other variables, and for analysis of

subjective discomfort to hand washings and ABHR. Cochran-Armitage Test was applied to test for trends between HCWs with HE within last year and HCWs without HE and other variables. Pearson's correlation was used to evaluate the correlation between hand washings and ABHR. Binary logistic regression analysis was performed for analysis of associations between HE and wet work exposures, atopic dermatitis and life-style factors. Cut-off values of dichotomized exposures in the regression analysis were chosen by evaluating the mean of each exposure. With respect to ABHR, we applied the cut-off used in most studies ( $\leq 20$  and  $>20$ ) with the purpose of comparing. In the multivariate models, confounders were stepwise included based on their significance level in the univariate analysis. Missing data was not imputed and remained missing in all analyses.

### **2.5 Ethical considerations**

The study was approved by the local Ethical Committee (no.: H-20007169), and the Danish Data Protection Agency. Informed consent was obtained from all participants.

## **3. RESULTS**

The overall response-rate was 43.6% (2125 of 4876), with no difference between the hospitals. With respect to females and males, the response rates were 46.1% and 34.5%, respectively. The mean age was higher in responders compared to non-responders ( $42.7 \pm 12.2$  years versus  $39.9 \pm 12.0$  years, respectively) ( $P < .001$ ). Background characteristics of the study population are given in Table 1.

### **3.1 Prevalence of HE**

The one-year prevalence of HE was 14.7%. The point-prevalence of HE was 6.4%, while a total of 27.1% reported having had HE once in their lives.

HE severity was reported on a visual analogue scale (VAS). HCWs with current HE reported a mean HE severity of  $3.59 \pm 2.34$  points; and mean HE severity for HCWs reporting HE within the last year was  $3.57 \pm 2.20$  points.

#### **Sex and age**

Characteristics of sex and age are given in Table 1. A total of 15.6% female HCWs reported HE within last year as compared to 9.8% of male HCWs ( $P = .005$ ).

#### **Department**

No differences were found with respect to the one-year prevalence at the different departments (Table S1). None of the departments were exclusively for COVID-19 patients. Patients with

COVID-19 were primarily hospitalized at the Dept. of Emergency, Anesthetics and Intensive care, and Internal medicine.

### **3.2 Wet work exposures and association with HE within last year**

Wet work exposures stratified by HE are given in Table 2. Frequent hand washings (>20 times daily) were reported by 11.3% HCWs with HE and 8.1% HCWs without HE. Frequent ABHR use (>20 times daily) was reported by 80.4% with HE and 74.7% without HE. On a normal shift, gloves were worn more than five hours by 8.7% with HE and 6.6% without HE. ABHR was applied on wet skin more than once in a shift by 62.3% and 56.3% with and without HE, respectively. Gloves were worn on wet skin more than 10 times per day by 8.4% with HE and 4.1% without HE. A positive correlation was found between hand washings and use of ABHR ( $r=0.43$ ,  $P<.001$ ).

The associations between wet work exposures and HE based on a logistic regression analysis are shown in Table 3. The analysis included HCWs reporting HE within last year and HCWs without HE. Frequent hand washings increased the odds for HE by 73% (95% CI 1.26-2.36) and gloves worn on wet skin increased the odds for HE by 99% (95% CI 1.27-3.12) after adjusting for potential confounders, Table 3. ABHR use, glove use and ABHR applied on wet skin were significantly associated with HE in the univariate analysis, however, not in the adjusted multivariate analysis (Table 3). Further adjustment for non-occupational wet work did not change the results in the adjusted model.

### **3.3 Subjective discomfort**

Data on subjective discomfort to hand washings and ABHR reported by HCWs with and without HE is given in Table 4. Overall, HCWs reported subjective discomfort (i.e. stinging, burning, pain) to ABHR ( $n=298$ ) more often than subjective discomfort to hand washings ( $n=160$ ) ( $P<.001$ ). A total of 19.0% HCWs with HE and 4.6% without HE reported subjective discomfort to hand washings, respectively. With regards to ABHR, 32.2% HCWs with HE and 10.2% HCWs without HE reported discomfort, respectively.

In total, 37 HCWs reported reduced compliance to hand washings (i.e. skipped a hand washing due to subjective discomfort), and of these 28 had a history of HE ( $P<.001$ ). Further,

significantly more HCWs with a history of HE (6.5%) reported reduced compliance to ABHR due to discomfort as compared to HCWs without HE (3.0%), ( $P=.009$ ).

