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Research Article

Self-Evaluation of Health State in Chinese Navy of Different Fleets

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Abstract

Objective: To clarify physical and psychological states and corresponding medical need of Chinese navy.

Methods: A cross-sectional study was performed in the total of 438 soldiers of two fleets in different latitudes in China by a self-reported questionnaire. The physical and psychological states were investigated and the potential medical needs were explored.

Results: The top was muscle and skeletal system disease, affecting up to 59% of the population, followed by respiratory disease, skin disease, and oral disease. The frequency of oral disease increased gradually with aging, with the first peak at 26-30 years. Ophthalmic and ear-nose-throat diseases became more frequent in those at 40 years or older. The frequencies of skin disease and oral disease were higher in the submarine of fleet B (north) than that of fleet A (east) by multiple comparisons (P<0.0125). In fleet A, the frequencies of influenza and diarrhea in submarine were higher than those in surface vessels (P<0.001). The corps with poorer psychological states suffered more physical diseases than those with better psychological states (P=0.040).

Conclusions: Disease profiling in Chinese navy might be related to age, working in different latitudes, occupational exposure, and psychological states. Submarine force is more susceptible to infectious disease than surface vessels, possibly due to the closed environment. Medical service should be precisely provided to the different vulnerable population, missions, and branches.

Introduction

Navy corps is supposed to be the major defensive support for costal countries. Many missions of navy corps are implemented either offshore or far sea. The health states of the corps, working and living in the environment different from inland, should be given a special concern. Neuromusculoskeletal injuries were considered as one of the largest detractors from military readiness and causes of disability in the military, and early physical therapists intervention can prevent and rehabilitate injuries and promote human performance optimization by a ten-year review [1,2]. The link between deployment and development of chronic lung disease is suggested [3]. An Acceptance and Commitment Therapy (ACT)-based program called Mindfulness for Pain and Performance Enhancement (MPPE) is proved to help recruits effectively handle pain and improve their physical performance [4]. The impact of psychological stressors should also be addressed within naval service populations [5]. Tele-Critical Care (TCC) has recently been taken as an effective mean to extend physician expertise and to improve outcomes of critically ill patients [6]. Several evaluation systems including NPS (U.S. National Park Service) and high-fidelity medical simulation scenario are successfully applied to assess the medical demand of navy [7,8]. However, health events in the navy of developing countries remain unknown.

In recent years, Chinese navy has developed and undertaken multiple international ocean navigations, including Somalia escort, Gulf of Aden escort, multi country joint naval training, including Rim of the Pacific (RIMPAC), and many kinds of military visits. The navy corps routinely takes a long journey, exposes to the complex climates and environments, and therefore may be stressed a lot from physical and psychological problems. In addition, spectrum of disease and life style in China especially for young

people has been changed a lot [9,10]. Thus, the health states of Chinese navy should be updated while their health demand should be specified.

Methods

Participants

A cross-sectional study was performed in Chinese navy. The sample size was determined by the following formula: $n = \frac{\mu_{\frac{\alpha}{2}}^2 \pi (1-\pi)}{\delta^2}$. π is the rate of the population regarding to the certain event. In Chinese military, the prevalence rate of training injuries is about 20% according to the meta-analysis of Chinese military training injuries during 1990-2011 [11]. Thus, we took 0.2 as the default value. When $\alpha=0.05$, $\delta=0.2\pi$, the minimum sample size was about 384. Considering the loss of samples including no response rate or incomplete questionnaire, we added 15% more to the minimum sample size to perform the following sampling. We chose two fleets to perform cluster sampling, termed as fleet A and fleet B, which were located in the east and north of the Chinese coast, respectively. Based on the total number of soldiers in these two fleets, 3 subunits and 5 subunits were randomly selected from the two fleets, respectively. A total of 170 soldiers from fleet A and 290 soldiers from fleet B were selected to complete the questionnaire. We received a total of 438 valid questionnaires, including 159 from fleet A and 279 from fleet B. In fleet A, 79 soldiers served on the surface vessels and 80 served at the submarine force. All 279 members in fleet B served at the submarine force. All the recruits were male, with an average age of 25.82±5.08 years. The average service duration was 7.15±5.02 years.

