



# OPEN A cross-sectional study of clinical characteristics and risk factors for hand eczema in the general Chinese population

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In the general population, there is limited evidence for the associations between hand eczema (HE) and lifestyle factors, and between the severity of HE and quality of life. This study aimed to estimate the risk factors for the incidence of HE in the general population and the risk factors for the severity of HE. A cross-sectional questionnaire was administered to 121 HE patients in a hospital from December 2018 to December 2019 in Wuhan. The severity of HE was significantly associated with working with wet hands more than 5 h per day and chapped skin. Sixty-seven patients have positive patch test results. Working with wet hands for more than 5 h per day and chapped skin were the most common and significant risk factors for HE. Working hours with wet hands per day was an independent risk factor for the hand eczema severity index and dermatology life quality index, and there was a significant positive correlation between chapped skin and the severity of hand eczema and higher transepidermal water loss (TEWL). The results also revealed a significant positive correlation between the severity of HE and the impact on quality of life and the severity of TEWL. Prolonged wet hand work can lead to a higher rate of severe hand eczema in the general population. HE can be relieved by reducing the wet hand working time and hand moisturizing.

**Keywords** Hand eczema, Risk factor, The severity of hand eczema, The quality of life, Transepidermal water loss

Hand eczema (HE) is an inflammatory disorder that commonly affects the skin of the hands<sup>1</sup>. The typical clinical signs of HE include redness, skin thickening, scaling, edema, vesicles, areas of hyperkeratosis, cracks (fissures), and erosions. The pathogenesis of this disorder is multifactorial and includes endogenous genetic predisposing factors as well as a variety of exogenous factors, such as irritants or allergens<sup>2</sup>.

Hand eczema is an underlying chronic condition that is very common worldwide, and it leads to a considerable socioeconomic burden as well as severe, long-term, and negative effects on patients' quality of life<sup>3</sup>. Severe hand eczema can have profound economic consequences, including the direct costs of treatment as well as the indirect costs associated with disability, workers' compensation, and rehabilitation, absence from work and job losses<sup>4</sup>. Additionally, severe hand eczema can affect patients' psychosocial functioning and general well-being. A meta-analysis of 66 studies including nearly 570,000 individuals from the general population reported an overall lifetime prevalence of 14.5% (95% CI 12.6–16.5%)<sup>5</sup>. The overall one-year incidence of HE was 9.1% (95% CI 8.4–9.8%), with a point prevalence of 4% (95% CI 2.6–5.7%). Hand eczema is the most frequent occupational skin disease, particularly among workers exposed to “wet work”, such as healthcare workers, food handlers, and hairdressers. The estimated incidence of occupational HE ranges from 0.7 to 1.5 cases per 1000 workers per year among individuals exposed to wet work<sup>6</sup>. Several studies have examined the prevalence of hand eczema and its risk factors in healthcare workers<sup>7,8</sup>. Healthcare workers are at increased risk of developing hand eczema because of work-related wet hand habits and increased risk of exposure to contact allergens. Several studies have

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examined the association between occupational exposure and hand eczema, but the associations between the incidence of hand eczema and lifestyle factors in the general population remain to be studied.

This study aimed to analyze lifestyle habits, symptoms, patch test, transepidermal water loss (TEWL), Hand Eczema Severity Index (HECSI), and dermatology Life quality index (DLQI) among Chinese HE patients in general population who attended dermatology departments in order to identify the risk factors for HE severity.

## Methods

### Study design and patients

The survey was conducted using convenient sampling to investigate patients diagnosed with HE in the dermatology department of a hospital in Wuhan from December 2018 to December 2019. This research protocol was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of Wuhan No.1 Hospital, all participants were informed and willing to sign a consent form prior to their involvement.

The inclusion criteria for patients were as follows: were  $\geq 12$  years of age; had been diagnosed with hand eczema by two senior doctors based on the diagnostic criteria<sup>2,9</sup>; and negative mycological test results.

