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ORIGINAL RESEARCH

Factors Influencing the Mental Health of Firefighters in Shantou City, China

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Background: Firefighters are routinely exposed to occupational stress and are therefore vulnerable to psychological problems.

Patients and Methods: This study assessed the prevalence of mental health symptoms and potential contributing factors in a sample of firefighters in Shantou city, in the Guangdong Province of China. We conducted a cross-sectional survey with 335 firefighters, including 329 male and 6 female firefighters. We used a questionnaire which assessed anxiety and depression, as indicated by the Zung Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS), as well as other mental health symptoms, using the Symptom Checklist-90 (SCL-90). Basic information and potential-related factors were also collected.

Results: The average age of participants was 27.38 (SD ± 6.11) years. Assessed by the indexed score of different scales, SAS and SDS positive screening rates were 6.86% and 22.68%, respectively. SCL-90 scores indicated that 6.86% of participants had mental health symptoms. Logistic regression analysis showed that educational level, firefighter rank, and birth order were associated with mental health outcomes. Firefighters in Shantou were also shown to have better mental health outcomes than the Chinese military, but worse than the national population of firefighters.

Conclusion: These findings indicated the mental health of firefighters is not good. It is necessary to explore effective approaches to help preventing and treating mental disorder in firefighters.

Keywords: firefighter, mental health, depression, anxiety, influencing factors

Background

In 2018, according to the China Fire Protection Yearbook, the National Fire Department of China received 1.157 million emergency calls. Furthermore, it was the sixth consecutive year that alarm calls exceed one million. The average number of daily emergency calls was 3170, among which 647 were for putting out fires. Twenty-four firefighters died in the "8.12" accidental fire and explosion at Tianjin port in 2015. In 2017, the Liangshan forest fire took the lives of 30 firefighters. Between 2000 and 2017, at least 2411 firefighters were injured in China.[1]

Firefighters serve as a first response team in providing assistance. Their occupational responsibilities include routine exposure to emergency situations, such as putting out fires, extracting victims of car accidents, rescuing individuals attempting suicide from high buildings, and many other difficult situations that may pose a substantial risk of serious injury or death. Thus, repeatedly encountering life-threatening events and tragedies would presumably have a great impact on one's psychological and physical health.[2]

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Apart from routine duties, firefighters are required to carry out intense special physical and technical training every day. Especially for new employees, it is important to be familiar with the use of rescue equipment and perform repeated training actions. Such repeated high-pressure demands could easily trigger obsessive-compulsive symptoms.[3] They feel need to repeatedly check something for harm, leaks, damage, or fire, for fear of having made mistakes. At the same time, the duty-related trauma exposure can affect the comprehensive mental health profile of firefighters.[4]

There are some reports that investigated the mental health of firefighters nationwide. Based on the study that established the Symptom Checklist-90 (SCL-90) local norm in China,[5] in 2005, Liu et al developed the SCL-90 military norm.[6] In 2017, Lu et al[7] conducted a survey using stratified sampling of front-line firefighters in 10 provinces to develop the SCL-90 firefighter norm in China. Their research showed that the mental health of firefighters was generally better compared to local or military norms; however, factors such as different tasks, regional conditions, economic development, and ethnic areas can significantly impact the mental health of front-line firefighters.[8,9] Furthermore, there are still inconsistencies in the findings of previous research.[10,11]

Some evidence suggests that the prevalence of depression and depressive symptomatology in firefighters is higher than in the general population.[12] Pyle et al[13] examined the rates of depressive symptoms in a sample of 132 firefighters in the Midwest of the United States (U.S.) and found that 15.6% of participants showed symptomology consistent with depression. Other research has also suggested that rates of depression in firefighters are higher than the general population in the U.S., which typically is less than 10%.[14,15] For example, a study by Stanley et al[16] demonstrated that a single occupational exposure to a suicide attempt or death was associated with an increased risk of suicidal behavior among firefighters. Researchers in the U.S. and many other countries have paid more attention to suicidal attempts and behaviors among firefighters. The prevalence of suicide ideation among 1027 firefighters in U.S. was as high as 46.8% and found a relative prevalence of depression and drinking and alcohol misuse among them.[16,18] Additionally, some studies have focused on post-traumatic stress disorder (PTSD) in firefighters.[16,19] In South Korea, a nationwide, population-based survey of all employed firefighters found that the rate of PTSD was estimated to be 5.4%.[20] Additionally, a cross-sectional survey in Australia indicated that the rates of PTSD and depression in current and retired fire-fighters were 8% and 5%, respectively.[21]

At present, most studies have indicated that the psychological health of firefighters is different from that of the general population. To our knowledge, there are few studys that have used cluster sampling of firefighters in a whole city to explore potential factors assocaited with mental health and that even compare to a military population. Therefore, we investigated the firefighters in our city and explored the possible impact of educational level, firefighter rank, and family situation to their mental health disorders.