Questionnaire and Epidemiological Investigation

A self-reported questionnaire was designed by three investigators (XT, YD, and HZ). After two rounds of pre-survey, final version of the questionnaire was determined and included the following three main parts (Appendix A). The demographic characteristics such as age, gender, and service years in the navy was recorded in part one. Part two was composed of two multi-choice questions (Q1 and Q3), eight single-choice questions (Q16-Q23) and one essay question (Q24), in which basic physical and psychological problems were acquired. Part three was composed of seven multi-choice (Q2, Q4, Q5, Q8, Q10, Q12, and Q13), five single-choice (Q6, Q7, Q11, Q14, and Q15) and

one essay questions (Q9), in which the potential risk factors related to the health, hygiene consciousness, medical needs were investigated. Because the questionnaire was self-administered, all the questions were listed according to the logical order so that those surveyed were easy to follow. Except for the investigation by using questionnaire, 20 navy medical workers in fleet A were personally interviewed on the current measures of healthy and epidemic prevention, future demand of navy hygiene and health care workers. All procedures performed in our studies involving human participants were in accordance with the ethical standards of the Institutional Ethical Review Board of Naval Medical University and with the 1964 Helsinki declaration. A verbal consent of each respondent was obtained before the interviews were conducted. The investigation began in September 2014. The physical and mental states of past six months were obtained from each soldier. The surveyors were trained according to the standardized protocol. The primary data was double checked by the two authors responsible for double entry. The missing items were completed or deleted as appropriate. The response rate of each question was calculated.

Statistical Analysis

Comparative analysis was performed between submarine force and surface fleet, or between fleet A and fleet B. The comparison of categorical data was performed using Chi-square test. The quantitative data was analyzed using Student's t test. Specially, P value was adjusted for multiple comparisons. All statistical tests were two-sided and conducted using Statistical Program for Social Sciences (SPSS 21.0, Chicago, IL, USA). A P-value of <0.05 was considered as statistically significant.

Results

Self-assessment of Physical State of Navy Corps

The self-reported rates of common diseases in two fleets were sorted in descending order as followed: muscle and skeletal system disease, respiratory disease, skin disease, oral disease, digestive disease, and ophthalmic and ear-nose-throat diseases. Such a trend was also found both in the surface vessels and submarine force in both fleets. As to the submarine branch, the self-reported rates of skin disease and oral disease were significantly higher in fleet B than those in fleet A (Table 1). In fleet A, some diseases were apparently higher in the surface vessels than that in the submarine force with no significance.

Problems	Frequency of fleet A (%)		Frequency of fleet B (%)	Total (%)
	Surface Vessels	Submarine	Submarine	
Physical				
Muscle and skeletal system	53.3	49.4	63.6	59.0
Respiratory system	45.3	35.0	50.0	46.3
Skin disease	41.3	22.1*	45.3	40.2
Oral disease	25.3	18.2*	38.8	32.4
Digestive system	17.3	16.9	34.1	27.8
Ophthalmic and Ear-nose-throat diseases	13.3	7.8	18.2	15.4
Psychological				
Trouble sleeping	56.4	38.5*	56.3	53.1
Being awakened by nightmare	44.9	33.3	48.7	45.2
Special scene flashed in the mind	48.7	43.6	50.5	51.0
Being worried about training injury	48.1	53.9	66.4	61.1
Being affected by sailing over 7 days	58.4	49.4	42.6	47.0
Being confident with the mission assigned by the supervisor	90.8	92.3	87.8	89.2
Being friendly with others	96.2	98.7	97.8	97.7
*$P<0.0125$, When compared the submarine forces between fleet A and fleet B.				

Table 1: Self-reported rates of physical and psychological problems in the Navy corps from March to September, 2014.

