

Hand eczema and wet work: dose–response relationship and effect of leaving the profession

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Summary

Background. Wet work is an important risk factor for occupational hand eczema.

Objectives. To examine the effect of job change in workers with occupational hand eczema caused by wet work, and to evaluate the dose–response relationship between intensity of wet work and eczema.

Method. The study is based on a subgroup ($n = 954$) from a descriptive, registry-based study including all participants with occupational hand eczema caused by wet work recognized by the Danish Labour Market Insurance Authority in 2010 and 2011. A follow-up questionnaire was sent out 4–5 years later (response 58%).

Results. Change of profession and being outside the labour market had a positive effect on healing and improvement of hand eczema. Inverse dose–response relationships were found between the amount of time spent with wet hands at work and healing ($p = 0.001$) and improvement ($p < 0.001$), and between the frequency of hand washing at work and healing ($p = 0.013$) and improvement ($p < 0.001$).

Conclusions. Leaving the profession has a positive effect on eczema; however, even minor changes in exposure to wet work were associated with healing and improvement. This information has implications with respect to advice given to patients with occupational hand eczema caused by wet work.

Key words: change of job; change of profession; hand washing; healing of hand eczema; improvement of hand eczema; occupational hand eczema; wet hand; wet work.

Wet work is frequently associated with the development of occupational hand eczema (1). Wet work occupations comprise, among others, healthcare workers, cleaning personnel, and kitchen workers, which are all high-risk occupations for the development of hand eczema (1, 2). Wet work, and in particular frequent hand washing at

home, has also been reported to contribute to the development of hand eczema (3, 4).

The development of irritant contact dermatitis is a complex process, and involves factors causing susceptibility of the individual person, such as atopic dermatitis and/or filaggrin mutations (5), as well as external exposures, of which wet work is the most common. Occupational contact dermatitis caused by wet work represents approximately 60% of recognized cases of occupational contact dermatitis in Denmark (1). Wet work has generally been defined as having wet hands for > 2 h per working day, or hand washing > 20 times per working day, or wearing occlusive gloves for > 2 h per working day (6). In Germany, regulations regarding the duration and frequency of exposure to wet work have already been implemented (7). Although previous

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research has clearly identified wet work as a major cause of hand eczema (4, 6), and one of the most important players in relation to occupational hand eczema (1, 8), there is little evidence to show how much wet work is needed to induce hand eczema, or to cause deterioration of already existing hand eczema. Earlier studies have discussed whether many short exposures to wet work are more damaging than one single long exposure (9), and the irritant effect of (glove) occlusion itself has been challenged (10). For workers engaged in wet work occupations, we also need more information on the effect of a decreased amount of wet work or change of profession on occupational hand eczema.

The aims of this study were to examine the effect(s) of job change in a population of patients with recognized occupational hand eczema caused by wet work exposure, and to evaluate the dose–response relationship between intensity of wet work and symptoms of hand eczema.

Methods

Baseline data comprising age, sex, atopic eczema, work exposure causing the hand eczema (i.e. wet work) and profession at the time of notification was obtained from the Danish Labour Market Insurance. The study is based on a subgroup from a larger descriptive, registry-based study including all participants with recognized occupational hand eczema in the period January 2010 to the end of December 2011 ($n = 1496$) (11). The subgroup comprises participants with recognized occupational irritant hand eczema caused by wet work who answered a follow-up questionnaire, including a question on current job situation ($n = 954$). The decision to recognize the hand eczema as being caused by wet work was made by the Danish Labour Market Insurance on the basis of medical specialist statements and/or medical files from dermatological departments or departments of occupational and environmental medicine. Recognition of occupational hand eczema caused by wet work was based on a chronic, relevant exposure that was likely to have caused the dermatitis, without any further specifications. In the legal assessment of the cases, the profession that the participants were working when first seeking medical assistance for the occupational hand eczema is documented, and this has been used as the basis for the decision. Some patients may have had a pre-existing hand eczema and have had their case recognized because of occupational aggravation. Classification of profession at baseline was registered according to the files in the Labour Market Insurance, and was based on the Danish Occupational Classification System (13), in which job titles are given a five-digit code (11).

Follow-up data were obtained from a questionnaire sent to participants 4–5 years after the recognition of occupational hand eczema, comprising questions on current profession and current exposure to wet work, eczema status, and health-related quality of life (HR-QoL). Change of profession was assessed as any change in the five-digit code from baseline to follow-up. Profession at follow-up was obtained with the question: 'What is your current profession?' Participants who were no longer active in the labour market were grouped as 'out of the labour market'.