### **3.4 Atopic dermatitis**

Atopic dermatitis was reported by 33.7% HCWs with HE and 9.5% HCWs without HE, Table 1. A strong association was found between atopic dermatitis and HE (crude OR 7.14 (95% CI 5.28-9.65), adjusted OR 8.27 (95% CI 5.94-11.51) with adjustment for wet work exposures, sex, age, BMI, tobacco smoking, children <4 year and perceived stress) (Table S2).

### **3.5 Life-style factors**

No significant differences with respect to tobacco smoking and children <4 years in the household were found between HCWs with and without HE (Table 1). A trend between increasing BMI and HE within last year was found (Table 1). Frequent stress was associated with HE (OR 1.80 (95%CI 0.99-3.25)) in the univariate analysis but not in the multivariate analysis (Table S2). Frequent stress was reported more often by HCWs experiencing subjective discomfort to ABHR ( $P<.001$ ).

## **4. DISCUSSION**

In this cross-sectional questionnaire-based study in HCWs presenting data from 2020, we found a one-year HE prevalence of 14.7%, which is lower than the previously reported 21% in two Scandinavian studies from 2009 and 2014, respectively <sup>3,4</sup>. Use of gloves on wet skin was identified as a yet unmapped risk factor for HE in addition to frequent hand washings, while no significant associations were found with respect to use of ABHR or gloves (on dry skin). Subjective discomfort was reported significantly more often to ABHR than to hand washing, and up to three times more often in HCWs with HE than without HE.

Several other studies have evaluated the HE prevalence in HCWs in the past years with prevalence ranging between 12-33% in Dutch and German HCWs <sup>20-23</sup>, and even up to 74.5-76.9% in Asian HCWs <sup>24-31</sup> illustrating the difficulties in comparing HE data across countries. New recommendations on hand hygiene, with increased use of ABHR and less hand washings, has been introduced during the last decade. When attempting to assess the influence of these

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recommendations on the HE prevalence, and with no systematic studies planned to assess this, it is important to ensure that the study populations are comparable, and that the diagnosis of HE and registration of exposures are performed in identical ways. Our study design and methods regarding HE prevalence and exposure assessment in HCWs are similar to that used in 2009 in a study by our group <sup>3,7</sup>. In our present study, the HE prevalence in HCWs was 14.7 %, as compared to 21.0% reported in 2009<sup>3</sup>. Regarding data on exposures, we found lower number of hand washings in the present study than reported in 2009 (9.1 % of HCWs reported >20 hand washings per shift in the present study as compared to 13.1% in 2009) and a higher number of ABHR use (76.0% in the present study reported > 20 ABHR per day versus 46.2 % in 2009)<sup>7</sup>. With respect to ingredients in hand soaps before new EU regulations in 2017, most hand soaps contained methylisothiazolinone (MI) or methylchloroisothiazolinone(MCI)/MI and contact dermatitis due to these allergens could have contributed to the high prevalence in 2009<sup>3</sup>. However, Ibler et al. reported that only 1.7% HCWs had positive patch tests to MCI/MI<sup>32</sup>, thus making it unlikely that a reduction in MCI/MI contact allergy would have influenced the prevalence noticeably. Although data is not directly comparable, our findings indicate that the lower number of hand washings together with the markedly increased use of ABHR are related to the declining prevalence of HE. We find this interesting to report, since there are to date no field studies supporting that the general change in recommendations to increased use of ABHR and decreased number of hand washings has influenced the prevalence of HE. Experimental studies have shown that ABHR does not influence the skin barrier in a negative direction <sup>10</sup>, and our real-life data underlines that the increased use of ABHR in the present study is related to a lower HE-prevalence, thus supporting the experimental data.

In the present study, we included HCWs from departments with direct patient contact only, while Ibler et al. in 2009 also included HCWs in manager positions <sup>3</sup> with minimal wet work and thereby a lower risk of HE. These differences support that the HE prevalence may truly have declined over the last decade. Obviously, no firm conclusions can be made by comparison of the present data to previous reports, since multiple factors are involved, however, our data indicates that the increased use of ABHR, and less hand washings could partly explain the declining HE-prevalence.

Our study was planned before the COVID-19 outbreak; however, it took place during the first two months of the outbreak. It cannot be excluded that COVID-related increased attention on hand hygiene could have facilitated a temporary behavioral change in HCWs with respect to their use of ABHR and hand washings. However, despite an increased focus on hand hygiene procedures during the COVID-19 pandemic, the prevalence of HE did not increase compared to previous data. This may be explained by the fact that Danish HCWs demonstrate a solid basis of knowledge on skin protection.

