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The correlation between self-reported hand eczema and clinically based diagnosis in professional cleaners

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Abstract

Background: Most studies investigating the prevalence of hand eczema (HE) in professional cleaners use self-reported questionnaire-based data. However, no validation studies of self-reporting of HE among professional cleaners have previously been conducted.

Objectives: To investigate (1) the point prevalence of self-reported HE, (2) the point prevalence of HE estimated by physical examination of the hands and (3) the sensitivity and specificity of self-reporting of HE compared with the diagnosis based on physical examination among professional cleaners.

Methods: Professional cleaners at three different hospitals in Region Zealand were invited to fill out a questionnaire. The point prevalence of self-reported HE was estimated based on questions from the Nordic Occupational Skin Questionnaire. After completing the questionnaire, each cleaner underwent a physical examination of the hands by a dermatologist on the same day.

Results: In total, 234 cleaners were invited to participate in the study, and 224 (response rate = 96.0%) agreed to take part. Based on the self-reported questionnaires, 5.3% (n = 12) of the cleaners had current HE. Based on an examination by a physician, 19.2% (n = 43) of the cleaners had current HE. The sensitivity of self-reported HE was found to be 28.0%, while the specificity was found to be 100.0%. The positive predictive value was found to be 100.0%, while the negative predictive value was 85.0%.

Conclusion: The true point prevalence of HE among professional cleaners is underestimated when based on self-reporting.

KEYWORDS
cleaning, contact allergy, dermatitis, sensitization

1 | INTRODUCTION

Hand eczema (HE) is a common occupational skin disorder, particularly in high-risk occupations such as healthcare workers, hairdressers and professional cleaners. The reported lifetime prevalence rates have reached as high as 40%.[1,2] In particular, professional cleaners are at risk as they are frequently exposed to wet work as well as allergens and irritants, which are considered important causes of HE.[3] Reduced productivity, reduced quality of life, increased sick leave and impaired fine motor skills are severe consequences reported by cleaners suffering from HE.[3–10]

In epidemiological studies investigating larger populations, clinical examination is difficult to manage, and prevalence studies of HE among cleaners are often based on self-reporting in questionnaires.[11–16] Only a few studies have investigated the prevalence based on clinical examination of the hands.[5,6,17] Clinical examination is regarded as the gold standard for determining the prevalence of HE, and some studies have already compared the results of self-reporting and clinical examination for HE to validate the accuracy of self-reporting within other occupational groups than cleaners.[18–23] Self-reported data provide a unique dimension of clinical data, as they ideally provide important insights into the individual patient's subjective experience of the situation. This requires that the target population fully understands the questions and has the proper knowledge to answer them. Entities engaged in clinimetrics (the science of clinical measurement, particularly focusing on the development and evaluation of methods for measuring clinical phenomena) such as COSMIN provide guidelines, which can be used to assess the methodological quality of studies on measurement properties of health-related patient-reported outcome measures.[24] These guidelines help researchers evaluate the reliability, validity and responsiveness of measurement instruments used in clinical research and practice that may be used in this context as well.[24] In addition, any questionnaire should first, before use, be validated in the target population to ensure the relevance, effectiveness and clarity of the self-reported data. To the best of our knowledge, validation of available screening tools for self-reporting HE has yet to be conducted among Danish professional cleaners.

This means that the true prevalence of HE may differ from the one obtained by self-reporting for several reasons. First, comparability becomes challenging when different assessment methods are used (self-reporting vs. clinical examination). Second, the validity of a particular assessment used for self-reported HE may fluctuate across different target populations. This is important because, under-reporting may negatively affect the development and implementation of preventative measures. The aims of this study were to investigate (1) the point prevalence of HE in cleaners estimated by self-reporting, (2) the point prevalence of HE estimated by the physician-verified examination of the hands and (3) the sensitivity and specificity of self-reporting of HE compared with the physician-verified diagnosis (criterion validity).