Eczema status at follow-up was assessed by the participants as healing of hand eczema or improvement of hand eczema since baseline. Healing of hand eczema was defined as being clear of hand eczema for the previous 12 months. Improvement of hand eczema was rated according to the participant's answer to the question 'How do you describe your occupational eczema as compared with its status in 2010/2011 when your case was recognized?' and divided into 'better' versus 'same or worse'. If the participants had answered 'better', the hand eczema was classified as 'improved'. Participants who had answered that they had been free of hand eczema since its recognition and therefore did not answer the questions on self-evaluated improvement were placed in the group 'improved'. HR-QoL was analysed with the validated Dermatology Life Quality Index (DLQI) questionnaire with scores ranging from 0 to 30, where low values indicate little effect on HR-QoL (12). Wet work exposure at follow-up was assessed from answers in the questionnaire regarding the amount of time spent with wet hands and number of hand washes. Time spent with wet hands during working hours was divided into 'no exposure, less than $\frac{1}{2}$ h per day, between $\frac{1}{2}$ and 2 h per day, and more than 2 h per day'. Number of hand washes during working hours and in leisure time was divided into '0 to 5 times a day, 6 to 10 times a day, 11 to 15 times a day, 16 to 20 times a day and more than 20 times a day'. Both questions are taken from the Nordic Occupational Skin Questionnaire 2002 (NOSQ 2002) (13), and were altered to fit our study. In the question on wet hands we added 'no exposure', and in the question on number of hand washes we added the interval 11–15 times a day and asked the same question for leisure time. The questions on hours spent with wet hands and number of hand washes have previously been validated (4).

Logistic regression analysis was used to test for associations between eczema variables and change of profession/being out of the labour market at follow-up 4–5 years later. Odds ratios (ORs) are given as crude ORs and as ORs adjusted for age (continually), sex, atopic dermatitis, and severity 'at its worst'. Severity 'at its worst' was assessed from the questionnaire item where

participants were asked to rate hand eczema severity 'at its worst' on a scale from 0 (clear) to 10 (worst). We used the NOSQ 2002 question on severity 'at worst' to assess severity 'at its worst' during the follow-up period, and adjusted for this in the adjusted regression analyses (13). The DLQI was modelled as a continuous scale (12) and, as the scores were not normally distributed, a negative binomial regression analysis was applied to test for differences regarding DLQI and change of profession for participants with recognized occupational hand eczema caused by wet work. The Cochrane–Armitage trend test was used to test for linear trends in healing and improvement when participants were exposed to either wet hands or hand washing in four categories. The outcomes healing and improvement were analysed with separate Poisson models to estimate relative risks (RRs). The models were adjusted for age (continuous), sex, atopic dermatitis, and severity. The correlation between exposure at work and exposure during leisure time was quantified and tested with Pearson correlation analysis. Statistical analyses were performed with SAS ENTERPRISE GUIDE 7.1 (SAS, Cary, NC, USA).

Results

Of the 1496 included participants with recognized occupational hand eczema who answered the questionnaire (response 58%) (11), 954 (63.8%) were recognized as having occupational irritant hand eczema related to wet work, and were available for the present study. Demographic variables are shown in Table 1. A total of 479 (50.2%) were still in the same profession, 299 (31.3%) had changed profession, and 176 (18.5%) were outside the labour market.

Effect of change of profession or being outside the labour market

Healing was reported by 19.1% of the participants who had changed profession, by 27.7% of the participants outside the labour market, and by 15.3% of the participants still in the same profession at follow-up. The chance of healing was markedly increased for participants who had left the profession. The adjusted ORs were 1.46 (95%CI: 0.86–2.47) for participants who had changed profession and 3.15 (95%CI: 1.85–5.38) for those outside the labour market, as compared with those still in the same profession (Table 2).

Improvement of their hand eczema at follow-up was reported by 66.6% of the participants who had changed profession, by 60.5% of the participants outside the labour market, and by 52.4% of the participants still in the same

Table 1. Demographic data for included participants (recognized occupational hand eczema caused by wet work)

Recognized occupational hand eczema		N = 954
Sex, n. (%)	Women	823 (86.3)
	Men	131 (13.7)
Age (years), median (Q1–Q3)		35 (26–47)
Atopic dermatitis, n. (%)	Yes	260 (26.3)
	No	694 (72.7)
Professions (top five), n. (%)	Healthcare personnel (doctors, nurses, etc.)	406 (42.5)
	Restaurant, hotel and housekeeping staff	178 (18.7)
	Beauty industry workers	75 (7.9)
	Childcare workers/caregivers	75 (7.9)
	Cleaning personnel (property administrators, etc.)	71 (7.4)
	Others	149 (15.6)

Q1, 25th percentile; Q3, 75th percentile.

profession. The chance of improvement of their hand eczema was markedly increased for participants who had left the profession. The adjusted ORs were 2.13 (95%CI: 1.49–3.05) for participants who had changed profession and 1.79 (95%CI: 1.19–2.70) for those outside the labour market, as compared with those still in the same profession (Table 2).

