Hand dermatitis among university hospital nursing staff with or without atopic eczema: assessment of risk factors

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Summary

Background. Nurses are prone to develop hand dermatitis. Although an atopic constitution has been identified as a genetic risk factor, the behavioural risk factors associated with hand dermatitis in wet work conditions have not been fully explored.

Objectives. This study aimed to clarify the impact of atopic eczema (fulfilling the diagnostic criteria during the past 1 year) on the occurrence of hand dermatitis and to identify the behavioural risk factors among non-atopic nurses with hand dermatitis.

Methods. From August 2007 to July 2009, nurses from Kaohsiung Medical University Hospital were recruited. The associations between different risk factors and hand dermatitis were documented. In addition, the behavioural risk factors among non-atopic nurses were evaluated via observational study.

Results. One thousand one hundred and thirty-two nurses participated in the first part of the study, which revealed that individuals with atopic eczema had a 3.76-fold increased risk for hand dermatitis. However, among 248 nurses with hand dermatitis, only 43 had atopic eczema. The observational study performed on 140 non-atopic nurses identified frequency of hand washing as the behavioural risk factor associated with hand dermatitis.

Conclusions. Although atopic eczema is the major risk factor for hand dermatitis, those with atopic eczema constitute only 17% of nurses with hand dermatitis. Decreasing hand washing frequency is the most effective strategy to reduce the occurrence of hand dermatitis among non-atopic nurses.

Key words: atopic eczema; hand dermatitis; hand wash frequency; nurses.

Next to musculoskeletal complaints, the skin is the second organ most frequently affected by occupational diseases. Hand dermatitis, in particular, is the most commonly observed (more than 90%) occupational skin disease, and has serious consequences, including prolonged sick leave, increased health costs, and reduced life quality (1–5). A comprehensive understanding regarding hand dermatitis is essential for establishing proper prevention and treatment strategies for this frequently debilitating skin condition (6).

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Genetic and environmental factors play important roles in the aetiology of hand dermatitis. Atopic eczema is a well-established risk factor associated with hand dermatitis (7). In a recent review focusing on the epidemiology of hand dermatitis in the general population, atopic eczema was identified as the single most important factor for the development of hand eczema (8). It has previously been suggested that as many as one-half of patients with hand dermatitis can be considered to be atopic patients (9). Both skin barrier and immune system dysfunction have been shown in patients with atopic eczema (10), and these factors may predispose atopic patients to develop hand dermatitis. Bryld et al. (11) found higher risks for female twins to develop hand dermatitis than for their male counterparts, and suggested that the increased risk for hand dermatitis in women may relate to environmental and not genetic factors, highlighting that certain environmental exposures, such as wet work, may play a dominant role in inducing hand dermatitis when encountered. In addition, a previous twin study has also shown that the majority of hand dermatitis is attributable to environmental factors, and that the heritability of hand dermatitis cannot be explained by comorbidity with atopic eczema (12). The role and impact of atopic eczema, in the context of occupational hand dermatitis where a wet work environment is often involved, has not been clarified.

Nursing staff in hospitals represent a special population that may provide important insights into this complex issue. Approximately one-third of nurses are found to have hand dermatitis (1, 5). In addition, wet hospital work has a strong association with the development of hand dermatitis, and has been reported to increase the risk of hand dermatitis two-fold as compared with dry office work (13). In terms of environmental/behavioural risk factors, a previous study by us showed that working in a special care unit and nursing for >10 years are associated with the occurrence of hand dermatitis among nurses in a university hospital (5). The high occurrence rate of hand dermatitis among nursing stuff is often attributed to their wet work conditions (2), which frequently involve hand decontamination procedures that are crucial in hospital nursing work to avoid nosocomial infections (14, 15). Different behavioural factors have been proposed to contribute to the development of hand dermatitis in the wet work environment, including the duration and/or frequency of hand washing, use of alcohol-based hand rubs, and glove wearing. (16, 17) Currently, there is no consensus regarding the most important risk factor associated with the development of hand dermatitis in a wet work environment. An approach to address this issue is through large-scale questionnaire studies. However, Jungbauer et al. (16) have already shown that the questionnaire method does not accurately reflect the amount of wet work activity that takes place in a hospital working environment, and conducting an observational study may therefore be the only way to identify the exposures associated with the development of hand dermatitis in such an environment. The current study aimed to clarify several important issues regarding hand dermatitis among university hospital nursing staff. First, the statistical significance and clinical impact of atopic eczema, as defined by fulfilling the diagnostic criteria during the past 1 year for the development of hand dermatitis, were determined. Subsequently, an observational study was undertaken to identify the behavioural risk factors associated with hand dermatitis among non-atopic nurses.

