



# Epidemiological survey of warts in Chinese military recruits: A cross-sectional and follow-up study

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## ABSTRACT

**Background:** Warts are very common in military personnel, either at war or during peace times. However, little is known about the prevalence and natural course of warts in military recruits in China.

**Objective:** To investigate the prevalence and natural course of warts in Chinese military recruits. **Methods:** In this cross-sectional study, the head, face, neck, hands, and feet of 3093 Chinese military recruits aged 16–25 years in Shanghai were examined for the presence of warts upon enlistment medical examinations. Questionnaires were distributed to collect the general information of the participants before the survey. All the patients were followed up by telephone interview for 11–20 months.

**Results:** The prevalence rate of warts in Chinese military recruits was 2.49%. The diagnosis of most cases was common and plantar warts, which were usually less than 1 cm in diameter and with mild discomfort. Multivariate logistic regression analysis showed that smoking and sharing personal items with others were risk factors. Coming from southern China was a protective factor. Over 2/3 of patients recovered within 1 year and the type, number, and size of warts and treatment choice did not predict resolution.

**Study limitations and Conclusions** This study demonstrated that warts had a relative lower morbidity and a higher spontaneous resolution rate in Chinese military recruits. The telephone interviews following the initial survey and the limitations of a cross-sectional study were the main drawbacks.

## 1. Introduction

It is well known that warts are very common among teenagers and have a higher prevalence rate among Caucasians [1,2]. In the last five decades, warts were also the most common dermatological reason for seeking medical attention during combat and peace-keeping deployments and had a high morbidity in military camps during peace times [3,4]. However, little is known about the prevalence and clinical profile of warts in Chinese military recruits.

Warts may resolve spontaneously, with a higher possibility among younger and non-Caucasian skin type teenagers [5]. There is little research on the natural course of warts in military personnel.

We carried out a cross-sectional study in Chinese military recruits to evaluate the prevalence and risk factors of warts in this group.

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**Table 1**  
Demographic characteristics associated with the prevalence of warts were compared by chi-squared test.

Characteristics	No. With/Without warts	$\chi^2$	P value
General information			
Sex	male	73/2728	3.311 <sup>a</sup>
	female	4/365	
Age (year)	≤18	5/327	6.433
	19–20	37/1337	
	21–22	22/1060	
	≥23	13/292	
Ethnicity	Han	76/2938	0.117 <sup>a</sup>
	other	1/78	
Residential area	rural	36/1567	0.814
	urban	41/1449	
Region	south	1/343	7.709 <sup>a</sup>
	other	76/2673	
BMI	<24	49/2175	2.672
	≥24	28/841	
Education	senior high school or lower college or higher	12/605	0.942
	junior high school or lower senior high school	65/2411	
Father's education	junior high school or lower senior high school	47/1873	0.153
	college or higher	19/782	
Father's occupation	non-manual labor	7/327	0.166
	manual labor	33/1284	
	other	28/1211	
Mother's education	junior high school or lower senior high school	12/487	3.002
	college or higher	49/2093	
	non-manual labor	22/628	
Mother's occupation	manual labor	5/268	0.884
	other	29/1286	
	other	25/955	
Number of brothers/sisters	only child	22/748	0.063
	one brother/sister	33/1251	
	more than one brother/sister	31/1235	
Yearly household income (Chinese ¥/year)	<50,000	13/530	0.731
	50,000–10000	23/808	
	>100,000	33/1256	
Being from a single-parent family	yes	21/952	3.947 <sup>a</sup>
	no	4/59	
lifestyles variables			
Drinking	no	73/2957	3.523
	less than once a month	36/1654	
	several times a week	29/1066	
Smoking	no	12/296	8.992
	yes	45/2224	
Sleep time point (o'clock)	before 22	32/792	1.383
	between 22 and 24	9/410	
	after 24	52/2125	
Daily sleeping hours (h/day)	<6	16/481	1.425 <sup>a</sup>
	6–8	1/75	
	>8	58/2092	
Excise	no	18/849	3.441
	yes	12/748	
Frequency of washing one's own socks	once a day	65/2268	1.880
	once every two days	45/1989	
	once over three days	27/865	
Psychological stress	mild	5/162	0.002 <sup>a</sup>
	moderate or severe	73/2836	
Skin diseases	no	4/180	3.746
	yes	68/2828	
Frequent flu infection	no	9/188	0.217 <sup>a</sup>
	yes	74/2863	
Environmental factors			
History of exposure to warts patient	yes	3/153	3.311 <sup>a</sup>
	no	1/7	
Hyperidrosis of foot	no	76/3009	4.539
	yes	55/2446	
Number of roommates	≤2	22/570	0.793
	3–4	22/833	
	≥5	15/718	
		40/1465	