The self-reported rate of each disease obviously increased with aging (Figure 1). The frequencies of digestive, respiratory and skin diseases were rising steadily. Muscle and skeletal disease kept at a frequency of 60% in those under the age of 30; however, in those the age of 30 years or older, the frequency approximately increased up to 80%. Two peaks at the frequency of oral disease were observed in the age group of 26-30 and 36-40 years, respectively. The self-reported rates of ophthalmic and ear-nose-throat diseases increased a lot in the soldiers at the age of 40 or older.
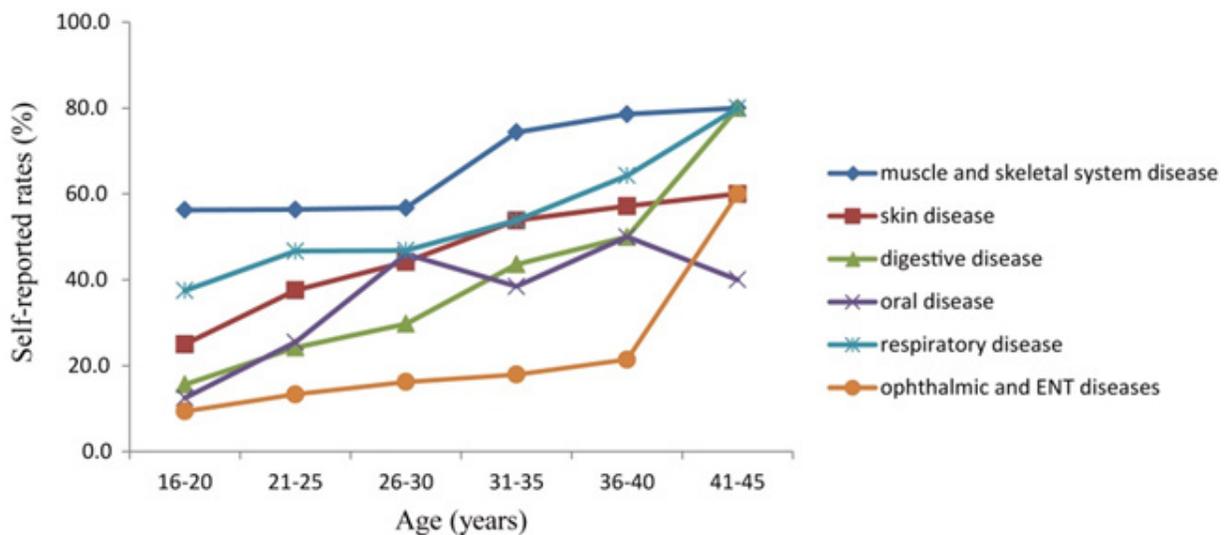

Figure 1: The self-reported rates of major common diseases in all surveyed navy soldiers at the different age groups.

We further investigated the self-reported rates of infectious diseases that the corps had in the past six months. Generally, the most common infectious diseases were influenza and diarrhea, with the frequencies of 65.1% and 48.6%, respectively. Moreover, the corps at the age of 21-25 was high risk group predisposed to influenza and diarrhea, whose frequencies were 42.4% and 46.2%, respectively. Other infectious diseases according to the frequency in descending order were malaria, hepatitis, and pulmonary tuberculosis. The self-reported rates of infectious disease in the submarine force of fleet A and fleet B were similar (P>0.05, Figure 2). In fleet A, the frequencies of influenza and diarrhea in the submarine force were much higher than that in the surface vessels (P<0.001), indicating that airtight cabin of submarine force increases pathogen transmission. In the submarine force, 7 patients were reported in fleet B and only 1 in fleet A (7/264 vs 1/76).
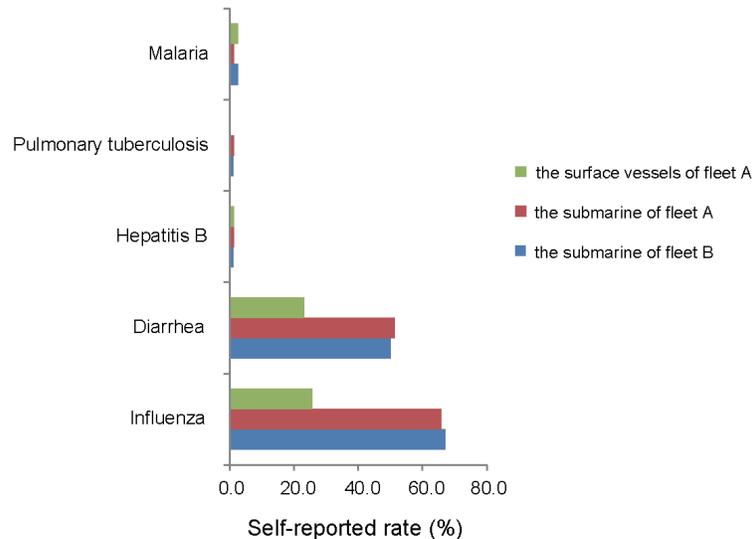