The exclusion criteria were as follows: acute exacerbation of dermatitis; use of systemic antihistamines within the last three days or the use of glucocorticoids or immunosuppressants within the last two weeks; pregnancy or breastfeeding; scarring, pigmentation, atrophy, nevus erythematosus, or other imperfections of the skin that would interfere with judgment of the test results; inability to control behavior or ensure the conditions of the patch test; a poorly controlled chronic condition that may require multiple oral corticosteroid treatments, e.g., severe poorly controlled asthma comorbidities; active tuberculosis (TB), human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) or other infectious diseases; or inability to participate in the survey due to special circumstances (e.g., mental abnormalities, poor physical condition, etc.).

### Patch test method

A contact allergen patch test detection kit from Sanming Hezhong Biotechnology Company was used. Before testing, the normal skin on both sides of the spine of the patient's upper back was selected, the skin of the part to be tested was cleaned with saline solution and wiped dry; the protective paper of the skin patch test chamber was removed, the skin patch test chamber containing allergens was struck firmly and flatly from the bottom to the top, and then the skin patch gently pressed with the palm of the hand to expel the air.

All readings at 48 hours were performed by the same dermatologist who applied the tests, and the determination criteria were based on the standard interpretation of results recommended by the International Contact Dermatitis Research Group (ICDRG)<sup>10</sup>. The readings were categorized as follows: (1) “-” is a negative reaction with no skin change; (2) “±” is a suspicious reaction with only mild erythema; (3) “+” is a weak positive reaction with erythema, infiltration and a few papules; (4) “++” is a strong positive reaction, with erythema, marked infiltration, papules, and blisters, and the reaction may extend beyond the test area; (5) “+++” is an extremely strong positive reaction, with erythema, marked infiltration, papules, blisters, and large blisters, and the reaction extends beyond the test area; (6) “IR” is an irritant reaction.

The survey included a patient survey and a clinical diagnosis by the doctor. The dermatologist conducted a thorough physical examination of outpatients to diagnose eczema or dermatitis. If the patient was diagnosed, the doctor conducted an interview and filled out a questionnaire (see the [supplementary file](#)). All respondents, including patients or guardians of minors, were required to answer relevant questions.

The predesigned case records included the following data: age, gender, past history, family history, symptoms, duration, frequency of hand washing, working time of wet hands, season of worsening hand eczema, prescription medicine, HECSI score, DLQI score and TEWL score. The patients were also subjected to patch testing.

The criteria for interpretation were those established by the International Contact Dermatitis Research Group<sup>2</sup> and the Chinese Hand Eczema Scientific Research Collaboration Group<sup>9</sup>. The clinical types were classified based on the relevant criteria for the classification of chronic hand eczema subtypes<sup>3</sup>: irritant contact dermatitis (ICD), allergic contact dermatitis (ACD), contact urticaria (CU)/protein contact dermatitis (PCD), atopic hand eczema (AHE), endogenous hyperkeratotic hand eczema, mixed hand eczema, and unclassified hand eczema.

### Statistical analysis

Statistical analyses were performed via SPSS version 25.0 (SPSS Inc., Chicago, IL, USA). Continuous variables are expressed as the means  $\pm$  standard deviations for normally distributed data and medians (inter-quartile ranges) for skewed data. Categorical variables are presented as counts (percentages). The chi-squared test was used to compare the qualitative variables. Correlations were analyzed via Spearman correlation analysis. Two-group comparisons were performed via the Mann-Whitney U-test and chi-squared test, and multigroup comparisons were performed via the Kruskal-Wallis test. Linear regression and logistic regression were used to determine the ability of demographic characteristics, clinical findings, and laboratory values to predict the severity of hand eczema. Two-sided  $P < 0.05$  denoted statistical significance.