2 | METHODS

2.1 | Study population

The present study is based on data from the HEIC (Hand Eczema in Cleaners) trial (NCT05763914).[25] The trial targeted professional hospital cleaners employed at Køge, Slagelse and Holbæk hospitals during the period of 14 November to 5 December 2022. The data investigated in the current study were collected at the baseline of the trial. Inclusion criteria necessitated participants to be professional cleaners: (1) aged 18 or older, (2) having sufficient Danish language skills and (3) providing written informed consent. Evaluation of language abilities took place during a pre-baseline meeting, where potential participants who expressed interest engaged in one-on-one discussions with the research team. Those who (1) had insufficient Danish language skills, (2) suffered from other skin diseases than HE on the hands (e.g., psoriasis), (3) were pregnant and (4) were currently being treated with topical or systemic immunomodulatory therapies were not allowed to participate. The study received approval from by the Regional Ethics Committee for the Zealand Region (journal number: EMN-2022-04317).

2.2 | Questionnaire

During the baseline interview, each participant was asked to complete a questionnaire, of which a selected number (11 questions) were included in the present study covering the following: demographic information ($n = 5$), previous and current comorbidities ($n = 3$) and HE-related outcomes ($n = 3$) (Table S1). Questions about comorbidities concerning HE (such as atopic dermatitis [AD], asthma, and hay fever) were investigated using questions A2, A4 and S5b from the Nordic Occupational Skin Questionnaire (NOSQ-2002).[16,26,27] The response options for all the questions were (1) 'Yes', (2) 'No' and (3) 'I don't know'.

The prevalence of self-reported HE was investigated using three questions (D1, D2 and D5) from NOSQ-2002.[27] This method had previously been used in another, similar study investigating the validation of self-reported HE among Danish hairdressing apprentices.[28] Participants who reported current eczema either on their hands alone or on their wrists or forearms combined with their hands were considered to have self-reported HE.

During the baseline interview, participants were informed about the availability of the study group to address any queries pertaining to the questionnaire. For individuals unfamiliar with the concept of HE, the study group was prepared to provide a standardised definition based on established HE guidelines.[1] This was 'HE is a prevalent inflammatory skin condition categorized into acute/subacute or chronic stages. Acute/subacute HE is marked by eczematous lesions mainly on the hands, potentially spreading to the wrists or forearms, lasting less than three months and occurring annually. Conversely, chronic HE refers to a prolonged eczematous condition persisting

over three months or recurring two or more times per year. Depending on the stage, signs/symptoms may include redness, dryness, swelling, papules, fissures, blistering or itching'.[1] However, none of the participants took advantage of this assistance.

2.3 | Physical examination

A physician examined each participant and evaluated the overall impression of the presence of HE from clinical practice based on the objective signs (erythema, infiltration/papulation, vesicles, fissures, scaling and oedema). The clinical diagnosis of HE was based on the presence of at least two signs represented in the Hand Eczema Severity Index (HECSI) score, and the severity of HE was evaluated using the HECSI score.[28,29] The HECSI score is a validated clinical scoring tool used to investigate signs of HE, severity and location of HE. The calculation of the score is based on the evaluation of five different areas, namely fingertips, fingers, palms of the hands, back of the hands and wrists. For each area, different signs are evaluated on a four-point scale.[28,29] The signs include erythema, infiltration/papulation, vesicles, scaling, fissures and oedema. The final score is based on both the extent of the area affected by eczema and the severity. On the HECSI score, which ranges from 0 to 360, a score of 0 indicates the absence of HE, while a score of 360 indicates the most severe possible case of HE.[28,29] The severity of HE is classified according to the HECSI score into the following categories: almost clear (0), mild (1–16), moderate (17–37), severe (38–116) and very severe (≥117).[30] The dermatological examination occurred on the same day following the participant's completion of the questionnaire. The hands of each participant were examined (regardless of having self-reported HE or not), and the examiner was unaware of the participant's status regarding having self-reported HE. No attempt was made in the present study to differentiate between different aetiological subtypes of HE (irritant HE, allergic HE, atopic HE or protein contact dermatitis/contact urticaria) as that requires additional medical history and patch testing to confirm the actual cause of the HE.

