의학석사 학위논문

Grief reaction, Resilience, Public Service Motivation, and Work Engagement among Firefighters in COVID-19

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이 논문을 의학석사학위 논문으로 제출함

2023년 4월

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ABSTRACT

Introduction

We aimed to explore the influence of resilience, public service motivation, and grief reactions on work engagement of firefighters during the coronavirus disease (COVID-19) pandemic.

Methods

An online survey was conducted with 304 firefighters assigned to Gyeonggi-do between October 27 and 28, 2022. We collected demographic information such as age, sex, marital status, history of psychiatric symptoms, and current symptoms. Additionally, work-related data such as occupation, work shift, years of service, experience of civilian death, and main stressors were collected. Mood, anxiety, insomnia symptoms, and work-related attitudes of the participants were assessed using the Patient Health Questionnaire-9 (PHQ-9), Generalized Anxiety Disorder-7 (GAD-7), Brief Resilience Scale (BRS), Public Service Motivation (PSM) scale, Stress and Anxiety to Viral Epidemics-9 (SAVE-9) scale, Pandemic Grief Scale (PGS), and Utrecht Work Engagement Scale-9 (UWES-9).

Results

The leading causes of stress among firefighters were physical and mental health decline due to a heavy workload (46.4%), verbal abuse and assault from civilians (33.9%), conflict with coworkers (18.4%), and the death of colleagues (13.2%). Results of the logistic regression analysis revealed that resilience, public service motivation, and witnessing death had a major impact on work engagement. In addition, among firefighters who had experienced civilian death on the job, resilience and public service motivation remained key factors affecting work engagement.

Conclusion

Work engagement of firefighters is influenced by resilience, public service motivation, and exposure to death.

Key words: Firefighter, COVID-19, Stress, Anxiety

1. INTRODUCTION

The coronavirus disease (COVID-19) pandemic has been a monumental event that has had multiple impacts on society worldwide. The World Health Organization (WHO) declared COVID-19 a pandemic on January 30, 2020. Since then, more than 600 million people have been infected, resulting in over 6 million deaths worldwide. In Korea alone, over 250 000 people have been infected, and more than 30 000 people have died because of COVID-19.

The COVID-19 pandemic has affected various aspects of our daily lives. Strong containment policies have been implemented worldwide to prevent the spread of the virus, and social distancing has been implemented as quarantine. The service industry, including restaurants, hotels, and other tour-related businesses had a direct impact. Many businesses are closed or downsized, leading to job losses. Cultural and religious events and major sporting events were severely restricted, depriving social interaction and community engagement[1].

In these situations, the pandemic not only caused physical risks to people but also led to a wide range of mental health issues. Isolation, lack of medical support, economic loss, and social isolation have become major stressors that cause widespread emotional distress[2]. People were not only worried about getting infected by the virus, but also about spreading it, which resulted in overall anxiety rising. In a study that included adults who had recovered from COVID-19, 31% reported depression, 42% reported anxiety, and 40% reported insomnia[3]. Another systematic meta-analysis summarized that stress, anxiety, and depression were prevalent in a general population during the COVID-19 pandemic, with rates of 29.6%, 31.9%, and 33.7%, respectively[4].

Impact of COVID-19 on the mental health of firefighters

During the COVID-19 pandemic, many studies examined the difficulties and mental health issues of various occupational groups. Medical staff have been well identified as being most vulnerable to the pandemic, as they report high levels of depression, anxiety, and virus-related anxiety which have impacted their quality of life[5-7]. Similarly, public workers reported work-related stress and anxiety due to increased health and quarantine work related to COVID-19[8, 9]. School teachers and police officers were also among the occupations crucially impacted by the pandemic[10, 11].

Firefighters were among the most affected by the COVID-19 pandemic, as they play a vital role in protecting the public and responding to a wide range of emergencies. They experience a high level of work-related stress compared to other occupational groups and are also at a higher risk of developing psychiatric symptoms such as depression, anxiety, and insomnia[12-15]. However, the pandemic has created even more challenges for firefighters, including increased workload, exposure to the virus, and traumatic events.