## Results

### Characteristics of participants

Among the 121 patients, 59 (48.8%) were male and 62 (51.2%) were female, with no statistically significant difference in the male/female ratio ( $p = 0.15$ ). The patients with hand eczema had a mean age of 36 [29–49.75] years and a mean disease duration of 3 [1–4] years. The average duration of hand eczema was 3 [2–4] years, with a mean daily duration of working with wet hands of 1 [0–2] hour. The average score for the Dermatology Life Quality Index (DLQI) was 8 [5, 13]. The study included patients from various occupations, such as clerical

workers (14, 11.5%), builders (9, 7.4%), factory workers (9, 7.4%), students (7, 5.8%), healthcare workers (7, 5.8%), and miscellaneous workers, including hairdressers, chefs, programmers, housewives, famers, vegetable vendors, layers and retirees. The mean number of hands washed per day was 6 [4–9.75] (Table 1).

Clinical presentation

Morphologically, allergic contact dermatitis was the most common pattern observed in 35 (29%) patients, followed by irritant contact dermatitis (26.4%), mixed hand eczema (15.7%), endogenous vesicular hand eczema (9.1%), unclassified hand eczema (9.1%), atopic hand eczema (6.6%), and endogenous hyperkeratotic hand eczema (4.1%). The common types of lesions in patients with HE were itching (77.7%), scaling (74.4%) and chapped skin (73.6%). Among them, a greater proportion of HE patients with chapped skin had severe HECSI ( $p=0.006$ ). In addition, HE patients had a higher rate of severe HECSI with wet hands for longer periods of time ( $p=0.006$ ) (Table 2).

Patch test

Among the 121 HE patients who underwent patch testing, 66 (54.5%) tested positive, whereas 55 (45.5%) tested negative. Nickel sulfate 17 (25.75%) was the most common sensitizer, followed by p-phenylenediamine (22.73%) and Carba mix (22.73%) (Table 3). Among the 66 patients with positive patch tests, 22 patients had HECSI scores greater than 12, 25 patients had scores between 6 and 12, and 19 patients had scores less than 6. However, statistical analysis revealed that the ratio of a positive patch test score to a high HECSI score was insignificant ( $p=0.532$ ) (Table 2).

Hand eczema severity index and dermatology life quality index

To better assess the risk value of the HECSI, a cutoff point transformation was applied to turn this indicator into a binary variable. Based on the IQR distribution of the HSCSI (9 [4, 14.75]) among patients with eczema in this study, we selected a median of 9 as the cutoff point and classified scores  $\leq 9$  as mild and scores  $> 9$  as severe. All variables were analyzed via univariate logistic regression and a multivariable model. After stratification based on the median HECSI score, 32 (26.4%) of the males had a HECSI score greater than 9, whereas 28 (23.1%) of the females did, with no significant difference between males and females ( $p=0.198$ ). Table 4 shows that working with wet hands for more than 5 h per day ( $p=0.025$ ) was the most common and significant risk factor for hand eczema in participants. Among the patients with hand eczema included in our analysis, only 14 patients (11.57%) had wet hands working  $>$  for 5 h, while 73 patients in the working with wet hands for 1–2 h accounted for the highest proportion (60.33%). Multivariate logistic regression analysis revealed that, compared with working with wet hands for 1–2 h per day, hand eczema was likely to be more severe when working with wet hands more than 5 h per day (OR: 8.71, 95% CI: 1.27–59.97,  $p=0.028$ ). The results analysis also found that chapped skin, as one of the chronic symptoms of hand eczema, had a strong positive correlation with the severity of HE (OR: 3.72, 95% CI: 1.27–10.91,  $p=0.017$ ). The results from a multivariate linear regression analysis with HECSI, DLQI and TEWL as dependent variables are shown in Table 5. Male sex and working with wet hands more than 5 h per day were found to be independent risk factors for increased HE severity. Working with wet hands for more 5 h per day was an independent risk factor for the DLQI, and chapped skin also had a positive correlation with higher TEWL. A highly significant correlation was found between DLQI and HECSI scores ( $p=0.002$ ) (Fig. 1a) and between TEWL and HECSI scores ( $p=0.034$ ) (Fig. 1b).

Discussion

Hand eczema is a common occupational dermatosis<sup>11</sup> that is associated with high-risk occupations including construction, metal industry, automotive repair, cleaning (including industrial, hospital and domestic cleaning), food processing, manufacturing and hairdressing<sup>12,13</sup>. Our study revealed that more than 55.4% of hand eczema cases in the general population were caused by allergic contact dermatitis and irritant contact dermatitis, highlighting the importance of exogenous factors.