With respect to HR-QoL, the median DLQI (25–75% quartiles) scores were 2 (1–5) for participants who had changed profession, 3 (1–6) for participants outside the labour market, and 2 (0–5) for participants still in the same profession. Participants who had changed profession and participants outside the labour market had an increased risk of having a higher DLQI score, indicating a negative effect on HR-QoL, as compared with participants in the same profession [adjusted incidence rate ratio (IRR) 1.10 (95%CI: 0.92–1.32) and adjusted IRR 1.44 (95%CI: 1.17–1.77), respectively] (Table 2).

Wet work at follow-up

Calculations for wet work at follow-up were only performed for the 778 participants still active in the labour market at follow-up. Inverse dose–response relationships were found between hours spent with wet hands at work and healing ($p = 0.001$) and improvement ($p < 0.001$) of hand eczema. For each step down to a lower category of time spent with wet hands at work, the chance of healing

Table 2. Course of hand eczema and quality of life [Dermatology Life Quality Index (DLQI)] after change of profession among participants with recognized occupational hand eczema caused by wet work (N = 954)

Self-reported healing of hand eczema during the last 12 months (n = 934, 20 missing)				
	Total, n. (%)	Healed, n. (%)	Crude OR (95%CI) ^a	Adjusted OR (95%CI) ^{a,b}
Same profession	471 (50.4)	72 (15.3)	1	1
Change of profession	293 (31.4)	56 (19.1)	1.31 (0.89–1.92)	1.46 (0.86–2.47)
Outside labour market	170 (18.2)	47 (27.7)	2.12 (1.39–3.22)	3.15 (1.85–5.38)
Self-evaluated improvement at follow-up (n = 934, 20 missing)				
	Total, n. (%)	Better, n. (%)	Crude OR (95%CI) ^a	Adjusted OR (95%CI) ^{a,b}
Same profession	466 (49.9)	244 (52.4)	1	1
Change of profession	296 (31.7)	197 (66.6)	1.81 (1.34–2.45)	2.13 (1.49–3.05)
Outside labour market	172 (18.4)	104 (60.5)	1.39 (0.98–1.99)	1.79 (1.19–2.70)
DLQI (n = 943, 11 missing); higher score indicates lower life quality				
	Total, n. (%)	DLQI median (Q1–Q3)	Crude IRR (95%CI) ^c	Adjusted IRR (95%CI) ^{b,c}
Same profession	474 (50.3)	2 (0–5)	1	1
Change of profession	299 (31.7)	2 (1–5)	1.08 (0.91–1.29)	1.10 (0.92–1.32)
Outside labour market	170 (18.0)	3 (1–6)	1.43 (1.16–1.76)	1.44 (1.17–1.77)

CI, confidence interval; IRR, incidence rate ratio; OR, odds ratio.

Estimates with *p*-values of < 0.05 are highlighted in bold.

^aLogistic regression.

^bVariables adjusted for: sex, age, atopic dermatitis and severity.

^cGeneral linear regression with DLQI score from 0 to 30 as the outcome. Estimates have been back-transformed with an exponential function, and represent ratios (e.g. 1.44 = 44% increase).

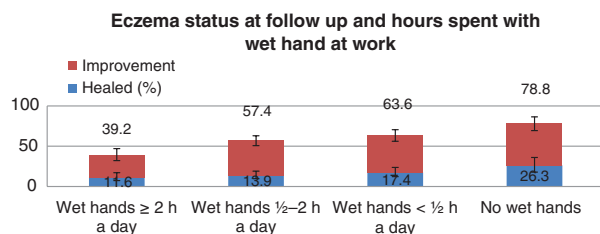


Fig. 1. Participants with recognized wet work at baseline and still active in the labour market at follow-up (n = 778) (excluded: 176 participants who were outside the labour market at follow-up). Total in Table 702. Missing information on healing, improvement or current amount of hand washing: 76. Number of participants with healed hand eczema at follow up n = 112. Participants with improved hand eczema at follow-up n = 401.

increased by 34% [adjusted RR 1.35 (34% (1.03–1.75))], and for each step down to a lower category of wet hands at work the chance of improvement increased by 8% [adjusted RR 1.08 (95%CI: 1.05–1.10)] (Fig. 1).