To prevent the spread of the virus, firefighters had to make great efforts as they were in charge of transporting suspected COVID-19 patients. Owing to the high risk of contact with COVID-19 patients, they had to wear Level D protective clothing, overshoes, gloves, N95 masks, and goggles. After transportation, disinfection was carried out, and if the transferred patient was confirmed to have COVID-19, firefighters who participated in the transfer were quarantined in their own quarantine facilities. Because isolation facilities and emergency rooms in hospitals have been overloaded during the pandemic, they had to transport patients for longer distances to find available facilities.

As the number of firefighters quarantined or infected has increased, there has also been an increase in cases of repeated overnight shifts or working on holidays. Due to the decrease in the number of available firefighters, burnout has become common, leading to a crisis in firefighting

functions. These challenges may lead to significant mental and emotional stress for firefighters, impacting their well-being and work quality.

Therefore, a few studies have been conducted globally on the mental health of first-line workers including firefighters during the COVID-19 pandemic. A study conducted in the USA in 2020 reported that COVID-19-exposed first-line workers reported higher alcohol use severity, and COVID-19-related worry was significantly associated with post-traumatic stress disorder (PTSD) symptoms[16]. Another study conducted with firefighters reported chronic stress, negative impacts on mental health and relationship issues[17].

Depression among firefighters in COVID-19 and its effect on work engagement

The pandemic has been a large-scale traumatic event, and disruptions to life caused by disasters or epidemics have been associated with an increased burden of mental illness[18]. Depression is a key mental health problem during the COVID-19 pandemic. In a study conducted in the United States, the prevalence of depression symptoms was more than three times higher than before the pandemic[19], and another study found that pandemic distress could be associated with not only depressive symptoms but also the risk of suicide[20].

First-line workers have been particularly affected by the pandemic, and studies have shown that they are vulnerable to developing depressive symptoms. In one study, nurses with depressive symptoms showed a decreased quality of life during the pandemic, suggesting that this could have a negative impact on patient care[21]. Moreover, stress in the work environment leads to depression in health care professionals, and these severe depressive symptoms are associated with poor quality of life[22]. Stress and anxiety in response to the pandemic have been found to lower the quality of life among healthcare workers[5]. As firefighters play an important role in fighting the pandemic and are exposed

to unique challenges, they are vulnerable to depressive symptoms caused by the fear of coworkers' infection, work overload, and social stigma[23].

Depressive symptoms among first-line workers can have serious consequences for their motivation. Burnout due to excessive workloads or decreased quality of life can lead to reduced motivation to continue working, which can negatively affect disaster response[24]. Thus, understanding the relationship between depressive symptoms and motivation is crucial, especially in disaster situations such as the COVID-19 pandemic, where the positive motivation of first-line workers is critical for an effective response.

Work engagement is one theory that has been applied to understand the factors that maintain positive job motivation among firefighters[25]. Work engagement refers to the degree of attachment, passion, and concentration on one's work. It has been shown to affect various areas related to work results such as work efficiency, civic behavior, and customer satisfaction[26]. Moreover, high levels of work engagement have been linked to improved teamwork, which is proportional to team performance[27].

Work engagement is considered an important psychological resource for rescue workers such as firefighters. It has been suggested that work engagement can protect individuals from negative health effects such as depression, sleep disturbances, relational conflicts, burnout, and fatigue[28]. Research has shown that higher levels of work engagement are associated with better mental health outcomes and can serve as a buffer against the negative effects of stress and burnout[26]. Studies have also shown that work engagement can positively impact the overall well-being of workers and improve their ability to cope with job demands[29]. These findings suggest that job engagement can affect firefighter’s job performance.

Several studies have been conducted on the work engagement of first-line workers during the COVID-19 pandemic. In a study with nurses, infection control and frustration were negatively associated with work engagement, whereas mental demand and good performance were positively associated with work engagement[30]. Another study conducted with

healthcare professionals have found that distressed professionals have significantly lower levels of work engagement[31].