Figure 2: The self-reported rates of common infectious diseases in surveyed navy soldiers of different fleets.

Self-Assessment of Psychological Health

Psychological problems were self-reported in 47.3% of the corps. The frequency increased with aging. In the age group of 21-25 years, the rate was 47.1%. The age group of 31-35, the rate was 62.5%. All the personnel at the age of 41-45 reported psychological problems. Approximately 10% of the soldiers ever reported to have psychological problems previously. Although the rate of ever having psychological problems in the submarine force of fleet A was higher than that of fleet B (16.7% vs 8.1%, P=0.028), the self-reported rate of the existing psychological problem of the former was much lower than that of the latter (29.5% vs 52.6%, P<0.001). This indicated some intervention in fleet A worked well. Furthermore, the frequency of the existing psychological problem of the submarine force was significantly lower than that of surface vessels in fleet A (29.5% vs 46.8%, P=0.019).

The events reflecting current psychological state were also shown in Table 1. Over half of the soldiers suffered from trouble sleeping. Of the soldiers with the existing psychological problem, 70.15% had trouble in sleeping. More "trouble sleeping" existed in the submarine force of fleet B than that of fleet A (56.3% vs 38.5%, P=0.007). Most of those surveyed (89.2%) were confident with the mission assigned and 97.7% claimed to have a good relationship with others. However, the average self-evaluation score on psychological health was relative lower (77.83±13.61). The self-evaluated score in fleet A was higher than that in fleet B (81.70±12.08 vs 75.75±13.96, P<0.001). The self-evaluated score in the surface vessels was higher than that in the submarine force (80.48±12.11 vs 77.34±13.86, *P*<0.001). For the submarine force, the score in fleet A was much higher than that in fleet B (82.17±11.49 vs 78.30±11.45, *P*<0.001). To further clarify the relationship between the evaluation score and related risk factors, we defined the personnel scored under 60 as the unsatisfied group and that above 95 as the satisfied group. The unsatisfied group enrolled 25 soldiers including 1 from the surface vessel of fleet A, 2 from the submarine force of fleet A, and 22 from fleet B. The satisfied group enrolled 22 soldiers including 14 in fleet A (6 from the surface vessels; 8 from the submarine force) and 8 from fleet B. Particularly, the average types of physical diseases each person reported in the unsatisfied group were almost double than those in the satisfied group (2.8 vs 1.4, P=0.04), which indicated physical health was correlated to psychological health.

Risk Factors Related to Health Problems

To further explore the risk factors, the potential items related to living condition, working environment, living habits, and health education were listed in Table 2. Long-term stay in the closed working condition, humid climate at costal location, heavy maintenance for vessels were considered as the top reasons to cause disease by the submarine force. Whereas in the surface vessels, long-term stay in the closed working condition, humid climate at costal location, poor dietetic hygiene and shortage of fresh water supply were the top reasons. Except for the items in the questionnaire, the surface vessels made supplementary items affecting health: 1) no time to be hospitalized due to busy work; 2) too short time to do exercise; 3) only physical examination without further treatment; and 4) unqualified fresh water and unclean tableware.