2.4 | Statistical analysis

The data were analysed using IBM SPSS statistical software version 24.0, developed by IBM Corp. located in Armonk, NY, USA. The current study investigated criterion validity, which is a specific type of validity evaluating how well a measure corresponds to a specific criterion or standard.[18,31,32] In other words, it assesses whether results obtained from a particular measurement (such as questionnaire-based data) can predict or correlate with an external criterion or a 'gold standard' (clinical examination of the hands).[32] To examine this, the sensitivity and specificity of the self-reported diagnosis compared to the dermatological diagnosis ('golden standard') calculations were made to determine the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) (Appendix A). Sensitivity, in general, refers to the ability of a screening tool to identify and classify the

condition.[31] In this study, sensitivity refers to the percentage of cleaners with a dermatological diagnosis of HE, who also reported a positive self-diagnosis.[18] Specificity generally refers to the ability of a screening tool to classify a non-condition when no condition is present.[31] In this study, specificity refers to the percentage of cleaners with no dermatological diagnosis of HE, who also reported a negative self-diagnosis.[18] PPV refers to the proportion of all cleaners with a self-reported diagnosis of HE, who also had a positive diagnosis on examination.[18] The PPV should be high for a questionnaire to identify cleaners with HE.[31] NPV refers to the proportion of cleaners with no self-reported HE who also had a negative result after their dermatological examination.[18,31]

3 | RESULTS

3.1 | Study population

In total, 234 professional cleaners were invited to participate in the study. Out of these, 224 individuals agreed to participate (a response rate is 96.0%). Among the participants, 89.3% ($n = 200$) of the individuals were female, and 10.7% ($n = 24$) were male. Their average age was 49.7 (years) ± 12.7 (standard deviation). Most of the study population reported vocational education as their highest level of educational attainment ($n = 107$, $n = 47.8\%$). However, 24.6% ($n = 55$) reported to have completed higher education, 19.2% ($n = 43$) had completed elementary school and 8.5% ($n = 19$) reported that they had no previous education. A percentage of 6.7% ($n = 15$) had a history of AD, 15.6% ($n = 35$) had asthma and 46.9% ($n = 105$) had hay fever or other symptoms of nasal allergy. A small proportion of the participants, 8.9% ($n = 20$), had worked as professional cleaners for less than a year, while 29.0% ($n = 65$) had been working for between 1 and 5 years and the majority, 62.1% ($n = 139$), had worked as cleaners for 5 years or more.

3.2 | The point prevalence and clinical characteristics of HE

The number of professional cleaners with HE based on self-reported questionnaires and dermatological examinations is illustrated in Table 1. Based on the self-reported questionnaire, 5.3% (12 out of 224) of the study population had current HE with a mean HECSI score of 29, a median of 16 and a range between 6 and 131 (Table 2). When examined by a physician, current HE was found among 19.2% (43 out of 224) of the study population, with a mean HECSI score of 30.3, a median score of 22 and a range between 6 and 144 (Table 2).

Among those with no self-reported HE, who, however, were found to have HE based on dermatological examination (false negative, $n = 31$), the mean HECSI score was 31, while the median score was 27 and the range was between 16 and 144 (Table 2). Discussing the same group, all participants were female (100%, $n = 31$), the majority 74.2% ($n = 23$) had worked for 5 years or more as

HE based on self-reported questionnaire	HE based on dermatological examination		
	Yes	No	Total
Positive	12	0	12
Negative	31	181	212
Total	43	181	224

TABLE 1 The number of cleaners with hand eczema (HE) based on dermatological examination and self-reported questionnaire.

TABLE 2 The Hand Eczema Severity Index (HECSI) score of the three groups.

	All cleaners, who had hand eczema based on dermatological examination ($n = 43$)	Cleaners with self-reported hand eczema, who also were assessed to have hand eczema based on dermatological examination ($n = 12$)	Cleaners with no self-reported hand eczema, who however had hand eczema based on dermatological examination ($n = 31$)
HECSI score			
Mean	30.3	29.0	31.0
Median	22.0 (18.0–35.0)	16.0 (7.0–39.0)	27.0 (20.0–34.0)
Range	6–144	6–131	16–144

professional cleaners, while 19.4% ($n = 6$) had worked for between 1 and 5 years and 6.5% ($n = 2$) had worked for less than a year (Table 3). In addition, 74.2% ($n = 23$) did not report having AD, while 16.1% ($n = 5$) could not remember whether or not they had had AD and 9.7% ($n = 3$) reported having had AD. Discussing the educational background in the same group of the cleaners, 48.4% ($n = 15$) reported vocational education as the highest achievement, while 29.0% ($n = 9$) reported higher education, 16.1% ($n = 5$) reported elementary school and 6.5% ($n = 2$) reported non-education.