Materials and Methods

Study population

This study took place from August 2007 to July 2009. A total of 1218 nursing staff from Kaohsiung Medical University Hospital were invited to participate in the study. The study was approved by the institutional review board of Kaohsiung Medical University Hospital, and informed consent was given by the participating staff. Of the invited participants, 1132 completed the study. The documentation of hand dermatitis and atopic eczema among this study population has been previously described (5, 18). For identification of hand dermatitis, a validated questionnaire was used. Briefly, this questionnaire, comprising 13 questions, was developed to evaluate the signs and symptoms, locations of affected skin areas, duration of symptoms and differential diagnoses of hand dermatitis. Hand dermatitis was defined on the basis of an established diagnostic algorithm (4). Atopic eczema was clinically diagnosed according to the Hanifin and Rajka criteria during the past 1 year (19). The phenotypes of the participants were categorized into three groups: (i) atopic eczema ($n = 90$); (ii) non-atopic hand dermatitis ($n = 205$); and (iii) a 'control' group with no atopic eczema and no hand dermatitis ($n = 837$). A schematic diagram describing the design of the study and the classification of the participants is shown in Fig. 1. The demographic information of the participants is summarized in Table 1.

Observational study

As the questionnaire method has been shown to inaccurately reflect the actual amount of wet work performed during practical nursing, a continuous

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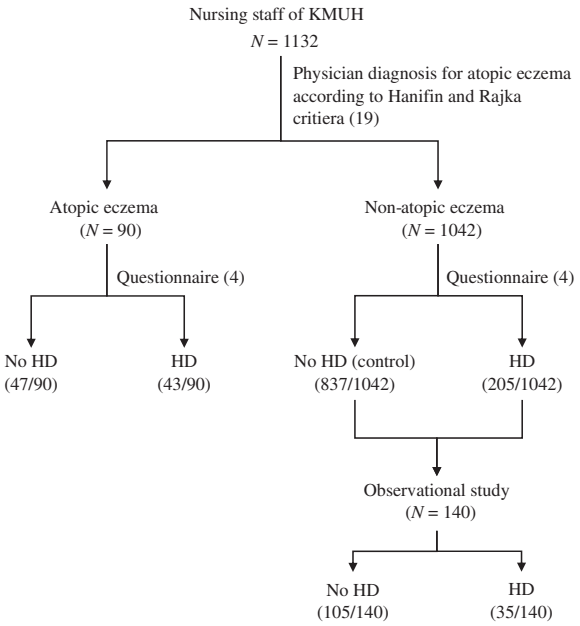

Fig. 1. Schematic diagram showing the design of the study and the classification of the participants. The references for diagnostic criteria are given in parentheses. *N*, number of individuals; HD, hand dermatitis.

observational study developed by Barnes (20), and previously used by Jungbauer et al. (16), was conducted to document the wet work activities performed by nurses on general wards, including both medical and surgical units, during a 4-hr morning shift. General wards were chosen because special care units and outpatient clinics do not allow the presence of observers for 4 hr at our institution. Requests were sent to nurses without atopic eczema working on general wards who had participated in our previous study (5) to enrol in this follow-up observational study; 140 nurses agreed to participate.