(continued on next page)

**Table 1** (continued)

Characteristics		No. With/Without warts	$\chi^2$	P value
Using public bathroom or swimming pools	yes	56/1715	7.721	0.005
	no	21/1301		
Sharing personal items with others	yes	64/2726	4.488	0.034
	no	13/290		
Having pets	yes	17/508	1.460	0.227
	no	60/2508		
Family members or friends with warts	yes	0/14	0.359 <sup>a</sup>	1.0
	no	77/3002		

<sup>a</sup> Fisher's exact test.

In addition, we sought to explore the natural course and possible prognostic factors of this disease in the military environment.

## 2. Methods

This study was conducted in the period from October 2020 to April 2022 in Shanghai. The head, face, neck, hands, and feet of all recruits were inspected by dermatologists from the First Affiliated Hospital of the Naval Medical University. Informed consent was obtained from all the participants before the survey. This study was approved by the Ethics Committee of the First Affiliated Hospital of the Naval Medical University. (CHEC2020-145)

All the recruits were asked to complete a questionnaire about the presence of possible risk factors for warts, including socio-demographic, lifestyle and environmental items. Sociodemographic factors consisted of sex, age, ethnicity, living environment (country/city), education, parents' education and occupation, number of brothers or sisters. Lifestyles variables were alcohol intake, smoking, time of sleep onset, daily sleeping hours (h/day). Smoking was evaluated by smoking index as cigarette-year. Alcohol intake was measured by the frequency at which they consumed alcohol. Related environmental risk factors included number of roommates, contact with warts patients, history of HPV prophylactic vaccination, frequency of flu infection, sharing personal items with others, using public bathroom or swimming pools, family members or friends having warts, with skin diseases or hyperhidrosis. Frequent flu infection was defined as having more than three episodes within three months during the most recent year. Sharing personal items with others was defined as sharing nail clippers, towel, slippers or wash basin  $\geq$  three times within a month and lasting for more than six months. Skin diseases and hyperhidrosis were self-reported by recruits based on their own perceptions. Those recruits were excluded who refused to participate in the survey or whose questionnaires were incomplete.

The type and number of warts as well as the discomfort caused by the lesions were recorded. Dermatology Life Quality Index (DLQI) was used to evaluate the impact of the lesions on patients' life quality [6]. All the patients were followed up by telephone interview for 11–20 months (mean 15.1 months). Complete resolution was defined as warts being no longer visible or palpable.

Demographic characteristics were compared by chi-squared test or fisher's exact test. Multivariate logistic regression analyses were used to determine risk factors and the adjusted odds ratio (a OR) with 95% CI was calculated. Cox proportional-hazards models were used to estimate the hazard ratios for the resolution of warts. Statistical analyses were performed with IBM SPSS version 25.0. All statistical tests were two-sided with  $P < 0.05$  being considered to have significant differences.

## 3. Results

A total of 3240 Chinese military recruits were investigated, of whom 51 refused to participate, and 96 did not completely fill out the questionnaire. As a result, we collected 3093 valid questionnaires, of which 2728 were from males and 365 from females. There were 77 patients with warts, resulting in a 2.49% prevalence (2.68% for males, and 1.10% for females) (Table 1). The number of females in this survey was significantly lower than that of males. Multivariate logistic regression analysis showed that smoking, being from a single-parent family, sharing personal items with others were risk factors, and the relative risk increased by 1.69, 2.93 and 1.86 times respectively. The origin from southern China was a protective factor, and the incidence was only 0.101 times (Table 2).