Work engagement has been studied extensively in relation to various psychological factors and psychiatric symptoms. Multiple studies have identified resilience as a factor that enhances work engagement and protects against burnout, even lowering workers' intentions to quit[32-34]. Public service motivation (PSM) is also a significant predictor of employee work engagement[35]. Work engagement has had a negative effect on depressive symptoms and a positive effect on life satisfaction[36].

Trauma and grief reactions of firefighters in COVID-19

Additionally, exposure to traumatic events can lead to the development of trauma-related symptoms[37]. Firefighters often experience traumatic events in their jobs, such as the injury or death of colleagues, assaults, suicides, or failed rescues. They were more likely to experience traumatic stress symptoms than those who did not work in the emergency services[38]. Firefighters who were exposed to death or related traumatic events were more likely to suffer from anxiety, insomnia, or depression, which increased the risk of suicide[37, 39]. Moreover, posttraumatic stress can lead to reduced job engagement and quitting among firefighters[40]. The COVID-19 pandemic has further exacerbated the stress associated with death, as firefighters had to manage medical emergencies and transfer patients while mitigating the risk of COVID-19 transmission.

Due to the higher frequency of deaths experienced by firefighters, efforts have been made to develop stress management programs for first-line workers[41, 42]. However, during the COVID-19 pandemic, adequate intervention has been disrupted because of quarantine rules, social isolation, or anxiety regarding transmission. Recent study has found that COVID-19 deaths are responsible for more severe bereavement, which can

lead to prolonged grief[43].As firefighters face a higher number of deaths, and considering COVID-19 related grief reactions, they are expected to be more impacted by death-related psychiatric symptoms than the general population. To measure the severity of these symptoms, measurement tools, such as the Pandemic Grief Scale, have been developed[44].

Role of resilience in reducing work-related stress in firefighters

Because firefighters are frequently exposed to these traumatic situations, many efforts have been made to prevent and protect them from psychological risks. Not all individuals exposed to disaster suffer from PTSD, and even some of them showed the ability to manage and cope with risks well. This protective psychological factor is referred to as resilience. Resilience refers to the ability to adapt and recover from difficult emergency situations, disasters, or stressful environments[45]. Resilience lowers the incidence of psychiatric disorders and prevents PTSD symptoms caused by exposure to trauma[46]. Studies on resilience have been conducted, particularly among firefighters who are exposed to psychological risks. These studies indicate that resilience reduces the prevalence of emotional stress and symptoms in firefighters and acts as a protective factor[47, 48]. Additionally, the assessment and improvement of firefighters' resilience have been explored[49].

The COVID-19 pandemic is a catastrophic situation, and resilience has been identified as a factor in coping with it and influencing psychiatric prevalence. Owing to the risk of exposure to the virus, social isolation, and stress associated with the lockdown, people are experiencing high levels of depression and anxiety[50]. High resilience enables individuals to experience fewer symptoms, less rumination and anxiety, and greater optimism about the future[51]. The importance of resilience in human psychology has increased during the COVID-19 era.

For firefighters exposed to more traumatic experiences during the pandemic, resilience is expected to play an important role in individual competence and psychiatric protection. It is

also important to explore how resilience interacts with other psychological factors, and how it affects the actual capabilities of firefighters to develop methods that support and strengthen their mental and emotional well-being.

Role of PSM in reducing work-related stress in firefighters

PSM is another psychological factor that might affect the mental health and performance of firefighters. PSM is defined as "an individual's predisposition to respond to motives grounded primarily or uniquely in public institutions and organizations," and has been extensively studied in the field of public management since the 1990s[52]. It can be divided into three components: rational, norm-based, and affective motives. Rational motives are driven by individuals' desires to maximize their own benefits and personal interests, which are related to participation in the policy-formation process and the identification of social policy success. On the other hand, norm-based motives refer to the desire to serve the public interest, loyalty to the government, and the enhancement of social equality. Finally, affective motives are rooted in the desire to help others, commitment to a program from genuine conviction about its social importance, and patriotism[52].