3.3 | The validity of self-reporting of HE

Table 4 illustrates the sensitivity, specificity, PPV and NPV of self-reporting of HE. The overall sensitivity was 28.0% (95% confidence interval [CI] 15.0%–44.0%), and the specificity was found to be 100.0% (95% CI 98.0%–100.0%). Regarding predictive values, our study found a PPV of 100.0% (95% CI 74.0%–100.0%) and a NPV of 85.0% (95% CI 80.0%–90.0%).

4 | DISCUSSION

A main finding of this study is that the true point prevalence of HE among Danish hospital cleaners is underestimated when based on data collected solely by questionnaire. In our study, 13.8% ($n = 31$) of the population who did not report having HE were in fact on physical examination diagnosed with the disease. This indicates a significant divergence from the true prevalence, that is, from 5.3% to 19.2%. These findings emphasise the need for discussing the method and definition of HE when investigating the prevalence of HE in professional cleaners. The results of the validation part in the current study help to interpret the differences in the prevalence based on self-reported and clinical-based diagnoses. In terms of self-reporting, the

sensitivity for detecting HE was found to be 28.0%, and the specificity and PPV were both 100.0%. Thus, due to its low sensitivity, self-reporting of HE may not be an adequate screening tool for ruling out HE among Danish hospital cleaners. However, it can be used as a confirmatory test, used to rule in a diagnosis. Among those with a self-reported diagnosis of HE, the dermatological examination may not be necessary because all self-reported instances were confirmed on clinical examination by a physician. This could lower the costs and time required to investigate the prevalence of HE in larger populations.

Surprisingly, the false-negative cases in our study also included cleaners with moderate-to-severe HE with a mean HECSI score of 31.0, a median HECSI score of 27.0 and a range of between 16 and 144. Different reasons are suggested for this: some cleaners might not know about HE, while others may confuse it with other skin diseases such as tinea manus, palmoplantar pustulosis or psoriasis.[28] Some workers might also associate skin problems with the notion of workplace 'culture'. It is also possible that some cleaners in our study were worried about the consequences for their employment if they reported having had HE. In addition, cultural differences may also have an impact on self-reporting of HE.

Currently, there are no prevention programmes for workers in the cleaning sector either nationwide or hospital-wide in Denmark. The education of cleaners, regardless of their demographic characteristics, is essential to ensure the same level of awareness about HE as in other industries.

Several studies have investigated the sensitivity and specificity of self-reported HE compared to the physician-based diagnosis.[18–23,28] However, it is important to notice the differences regarding the definition of self-reported HE, criteria for the physician-based diagnosis and outcomes of the studies (point prevalence vs. 1-year prevalence), when discussing the results. Point prevalence of HE was investigated in four studies among Danish hairdressing apprentices ($n = 502$), Dutch rubber workers ($n = 202$), Swedish patients from outpatient clinics ($n = 208$) and Swedish secondary school children

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TABLE 3 The characteristics of the cleaners based on different groups.