Most of the patients had common and plantar warts (72/77, 93.50%), mainly involving the right hand and the soles of feet (58/77,

**Table 2**  
Multivariate logistic regression models for the occurrence of cutaneous warts.

Characteristics	P value	OR	95% CI	
			Lower	Upper
Region				
south/other regions	0.023	0.101	0.014	0.732
Being from a single-parent family				
yes/no	0.045	2.934	1.025	8.396
Smoking				
yes/no	0.001	1.693	1.213	3.059
Sharing personal items with others				
yes/no	0.047	1.863	1.009	3.438

75.32%). Nearly half (33/77,42.86%) of patients had multiple warts and about one-tenth (8/77,10.39%) had warts more than 1 cm in diameter. Nearly twenty percent (12/77,19.48%) of patients reported a history of trauma before the rashes occurred. About seventeen percent of patients (13/77,16.88%) had undergone treatment before this survey. Nearly half of patients (33/77,42.86%) reported discomfort, with the most common symptoms were being worried due to persistence (17/77, 22.01%), unsightly appearance (17/77, 22.01%) and pain (8/77, 10.39%). Nearly sixteen percent of patients (12/77,15.58%) reported an impact on training, daily life or learning, with a patient reported a DLQI score of 14 points (Table 3).

Of all the 77 patients, 10 were lost to follow-up: 7 could not be contacted, 3 rescinded their participation. Consequently, there were 30 cases of common warts, 3 cases of plane warts and 34 cases of plantar warts for telephone follow-up. 39 cases were untreated and 28 cases were treated with cryotherapy, CO2 laser, plasters containing 78% salicylic acid and 4% phenol, traditional Chinese medicine or unknown therapy. Of all the 67 patients, 71.64% (48/67) had their lesions cleared during follow up, with no significant differences between those treated (28/39) or non-treated (20/28). 23 (34.33%) cases recovered within 6 months, 20 (29.85%) cases recovered within 1 year, and 5 (7.46%) cases recovered beyond 1 year. Multivariate Cox analysis showed that the type, number, and size of warts and treatment choice did not predict resolution (Table 4).

#### 4. Discussion

The prevalence rate of warts was reported to be 3.0%–33% among teenagers and 1.3%–6.0% in young adults [7,8]. Compared with Caucasians, non-Caucasians have a low morbidity. A European survey showed that the lifetime prevalence rate of this disease among adults was 41% [9]. A recent study found the prevalence of the disease among Chinese college students was 1.4% (2.0% for males and 0.9% for females). Warts were also the most common reason among skin conditions for physician consultation in wartime during the Vietnam War [3]. Koreans reported a point prevalence of 4.7% in their active troops and drew a conclusion that the prevalence of this disease increased with the increase of service years [4]. This study revealed that warts prevalence in Chinese recruits was 2.49%, which was relatively lower compared with Korean active forces, but comparable to that of Chinese male college students. A prospective study is needed to investigate the change of prevalence rate of the disease after enlisting in the military.

This survey found that the incidence of warts in male is higher than that in female. However, due to the significant gender difference in the military composition and the small number of females in this study, we cannot draw a conclusion that males have a higher morbidity. We found the recruits from southern China had a relative lower morbidity. A European study had revealed that the prevalence of cutaneous warts in northern Europe was higher than that in southern Europe (Italy and Spain) [9]. As China is a vast country and the number of recruits from south China did not exceed 500 in this study, a larger epidemiological survey between different latitudes in this country is warranted to support this survey result. Age, educational level, family economic situation and parents' occupation had no significant influence on the prevalence of this disease in recruits.

The risk factors of warts are still unclear. There were studies that suggested smoking, poor hygiene and low family income were risk

**Table 3**  
Clinical characteristics of the patients with warts.

Characteristic of warts	Frequency (n)	%	
Diagnosis	common wart	37	48.05
	plane wart	5	6.49
	plantar wart	35	45.45
Location	left hand	9	11.69
	right hand	21	27.27
	sole of feet	37	48.05
	dorsum of feet	4	5.19
	head, neck, face	2	2.60
	any two of the aforementioned locations	3	3.90
	other	1	1.30
No. Of warts	single	44	57.14
	multiple	33	42.86
Size	< 10 mm	69	89.61
	≥10 mm	8	10.39
History of trauma	yes	12	15.58
	no or unknown	65	84.42
Discomfort caused by warts	no	44	57.14
	being worried due to persistence	17	22.01
	unsightly appearance	17	22.01
	pain	8	10.39
Negative impact on training, learning and daily life	No	65	84.42
	yes	12	15.58
Previous treatment options	no	64	83.12
	hospital consult	3	3.90
	other	10	12.99
DLQI scores	0	60	77.92
	1–3	16	20.78
	≥4	1	1.30