Patients and Methods

Research Design and Setting

The present study used cluster sampling data obtained from a cross-sectional survey conducted in Shantou, a coastal city of Guangdong Province, China. The sample consisted of 386 firefighters from all stations in the area, with 335 ultimately able to complete the survey. Most of the eligible participants were men, with only six women included in the sample. Ages ranged from 18 to 51 years old. With the permission and help of local authorities, this study was conducted over two consecutive days in August 2018. Questionnaires were distributed by the officer from their medical section or training section in each station. The questionnaire sheets were anonymous and returned after all were finished. This study was conducted in accordance with the Declaration of Helsinki. It was approved by ethics review board of the First Affiliated Hospital of Shantou University Medical College. Informed consent was documented from the Bureau of Fire Protection before the survey began.

Measures

Demographic Characteristics

Sociodemographic and occupational characteristics included age, gender, educational level, native place, birth order, job position, habit of drinking alcohol, and smoker.

Zung Self-Rating Depression Scale

The Zung Self-Rating Depression Scale (SDS) is a 20-item self-report questionnaire which assesses for symptoms found in analytic studies to be associated with depressive disorders.[22] Previous studies have demonstrated its reliability and validity in Chinese populations.[23] The SDS uses a 4-point scale ranging from 1 (none or some of the time) to 4 (most or all of the time). The scale has a raw score range of 20 to 80 points. The raw score is then converted

to an index score. Items assess psychological and physiological symptoms and are rated by respondents according to how well each item applied to them within the past week. Depression levels are assessed by the maximum score (80) and either expressed as a decimal or multiplied by 100 to be expressed as a whole number with an index score range of 25 to 100. Index scores below 49 indicate no depression, 50–59 indicate mild to moderate depression, 60–69 indicate moderate to severe depression, and scores over 70 indicate severe depression.

Zung Self-Rating Anxiety Scale

The Zung Self-Rating Anxiety Scale (SAS) is a 20-item self-report questionnaire that assesses symptoms associated with anxiety.[24] It is divided into four grades according to the frequency of symptoms, on a scale from 1 (very little) to 4 (very much), regarding the degree to which individuals fear anxiety-related consequences. Similar to the SDS, this scale has a raw score range of 20 to 80 points. After converted into an index score, less than 50 is considered in the normal range, 50–59 indicates mild to moderate anxiety, 60–69 indicates moderate to severe anxiety, and scores over 70 indicate severe anxiety.[25]

The Chinese Version SCL-90

The SCL-90, which is used to assess mental health disorders and psychological health conditions, was designed to evaluate a broad range of psychological problems and symptoms of psychopathology, and has been verified as a popular and useful tool. Chinese scholars introduced and developed a Chinese version of the SCL-90, which has since been widely used in China. In this study, Cronbach's alpha coefficient was 0.97. There is good internal consistency reliability for the Chinese version of SCL-90. The scale consists of nine dimensions with 90 items in total. Each item is rated on a scale ranging from 1 to 5, indicating no symptoms to severe symptoms. The primary symptom dimensions assessed are as follows: somatization (SOM), obsessive-compulsive symptoms (OCS), interpersonal sensitivity (INTS), depression (DEPR), anxiety (ANX), hostility (HOS), phobic anxiety (PHOA), paranoid ideation (PARI), and psychoticism (PSY). According to the national norm, if the total score is more than 160 points, the number of positive items is more than 43, or the score of any factor is more than 2, then it is considered to be positive, and further examination is needed.[26]

Quality Control

With the permission and help of local authorities, all the firefighters in different districts were asked to sit in a meeting room before the survey began. Synchronized through a remote video conference device, two trained researchers were conducting the investigation in the fire-protection station, provided a detailed explanation of the requirements of the questionnaire and how to effectively answer the questions. After detailed explaining the purpose and primacy of research, each one was told to sign the inform consent if they were willing to join the research. The questionnaires were answered by participants independently, based on their true feelings about the items. The questionnaires were removed due to poor quality responses, such as some vacancy in filling sheet or obvious contradictory in the same questionnaire. We used EpiData version 3.1 to build a database, and the data were double entered separately by two researchers and cross-checked twice.