PSM is associated with an individual's citizenship behavior, job performance, and job satisfaction[53-57]. Firefighters with high levels of PSM may also be expected to be more motivated to do their best, solve problems, and prioritize public needs. One study showed that firefighters who showed extra-role behavior were related to their PSM as they are committed to the occupation[58].

Considering the critical role of firefighters during the COVID-19 pandemic, it is essential to understand their motivations and job satisfaction. Concerns about infection, adaptation to changing conditions and new safety environments may reduce motivation

and willingness to take risks. Research conducted in Korea during the pandemic has shown that PSM is a mitigating factor for work-related stress among public workers[59]. Therefore, it can be inferred that the motivation and job performance of firefighters may also have been affected during the pandemic; however, this area has not been studied extensively to date.

Purpose of this study

Work engagement plays a key role in the mental health and job satisfaction of firefighters. It serves as a protective factor that prevents burnout and promotes overall well-being and performance. In the context of the COVID-19 pandemic, work engagement has become even more vital for firefighters because a high level of work engagement is required to overcome the risks of the virus and carry out rescue activities. It has been known that depressive states are subsequently related to low work engagement[60]. During the pandemic, firefighters are at a heightened risk of experiencing depression, given the nature of their work.

Nevertheless, there is a lack of research on the mental state of firefighters, compared to other healthcare workers. To our knowledge, no studies have reported on depressive symptoms and work engagement among firefighters during the COVID-19 pandemic. Furthermore, little is known about how psychological factors such as resilience, public service motivation, and grief reactions affect the relationship between depressive symptoms and work engagement among firefighters.

Therefore, this study aimed to investigate the factors that affect work engagement of firefighters during the COVID-19 pandemic. Furthermore, we will also explore whether psychological factors such as grief reactions, resilience, and public service motivation mediate the effect of depression on work engagement. In addition, factors affecting work engagement in the case of firefighters who have been exposed to death during their work will be investigated.

2. MATERIALS AND METOHDS

Participants and Procedure

An anonymous online survey was conducted among firefighters in Gyeonggi-do, South Korea during October 27th to 28th, 2022. A total of 304 firefighters participated in the study voluntarily. The study was approved by the Institutional Review Board (IRB) of the Asan Medical Center.

The survey was conducted using Google Forms and included demographic and clinical information such as age, sex, marital status, past history of psychiatric symptoms, and current symptoms. Additionally, work-related data such as occupation, work shift, years of service, experience of death of a civilian, and main stressors were collected. To evaluate mood, anxiety, insomnia symptoms, and work-related attitudes, the participants completed several scales such as PHQ-9, GAD-7, ISI, BRS, PSM, PGS, COVID-19 related experience, and SAVE-9.

Assessment tools

1) Patient Health Questionnaire-9 (PHQ-9)

We used the Patient Health Questionnaire-9 (PHQ-9) to evaluate depressive symptoms[61]. PHQ-9 is a self-report questionnaire which consists of 9 questions that assess symptoms of anhedonia, depression, insomnia, fatigue, decreased appetite, guilt, decreased concentration, psychomotor retardation, and suicidal/self-harm thoughts. Each question is scored on a scale of 0-3 points. A score of 10 or more on the PHQ-9 indicates significant depressive symptoms, with higher scores indicating more severe symptoms. In this study, we applied the Korean version of the scale[62]. Cronbach's alpha among this sample was 0.911.

2) Utrecht Work Engagement Scale - 9 (UWES-9)

The Utrecht Work Engagement Scale - 9 (UWES-9) is a shortened version of the original Utrecht Work Engagement Scale (UWES) that was developed to measure work engagement[63]. It contains 9 items that measure the same three dimensions of work engagement as the original scale: vigor (energy and persistence when facing work-related tasks), dedication (involvement and enjoyment in work) and absorption (the extent to which one is fully engrossed in their work). The items are rated on a 7-point Likert scale, with 0 indicating "never" and 6 indicating "always." The score from the scale reflects the level of engagement of an individual in the work. In this study, we applied the Korean version of the scale[64]. Cronbach's alpha among this sample was 0.964.