**Table 4**  
Univariate and multivariate cox regression analyses of potential factors affecting resolution of warts.

Characteristics	No. With/Without complete resolution	Crude HR (95% CI)	Adjusted HR (95% CI)
Sex	female	1/3	1.00 (ref)
	male	47/16	0.587 (0.166–2.083)
Age	18–21	33/11	1.00 (ref)
	22–24	15/8	1.188 (0.469–3.013)
Diagnosis	1	21/9	1.00 (ref)
	2	26/8	1.152 (0.245–5.409)
	3	1/2	0.956 (0.200–4.572)
Smoking	no	30/11	1.00 (ref)
	yes	18/8	0.637 (0.256–1.590)
Alcohol intake	yes	24/11	1.00 (ref)
	no	24/8	0.480 (0.174–1.326)
Hyperidrosis	no	34/11	1.00 (ref)
	yes	14/8	0.844 (0.336–2.123)
Treatment	no	28/11	1.00 (ref)
	yes	20/8	0.721 (0.289–1.802)
Number of warts	1	33/8	1.00 (ref)
	≥2	15/11	1.027 (0.401–2.626)
Diameter	< 1 cm	42/18	1.00 (ref)
	≥ 1 cm	6/1	0.745 (0.098–5.664)
Discomfort	no	28/12	1.00 (ref)
	yes	20/7	1.201 (0.471–3.060)

factors of the disease [2,10]. We found smoking, sharing personal items with others were risk factors, which were consistent with previous studies [10]. Smoking is a notorious risk factor for a range of diseases [11]. Nicotine may cause a decrease in antibody response levels and inhibition of T cell proliferation, which may be associated with smokers' increased susceptibility to warts [12]. Sharing personal belongings may increase the chances of exposure to viral contaminants, thereby increasing the risk of infection. We found that being from a single-parent family was also a risk factor. As there were only 63 recruits coming from single-parent families, which was a small number compared with those surveyed, we couldn't rule out that this finding is an accidental phenomenon. Though being from single-parent families may affect children' personality and behavior, further large-scale investigations are needed to verify whether it is a risk factor of warts [13].

We found the most common symptoms in our patients were being worried due to persistence, unsightly appearance and pain; the percentages of those with symptoms were higher than previous reports [14]. About sixteen percent of our patients reported the impact of the disease on training, daily life or learning, with a patient got 14 points in DLQI score, implying that warts were not merely a blemish on the skin in some cases [15]. Besides, most of the patients suffered from common and plantar warts, with less than 1 cm in diameter and mild discomfort, which were comparable to those of previous studies in the same age group in Chinese [14].

It is reported that the spontaneous resolution rate of warts within 2 years was 67% in teenagers [5,16]. An earlier study found that slightly over half of Chinese college students with warts recovered spontaneously within 2 years [14]. However, the resolution rate in our study was higher compared with Chinese college students and comparable to that of teenagers. This might be related to the military environment, for example, the high intensity training excise. It is reported that proper excise is a protective factor for warts [17]. We found the type, number, and size of the warts and treatment choice did not predict resolution, which was consistent with previous studies [5].

Our study has several strengths. This is the first study focusing on epidemiological and clinical characteristics of warts in Chinese military recruits. The participation rate was high given the survey was conducted along with the military-entry health examinations. Although previous studies had found 96% of warts were located on hands and feet, we surveyed recruits' head, face, neck, hands and feet to ensure that warts were found as much as possible [18]. Moreover, we found the resolution rate of warts within 1 year was higher in military environment. There are also some limitations in this study. First, the patients were only followed up by telephone after the initial survey and could not be examined again to observe the changes of the lesions accordingly. Second, the limitations of a cross-sectional study prevent us from analyzing the causal relationships of risk factors.

## 5. Conclusions

Chinese military recruits had a relatively lower morbidity and a higher spontaneous resolution rate of warts. A prospective study is needed to investigate the prevalence rate and possible causes of the disease after enlisting in the military.

## Authors' contribution

Jianhua Wu: Conceived and designed the experiments; Approval of the final version of the manuscript.

Ran Liu: Data collection, analysis and interpretation; Effective participation in research orientation.

Tao Zhou: Performed the experiments; Preparation and writing of the manuscript.

### The place where the study was conducted

The study was conducted in Shanghai, China.

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### Data availability statement

Data will be made available on request.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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