As in line with the literature, we found frequent hand washings to be associated with HE<sup>4,33–35</sup> and a lack of association between ABHR and HE<sup>4,7,10,22</sup>. Experimental data has recently suggested an association between use of ABHR on wet skin and HE<sup>13</sup>, and although we did not find a significant association this should be further explored in future studies.

We found a strong association between the use of gloves on wet skin and HE, a risk situation which has not previously been evaluated. According to the WHO guidelines<sup>12</sup>, disinfection of hands before and after glove use is recommended, and it is anticipated that HCWs may don gloves before their hands are completely dry, leading to an increased risk for skin damage. In addition, remains of detergents may also be present on the skin after incomplete drying, which may intensify the impairment of the skin barrier function<sup>36</sup>. Further, wet skin may facilitate an increased bacterial transmission to surroundings<sup>37,38</sup> and an increased penetration of some allergens<sup>39</sup>. To date, focus has primarily been on gloves applied onto dry skin, however, gloves worn on wet skin may be a hitherto overlooked risk factor for HE.

Subjective discomfort to hand washing and in particular to ABHR was more frequent in HCWs with HE compared to HCWs without HE, and this discomfort was correlated to increased stress level. It could be speculated that discomfort to hand washing and ABHR may lead to reduced compliance regarding hygienic measures, and even though this appeared to be rare in our study, the problem is still important to pay attention to, since an underreporting could be expected here. Our data on subjective discomfort underscores the need for an alternative to ABHR, since ABHR – although not damaging the skin barrier – causes discomfort when used on broken skin. Additionally, subjective discomfort to hand washings was four times more frequent in HCWs with HE than without emphasizing the difficulties with not only ABHR use but also hand washings.

We found a strong association between atopic dermatitis and HE, supporting previous findings<sup>4,40</sup> although the relationship recently was questioned in a population of occupational HE patients<sup>41,42</sup>. However, it is important to take the validity of the question on self-reported atopic dermatitis into account, since the sensitivity of the question is higher among individuals with HE compared to individuals without HE resulting in a potential overestimation of atopic dermatitis as a risk factor for HE<sup>43</sup>. Regarding life-style factors, we found no significant associations with HE which could be explained by the fact that the majority of HCWs may be strongly aware of healthy life-style factors.

A strength of our study was that we included HCWs employed at clinical departments at different hospitals in Greater Copenhagen area. The questions incorporated in our questionnaire were all validated. We identified and explored hitherto neglected exposures (e.g. ABHR and gloves applied on wet skin). A response rate of 43.6% may be considered as a limitation, however, it is comparable to similar surveys<sup>4</sup>. The cross-sectional design has limitations and conclusions on causation cannot be drawn. Healthy worker effect might have influenced the results of our study contributing to a lower prevalence of HE and recall bias might have had an impact on the self-reports.

## **5. CONCLUSION**

We found a one-year HE prevalence of 14.7% in HCWs, which is lower than reported in previous comparable studies, and accompanied by lower number of hand washings, and increased use of ABHR than previously reported. Glove use on wet skin was identified as a hitherto unexplored risk factor for HE. Although our data indicates that the prevalence of HE in HCWs may be declining, preventive measures should still be in focus, since the prevalence is markedly higher than in the general population.

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**Table 1** – Background characteristics of the study population