The patch test can identify allergens and help patients avoid exposure and flare-ups. Notably, nickelous sulfate is the most common sensitizer. Nickel exposure is present in many everyday items, including metal jewelry, buttons, zips, coins, spectacle frames, watches, keys, and alloys containing nickel. It can cause allergic reactions in some individuals. To avoid contact dermatitis, prolonged exposure to nickel-containing items is recommended if the patient is sensitive to nickel. It is important to be aware of these sources of nickel to prevent

	IQR
Age	36 [29, 49.75]
The working times with wet hands	1 [0, 2]
The times of hands washing	6 [4, 9.75]
The disease duration	3 [1, 4]
DLQI	8 [5, 13]
HECSI	9 [4, 14.75]
The duration of hand eczemas per year	3 [2, 4]

**Table 1.** General characteristics and main disease assessments of patients with hand eczema. IQR, Interquartile Range.

Variable	HECSI	U	P value
Gender		2005.5	0.15
Female	7 [4, 13]		
Male	10.5 [5, 19.5]		
Age		5.893	0.117
≤ 30.00	6 [4, 12]		
31.00–40.00	10 [5.5, 16.25]		
41.00–50.00	9.5 [6, 15.25]		
≥ 51.00	13 [4, 24.5]		
Disease duration		0.193	0.979
1–6 month	10 [4, 16.25]		
6 month–1 year	6 [4, 20]		
1–3year	10 [5, 14]		
≥ 3 year	9 [6, 14]		
Hand washing (times daily)		1939.5	0.206
≤ 5 times	8.5 [4, 13.75]		
≥ 5times	10 [5.5, 18]		
Erythema		1617	0.651
No	10 [5, 14.75]		
Yes	8 [4, 17]		
Blister		1723.5	0.946
No	10.5 [4, 15.75]		
Yes	8.5 [4.75, 14.5]		
Swelling		1426	0.396
No	8.5 [5, 14]		
Yes	10 [4, 26]		
Scaling		1539.5	0.119
No	6 [4, 12.75]		
Yes	10 [5, 17]		
Chapped skin		1768	0.006
No	5 [3, 12]		
Yes	10 [6, 17.75]		
Keratnize		1453	0.762
No	8.5 [4, 15.5]		
Yes	10 [4.5, 15.5]		
Itch		1217.5	0.717
No	11 [3.5, 16.5]		
Yes	9 [5, 14.75]		
Pain		1870	0.177
No	8 [4, 14]		
Yes	10 [6, 17]		
Working with wet hands (hours daily)		15.180	0.010
≤ 1.00	7 [4, 13]		
1.01–2.00	9 [6, 16]		
2.01–3.00	5.5 [3.5, 6.75]		
3.01–4.00	14.5 [7.5, 22.25]		
4.01–5.00	15.0 [5.75, 16.75]		
≥ 5.01–	21.5 [11.5, 40.5]		
HE aggravation season (Spring)		1057.5	0.872
No	8 [4, 16.75]		
Yes	10 [6, 13]		
HE aggravation season (Summer)		1276	0.693
No	9 [4.5, 16]		
Yes	10 [4, 13.25]		
HE aggravation season (Autumn)		575	0.94
No	8.5 [4.25, 16]		
Continued			

Variable	HECSI	U	P value
Yes	11 [4, 13]		
HE aggravation season (Winter)		1224	0.612
No	9 [5, 16]		
Yes	9 [4, 14.5]		
HE aggravation season (All seasons)		1692.5	0.212
No	10 [4, 14]		
Yes	9 [6, 19.5]		
History of the skin disease		1609.5	0.486
No	10 [4.5, 16.5]		
Yes	8 [4, 15]		
Previous allergic diseases		1493.5	0.918
No	9.5 [4, 14.5]		
Yes	9.5 [4.25, 15.75]		
Family skin disease		1514.5	0.364
No	10 [5, 18]		
Yes	8 [4, 13.75]		
Family history of allergic diseases		996	0.472
No	9.5 [4, 14]		
Yes	9 [4.75, 21]		
Patch test		1831	0.532
Negative	9.5 [4.25, 14]		
Positive	9.5 [4, 17.25]		