3) Generalized Anxiety Disorder 7 (GAD-7)

Generalized Anxiety Disorder 7 (GAD-7) is a self-report scale used to assess the severity of generalized anxiety disorder symptoms[65]. It consists of 7 questions, each of which is rated on a scale of 0 to 3, with 3 being the maximum score. The total score for the scale ranges from 0 to 21, with a higher score indicating a higher level of anxiety. In this study, we applied the Korean version of the scale[66]. Cronbach's alpha among this sample was 0.927.

4) Insomnia Severity Index (ISI)

Insomnia Severity Index (ISI) is used to evaluate insomnia symptoms[67]. It consists of 7 self-report questions to assess difficulty initiating sleep, difficulty maintaining sleep, early morning awakening, sleep satisfaction, impairment of daily functioning due to sleep problems, and distress caused by insomnia. Each question scored on a 0-4 point Likert scale. A score of 0-7 is considered normal without insomnia, a score of 8-14 is subthreshold insomnia, a score of 15-

21 is considered moderate insomnia and a score of 22-28 is classified as severe insomnia. In this study, we applied the Korean version of the scale[68]. Cronbach's alpha among this sample was 0.892.

5) Stress and Anxiety to Viral Epidemics-9 (SAVE-9)

Stress and Anxiety to Viral Epidemics-9 (SAVE-9) scale is a self-report rating scale that measures the work-related stress and anxiety response of healthcare workers to viral epidemics[69]. The scale consists of 9 items, each rated on a 5-point Likert scale ranging from 0 (never) to 4 (always). A higher total score on the SAVE-9 scale reflects a more severe degree of work-related stress and anxiety response to viral epidemics.

Since the SAVE-9 scale was originally developed to assess work-related stress and viral anxiety of healthcare workers in this COVID-19 pandemic, it needs to be adapted for firefighters. The item 7 of the original scale was "After this experience, do you think you will avoid treating patients with viral illnesses?"[69]. We had adapted the scale for school teachers[70] (Do you think you will avoid teaching children who have had viral illnesses?) and public workers[71] (After this experience, do you think you will avoid dealing with visitors with viral illnesses?) by adapting item 7 for each group. In this study, we changed item 7 for firefighters as " After this experience, do you think you will avoid saving people with viral illnesses?", and explored the reliability and validity of the SAVE-9 scale among this sample. The internal consistency reliability of the SAVE-9 (Cronbach's alpha = 0.880, McDonald's Omega = 0.889) were shown to be good. According to the original SAVE-9 scale[69] we explored the validity of the two-factor model of the firefighter's version of the SAVE-9 scale (factor I - item 1, 2, 3, 4, 5, and 8; factor II - item 6, 7, and 9). Confirmatory factor analysis (CFA) showed good fits for models for two-factor model of the firefighter's version of the SAVE-9 [Comparative Fit Index (CFI) = 0.999, Tucker-Lewis index (TLI) = 0.999, Root Mean Square Error of Approximation (RMSEA) = 0.012, and Standardized Root

Mean squared Residual (SRMR) = 0.047]. Multi-group CFAs with a configural invariant model revealed that firefighters' version of the SAVE-9 could measure viral anxiety in the same way across sex, having depression, or having anxiety. Multigroup CFAs with metric or scalar invariant models also showed similar results.

6) Pandemic Grief Scale (PGS)

The Pandemic Grief Scale (PGS) is a self-report questionnaire used to evaluate dysfunctional grief associated with a COVID-19 death[44]. It consists of 5 items that measure grief-related symptoms such as suicidal ideation and bereavement-related stress. Each item is rated on a scale of 0-3 points, with higher scores indicating more severe dysfunctional grief and potential functional impairment due to a COVID-19 loss. We applied the Korean version of PGS in this study[72]. Cronbach's alpha among this sample was 0.843.