	All the cleaners, who had hand eczema based on dermatological examination (n = 43), n (%)	Cleaners, in which only the clinical examination revealed their hand eczema (n = 31), n (%)	Cleaners, with self-reported hand eczema, who also were assessed to have hand eczema based on dermatological examination (n = 12), n (%)
Gender			
Female	42 (97.7)	31 (100)	11 (91.7)
Male	1 (2.3)	-	1 (8.3)
Age			
Years ± (standard deviation)	51.5 ± 11.2	53.1 ± 9.4	47.5 ± 14.6
Education			
Non-education	3 (7.0)	2 (6.5)	1 (8.4)
Elementary school	9 (20.9)	5 (16.1)	4 (33.3)
Vocational education	19 (44.2)	15 (48.4)	4 (33.3)
Higher education	12 (27.9)	9 (29.0)	3 (25.0)
Atopic dermatitis			
Yes	6 (14.0)	3 (9.7)	3 (25.0)
No	29 (67.4)	23 (74.2)	6 (50.0)
I do not know	8 (18.6)	5 (16.1)	3 (25.0)
Asthma			
Yes	5 (11.6)	4 (12.9)	1 (8.3)
No	38 (88.4)	27 (87.1)	11 (91.7)
Hay fever or other symptoms of nasal allergy			
Yes	18 (41.9)	13 (41.9)	5 (41.7)
No	21 (48.8)	17 (54.8)	4 (33.3)
I do not know	4 (9.3)	1 (3.3)	3 (25.0)
Duration of being in the profession			
Less than a year	4 (9.3)	2 (6.5)	2 (16.7)
Between 1 and 5 years	9 (21.0)	6 (19.4)	3 (25)
For 5 years or more	30 (69.7)	23 (74.2)	7 (58.3)

TABLE 4 Validation of self-reporting of hand eczema compared to diagnosis based on dermatological examination.

Sensitivity	(95% CI)	Specificity	(95% CI)	Positive predictive value	(95% CI)	Negative predictive value	(95% CI)
28%	(15%–44%)	100%	(98%–100%)	100%	(74%–100%)	85%	(80%–90%)

Abbreviation: CI, confidence interval.

(n = 2535).[20,22,23,28] In the Danish study, the self-reported HE was based on having had current eczema on hands, wrists or forearms based on questions from NOSQ-2002, and the clinical diagnosis was based on the HECSI score.[28] The sensitivity of HE in the same study was reported to be 70.3%, while the specificity was 99.8%.[28] The lower sensitivity observed in our study compared to another Danish study examining hairdressing apprentices may stem from several factors. These include differences in knowledge and awareness within educational settings, variations in perceived risk and discrepancies in disease awareness among participants. In the Dutch study, the self-reported HE was defined as having one or more symptoms (red swollen hands or fingers, red hands or fingers and fissures, vesicles on the hands or at the sides of the fingers, scaling hands or fingers with fissures or itching hands or fingers with fissures) recurrent or lasting more than 3 weeks.[22] In addition, the clinical diagnosis was defined on morphological signs such as erythema, papules, vesicles, scaling and fissures.[22] The sensitivity of 71.4% and the specificity of 76.1% were reported for self-reported HE in the Dutch study.[22] In the first Swedish study, the self-reported HE was defined based on the question 'Do you have HE' on the day of the examination, while the clinical diagnosis was based on the following signs such as erythema, papules, vesicles, scaling, fissures, lichenification and hyperkeratotic.[23] This study reported the sensitivity of self-reported HE to be 87.0%, while the specificity was 79.0%.[23] In the second Swedish study, the

self-reported HE was defined on the question 'Do you now have eczema or other rash on your finger, finger webs, palms, backs of the hands or wrists?' and the clinical diagnosis was defined on morphological signs such as erythema, induration, papules, vesicles, scaling, pustules, lichenification and fissures.[20] The sensitivity of self-reported HE in this study was 73.0%, while the specificity was 99.0%.[20]

Despite the differences in the target population, language proficiency as well as the definition of self-reported and clinical diagnosis of HE, it is also important to notice that the previously mentioned studies have been published at different times compared to our study. Every questionnaire investigating self-reported HE is developed based on available data at a certain point in time, reflecting the knowledge and perceptions of a specific population regarding the targeted disease. However, as knowledge and awareness about a disease (in this case HE) progress and as interventions or educational campaigns are implemented, the understanding and perception of different population groups may evolve. This can lead to variations in how individuals perceive and interpret the disease, which in turn can impact their responses to questionnaire items. To the best of our knowledge, the NOSQ-2002 questionnaire, which is commonly used in most epidemiological studies, was developed in 2002.[20] The NOSQ-2002 questions are widely deemed suitable for assessing the prevalence of HE due to their demonstrated high sensitivity in certain studies.[26,28,33] However, there is a lack of validation for the NOSQ-2002 questions across different occupations. In addition, over the years, advancements in research, changes in occupational health policies or increased awareness campaigns might have resulted in different levels of knowledge and perceptions about HE among different worker groups. As a consequence, some worker groups may have a more nuanced understanding of HE compared to others. Therefore, validating a questionnaire initially before using it but also later periodically or whenever significant changes occur in the knowledge and perception of the targeted population is essential. This might help maintain the effectiveness and relevance of the questionnaire over time. Moreover, the low validity of self-reported HE might extend beyond professional cleaners to other occupations as well.