Statistical Analysis

We used SPSS (Statistical Product and Service Solutions) version 23.0 to analyze the data. Descriptive statistics frequencies and proportions were used to summarize participants' sample characteristics. For comparisons among groups, *t*-tests or ANOVAs (Analysis of Variance) were used to analyze differences, and the least significant difference (LSD) test was used. For non-normal distribution data, the Kruskal–Wallis *H*-test was used. Multivariable logistic regression analyses were also conducted to identify factors associated with the detection rate for mental health conditions. The p-value was set at <0.05 to be considered statistically significant.

Results

Sample Characteristics

There are approximately a total of 400 firefighters in Shantou city. Due to alternative leave, a total of 386 questionnaires were distributed to different stations at the same time, and 335 effective questionnaires were returned and used for data analysis, after removing questionnaires with low-quality answers (response rate of 86.78%). Among these 335 participants, only six (1.8%) were women. The average age was 27.38 ± 6.11. The majority of participants were young or middle age. Most were non-local to the area, accounting for 79.1%. Educational attainment for firefighters nowadays in China is high, and 60.03% of the participants

Table 1 Participants' SOCIODEMOGRAPHIC Characteristics

Education	N=335	%
High school diploma or below	124	37.0
College degree	202	60.3
Postgraduate degree	9	2.7
Native place		
Local	70	20.8
Non-local	265	79.1
Firefighter rank		
Cadet/firefighter	113	33.8
Engineer/driver/captain	111	33.1
Officer, chief of staff	111	33.1
Drinks alcohol		
Yes	54	16.1
No	281	83.9
Smoker		
Yes	159	47.5
No	176	52.5
Numbers of siblings in family		
1	144	43.0
2–3	157	46.8
After 4	34	10.2

(202) had a college degree. Nearly half (47.5%) of the participants smoked, while 16.1% reported they drink alcohol. Approximately 43% were either the first or only child in their family. Participants' sociodemographic information is summarized in Table 1.

Mental Health Measurement

SAS and SDS Scores

According to Chinese national norms, SAS and SDS standard scores ≥ 50 can be regarded as criteria for screening positive. Of all the participants, the mean SAS score was 37.27 ± 8.6. There were 23 (6.86%) participants classified as having anxiety (SAS ≥ 50); 18 showed mild symptoms and two showed severe symptoms. For depression, the mean SDS score was 40.93 ± 11.7. There were 76 (22.68%) participants with depressive symptom (SDS ≥ 50), among whom 27 showed moderate symptoms and four who showed severe symptoms. Higher values indicated increased severity.

SCL-90 Scores

Participants were screened for mental health symptoms. In a Chinese population, a positive indication of psychological problems is defined as a total SCL-90 score of ≥160 points, ≥43 positive items, or a score ≥ 2 on any subscale. In the present study, 23 participants had a total score higher than 160, which accounted for 6.8%. There were 52 participants who had positive items totaling higher than 43 points, which accounting for 5.82%. A total of 38 participants had factor scores higher than 2, accounting for 11.3%. Among all factors, SOM was 1.31 ± 0.45, OCS was 1.48 ± 0.47, INTS was 1.34 ± 0.43, DEPR was 1.26 ± 0.39, ANX was 1.25 ± 0.40, HOS was 1.26 ± 0.45, PHOA was 1.12 ± 0.27, PARI was 1.23 ± 0.36, and PSY factor was 1.21 ± 0.32. We found that the top three factors that had higher points were OCS (10.7%), SOM (6.6%), and INTS (6.0%).

Potential Factors Related to Mental Health

Table 2 shows the association between potential factors and prevalence of mental disorders, as detected by SAS, SDS, and SCL-90 scores in firefighters. Rates of depression based on SDS screening were significantly associated with educational level ($p \leq 0.001$) and firefighter rank ($p \leq 0.05$). The positive prevalence detected by SCL-90 was related to birth order ($p \leq 0.05$). *T*-test results showed that the difference has statistical significance. Almost all average scores of item factors in local firefighters were lower than the Chinese military norm, except for somatization. However, factors of somatization, compulsive symptoms, interpersonal sensitivity, anxiety, and psychotic symptom were higher than the national firefighter norm, which was shown to be a statistically significant difference.

