

# Prevalence of Dermatitis and Superficial Fungal Infection of the Hands in Seafood Workers: An Investigation from Food Markets in Ningbo, China

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**Objective:** Seafood workers have high risks of hand skin diseases. The purpose of this survey is to study the prevalence of occupational hand skin diseases in this population.

**Methods:** From March 2018 to October 2018, seafood workers in two food markets in Ningbo, China were investigated. Fungal microscopy and cultures from lesions on the hands and nails were performed. A community-based investigation of hand skin diseases was performed as a control group.

**Results:** One hundred and eleven of 135 (82.2%) seafood workers in two food markets in Ningbo were taken into the investigation. The prevalence of hand dermatitis was 50.5% (56/111) in seafood workers, which is significantly higher than that of the control group (7.43%,  $p < 0.001$ ). It was found that the incidence of superficial fungal infection of the hands in seafood workers was much higher than that in community residents (26.1% vs 2.7%,  $p < 0.001$ ). Without wearing waterproof gloves, longer working time per day, longer history of seafood work increased the risk of hand dermatitis, instead of candidial infection of the hands and nails.

**Conclusion:** Hand skin diseases are highly prevalent in seafood workers in Ningbo, a city in eastern China. This public health problem should be addressed in this population.

**Keywords:** seafood, hand dermatitis, fungal colonization, *Candida*

## Introduction

Skin diseases are one of the most common occupational diseases.<sup>1</sup> According to the Health and Safety Enforcement Agency, there are approximately 16,000 cases per year of work-related dermatitis in China,<sup>2</sup> and 4 million working days are lost due to occupational skin diseases in the UK every year.<sup>3</sup> In 2010, there were 850,000 cases of work-related dermatitis among workers in the US.<sup>2,4</sup> Contact dermatitis account for 70-90% of hand dermatosis, which is a common occupational cutaneous diseases.<sup>1,3,5-11</sup>

It has reported that hand dermatitis and fungal infections may be caused by prolonged exposure to water and gloves.<sup>10,12</sup> The prevalence rate of contact dermatitis was reported to be 8–11% in fishermen and the incidence of hand itching was 49.6%.<sup>10</sup> As hands are frequently exposed to water and occlusive gloves, the risk of hand dermatitis and fungal infection is estimated to be high for seafood workers.<sup>10,12</sup> However, there are limited epidemiological data concerning hand dermatitis and fungal infection in seafood workers.

In the coastal cities of China, seafood is one of the main food sources for people,<sup>13</sup> particularly for residents of Ningbo.<sup>14</sup> Ningbo ranks first in per capita seafood

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consumption in China.<sup>15</sup> The number of people employed in the seafood industry is growing rapidly. China has more than 14 million seafood practitioners.<sup>16</sup> There are 786,900 seafood practitioners in Zhejiang Province.<sup>16</sup> To analyze the prevalence of hand skin diseases in seafood workers, we conducted a cross-sectional survey in two representative seafood markets in Ningbo, Zhejiang Province, China.

## Methods

### Study Design

A cross-sectional survey was conducted from March to October 2018 to investigate dermatitis and hand fungal infection in seafood workers in two seafood markets in Ningbo, China. In this survey, seafood workers were defined persons who engage in seafood transportation, storage, and sales in seafood markets. During daily work, seafood workers are in contact with seafood with or without wearing waterproof gloves. To serve as a control, a survey of 148 residents from the community where the two vegetable markets were located was conducted concurrently. The study was approved by the ethics committee of the Beilun Traditional Chinese Medicine Hospital, Ningbo, China (8 March 2018; Approval number 2018-007). All participants provided written informed consent.

### Questionnaire and Data Collection

A questionnaire was designed for this survey. The questionnaire included demographic characteristics (gender, age, work experience), pertinent medical history (history of cutaneous diseases and treatment, complicated with chronic systemic diseases), glove-wearing behavior, and types of hand skin lesions.

To test the usability of the questionnaire, it was completed by three investigators (FL, BL and ZS), who then reached a consensus on how to implement the questionnaire. In order to ensure the feasibility and utility of the questionnaire, prior to formal data collection, a pre-survey was carried out on 2% of the sample from the two food markets. Data obtained from the questionnaires were recorded by two investigators (FL and ZS) after careful inquiry and examination. Two investigators (FL and JQ) analyzed the data. The hands of seafood workers and residents were examined and diagnosed by two investigators (FL and ZS). Hand dermatitis was defined as in previous studies.<sup>5,9,12</sup> We examined lesions on the hands, including erythema, plaques, papules, edema, blisters, scales, fissures, and ulcers. Nail changes were also detected. Symptoms, cutaneous eruptions and nail changes were

recorded on the survey form. During examination, photographs of hands were taken to record the signs of the hand skin rash.