Inverse dose–response relationships were found between frequency of hand washing at work and healing ($p = 0.013$) and improvement ($p < 0.001$) of hand eczema. For each step down to a lower category of frequency of hand washing at work, the chance of healing increased by 25% [adjusted RR 1.26 (95%CI: 1.04–1.49)], and for each step down to a lower category of frequency of hand washing at work the chance of

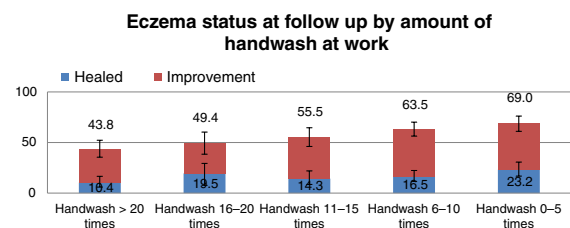


Fig. 2. Participants with recognized wet work at baseline and still active in the labour market at follow-up (n = 778) (excluded: 176 participants who were outside the labour market at follow-up). Total in Table 705. Missing information on healing, improvement or current amount of hand washing: 73. Number of participants with healed hand eczema at follow up n = 118. Participants with improved hand eczema at follow-up n = 406.

improvement increased by 4% [adjusted RR 1.04 (95%CI: 1.06–1.50)] (Fig. 2). No significant dose–response relationship was found between extent of glove usage and healing. An inverse dose–response relationship was found between glove usage at work and improvement of hand eczema $p < 0.001$. For each step down to a lower category of hours with occlusive gloves at work, the chance of improvement increased by 3% [adjusted RR 1.03 (95%CI: 1.02–1.04)] (Fig. 3). The frequencies of hand washing during working hours and during leisure time are shown in Fig. 4. A significantly positive correlation of 0.496 was found for frequency of hand washing at work and at home ($p < 0.001$).

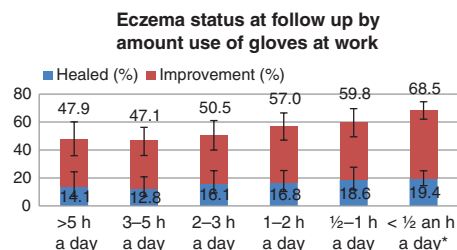


Fig. 3. Participants with recognized wet work at baseline and still active in the labour market at follow-up ($n = 778$) (excluded: 176 participants who were outside the labour market at follow-up). Missing information on healing, improvement or current amount of hand washing: 76. Number of participants with healed hand eczema at follow up $n = 119$. Participants with improved hand eczema at follow-up $n = 407$.

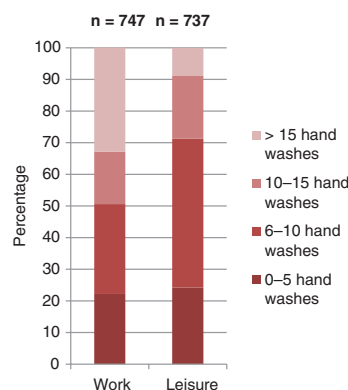


Fig. 4. Number of hand washes per day at work and at home.

Discussion

We found that leaving the profession in which the occupational hand eczema had started had a markedly positive effect on eczema at follow-up for patients with occupational hand eczema caused by wet work, although this was not reflected by an increase in HR-QoL (Table 2). Another important finding was an inverse dose-response relationship between wet work exposure at follow up and healing/improvement of eczema (Figs. 1 and 2). Our results confirm previous observations by Nielsen (14) in cleaners with hand eczema that those who had left the profession during the 2-year follow-up period had experienced a significant improvement with respect to eczema symptoms (redness, rough skin, and fissures). Although leaving the wet work profession did not lead to healing of hand eczema for the majority of patients in our study, it is evident that the chances of healing were markedly better for those who left the profession (Table 2). The relatively low number of cases with healed eczema is in agreement

with the literature (8), and is probably partly attributable to the strict definition, whereby eczema was only accepted as being healed if there had been no eruptions during the last year. It is possible that some participants who had left their profession had changed to another profession that also involved some degree of wet work. Surprisingly, a change of profession had no favourable impact regarding HR-QoL (Table 2). HR-QoL was affected negatively, in particular for those outside the labour market at follow-up, and it is possible that the psychological stress related to change of profession and being outside the labour market may negatively influence HR-QoL. However, the differences were small, and possibly below the minimal clinically important difference (15). An earlier study found a median DLQI score of 5.5 for hand eczema patients, indicating that hand eczema is a diagnosis that does indeed influence the quality of life (16). In our study, the median DLQI score was 2 at follow-up, which might suggest that time had had a positive influence, because of either acceptance or improvement of disease.