|                                 | HE within last year<br>n (%) | HE not within last year n (%) | Never had HE<br>n (%) | Total | P-value<br>( $\chi^2$ test) <sup>a</sup> | P for trend <sup>b</sup> |
|---------------------------------|------------------------------|-------------------------------|-----------------------|-------|------------------------------------------|--------------------------|
| <b>Total</b>                    | 311 (14.7)                   | 264 (12.4)                    | 1550 (72.9)           | 2125  |                                          |                          |
| <b>Sex</b>                      |                              |                               |                       |       | <b>.009</b>                              | n/a                      |
| Female                          | 277 (89.1)                   | 226 (85.6)                    | 1276 (82.3)           | 1779  |                                          |                          |
| Male                            | 34 (10.9)                    | 38 (14.4)                     | 274 (71.7)            | 346   |                                          |                          |
| <b>Age (years)</b>              |                              |                               |                       |       | <b>.307</b>                              | <b>.053</b>              |
| 22-29                           | 59 (19.0)                    | 42 (15.9)                     | 262 (16.9)            | 363   |                                          |                          |
| 30-39                           | 98 (31.5)                    | 60 (22.7)                     | 432 (27.9)            | 590   |                                          |                          |
| 40-49                           | 71 (22.8)                    | 69 (26.1)                     | 376 (24.3)            | 516   |                                          |                          |
| 50-59                           | 48 (15.4)                    | 54 (20.5)                     | 292 (18.9)            | 394   |                                          |                          |
| >60                             | 35 (11.3)                    | 39 (14.8)                     | 186 (12.0)            | 260   |                                          |                          |
| <b>weekly working hours</b>     |                              |                               |                       |       | <b>.554</b>                              | <b>.507</b>              |
| ≤30                             | 17 (6.5)                     | 18 (8.4)                      | 119 (9.3)             | 154   |                                          |                          |
| 30-39                           | 227 (86.3)                   | 176 (82.2)                    | 1061 (82.6)           | 1464  |                                          |                          |
| 40-60                           | 19 (7.2)                     | 20 (9.4)                      | 105 (8.2)             | 144   |                                          |                          |
| <b>BMI</b>                      |                              |                               |                       |       | <b>.175</b>                              | <b>.034</b>              |
| ≤25                             | 174 (58.6)                   | 145 (57.8)                    | 944 (63.5)            | 1263  |                                          |                          |
| 26-29                           | 87 (29.3)                    | 74 (29.5)                     | 402 (27.1)            | 563   |                                          |                          |
| ≥30                             | 36 (12.1)                    | 32 (12.7)                     | 139 (9.4)             | 207   |                                          |                          |
| <b>Tobacco use</b>              |                              |                               |                       |       | <b>.160</b>                              | <b>.114</b>              |
| Yes                             | 22 (7.2)                     | 29 (11.1)                     | 122 (8.0)             | 173   |                                          |                          |
| No, never                       | 170 (55.6)                   | 144 (55.2)                    | 918 (59.8)            | 1232  |                                          |                          |
| No, but previous smoker         | 114 (37.2)                   | 88 (33.7)                     | 494 (32.2)            | 696   |                                          |                          |
| <b>Children ≤ 4 years</b>       |                              |                               |                       |       | <b>.058</b>                              | n/a                      |
| Yes                             | 66 (21.3)                    | 36 (13.6)                     | 279 (18.1)            | 381   |                                          |                          |
| No                              | 244 (78.7)                   | 228 (86.4)                    | 1264 (81.9)           | 1736  |                                          |                          |
| <b>Perceived stress</b>         |                              |                               |                       |       | <b>.008</b>                              | <b>.570</b>              |
| Never or few times per year     | 98 (31.5)                    | 102 (38.6)                    | 497 (32.1)            | 697   |                                          |                          |
| Sometime every month            | 114 (36.7)                   | 93 (35.2)                     | 505 (32.7)            | 712   |                                          |                          |
| Sometime every week             | 57 (18.3)                    | 36 (13.7)                     | 322 (20.8)            | 415   |                                          |                          |
| Some days every week            | 25 (8.0)                     | 20 (7.6)                      | 174 (11.3)            | 219   |                                          |                          |
| Most days of the week           | 17 (5.5)                     | 13 (4.9)                      | 48 (3.1)              | 78    |                                          |                          |
| <b>Daily moisturizer use</b>    |                              |                               |                       |       | <b>&lt;.001</b>                          | <b>&lt;.001</b>          |
| Never                           | 83 (27.0)                    | 90 (34.2)                     | 638 (41.4)            | 811   |                                          |                          |
| 1-2                             | 48 (48.2)                    | 119 (45.2)                    | 654 (42.4)            | 821   |                                          |                          |
| 3                               | 35 (11.4)                    | 38 (14.5)                     | 165 (10.7)            | 238   |                                          |                          |
| ≥5                              | 41 (13.4)                    | 16 (6.1)                      | 85 (5.5)              | 142   |                                          |                          |
| <b>Atopic dermatitis (ever)</b> |                              |                               |                       |       | <b>&lt;.001</b>                          | n/a                      |
| Yes                             | 117 (37.9)                   | 75 (28.8)                     | 132 (9.5)             | 324   |                                          |                          |
| No                              | 148 (47.9)                   | 146 (56.2)                    | 1192 (85.9)           | 1486  |                                          |                          |
| Don't know                      | 44 (14.2)                    | 39 (15.0)                     | 64 (4.6)              | 147   |                                          |                          |

<sup>a</sup>HCWs with HE within last year, and HCWs with HE but not within last year and HCWs who never had HE were all included in the analysis.