Ten observers were trained to implement this time-study method. For the observation, we developed a list of nursing activities and skin exposures to potential irritants, including glove wearing, alcohol rub use, and hand washing with water and disinfectants. The frequency and duration of each event were recorded by an observer carrying a stop-watch. An orientation course was conducted prior to the field study to strengthen and validate the accuracy and consistency of the results documented by the observers. With this observation method, we evaluated the frequency and duration of wet work activities in 140 non-atopic nursing staff who gave their informed consent. Nursing staff with atopic eczema were not included in this observational study, as this medical condition is known be associated with the development of hand dermatitis, and may introduce additional confounding factors into the study. Nurses with <1 year of experience were also excluded from this part of the study.

Statistical analysis

Association between different variables and hand dermatitis. All variables that were significant in univariate analysis as demonstrated in our previous report (5) were included in the multivariate analysis, in addition to introducing atopic eczema as a new variant by the use of a logistic regression model. Odds ratios with 95% confidence intervals were then calculated. Statistical analysis was performed using the SPSS (Version 12.0) statistical software package. Differences were considered significant for $p < 0.05$.

Association between different wet work activities and non-atopic hand dermatitis. The duration and frequency of hand washing with water, alcohol rub use and glove wearing were compared between non-atopic hand dermatitis and control groups by logistic regression modelling, with mean values obtained from the control group serving as the cutoff points. Bonferroni correction was performed when significance was obtained. Differences were considered to be significant for $p < 0.05$.

Table 1. Demographic information of the study participants

		Negative ($n = 837$)		AE ($n = 90$)		chHD ($n = 205$)		
	Total	Mean ± SD/*n* (%)		Mean ± SD/*n* (%)		Mean ± SD/*n* (%)		*p*-value
Age (years)	1132	31.57 ± 7.47		30.46 ± 6.09		32.38 ± 7.13		0.11
Sex								
Male	7	5	(71.4)		0 (0)	2	(28.6)	0.80
Female	1125	832	(74.0)	90	(8.0)	203	(18.0)	—
Educational level								
High school/professional school	22	19	(86.4)	1	(4.5)	2	(9.1)	0.61
College/university	1110	818	(73.7)	89	(8.0)	203	(18.3)	—

AE, atopic eczema; chHD, chronic hand dermatitis; SD, standard deviation.

Table 2. Results from the multiple logistic regression analysis

Variables	Adjusted odds ratio	95% confidence interval	*p*-value
Atopic eczema			
Negative	1	—	Reference
Positive	**3.763**	**2.399–5.901**	**<0.001**
Work section			
Outpatient clinic	1	—	Reference
Regular ward	1.058	0.661–1.693	0.814
Special care unit	1.464	0.919–2.331	0.109
Years of working experience			
Less than 5 years	1	—	Reference
5–10 years	1.034	0.713–1.500	0.858
More than 10 years	**1.524**	**1.067–2.177**	**0.021**
Housework hours per week			
0–10	1	—	Reference
Above 10	1.455	0.939–2.254	0.093

Bold values indicate $p < 0.05$.

Results

Atopic eczema imparted the highest risk for developing hand dermatitis among nursing staff

As shown in Table 1, the control, atopic eczema and non-atopic hand dermatitis groups shared similar demographic profiles in terms of sex, age, and educational background. From our previous work, we knew that >10 years of nursing work experience and working in a special care unit were significantly associated with the occurrence of hand dermatitis among nursing staff (5). However, when the presence of atopic eczema was introduced as one of the covariates, it was obvious that this particular covariate was associated with the highest risk (3.76-fold) for developing hand dermatitis (Table 2). This result indicated the strong association between atopic eczema and hand dermatitis even in working conditions that entailed considerable amounts of wet work. However, it should be noted that only 43 of 248 (17%) nurses with hand dermatitis had concomitant atopic eczema. We then evaluated the behavioural risk factors associated with the occurrence of hand dermatitis among non-atopic nurses, as they constitute the majority of the hand dermatitis population.