Participants' scores for the nine dimensions of the SCL-90 refer to Table 3. The scores of five dimensions (SOM, OCS, INTS ANX, and PSY) for local firefighters were significantly higher than the Chinese national firefighter norm, indicating higher risks, more serious psychological problems, and more symptoms of psychopathology associated with firefighters in Shantou city, especially in SOM ($t = 3.38$, $p < 0.01$), OCS ($t = 5.367$, $p < 0.001$), and ANX ($t = 2.71$, $p < 0.01$). However, we also found that almost all local practical scores were lower than the military norm in OCS ($t = -2.746$, $p < 0.01$), INTS ($t = -4.596$, $p < 0.001$), DEPR ($t = -6.927$, $p < 0.001$), ANX ($t = -4.564$, $p < 0.001$), HOS ($t = -5.11$, $p < 0.001$), PHOA ($t = -8.238$, $p < 0.001$), PARI ($t = -8.339$, $p < 0.001$), and PSY ($t = -5.923$, $p < 0.001$). These results suggested that local firefighters may have better mental health than the Chinese military population.

Table 2 Possible Factors Associated with the Detection Rate of Participants' Mental Health Issues

	SDS n (%)	χ^2	SAS n (%)	χ^2	SCL90 n (%)	χ^2
Gender [#]						
Male	74 (22.5)	0.019	21 (6.4)	3.142	21 (6.4)	3.142
Female	2 (33.3)		2 (33.3)		2 (33.3)	
Education						
High school or below	44 (35.5) a	18.649***	9 (7.3)	0.342	8 (6.5)	0.288
College degree	30 (14.9) b		13 (6.4)		14 (6.9)	
Postgraduate degree	2 (22.2) [a, b]		1 (11.1)		1 (11.1)	
Firefighter rank						
Cadet/firefighter	32 (28.3) [a]	6.782*	12 (10.6)	5.519	10 (8.8)	4.501
Engineer/driver/captain	28 (25.2) [a, b]		3 (2.7)		3 (2.7)	
Officer, chief of staff	16 (14.4) b		8 (7.2)		10 (9.0)	
Native place						
Local	11 (15.7)	2.453	7 (10.0)	1.360	8 (11.4)	2.881
Non-local	65 (24.5)		16 (6.0)		15 (5.7)	
Rank of children in family						
1	29 (20.1)	2.169	15 (10.4)	5.101	16 (11.1) [a]	7.082*
2–3	41 (26.3)		6 (3.8)		6 (3.8) [b]	
after 4	6 (17.6)		2 (5.9)		1 (2.9) [a, b]	
Drinks alcohol						
Yes	16 (29.6)	1.769	6 (11.1)	1.815	7 (13.0)	3.743
No	60 (21.4)		17 (6.0)		16 (5.7)	
Smoker						
Yes	40 (25.2)	1.053	11 (6.9)	0.001	10 (6.3)	0.157
No	36 (20.5)		12 (6.8)		13 (7.4)	

Notes: *P<0.05; ***P<0.001; [#]Continuity Correction Chi-Square test; [a,b]Significant difference in comparison among three groups.

Discussion

Firefighting is a dangerous profession. Compared to other occupations, firefighters are almost four times more likely to experience a work-related injury or musculoskeletal disorder[27] and worse mental health outcomes. There have been many studies in western countries which examined mental health among firefighters and other first-responders. Usually applying measurements such as the SDS, SAS, or SCL-90, these studies had similar findings that firefighters often have negative physical and mental

Table 3 Average Scores of Participants Compared to National Firefighter Norm and Military Norm (x ± s)

Symptom	Local Participants (2018, n=335)	National FireFighter Norm (2017, n=893)	t value	Military Norm (2005, n=14,300)	t value
SOM	1.31±0.45	1.23±0.37	3.380**	1.36±0.46	−1.909
OCS	1.48±0.47	1.35±0.47	5.367***	1.56±0.52	−2.746**
INTS	1.34±0.43	1.28±0.45	2.571*	1.45±0.49	−4.596***
DEPR	1.26±0.39	1.22±0.40	1.785	1.41±0.49	−6.927***
ANX	1.25±0.40	1.19±0.34	2.710**	1.35±0.46	−4.564***
HOS	1.26±0.45	1.24±0.43	0.974	1.39±0.50	−5.111***
PHOA	1.12±0.27	1.13±0.30	−0.145	1.25±0.40	−8.238***
PARI	1.23±0.36	1.24±0.43	−0.625	1.39±0.50	−8.339***
PSY	1.21±0.32	1.18±0.33	1.980*	1.32±0.50	−5.923***

Notes: *P<0.05; **P<0.01; ***P<0.001.

health outcomes. Further, their rates of distress were shown to range from 25% to 32%,[1,28,29] and rates of PTSD ranged from 3.9% to 13%.[30,32] Research even found rates of suicidal ideation and attempts in firefighters to be 46.8% and 15.5%, respectively.[33,34] In China, however, there have not been many studies which focused on mental health in firefighters, and the results have not been consistent. Rui et al[35] investigated the mental health of firefighters using the SCL-90 and found that their overall mental health was significantly better than that of local and military populations. However, another study using the SCL-90 showed no significant differences in factor scores between firefighters and the Chinese adult norm.[36]