<sup>b</sup>Cochran Armitage test for trend was performed. HCWs with HE within last year and HCWs who never had HE were

included.

Statistically significant *P* -values are shown in bold. HE, hand eczema; BMI, body mass index; n/a, not applicable

**Table 2** Occupational and non-occupational exposures

|                                                                     | HE within last year<br>n (%) | HE not within last year<br>n (%) | Never had HE<br>n (%) | Total | <i>P</i> - value<br>( $\chi^2$ test) <sup>a</sup> |
|---------------------------------------------------------------------|------------------------------|----------------------------------|-----------------------|-------|---------------------------------------------------|
| <b>Total</b>                                                        | 311 (14.7)                   | 264 (12.4)                       | 1550 (72.9)           | 2125  |                                                   |
| <b>Hand washing with soap per day</b>                               |                              |                                  |                       |       | <b>.004</b>                                       |
| <5                                                                  | 57 (18.5)                    | 54 (20.4)                        | 359 (23.3)            | 470   |                                                   |
| 6-10                                                                | 94 (30.4)                    | 95 (36.0)                        | 588 (38.1)            | 777   |                                                   |
| 11-15                                                               | 81 (26.2)                    | 54 (20.5)                        | 330 (21.4)            | 465   |                                                   |
| 16-20                                                               | 42 (13.6)                    | 28 (10.6)                        | 141 (9.1)             | 211   |                                                   |
| >20                                                                 | 35 (11.3)                    | 33 (12.5)                        | 125 (8.1)             | 193   |                                                   |
| <b>ABHR use per day</b>                                             |                              |                                  |                       |       | <b>.176</b>                                       |
| <10                                                                 | 15 (4.8)                     | 9 (3.4)                          | 92 (5.9)              | 116   |                                                   |
| 11-20                                                               | 46 (14.8)                    | 45 (17.2)                        | 301 (19.4)            | 392   |                                                   |
| 21-30                                                               | 79 (25.4)                    | 65 (24.8)                        | 394 (25.4)            | 538   |                                                   |
| 31-40                                                               | 50 (16.1)                    | 53 (20.2)                        | 278 (18.0)            | 381   |                                                   |
| 41-50                                                               | 45 (14.5)                    | 39 (14.9)                        | 207 (13.4)            | 291   |                                                   |
| >50                                                                 | 76 (24.4)                    | 51 (19.5)                        | 277 (17.9)            | 404   |                                                   |
| <b>ABHR on wet skin per day</b>                                     |                              |                                  |                       |       | <b>.085</b>                                       |
| Never                                                               | 117 (37.7)                   | 99 (38.1)                        | 670 (43.7)            | 886   |                                                   |
| 1-5                                                                 | 124 (40.0)                   | 111 (42.7)                       | 603 (39.4)            | 838   |                                                   |
| 6-10                                                                | 33 (10.7)                    | 24 (9.2)                         | 140 (9.1)             | 197   |                                                   |
| 11-15                                                               | 11 (3.6)                     | 13 (5.0)                         | 54 (3.5)              | 78    |                                                   |
| 16-20                                                               | 15 (4.8)                     | 8 (3.1)                          | 29 (1.9)              | 52    |                                                   |
| >20                                                                 | 10 (3.2)                     | 5 (1.9)                          | 36 (2.4)              | 51    |                                                   |
| <b>Glove use in hours, h, per day</b>                               |                              |                                  |                       |       | <b>.006</b>                                       |
| Never                                                               | 6 (1.9)                      | 7 (2.7)                          | 68 (4.4)              | 81    |                                                   |
| < ½ h                                                               | 36 (11.6)                    | 41 (15.5)                        | 218 (14.1)            | 295   |                                                   |
| ½ - 2 h                                                             | 115 (37.0)                   | 87 (33.0)                        | 626 (40.4)            | 828   |                                                   |
| 2-3 h                                                               | 56 (18.0)                    | 55 (20.8)                        | 300 (19.4)            | 411   |                                                   |
| 3-5 h                                                               | 71 (22.8)                    | 55 (20.8)                        | 233 (15.1)            | 359   |                                                   |
| >5 h                                                                | 27 (8.7)                     | 19 (7.2)                         | 102 (6.6)             | 148   |                                                   |
| <b>Gloves on wet skin per day</b>                                   |                              |                                  |                       |       | <b>.002</b>                                       |
| Never                                                               | 139 (45.0)                   | 136 (51.9)                       | 871 (56.6)            | 1146  |                                                   |
| 1-5                                                                 | 113 (36.6)                   | 95 (36.3)                        | 515 (33.4)            | 723   |                                                   |
| 6-10                                                                | 31 (10.0)                    | 20 (7.6)                         | 90 (5.8)              | 141   |                                                   |
| >10                                                                 | 26 (8.4)                     | 11 (4.2)                         | 64 (4.1)              | 101   |                                                   |
| <b>Wet work in hours, h, per day (non-occupational)<sup>b</sup></b> |                              |                                  |                       |       | <b>&lt;.001</b>                                   |
| Never                                                               | 27 (8.7)                     | 23 (8.7)                         | 212 (13.7)            | 262   |                                                   |
| < ½ h                                                               | 138 (44.4)                   | 145 (54.9)                       | 809 (52.4)            | 1092  |                                                   |
| ½ - 2 h                                                             | 142 (45.6)                   | 93 (35.2)                        | 493 (31.9)            | 728   |                                                   |
| > 2 h                                                               | 4 (1.3)                      | 3 (1.2)                          | 31 (2.0)              | 38    |                                                   |