7) Brief Resilience Scale (BRS)

Brief Resilience Scale (BRS) is a rating scale used to measure resilience, which is the ability to quickly recover from difficulties[73]. The scale is made up of 6 questions, and participants rate each question on a scale of 1 to 5. The score is calculated by reverse coding items 2, 4, and 6. A higher score (ranging from 6 to 30) indicates a higher level of resilience. In this study, we applied the Korean version of the scale[74]. Cronbach's alpha among this sample was 0.832.

8) Public Service Motivation (PSM)

The Public Service Motivation (PSM) scale is used to assess an individual's motivation to engage in public service[75]. The original scale contains 24 items, but we used an abridged version of the PSM scale translated into Korean, with 10 items. Each item is rated on a 5-point

Likert scale, ranging from 1 (strong disagreement) to 5 (strong agreement). We applied the Korean version of this scale. Cronbach's alpha among this sample was 0.851.

Statistical analysis

In order to investigate factors related to firefighters' work engagement during the COVID-19 pandemic, participants were divided into two groups based on their UWES-9 scores: the top 25% and the bottom 75%. Demographic and occupational factors, including gender, age, marital status, years of service, exposure to death, type of shift work (none, 3 days shift, 21 days shift), roles (emergency medical service, rescue activity, fire suppression, office work), and COVID-19-related experiences, were compared between the two groups using chi-square test and t-test. Additionally, the upper 25% and lower 75% of UWES-9 scores were compared with each other by SAVE-9, PHQ-9, GAD-7, ISI, BRS, PSM, current psychological distress, and past psychiatric history. Significant viral anxiety response (defined as a SAVE-9 score of 22 points or higher), significant depression (defined as a PHQ-9 score of 10 points or higher), significant anxiety (defined as a GAD-7 score of 10 points or higher), and significant insomnia symptoms (defined as an ISI score of 8 points or higher) were compared too in the same way.

Pearson's correlation analysis was used to analyze the correlation between age and self-report questionnaire results. Next, logistic regression analysis was performed by inserting age, years of service, gender, marital status, type of shift work, past and present psychiatric symptoms, exposure to death, SAVE-9, PHQ-9, GAD-7, ISI, BRS, and PSM.

In part 2, a separate group of firefighters exposed to the death was analyzed in the same way to investigate grief reaction and its effect on work engagement. Pearson's correlation analysis was used to find out whether PGS was correlated with years of service, viral anxiety, depression, anxiety, insomnia, resilience, public service motivation, and work

engagement. In the case of firefighters exposed to death, logistic regression analysis including PGS was performed to identify factors affecting work engagement.

Finally, mediation analysis including BRS and PSM was conducted to identify psychological factors that mediate the relationship between depression and work engagement. Statistical analysis was performed using Jamovi version 2.3.18. Clinical variables were summarized as mean ± standard deviation, and the significance level was set at $p < 0.05$ (two-tailed).

3. RESULTS

Part 1. Factors influencing firefighter's work engagement in COVID-19

Out of the 304 participants, 240 (78.9%) were male, with a mean age of 35.7±8.3 years and mean years of employment of 8.2±8.2 years. Among them, 212 (69.7%) had experienced a client's death. Their shift working were categorized into three types: (1) 3 days shift (192, 63.3%), with 24 hours of work and 48 hours of break, (2) 21 days shift (45, 14.8%), with a one week day-work followed by two weeks of alternate night-work and rest, and (3) none (67, 22.0%) with daytime work only and no break. Their roles included emergency medical service (90, 29.6%), rescue activity (16, 5.3%), office work (63, 20.7%), and fire suppression (135, 44.4%). In terms of COVID-19 experience, 198 (65.1%) had been infected with COVID-19 before, 218 (71.7%) were quarantined, and 298 (98.0%) were vaccinated.

The SAVE-9 total score was 16.4 ± 7.9, with 85 (28.0%) scoring 22 or higher, indicating high viral anxiety. PHQ-9 was 3.7 ± 4.8 with 34 (11.2%) scoring 10 or above. GAD-7 score was 2.2 ± 3.7, with 15 (4.9%) scoring 10 or above. ISI score was 7.6 ± 6.0, with 133 (43.8%) scoring 8 or higher. BRS, PSM and UWES-9 scores were 20.7 ± 4.5, 28.9 ± 6.6 and 26.3 ± 12.0.