Problems	Frequency of fleet A (%)		Frequency of fleet B (%)	Total (%)
	Surface Vessels	**Submarine**	**Submarine**	
Long-term stay in the closed working condition	53.2	35.4	65.9	57.9
Humid climate of costal location	44.3	38.0	63.0	54.9
Heavy maintenance of vessels	30.4	48.1	59.6	52.1
Over-training	13.9	13.9	37.8	29.0
Lack of health knowledge and consciousness of health care	21.5	24.1	30.7	27.8
No regular physical examination	19.0	20.3	34.2	27.6
Poor dietetic hygiene, shortage of fresh water supply	34.2	13.9	26.3	25.5
Shortage of specialist, such as otolaryngologist, dermatologist	15.2	13.9	31.5	25.2
Complicated referral systems	13.9	10.1	32.6	25.0
Unhealthy living and dietary habits	16.5	15.2	19.3	18.0
Simple living facilities	10.1	11.4	4.4	13.6
Others	32.9	8.9	15.9	11.0

Table 2: The potential causes of physical and mental diseases.

The corps at different age groups claimed a different top risk factor. Heavy maintenance of vessels was taken as the top factor to affect health presented by soldiers at the age group of 16-20 and 31-40. Long-term stay in the closed working condition was the top factor presented by those at the age group of 21-30. Overloaded training was the top factor presented by those at the age group of 41-45. Approximately 77% of the corps considered that it was necessary to improve the working and living conditions.

The unhealthy living habits reported were ranked by order as smoking, alcohol intake, drinking condensed tea, chewing arecas, and biting nails (Figure 3A), which were all traditional unhealthy habits in modern China [12]. Such a trend was similar, either for the surface vessels or for the submarine force. Fleet B reported a significant higher frequency of drinking alcohol than did the submarine force of fleet A (58.0% vs 34.8%, *P*=0.01). We also investigated the ways that the corps acquired the knowledge of health care. The most popular way was via medical education carried out by medical doctors and nurses, followed by network, family members and friends, professional books, and popular magazines (Figure 3B). Getting knowledge from the network were more popular in the submarine force of fleet B than did that of fleet A (*P*<0.001). Family members and friends were more popular way in the surface vessels than submarine force of fleet A (*P*=0.009). In addition, about 76.1% of the corps considered it necessary to set up the specialists including otolaryngologist and dermatologist when executing a mission on the sea. Thus, health workers including the specialist played an important and irreplaceable role in performing health care and health promotion for the navy.
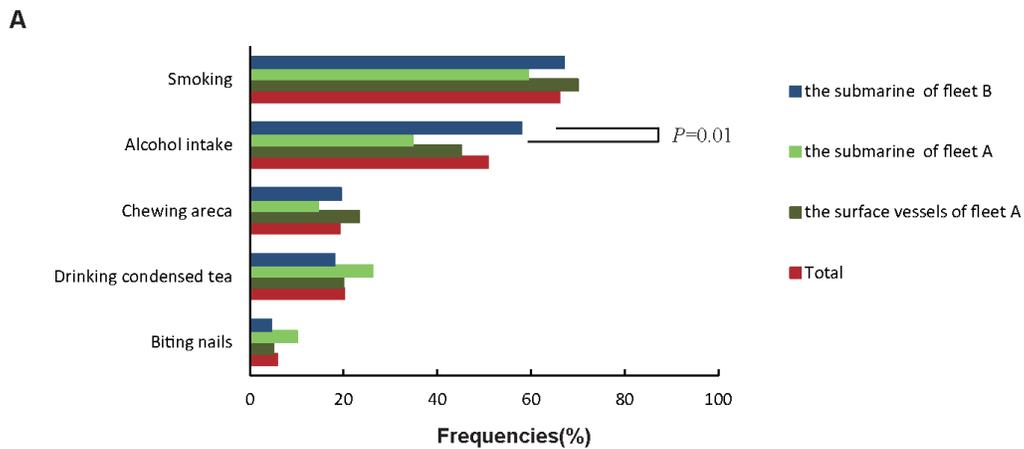
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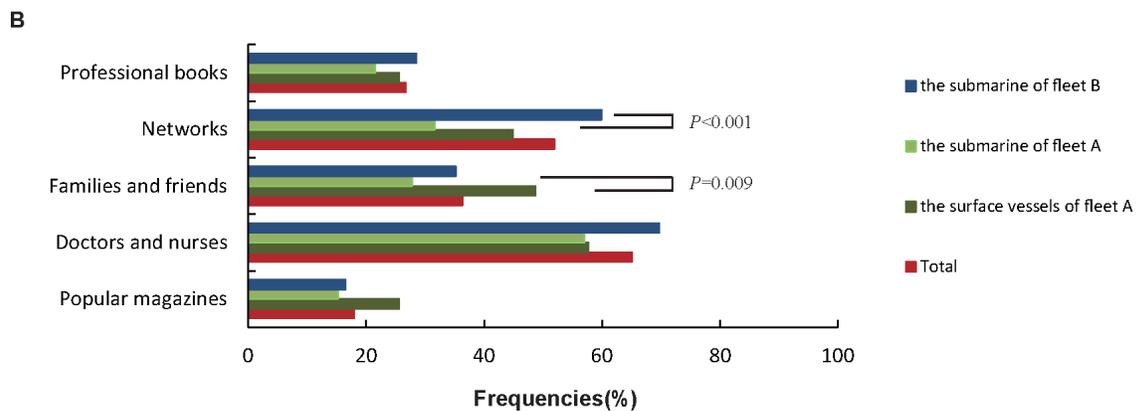**Figure 3A:** Frequencies (%) of unhealthy living habits.