Frequency of hand washing is the only determinant associated with the development of hand dermatitis among non-atopic nursing staff

Among the 140 random volunteers who agreed to participate in this study, 35 (25%) were identified as having hand dermatitis. This prevalence rate was similar to that in our previous study, in which 1132 nurses were included, and signified that results obtained from this randomly selected subpopulation may be extrapolated to reflect the condition of the nursing population in general at Kaohsiung Medical University Hospital. The mean durations and frequencies of hand washing, alcohol rub use and glove wearing were compared among non-atopic nursing staff with or without hand dermatitis. Subsequent to statistical analysis, the only parameter that showed significant association with the occurrence of hand dermatitis after Bonferroni correction was washing hands with water six or more times during the 4 hr of routine work. This result indicated that frequency of hand washing is the strongest risk factor associated with the development of hand dermatitis among the non-atopic nursing staff (Table 3).

Discussion

The strong association between atopic eczema and hand dermatitis in wet working conditions such as nursing has been confirmed in this study, as patients with atopic eczema were 3.76 times more likely to have hand dermatitis than their non-atopic counterparts. Therefore, the intrinsic skin barrier and immune system dysfunctions present in the atopic skin probably contributed to the high susceptibility of atopic individuals to develop hand dermatitis in a wet working environment. However, it should be noted that high statistical significance does not equate to high clinical relevance, as the absolute number of nurses with atopic eczema only accounts for 17% of those with hand dermatitis. The relatively low prevalence rate of atopic eczema in the general adult population (18) certainly contributed to this finding. Therefore, the behavioural risk factors of the non-atopic hand dermatitis group represent the most relevant and important clinical issue in the context of hand dermatitis among nursing staff.

The nature of nursing requires a significant amount of wet work, and poses a significant risk for the development of hand dermatitis (5). Even in countries with occupational skin protection programmes, the frequency of skin diseases in the working population remains high (21). The recommended preventive measures are often general and vague, suggesting that the nursing staffs should reduce the number of wet working procedures, decrease the duration of glove wearing when possible, and apply barrier creams before and after wet work (21). However, the specific behaviours in different wet work routines that may cause the highest risk for development of hand dermatitis have not yet been identified. Previous studies have shown that most cases of hand dermatitis among nursing staff are irritant contact dermatitis (1, 22, 23).

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Table 3. Behavioural risk factors of hand dermatitis for non-atopic nurses

	Negative ($N = 105$) *n* (%)	Positive ($N = 35$) *n* (%)	*p*-value	OR (95% CI)
Time (seconds)				
Hand washing				
≦106	72 (69)	21 (60)	—	—
>106	33 (31)	14 (40)	0.3524	1.45 (0.66–3.21)
Hand rubbing with alcohol	—	—	—	—
≦62	67 (64)	27 (77)	—	—
>62	38 (36)	8 (23)	0.1458	0.52 (0.22–1.26)
Gloves				
≦706	80 (76)	26 (74)	—	—
>706	25 (24)	9 (26)	0.8200	1.11 (0.46–2.67)
Frequency*				
Hand washing				
≦6 times	73 (70)	17 (49)	—	1.00
>6 times	32 (30)	18 (51)	0.0131	3.02 (1.26–7.23)
Hand rubbing with alcohol				
≦9 times	67 (64)	26 (74)	—	1.00
>9 times	38 (36)	9 (26)	0.2886	0.62 (0.26–1.50)
Gloves				
≦2 times	82 (78)	28 (80)	—	1.00
>2 times	23 (22)	7 (20)	0.2145	0.51 (0.17–1.48)

*Odds ratios (ORs) with 95% confidence intervals (CIs) and *p*-values were adjusted for the hand rubbing with alcohol and gloves by logistic regression model.
Bonferroni correction over the three tested risk factors gave a significance cutoff at $p = 0.0167$.