In total, there are around 400 firefighters in the city of Shantou, which have 6 million populations to serve. Among them, 335 were available to complete questionnaires in the present study. The strength of this study is that it included a relatively large sample size and explored potential factors affecting occupational stress. The present study showed that SCL-90 scores for almost all of the nine dimensions obtained from local firefighters were lower than the Chinese military norm. However, the scores for five dimensions (SOM, OCS, INTX, ANX, and PSY) were significantly higher than the Chinese firefighter norm. This finding indicated that the psychological condition of local firefighters was better than the Chinese military but worse than the average level of firefighters nationwide. We supposed the heavy workload due to high population density might lead to great pressure for these relatively few firefighters.

Alcohol is forbidden strictly when driving in our city. So there is only 16% of them drinking sometime but nearly half of them smoke. However, we found there was no significant relation between alcohol drinking or smoking and mental health issues. Sociodemographic factors such as educational level, and whether one was an only child were shown to impact mental health. Our study examined possible risk factors associated with firefighters' mental health and revealed that birth order was related to positive prevalence of the SCL-90 ($p < 0.05$). Firefighters with no siblings had significantly higher prevalence on the SCL-90 scales than those who did have siblings. First or only children were shown to have higher rates of mental health disorders than others. This finding was similar to previous research that found that the degree of psychological distress, impulses, somatization, and suspicion in firefighters without siblings was significantly higher than those with siblings.[37] A Chinese study on 662 military youth soldiers on SAS and SDS tools found that scores of single child are significantly higher than others have siblings.[38] Furthermore, being the only or first child in family often includes a duty to take care of one's parents. They have relatively poor tolerance to setbacks.

Our study found that the dictation rate of depression in the SDS scores was associated with educational level and firefighter rank. A total of 35.5% of participants who had high school diplomas or below was shown to have depressive symptoms. Those with lower levels of education had the highest rates of depression. Conversely, participants with higher levels of education levels had significantly lower rates of depression ($p < 0.01$ or $p < 0.05$). Additionally, those with higher ranks also showed lower rates of depression. This may be primarily due to fewer opportunities for exposure to being on the frontlines of emergencies. A Canadian survey of 8441 active and reserve military personnel found that social anxiety disorder was important when considering military mental health and that being an officer or a reservist decreased the odds of developing this disorder.[39] Thus, there is distinct occupational feature in the mental health of firefighters, as significant differences were shown among firefighters of different ranks or levels of work experience.

First-line firefighters often remain in a state of high stress during emergencies, such as putting out large fires. They may have experienced horrors such as seeing a body burned beyond recognition, as well as faced the risk of death at any time. These factors would presumably have a severe negative impact on mental health, especially for young firefighters. We suggest that psychological training to improve situational awareness and professional adaptability for firefighters is necessary, as are interventions to help them overcome psychological crises or negative emotions. Our findings suggested that mental health issues and symptoms in local firefighters are a situation for concern. Due to differences found based on location, economic situations, sample characteristics, and social circumstances, further studies are warranted to investigate reasons.

Limitations

Several limitations should be considered in the present study, including the sample from a single city and its cross-sectional design. In the future, research should be

conducted in multiple cities to better generalize findings and compare the differences. Although it is noted that three measurements of mental health were used to identify a series of psychological problems, such as DEPR, ANX, SOM, and OCS, more in-depth explorations on risk factors are be needed to properly address. Finally, access to social support for individual firefighters should be also provided.

Conclusion

This study showed that the screened positive rates of SDS, SAS, SCL-90 were 76%, 23%, and 23%, respectively. The scores of five dimensions of the SCL-90 (SOM, OCS, INTS ANX, and PSY) of our participants were significantly higher than the Chinese national firefighter norm, which indicates the local firefighters in the present study are at higher risk for more serious psychological problems. The findings suggested social support and psychological counseling are needed for this special occupational group. By applying three measurements, the present study presented authentic findings from baseline information about firefighters' mental health conditions in a coastal city. The present study suggested that training to improve mental health in career firefighters should be routinely performed. Mental health intervention is needed to help firefighters overcome psychological crises. Further, our findings indicated the need for more attention and support from the local government and the public. Further studies are suggested to explore different risk factors and barriers to mental health care.

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Disclosure

The authors report no conflicts of interest in this work.

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