### Fungal Microscopy, Culture and Identification

Skin lesions on the hands or nails were scraped and observed under microscopy. Only when hyphae or pseudo-hyphae was detected, a diagnosis of fungal infection was made. Clinical samples taken from the hands were inoculated in potato dextrose agar medium for fungal culture at 26°C. DNA extracted from the cultures was sequenced. Polymerase chain reaction products of rDNA-ITS were sequenced to identify pathogens to the species level.

### Statistical Analysis

SPSS 21.0 (IBM, Inc. Armonk, NY) was used for statistical analysis. Counting data were expressed as rate (%) and chi-squared test or Fisher's exact test was used for comparison between groups. Measured data were expressed as mean  $\pm$  standard deviation. Comparison between groups was analyzed by student's *t* test.

## Results

A total of 111 of 135 seafood workers (response rate: 82.2%) in 2 of 8 seafood markets in our investigation area were surveyed. For the control group, 186 residents were approached and 148 participated (response rate: 80%) (Table 1). Before the seafood workers were engaged in this work, there were no significant differences between them and the community population in the history of hand contact dermatitis and hand superficial mycosis (Table 1).

The incidence of hand dermatitis and superficial fungal infection in seafood worker group was much higher than those in the control group (Table 2). The clinical characteristics of hand dermatitis and fungal infection in seafood workers are listed in Table 2. Fungi isolated from cutaneous lesions of hands and nails are listed in Table 3.

We also compared the seafood workers with and without dermatitis and fungal infection of the hands. Wearing waterproof gloves, working time span, and seafood types were not related to the incidence of the diseases (Table 4). Without wearing waterproof gloves, long working time per day (>4h), and longer history of seafood work (>20years) were associated with risk of hand dermatitis. Wearing gloves and working time were not associated with risk of fungal infection of the hands. Furthermore,

**Table 1** Demographic Characteristics and Medical History of Seafood Workers in Two Food Markets and Community Residents in Ningbo, China

	Seafood Workers (n=111) n (%)	Community Residents Control (n=148) n (%)	P value
Age (Mean ± SD)	57.3±19.4	53.6±9.0	0.043
Female	63 (56.8)	96 (64.9)	0.185
Wet work environment	111 (100.0)	7 (4.7)	<0.001
History of hand skin diseases	4 (3.6)	11 (7.4)	0.192
History of tinea manus/ onychomycosis	6 (5.4)	4 (2.7)	0.429
Response rate to the survey	111/132 (82.2)	148/186 (80)	0.307
Hand dermatitis	56 (50.5)	11 (7.4)	<0.001
Hand fungal infection	29 (26.1)	4 (2.7)	<0.001
Only involving the hand skin	9 (8.1)	2 (1.4)	0.022
Involving the Nails	20 (18.0)	2 (1.4)	<0.001

**Table 2** Clinical Features of Hand Dermatitis and Hand Superficial Fungal Infection in Two Food Markets in Ningbo, China

	Hand Dermatitis (n=56) n (%)	Hand Superficial Fungal Infection (n=29) n (%)
Sites of Cutaneous Lesions		
Palmar/dorsal of the hands	39 (69.6)	11 (37.9)
Interdigital	29 (51.8)	21 (72.4)
Nails	26 (46.4)	20 (69.0)
Lesion Type		
Erythema	24 (42.9)	1 (3.5)
Scale	36 (64.3)	3 (10.3)
Erosion	17 (30.4)	17 (58.6)
Maceration	29 (51.8)	20 (69.0)

we found that when they were attacked by cutaneous diseases of the hands, they did not seek medical treatment in a timely fashion (Table 4).

**Table 3** Fungal Isolates from the Hands and Nails in Seafood Workers in Two Food Markets in Ningbo, China

Isolates	Number (%)
<i>Candida albicans</i>	15 (46.8)
<i>Candida parapsilosis</i>	3 (9.3)
<i>Candida guilliermondii</i>	2 (6.2)
<i>Candida glabrata</i>	2 (6.2)
<i>Candida krusei</i>	1 (3.1)
Other yeasts	8 (25.0)
Total	31 (100)

## Discussion

Wet-work is defined as immersing hands in liquids for more than 2 hours per working day, wearing waterproof gloves for more than 2 hours per working day, or washing hands >20 times per working day.<sup>17</sup> The risk of hand skin diseases is increasing in wet workers.<sup>17</sup> Various occupations have high exposure to liquids, including nurses, hairdressers, food handlers, florists, cooks and chefs, car mechanics, and a number of high-risk occupational groups.<sup>17</sup> The incidence of hand dermatitis varies according to the work type and wet work time per shift.<sup>11,12,17-19</sup> Seafood workers are exposed to water and seafood in their daily work. In the present epidemiological study, we found that the incidence of hand dermatitis was as high as 50.5% in seafood workers in a typical coastal city, Ningbo, China.