Alcohol-based hand rub use, prolonged glove wearing and hand washing with water have all been implicated as the major irritant leading to hand dermatitis among nurses. A previous observational study by Jungbauer et al. (16) did not examine the specific exposure associated with the development of hand dermatitis. In the current study, we addressed this important question in an observational study. We demonstrated that the frequency of hand washing is the most important risk factor associated with hand dermatitis. This result is in accordance with Malten's hypothesis regarding irritant contact dermatitis, which suggests that the risk of hand dermatitis associated with wet work depend on the frequency of wet-and-dry cycles rather than the total duration of wet work (24). Previous studies have suggested that prolonged use of gloves may result in occlusion, resulting in irritant dermatitis (17, 25). However, Wetzky et al. (26) have recently demonstrated that short-term and long-term single and repetitive glove occlusion produces no significant skin barrier damage, supporting our results, which did not show the duration of glove wearing to be a risk factor associated with the development of hand dermatitis. Alcohol-based hand rub use is often considered to be the cause of hand dermatitis among nursing staff. In a multicentre questionnaire study addressing nurses' perceptions of hand disinfection procedures, alcohol hand rubs were considered to be more damaging to the skin than hand washing (27). In contrast to the common belief among the nursing staff, alcohol hand rubs cause less skin irritation than hand washing in terms of transepidermal water loss, skin hydration, and erythema (28). The fact that alcohol can cause stinging in pre-irritated skin may have resulted in this common misconception among the nursing staff.

The major strength of this study is that the troublesome observational study was successfully performed in 140 non-atopic nurses, constituting more than 80% of the hand dermatitis population among the study populations. This approach allows for accurate documentation of the wet work activities associated with the occurrence of hand dermatitis. The study had several important limitations, which require further discussion. First, the nature of the hand dermatitis, such as allergic or irritant contact dermatitis, was not defined. Better phenotypic classification of hand dermatitis would allow for more detailed analysis and more definite conclusions concerning our study results (29). However, it has been reported that the majority of cases of hand dermatitis among healthcare workers are irritant contact dermatitis, and that the major risk factor for having allergic hand dermatitis is atopic eczema (30). As our studied group for the observational study consisted of non-atopic nurses, it is probable that our results were most applicable to irritant contact dermatitis. It worth noting that in this study, the

severity of hand dermatitis, in terms of fissuring, vesicles, and redness, was not significantly different between the atopic and non-atopic hand dermatitis group. Second, the participants of this study were college/university graduates from different parts of Taiwan; the wet work activities documented may reflect the principles taught at different schools rather than an association with hand dermatitis. However, the hospital training course for new nurses lasts for 3 months, and those with <1 year of work experience were excluded from the observational study. Therefore, this potential confounder should play a minimal role in our data analysis. It should be mentioned that education level may also affect the clinical course of hand dermatitis, as unskilled workers were reported to have a poor prognosis for hand dermatitis (31). As the majority of our studied subjects were highly educated, the effect of this potential confounder should also be minimal. Third, the phenomenon of reversed causality is more than likely to occur: nurses with hand dermatitis may change their wet work exposure because of their hand dermatitis. More detailed studies, focusing on this particular subgroup, will give important insights regarding this issue. Fourth, the decontamination procedure protocol at our hospital requires the use of disinfectant during hand washing with water and it is difficult to determine whether the development of hand dermatitis is more closely associated with exposure to water or the use of disinfectant. Nevertheless, routine nursing work usually encompasses standard decontamination procedures that require the use of disinfectants when hand washing with water. Therefore, our result is applicable in most clinical settings. Finally, it should be noted that the diagnosis of atopic eczema was made by dermatologists in this study, so the categorization of our participants in terms of having 'atopic' or 'non-atopic' hand dermatitis should be accurate. However, if the patient had 'infantile' or 'early childhood' atopic eczema that could not be recalled in adulthood, then misclassification may still have occurred.

In summary, we have shown that having atopic eczema is associated with the highest risk for developing hand dermatitis, even in situations in which behavioural/environmental factors are known to play a large role. However, owing to the low prevalence rate of atopic eczema in the adult population, atopic nurses constitute only a small proportion of the hand dermatitis population in our study, making the studies focusing on non-atopic nurses more clinically relevant. For non-atopic nurses, the frequency of hand washing represents the most significant risk factor associated with the development of hand dermatitis. This information should be made known to personnel who work in the related environment. More importantly, risk factors and misconceptions regarding the development of hand dermatitis among nursing staff should be emphasized during the teaching programmes for medical personnel. This would probably reduce the occurrence of hand dermatitis among nursing staff, and circumvent the complex procedures required for secondary or tertiary preventions.

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