<sup>a</sup> HCWs with HE within last year, and HCWs with HE but not within last year and HCWs who never had HE were all included in the analysis.

<sup>b</sup> Based on 8-hour spare time

Statistically significant *P* -values are shown in bold. HE, hand eczema; ABHR, alcohol-based hand rubs.

**Table 3** – Associations between wet work exposures and HE within the last year (n=311) compared to HCWs without HE (n=1550) using binary logistic regression analysis.

|                                               | Wet work exposures analysed separately | Wet work exposures analysed together | Wet work exposures adjusted for sex, atopic dermatitis and perceived stress | Wet work exposures adjusted additionally for age, BMI, tobacco, and children <4 years |
|-----------------------------------------------|----------------------------------------|--------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|                                               | OR (95% CI)                            | OR (95% CI)                          | OR (95% CI)                                                                 | OR (95% CI)                                                                           |
| <b>Hand washing with soap (times per day)</b> |                                        |                                      |                                                                             |                                                                                       |
| Low ( $\leq 10$ ) – Ref.                      |                                        |                                      |                                                                             |                                                                                       |
| High ( $> 10$ )                               | <b>1.66 (1.30-2.13)</b>                | <b>1.47 (1.12-1.91)</b>              | <b>1.60 (1.19-2.15)</b>                                                     | <b>1.73 (1.26-2.36)</b>                                                               |
| <b>ABHR use (times per day)</b>               |                                        |                                      |                                                                             |                                                                                       |
| Low ( $\leq 20$ ) – Ref.                      |                                        |                                      |                                                                             |                                                                                       |
| High ( $> 20$ )                               | <b>1.39 (1.03-1.89)</b>                | 1.09 (0.79-1.50)                     | 1.04 (0.73-1.47)                                                            | 1.00 (0.69-1.43)                                                                      |
| <b>Glove use (hours)</b>                      |                                        |                                      |                                                                             |                                                                                       |
| Low ( $\leq 3$ ) – Ref.                       |                                        |                                      |                                                                             |                                                                                       |
| High ( $> 3$ )                                | <b>1.66 (1.27-2.18)</b>                | <b>1.37 (1.02-1.83)</b>              | 1.26 (0.91-1.73)                                                            | 1.16 (0.83-1.63)                                                                      |
| <b>ABHR on wet skin (times per day)</b>       |                                        |                                      |                                                                             |                                                                                       |
| Low ( $\leq 5$ ) – Ref.                       |                                        |                                      |                                                                             |                                                                                       |
| High ( $> 5$ )                                | <b>1.41 (1.04-1.90)</b>                | 0.98 (0.70-1.39)                     | 1.01 (0.69-1.47)                                                            | 0.92 (0.62-1.37)                                                                      |
| <b>Gloves on wet skin (times per day)</b>     |                                        |                                      |                                                                             |                                                                                       |
| Low ( $\leq 5$ ) – Ref.                       |                                        |                                      |                                                                             |                                                                                       |
| High ( $> 5$ )                                | <b>2.04 (1.46-2.84)</b>                | <b>1.66 (1.13-2.44)</b>              | <b>1.85 (1.21-2.85)</b>                                                     | <b>1.99 (1.27-3.12)</b>                                                               |

Statistically significant values are shown in bold.