Table 1. Demographic and clinical characteristics of subjects

Variable	Subjects (N=304) N(%), Mean ± SD
Sex (male)	240 (78.9%)
Age, years	35.7 ± 8.3
Marital status (single)	142 (46.7%)
Years of service, years	8.2 ± 8.2
Witnessed death	212 (69.7%)
Shift working	
3 days shift	192 (63.2%)
21 days shift	45 (14.8%)
None	67 (22.0%)
Roles	
Emergency Medical Service	90 (29.6%)
Rescue activity	16 (5.3%)
Fire suppression	135 (44.4%)
Office work	63 (20.7%)
COVID-19 related experience	
Infected	198 (65.1%)
Quarantined	218 (71.7%)
Vaccinated	298 (98.0%)

Table 2. Psychiatric symptoms of participants

Variable	Subjects (N=304) N(%), Mean ± SD
Rating scales	
Stress and Anxiety to Viral Epidemics-9	16.4 ± 7.9
SAVE-9 ≥ 22	85 (28.0%)
Patient Health Questionnaire-9	3.7 ± 4.8
PHQ-9 ≥ 10	34 (11.2%)
Generalized Anxiety Disorder-7	2.2 ± 3.7
GAD-7 ≥ 10	15 (4.9%)
Insomnia Severity Index	7.6 ± 6.0
ISI ≥ 8	133 (43.8%)
Brief Resilience Scale	20.7 ± 4.5
Public Service Motivation	28.9 ± 6.6
Utrecht Work Engagement Scale-9	26.3 ± 12.0
Psychiatric history	
Current psychological distress	30 (9.9%)
Past psychiatric history	41 (13.5%)

Among 286 firefighters who reported job-related stress, the primary cause was Physical and mental health decline due to heavy overloads, with 141 individuals (46.4%). Verbal abuse and assault from civilians were the second most common cause, with 103 firefighters (33.9%) reporting this issue. Conflict with coworkers was identified as a cause of stress by 56 individuals (18.4%), while 40 firefighters (13.2%) reported the death of colleagues as a source of stress. Additional comments included irregular sleep patterns due to shift work, difficulty in selecting hospitals, unpredictable dangerous accidents, unnecessary desk work, and low wages.