B

Figure 3B: The ways by which the corps acquired health care knowledge.

To investigate the unexpected factors that disturb medical service, a total of 20 navy medical workers (10 with bachelor degree and 10 with senior college degree) were face-to-face interviewed in fleet A. The most serious problem reported was that the members can't be quickly adaptable to their job and working environment after graduation because their major was clinic medicine other than family medicine. Some of the medical workers just graduated could not succeed in performing intravenous injection although they might join the complex surgery in the hospital during their intern. So the corps preferred nurses to young medical doctors for medical need, which made the medical workers frustrated for a long time even suffered from mental disease at the end. Thus, family doctor was the urgent medical need for Chinese navy. The second problem was the air pollution caused by disinfection of ultraviolet radiation, especially in the confined space without good ventilation like the submarine. Most of the vessels made by iron and steel also limited the extensive application of the effective disinfector acetic acid peroxide.

Discussion

In this study, we for the first time exhibited the major spectrum and frequencies of diseases in Chinese navy of different sea areas, and then compared the health state and related risk factors in different fleets and branches including submarine force and surface vessels. The muscle and skeletal system disease, affecting up to 59% of the population, was the top one complained by the navy despite of different fleets or branches [13]. The age was one of the most important risk factors affecting physical health [14]. As shown in Figure 1, 25 years and 40 years were considered as the cutting age to stratify medical service into three stages: stage I, ≤25 years; stage II, >25

years and <40 years; stage III, ≥40 years. In stage I, muscle and skeletal system disease, respiratory disease and skin disease were the main physical problems. Soldiers at stage I was also susceptible to the infectious diseases. Except for these diseases, oral disease increased a lot after stage II. The self-reported rates of ophthalmic and ear-nose-throat diseases increased rapidly after stage III. The otolaryngologist and dermatologist were needed to serve the corps when executing the mission on the sea [15]. Therefore, medical needs should be met with the age- and mission-related issues by utilizing multilevel prevention [16]. Although the physical health state was not confirmed by the physicians in this study, the self-assessment should provide more valuable information [17,18]. Navy soldiers are mostly young person. Their duty is high frequent. Therefore, they prefer holding back the discomfort to seeing a doctor, especially for the chronic non-communicable diseases [19]. Therefore, the self-assessment beyond clinical diagnosis may reflect the real situation and urgent medical needs more extensively [20]. However, the evaluation on physical state in our study was somewhat superficial. More physical examinations should be performed to evaluate the real health state in this population.