BMI, Body Mass Index; OR, Odds Ratio; CI, confidence interval.

Confounders were stepwise included in the multivariate models based on their significance level in the univariate analyses.

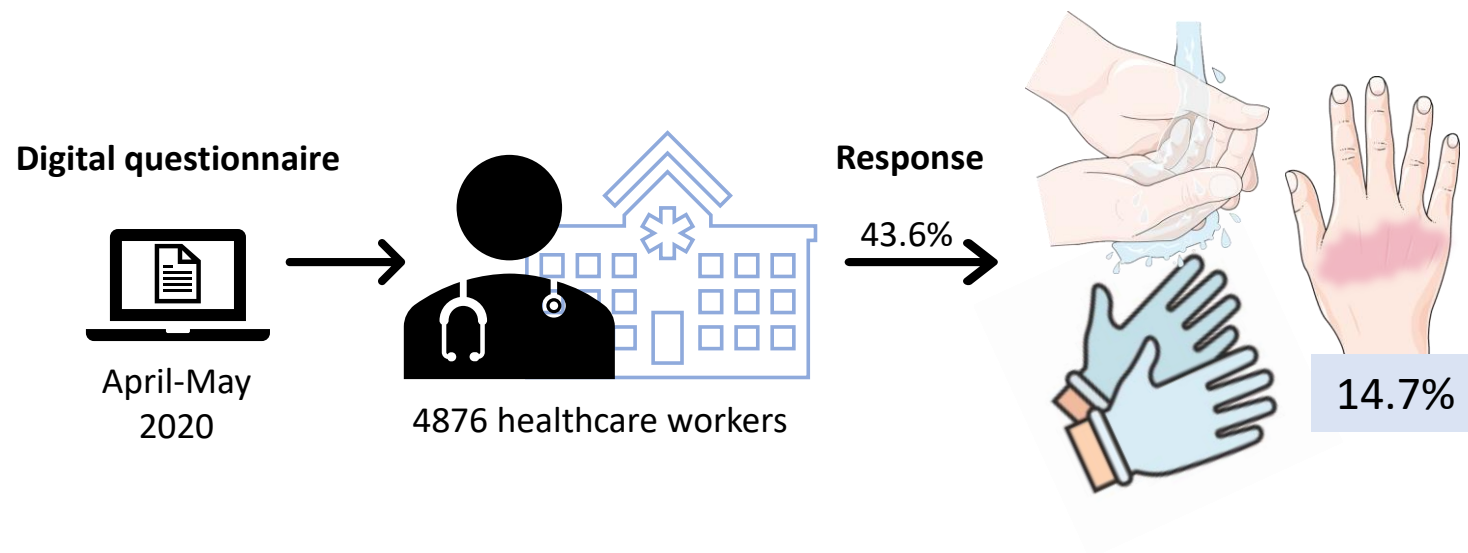
**Table 4** Subjective discomfort in relation to hand washings and alcohol-based hand rub (ABHR)

|                                                         | HE within last year<br>n (%) | HE not within last year<br>n (%) | Never had HE<br>n (%) | Total | P-value<br>( $\chi^2$ test) <sup>a</sup> |
|---------------------------------------------------------|------------------------------|----------------------------------|-----------------------|-------|------------------------------------------|
| <b>Hand washing with soap - stinging, burning, pain</b> |                              |                                  |                       |       | <b>&lt;.001</b>                          |
| Yes                                                     | 59 (19.0)                    | 30 (11.4)                        | 71 (4.6)              | 160   |                                          |
| No                                                      | 252 (81.0)                   | 233 (88.6)                       | 1472 (95.4)           | 1957  |                                          |
| <b>ABHR - stinging, burning, pain</b>                   |                              |                                  |                       |       | <b>&lt;.001</b>                          |
| Yes                                                     | 100 (32.2)                   | 40 (15.2)                        | 158 (10.2)            | 298   |                                          |
| No                                                      | 211 (67.8)                   | 224 (84.8)                       | 1384 (89.8)           | 1819  |                                          |

<sup>a</sup> HCWs with HE within last year, and HCWs with HE but not within last year and HCWs who never had HE were all included in the analysis. Statistically significant P-values are shown in bold.