The positive effect of job change on eczema was, as previously reported, also found for the total group of patients with recognized occupational hand eczema (17), and was not specific for wet-workers. We found clear dose-response relationships for the associations between wet work exposure at follow-up and healing and improvement of hand eczema (Fig. 1). A shorter period of time with wet hands and a lower frequency of hand washing at work were related to higher rates of healing and improvement. Other studies have investigated the effect of wet work in relation to hand eczema (4, 18–21) and found that wet work exposure is a risk factor for hand eczema. However, our study is, to our knowledge, the first to show a dose-response relationship between the amount of wet work and hand eczema in a population with occupational hand eczema caused by wet work in general.

Concerning glove usage, a negative effect of prolonged use on self-reported improvement was found, but not on healing of hand eczema (Fig. 3). This may be because improvement is based on a subjective and often vague assessment, and is therefore more prone to bias, whereas healing, based on an absence of hand eczema in the previous year, is a more exact parameter. Data concerning glove exposure and the effect on hand eczema are more complicated to interpret, as the use of gloves may be a component of protective measures. No glove usage may indicate that the participants do not protect themselves when performing wet work, or that they are not exposed to wet work. With respect to irritant effects of glove occlusion, studies have shown that skin hydration by occlusion has a different biological effect from that by water, so it seems less harmful to the skin than water, but that

glove usage worsens the negative effect on the skin barrier function of soap and detergents (10, 22). This supports our finding that it does not affect healing.

An earlier study indicated that leisure exposure may be an even larger concern than occupational exposure (3). However, our findings clearly show that the frequency of hand washing in this specific population is highest during working hours (Fig. 4). We also found a moderate correlation between the frequency of hand washing at work and that at home, indicating that participants with a high frequency of hand washing during working hours are also more exposed to hand washing at home. This observation was also previously reported (4), and may be a consequence of deeply incorporated routines that extend into leisure time. Social factors may also play an important role, as higher social classes may be more likely to outsource wet work assignments at home (e.g. house cleaning).

Studies employing educational programmes targeting patients with occupational hand eczema and aiming at reducing wet work exposures have suggested an effect of educational programmes (23–25). Our study clearly supports this, and indicates a positive effect of diminished water exposure during working hours on occupational hand eczema. The significant association between the amount of wet work and the symptoms of hand eczema (healing and improvement) at follow-up in our study is very convincing, and indicates that minor changes in wet work during working hours may directly influence the symptoms of hand eczema. A practical implication of this is that patients can be advised that even minor adjustments in work procedures may be helpful.

An advantage of our study is that we present a large cohort of all patients with recognized occupational hand eczema caused by wet work and that we have a relatively high response (58%). A limitation of the study is that, even though all of the included participants had a sufficient amount of wet work exposure at baseline as the cause of their hand eczema, this has not been clearly defined in

terms of time spent with wet hands and the frequency of hand washing. This implies that we were not able to conclude whether their amount of wet work at follow-up had changed since the recognition, or, in other words, whether the increased healing and improvement was a direct effect of a change in number of working hours spent with wet hands (including hand washing). Another limitation of the study is that the improvement/healing of hand eczema was self-assessed by the participants and not confirmed by a clinical examination. However, the participation rate would probably have been lower if the participants had had to show up for an examination. Moreover, it would have yielded a momentary picture of the hand eczema status, and not the status throughout the last 12 months. Evidence on the relationship between exposure to wet work and the symptoms of hand eczema is important to increase our understanding of the relationship, and to influence regulations with respect to maximum hours of wet work exposure. Future research should also aim at exploring the effects of job change, as well as dose–response relationships, for individuals who are more sensitive to wet work, in particular atopic individuals and/or individuals with filaggrin mutations (5, 26).

In conclusion, we provide new data on the relationship between wet work exposure and hand eczema healing and improvement. The data clearly show that leaving the profession has a positive effect on eczema, and also indicate that even a minor decrease in exposure is associated with healing and improvement of hand eczema. Changes in working procedures in terms of minimizing the time spent with wet hands, as well as job change, should be taken into consideration when patients with occupational hand eczema caused by wet work are guided.

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