**Table 2.** Distribution and comparison of factors affecting the severity of hand eczema.

Allergens	Positive (n = 66)n (%)	Allergens	Positive (n = 66)n (%)
Potassium dichromate	6 (9.09)	Oil of turpentine	3 (4.55)
Nickelous sulfate	17 (25.75)	Cobaltous chloride	11 (16.67)
Parabens	13 (19.70)	Benzyl alcohol	4 (6.06)
Benzocaine	2 (3.03)	p-Phenylenediamine	15 (22.73)
Formaldehyde	8 (12.12)	Imidazolidinyl urea	3 (4.55)
Bronopol	1 (1.51)	Iminodiacetonitrile	4 (6.06)
Epoxy resin	4 (6.06)	Naphthalene	5 (7.58)
Triethanolamine	7 (10.61)	Naphthalene	8 (12.12)
Colophony	12 (18.18)	Methylisothiazolinone	4 (6.06)
Methenamine	6 (9.09)	Lanolin	0 (0)
Neomycin Sulphate	2 (3.03)	Fragrance mix	7 (10.61)
Quaternium-15	4 (6.06)	Chrysanthemum extract	13 (19.70)
Tetramethylthiuram disulfide	9 (13.64)	Carbon black/ rubber composites	5 (7.58)
Carba mix	15 (22.73)	Mercapto Mix	6 (9.09)
Triclosan	3 (4.55)	Glutaric dialdehyde	13 (19.70)

**Table 3.** Etiological profile of the most common allergens established with a patch test.

skin irritation. This is because prolonged contact between the skin and metal alloys or plated items can result in the formation of divalent nickel due to the presence of nickel and perspiration. Nickel is also present in certain food products, such as nuts and chocolates<sup>14</sup>, and can also trigger or worsen contact dermatitis when ingested. In our study, 66 (54.5%) patients had hand eczema for more than a year, indicating a tendency toward chronic disease. In this study, we found no significant correlation between positive patch test results and the HECSI ( $p=0.532$ ), which is consistent with previous research<sup>15</sup>, although some studies suggest that positive patch test results may be correlated with scores on the HECSI<sup>16</sup>. Both international and Chinese guidelines<sup>2,9</sup> suggest that a negative patch test cannot be used to exclude specific allergens. The treatment of hand eczema involves identifying and removing potential causes, such as occupational history, living habits, and hobbies. The patch test is a classical and reliable method for detecting contact allergens safely and gradually. It plays a crucial role in identifying the causative factors of occupational and nonoccupational hand eczema patients. Positive results can help patients strengthen protective measures to avoid allergen exposure in their work and daily life. These finding have clinical importance in preventing this disease. The results of a patch test can be affected by various

Variables	Univariate		Multi-variate <sup>a</sup>	
	OR (95% CI)	P value	OR (95% CI)	P value
Gender		0.198		0.257
Male	1		1	
Female	1.61 [0.78, 3.34]		1.65 [0.7, 3.9]	
Age	1.02 [1, 1.05]	0.106	1.01 [0.98, 1.05]	0.481
Disease duration				
1–6 months	1		1	
6–12 months	0.89 [0.28, 2.91]	0.853	1.11 [0.29, 4.33]	0.879
1–3 years	0.98 [0.34, 2.78]	0.964	0.92 [0.27, 3.17]	0.888
≥ 3 years	0.78 [0.32, 1.89]	0.579	0.86 [0.31, 2.38]	0.858
Hand washing (times daily)		0.778		0.725
≤ 5 times	1		1	
> 5 times	1.11 [0.54, 2.29]		0.86 [0.36, 2.03]	
Working with wet hands (hours daily)				
≤ 1.00	1.03 [0.37, 2.91]	0.954	1.26 [0.41, 3.94]	0.688
1.01–2.00	1		1	
2.01–3.00	—	0.999	—	0.999
3.01–4.00	1.25 [0.14, 10.94]	0.840	1.78 [0.15, 20.89]	0.648
4.01–5.00	3.75 [0.33, 43.31]	0.290	7.20 [0.45, 116.06]	0.164
≥ 5.01–	7.50 [1.29, 43.69]	0.025	8.17 [1.27, 59.97]	0.028
Chapped skin		0.037		0.017
No	1		1	
Yes	2.51 [1.06, 5.98]		3.72 [1.27, 10.91]	
Prescription		0.063		0.414
External medicines	1		1	
System medicines	2.24 [0.96, 5.23]		1.52 [0.56, 4.15]	