Not only the physical state but also psychological health affects the performance in military occupations [21,22]. It has been suggested that the research on the navy, army, and air force should be treated as separate entities [20]. Our investigation indicated psychological problems were the very common issue in the navy, which is consistent with a previous study [23]. Moreover, the submarine of fleet B complained more trouble sleeping than that of fleet A ($P<0.0125$) and lower self-evaluation on psychological health. All these clues indicated that the psychological state of different branches of navy corps were different [24]. Fleet B reported long-term stay in the closed working condition whereas the submarine force of fleet A took heavy maintenance for vessels as the top reason to cause disease (Table 2), which indicated poor physical state of fleet B may be due to the tasks with longer term. Furthermore, the submarine force of fleet A reported more rates of ever being sick while less rates of existing psychological problem compared to that of fleet B. According to the survey on the medical workers of fleet A, the psychological guidance was regularly performed, including publicizing psychological health knowledge, outdoor training, and group counseling. Thus, the early psychological guidance in the navy was suggested to be set up systemically and individually according to the different military branches and missions. Additionally, the psychological state was highly associated with the related events including trouble sleeping in our investigation, although System Checklist-90 (SCL-90), the classic questionnaire, was not applied to evaluate the state of the corps. For example, over 70% of the soldiers with existing psychological problem complained a trouble sleeping, which was coincident with other studies [25]. Over half of corps was trouble in sleeping in our study, which was consistent to a study of sleeping deprivation on US navy [26].

Although both fleet A and fleet B have submarine branch, the self-rated health was relative poorer in the submarine of fleet B than that of fleet A. The self-evaluation score was correspondingly lower in fleet B than that of fleet A. Smoking in the submarine force was reported more in fleet B than in fleet A. These clues indicate that military service could influence health via affecting health behavior and might heighten the risk of initiating smoking [27,28]. Under the condition that limited space for physical activities, no sunlight exposure, and noisy environment, submariners are the high risk population susceptible to the common diseases and infectious diseases. Medical needs should be assessed comprehensively and independently [29]. The epidemic of malaria by self-report in our study was more serious than US navy and marine corps from 2013 statistics [30], although this epidemic in China decreased in these years. US navy and Chinese navy both engaged in the military missions and supplied the aids in malaria-endemic regions. Thus, quarantine restriction and isolated treatment are the key issue contributing to the gap of malaria epidemic between Chinese navy and US navy.

Conclusion

Fleets in different latitudes exhibited different frequencies of some kinds of disease. Submarine force is more susceptible to infectious disease than surface vessels, possibly because of the closed environment. The detail medical service for submarine force should be concentrated on the prevention and control of infectious disease. Effective medical care including routine physical examination, rehabilitation, and the specialist support during long-term navigation should be given separately to the different age population. The physical health was closely correlated to the psychological health. Family doctor was the first urgent medical need for Chinese navy.

Funding

Ethics Approved and Consent to Participate

All procedures performed in our studies involving human participants were in accordance with the ethical standards of the Institutional Ethical Review Board of Second Military Medical University (reference number: TMEC2014-002) and with the 1964 Helsinki declaration. Verbal consent of the respondents was obtained before the interviews were conducted.

Competing Interests

The Authors declare that there is no conflict of interest.

Authors' Contributions

Drs. Xiaojie Tan, Yibo Ding, and Shaoping Wu analyzed the whole data independently, presented the same results and drafted the manuscript. Drs. Yibo Ding, Hongwei Zhang and Xiaojie Tan were responsible for the questionnaire development. Drs. Yan Liu and Yujia Zhai were responsible for data entry. Drs. Xiaojie Tan, Yibo Ding, Hao Wang, and Jiluo Liu were responsible for epidemiology investigation. Drs. Shaoping Wu and Xiong Zhou were responsible for statistical analysis. Prof. Guangwen Cao designed and supervised the whole study and extensively revised the manuscript.

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