The incidence of fungal infection of the hands and nails was also much higher in seafood workers than those of the general population in our survey. The warm and humid climate in eastern China provides favorable conditions for yeast growth. High incidence of hand candidial infection may be associated with high temperatures while wearing the gloves and soaking hands in water. The local micro-environment of the hands of seafood workers may cause overgrowth of *Candida* and other yeasts in the hand microbiota.

Touching seafood with hands or wearing waterproof gloves are both wet risk factors for hand dermatitis and superficial fungal infection of the hands. We compared seafood workers with and without dermatitis and fungal infection; there were no significant differences among the age, sex, seafood type, and water type. Long time exposure to water may cause maceration and erosion the hand skin. In the survey, we found that wearing waterproof gloves, longer working time per day, and longer history of seafood work are high risk for hand dermatitis, instead of superficial fungal infection of the hands. Wet environment whether in the water or in the gloves are risk factors for candida growth, this can explain the similar rates of fungal infection of the hands in the two subgroups

**Table 4** Comparison of Seafood Workers with and Without Hand Dermatitis and Hand Superficial Fungal Infection in Two Food Markets in Ningbo, China

	With Hand Dermatitis (n=56) n (%)	Without Hand Dermatitis (n=55) n (%)	P value	With Fungal Infection (n=29) n (%)	Without Fungal Infection (n=82) n (%)	P value
Age (Mean± SD)	53.7±8.2	53.5±9.9	0.889	57.8±6.8	52.1±9.3	0.001
Female	36 (64.3)	27 (49.1)	0.106	12 (41.4)	51 (62.2)	0.052
Wearing waterproof gloves	30 (58.9)	41 (74.5)	0.021	20 (69.0)	54 (65.9)	0.760
Seafood Type						
Ice fresh	23 (41.1)	22 (40.0)	0.980	9 (31.0)	36 (43.9)	0.225
Fresh	31 (55.4)	32 (58.2)	0.764	19 (65.5)	44 (53.7)	0.268
Ice fresh+Fresh	2 (3.5)	1 (1.8)	0.987	1 (3.5)	2 (2.4)	1.000
Water Type						
Fresh water	13 (23.2)	14 (25.5)	0.783	8 (27.6)	19 (23.2)	0.634
Seawater	43 (76.8)	41 (74.5)	0.783	21 (72.4)	63 (76.8)	0.634
Period of Working (years)						
<10	6 (10.7)	14 (25.5)	0.043	5 (17.2)	14 (17.1)	0.790
10–19	15 (26.8)	19 (34.5)	0.375	9 (31.0)	24 (29.3)	0.858
20–30	35 (62.5)	22 (40.0)	0.018	15 (51.7)	44 (53.7)	0.858
Daily Working Time (hours)						
<4	0	3 (5.5)	0.235	0	3 (3.7)	0.566
4–8	14 (25.0)	28 (50.9)	0.005	10 (34.5)	32 (39.0)	0.665
>8	42 (75.0)	24 (43.6)	0.001	19 (65.5)	47 (57.3)	0.439

of seafood workers (with vs without wearing waterproof gloves, longer working time per day, and longer history of seafood work).

This study contributes evidence of hand skin diseases in seafood workers in a local city in China. However, there are few limitations in the study. First, this study was conducted as cross-sectional study. We could not exclude influence of climate on the incidence of hand skin diseases. Secondly, our study was based on seafood worker-report, clinical examination, and fungal examination. The diagnosis of hand dermatitis is clinical based, instead of based on patch tests. Finally, the sample size and the number of sites are not large, both of which could contribute to selection bias and low statistical power.

In conclusion, our study showed that hand skin diseases, hand dermatitis, and candidial infection of the hands and nails are highly prevalent in seafood workers in Ningbo, China. The data may be useful for controlling hand skin diseases of this specific population.

## Author Contributions

Formal analysis, FL, BL, ZS, SL and JQ; Investigation, FL, BL and ZS; Methodology, FL and JQ; Resources, FL, BL, ZS, SL and JQ; Writing – original draft, FL; Writing – review & editing, SL and JQ. All authors contributed to data analysis, drafting or

revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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