**Table 4.** Association between risk factors and hand eczema-logistic regression analysis. <sup>a</sup>, to better assess the risk value of HSCSI, a cut-off point transformation was applied to turn this indicator into a binary variable. Based on the IQR distribution of HSCSI (9 [4, 14.75] in patients with eczema in this study, we selected a median of 9 as the cut-off point, and classified ≤ 9 as mild and > 9 as severe. OR, odds ratio; CI, confidence interval.

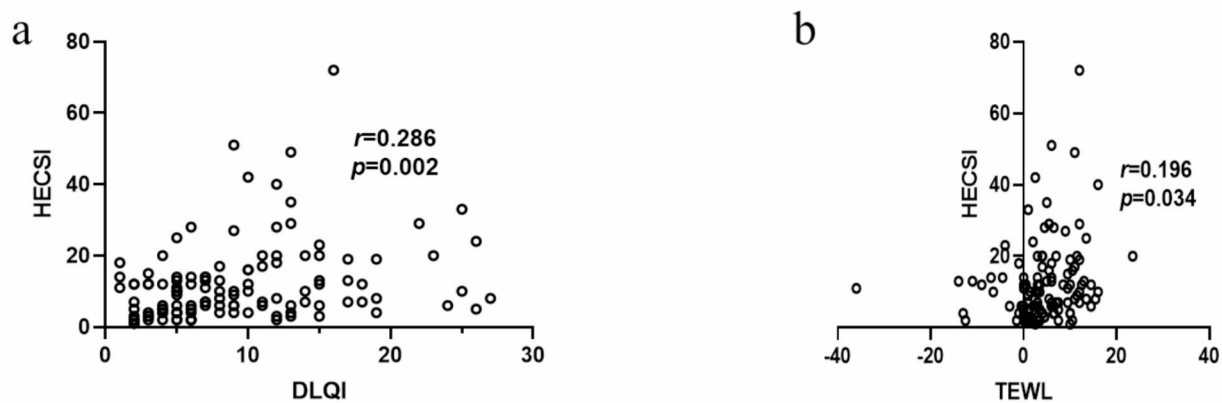
Variable	HECSI		DLQI		TEWL	
	Standard β	P-value	Standard β	P-value	Standard β	P-value
Age	0.134	0.137	−0.010	0.913	−0.025	0.797
Gender	0.230	0.009	0.005	0.958	0.004	0.970
Disease duration	0.089	0.301	0.084	0.363	0.134	0.159
Hand washing	0.070	0.431	0.115	0.223	0.118	0.223
Work with wet hands	0.361	0.000	0.331	0.001	−0.010	0.921
Chapped skin	0.133	0.137	0.081	0.398	0.228	0.021

**Table 5.** Multi-variate linear regression analysis with HECSI, DLQI and TEWL respectively as dependent variables.

factors, including the operator’s proficiency, storage of the patch test material, and the patient’s skin condition. Therefore, it is important to correlate the results clinically with the patient’s history of exposure to the reagent. Positive patch test results that are related or suspected to be related can be used as a basis for diagnosing allergic contact dermatitis. It is important to maintain objectivity and avoid subjective evaluations.