ABHR, Alcohol-based hand-rubs

HE, hand eczema



**An update on the prevalence and risk exposures associated with hand eczema in Danish hospital employees**

**-A cross-sectional questionnaire-based study**

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**Highlights:**

- The one-year prevalence of hand eczema was 14.7% which is lower than previously reported
- Hand eczema was associated with frequent hand washings, as previously reported, and to glove use on wet skin, which is a possible risk factor for hand eczema that should be further explored.
- Subjective discomfort was reported significantly more often to alcohol-based hand rubs than to hand washings, and up to three times more often in healthcare workers with hand eczema than without hand eczema.

## Supplementary Materials

**Table S1 – One-year prevalence of HE at departments**

|                              | HE within last year<br>n (%) | HE not within last year<br>n (%) | Never had HE<br>n (%) | Total | <i>P</i> -value<br>( $\chi^2$ test) |
|------------------------------|------------------------------|----------------------------------|-----------------------|-------|-------------------------------------|
| <b>Total</b>                 | 311 (14.7)                   | 264 (12.4)                       | 1550 (72.9)           | 2125  |                                     |
| <b>Department</b>            |                              |                                  |                       |       | 0.800                               |
| Surgical                     | 92 (15.3)                    | 76 (12.7)                        | 432 (72.0)            | 600   |                                     |
| Internal medicine            | 116 (14.3)                   | 103 (12.7)                       | 593 (73.0)            | 812   |                                     |
| Anesthetics + intensive care | 35 (13.2)                    | 38 (14.3)                        | 193 (72.6)            | 266   |                                     |
| Pediatrics                   | 15 (19.0)                    | 9 (11.4)                         | 55 (69.6)             | 79    |                                     |
| Dermato-venerology           | 10 (11.5)                    | 13 (14.9)                        | 64 (73.6)             | 87    |                                     |
| Emergency                    | 28 (15.2)                    | 19 (10.3)                        | 137 (74.5)            | 184   |                                     |
| Biochemistry/physiotherapy   | 15 (15.8)                    | 6 (6.3)                          | 74 (77.9)             | 95    |                                     |

HE, hand eczema. Statistically significant *P*-values are shown in bold.

**Table S2-** Association between life-style factors and HE reported within last year in a binary logistic regression analysis

|                                            | Univariate              | Multivariate<br>(adjusted for life-style factors,<br>atopic dermatitis, wet work,<br>sex and age) |
|--------------------------------------------|-------------------------|---------------------------------------------------------------------------------------------------|
|                                            | OR (95% CI)             | OR (95% CI)                                                                                       |
| <b>Atopic dermatitis</b>                   |                         |                                                                                                   |
| No - Reference                             |                         |                                                                                                   |
| Yes                                        | <b>7.14 (5.28-9.65)</b> | <b>8.27 (5.94 -11.51)</b>                                                                         |
| Don't know                                 | <b>5.54 (3.64-8.43)</b> | <b>5.97 (3.76-9.48)</b>                                                                           |
| <b>BMI</b>                                 |                         |                                                                                                   |
| <30 - Reference                            |                         |                                                                                                   |
| ≥30                                        | 1.31 (0.88-1.94)        | 1.01 (0.99-1.04)                                                                                  |
| <b>Perceived stress</b>                    |                         |                                                                                                   |
| Never or few times per year -<br>Reference |                         |                                                                                                   |
| Sometime every month                       | 1.14 (0.85-1.54)        | 1.23 (0.87-1.74)                                                                                  |
| Sometime every week                        | 0.90 (0.63-1.28)        | 0.99 (0.66-1.50)                                                                                  |
| Some days every week                       | 0.73 (0.45-1.17)        | 0.59 (0.33-1.04)                                                                                  |
| Most days of the week                      | <b>1.80 (0.99-3.25)</b> | 1.45 (0.71-2.96)                                                                                  |
| <b>Tobacco</b>                             |                         |                                                                                                   |
| No, never - Reference                      |                         |                                                                                                   |
| No, but previous smoker                    | 1.20 (0.96-1.62)        | 1.21 (0.88-1.65)                                                                                  |
| Yes                                        | 0.97 (0.60-1.58)        | 1.03 (0.59-1.80)                                                                                  |

Associations between healthcare workers (HCWs) with hand eczema (HE) within last year (n=311) and HCWs without HE (n=1550). BMI, body mass index; OR, Odds Ratio; CI, Confidence Interval. Statistically significant values are shown in bold.