4.1 | Strength and limitations

Our study includes a large number of Danish hospital cleaners working at different hospitals in Denmark, and a high response rate was obtained. To the best of our knowledge, this study is the first attempt to investigate the validation of self-reporting of HE among this target population. However, there may be some limitations to our results. Recall bias, selection bias and healthy worker bias are all relevant and should be mentioned. In addition, interview bias is also relevant since the physician helped some cleaners who had difficulties completing the questionnaire. In our study, the diagnosis of HE based on dermatological examination was based on different morphological signs. However, symptoms such as itching, burning, prickling or stinging, tenderness, aching or pain are also important when discussing the definition of HE.

In conclusion, the true point prevalence of HE among professional hospital cleaners is underestimated when investigated by self-reported data. The underestimation might be due to differences in awareness, knowledge and disease perception among cleaners. It is also possible that some cleaners worry about the consequences for their employment if they report their HE. Danish hospital cleaners, regardless of demographic characteristics, should be offered education and information regarding HE in order to increase awareness of the disease. This may be a stepping stone towards the early detection of HE. There is also a need for carefully constructed questionnaires with a validated level of sensitivity and specificity when screening and discussing self-reported HE with hospital cleaners.

AUTHOR CONTRIBUTIONS

Farnam Barati Sedeh: Conceptualization; investigation; writing – original draft; methodology; validation; writing – review and editing; software; formal analysis; data curation; supervision. **Anna Glenn Ullum:** Investigation; writing – original draft; data curation. **Thórunn Elísabet Michaelsdóttir:** Writing – original draft; validation; methodology; software; formal analysis; writing – review and editing. **Karl Bang Christensen:** Investigation; writing – original draft; writing – review and editing; methodology; software. **Sarah Gharabaghi Stückler:** Data curation; formal analysis; software. **Gregor Borut Ernst Jemec:** Conceptualization; investigation; writing – original draft; writing – review and editing; supervision. **Ole Steen Mortensen:** Conceptualization; investigation; writing – original draft; supervision; writing – review and editing. **Kristina Sophie Ibler:** Conceptualization; investigation; funding acquisition; writing – original draft; writing – review and editing; methodology; supervision.

CONFLICT OF INTEREST STATEMENT

Dr Sedeh disclosed receiving grants from Pfizer. Dr Jemec disclosed receiving grants from AbbVie, LEO Foundation, Afyx, InflaRx, Janssen-Cilag, Novartis, UCB, CSL Behring, Regeneron, Sanofi, Boehringer Ingelheim, Union Therapeutics and Toosonix, as well as personal fees from Coloplast, Chemocentryx, LEO Pharma, Incyte, Kymera and VielaBio. Dr Ibler disclosed participation in advisory boards and receiving personal fees from Astra Zeneca, Leo Pharma, Sanofi Genzyme and Eli Lilly. Dr Sedeh, Jemec, and Ibler assert that their involvement did not influence the content of this manuscript. Additionally, the remaining authors reported no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

APPENDIX A

		Status of person having hand eczema according to dermatological examination ('golden standard')	
		Has not the condition	**Has the condition**
Status of person having hand eczema according to self-reported questionnaire	Positive	*a* True positive	*b* False positive
	Negative	*c* False negative	*d* True negative

	Hand eczema according to dermatological examination		
Hand eczema according to self-reported questionnaire	**Yes**	**No**	**Total**
Yes	*a*	*b*	*a + b*
No	*c*	*d*	*c + d*
Total	*a + c*	*b + d*	-
			Calculation
Sensitivity			$[a/(a + c)] \times 100$
Specificity			$[d/(b + d)] \times 100$
Positive predictive value			$[a/(a + b)] \times 100$
Negative predictive value			$[d/(c + d)] \times 100$