Moreover, our study revealed no significant correlation between the HECSI and the number of hand washes<sup>8</sup> or the duration of hand eczema<sup>17</sup>, which is consistent with previous research. However, some studies<sup>15,18</sup> have suggested a correlation between hand washing more than 20 times, a family history of atopic disease, and the severity of hand eczema. The results of our study are consistent with previous research<sup>19–21</sup> that has demonstrated a significant correlation between the duration of wet hand work and the severity of hand eczema. Furthermore, symptoms of hand eczema improve significantly after removal from the wet hand work environment. In previous studies<sup>22,23</sup>, there were significantly more female patients than male patients, whereas in our study, there were more male patients than female patients in the general population, which may be due to our small sample size.





**Fig. 1.** Correlation of HECSI with DLQI and TEWL.

The DLQI is a valid objective indicator for measuring the quality of life of patients with skin diseases, including hand eczema<sup>24</sup>. A positive correlation between the DLQI and the HECSI reflects the close relationship between quality of life and disease severity and supports the use of the DLQI as a clinically relevant parameter. The chronicity and frequent recurrence of hand eczema significantly affect patients' quality of life. Our study revealed that more than 50% of the patients had a disease duration exceeding one year, indicating the chronic duration of HE and the need for long-term treatment. The DLQI was found markedly negatively affected in HE patients and was significantly correlated with disease severity. Our findings are in accordance with those of previous studies<sup>25–27</sup>. The psychosocial burden caused by HE is a phenomenon that cannot be ignored. HE influences patients' DLQI score and may further contribute to patients' psychiatric disorders, such as depression and anxiety.

In addition, TEWL is an important noninvasive marker for detecting the physiological state of the skin and can reflect the barrier function of the skin. The amount of water in the stratum corneum of the epidermis plays an important role in regulating the physiological function of the skin, and it is also a manifestation of the physiological function of the whole skin and even the physiological function of the whole body in the skin<sup>28</sup>. Higher TEWL is usually associated with the skin barrier impairments, which can lead to dryness, itching, pain, peeling, and breakage in people with hand eczema. Our analysis revealed a positive association between TEWL and HECSI scores in the general population with hand eczema. Impaired skin barrier function is closely related to HECSI and is the cause of recurring episodes of hand eczema, which can prolong and worsen the condition. Chapped skin symptoms indicate impaired skin barrier function, which can increase skin moisture loss and worsen hand eczema. Working with wet hands for long periods of time can also lead to abnormal hydration of the skin barrier, exacerbating hand eczema. As an indicator of skin barrier function, TEWL can be used not only as a monitoring index of disease severity but also as an indicator for evaluating the effectiveness of disease treatment. Combining the general clinical manifestations of hand eczema and physiological indicators, including the TEWL indicator, this method of combining subjective and objective assessment can be used to more accurately assess hand eczema and guide clinical work.

## Conclusions

Prolonged wet hand work and chapped skin can lead to a higher rate of severe hand eczema in the general population. Specifically, working with wet hands for more than five hours per day and chapped skin were associated with the severity of HE. Furthermore, working with wet hands for more than five hours per day was identified as an independent risk factor for increased severity and reduced quality of life in patients with HE. Finally, there was a significant positive correlation between chapped skin and the severity of hand eczema and higher TEWL. The severity of HE was found to be positively associated with both reduced DLQI and TEWL. Patch tests revealed that the most common allergens that cause hand eczema are nickelous sulfate, carba mix and p-phenylenediamine. This study has several limitations. First, this was a single-center study. Second, the patch test detects only common allergens and does not include the use of allergic items by patients. It should ideally include China standards, cosmetic series, plant series, patients' own products and other work-related antigens at appropriate dilutions. Further research is needed to address the above deficiencies to better understand the influencing factors of hand eczema in the general population of China.

## Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Conceptualization: F.H., L.C. Data Curation: Z.Q., Q.J., B.W., R.J., K.C., Y.Z. Formal Analysis: Z.Q., Q.J., L.C., F.H. Methodology: Z.Q., Q.J., C.Y., L.C., F.H. Writing—Original Draft Preparation: Z.Q., Q.J., B.W. Writing—Review and Editing: Z.Q., F.H., C.Y. Supervision: F.H., L.C.

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## Declarations

## Competing interests

The authors declare no competing interests.

## Additional information

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