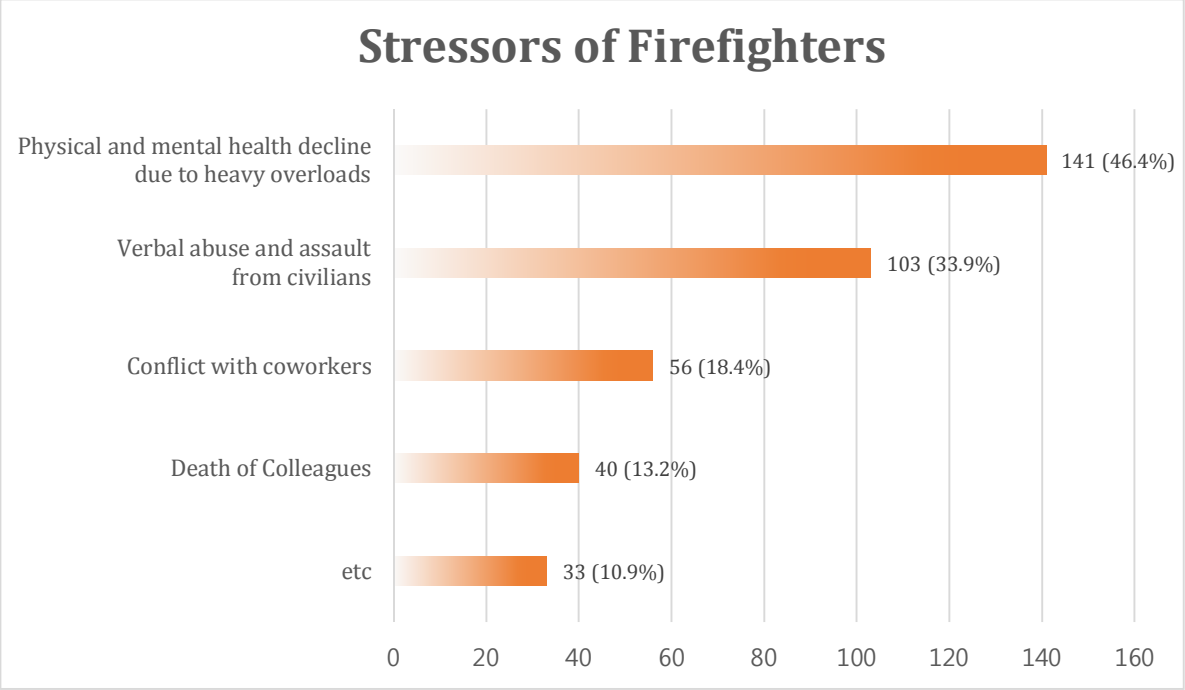

Figure 1. Stressors of Firefighters

Comparing gender, male firefighters were older and had longer service years than female firefighters. There were no significant differences by gender in the case of witnessing death. As for the type of work, males accounted for a higher proportion in the 3-day shift. Women tended to engage in emergency medical service, and men showed a significantly higher rate than women in fire suppression. Female firefighters were infected with COVID-19 or quarantined more than male firefighters.

In terms of psychological factors and psychiatric symptoms, most indicators showed significant differences according to gender. In the case of female firefighters, SAVE-9, PHQ-9, GAD-7, and ISI were higher than male firefighters, and there were more female firefighters answering that they have current psychologic distress. Resilience, public service motivation, and work engagement were higher in males.

Table 3. Demographic and clinical characteristics of subjects (by Sex)

Variable	Male (N=240)	Female (N=64)	P-value
Age, years	36.5 ± 8.7	33.0 ± 5.9	**0.003**
Marital status (single)	134 (55.8%)	28 (43.7%)	0.085
Years of service, years	8.9 ± 8.7	5.8 ± 5.6	**0.007**
Witnessed death	164 (68.3%)	48 (75.0%)	0.302
Shift working			
3 days shift	160 (66.7%)	32 (50.0%)	
21 days shift	32 (13.3%)	13 (20.3%)	**0.049**
None	48 (20.0%)	19 (29.7%)	
Roles			
Emergency Medical Service	47 (19.6%)	43 (67.2%)	
Rescue activity	15 (6.3%)	1 (1.6%)	**<0.001**
Fire suppression	130 (54.2%)	5 (7.8%)	
Office work	48 (20.0%)	15 (23.4%)	
COVID-19 related experience			
Infected	147 (61.3%)	51 (79.7%)	**0.006**
Quarantined	162 (67.5%)	56 (87.5%)	**0.002**
Vaccinated	235 (97.9%)	63 (98.4%)	0.790

Table 4. Psychiatric symptoms of participants (by Sex)

Variable	Male (N=240)	Female (N= 64)	P-value
Rating scales			
Stress and Anxiety to Viral Epidemics-9	15.1 ± 7.7	21.3 ± 6.5	**<0.001**
SAVE-9 ≥ 22	50 (20.8%)	35 (54.7%)	**<0.001**
Patient Health Questionnaire-9	3.2 ± 4.3	5.9 ± 5.7	**<0.001**
PHQ-9 ≥ 10	21 (8.8%)	13 (20.3%)	**0.009**
Generalized Anxiety Disorder-7	1.8 ± 3.3	3.7 ± 4.6	**<0.001**
GAD-7 ≥ 10	9 (3.8%)	6 (9.4%)	0.065
Insomnia Severity Index	7.1 ± 5.8	9.5 ± 6.2	**0.004**
ISI ≥ 8	95 (39.6%)	38 (59.4%)	**0.005**
Brief Resilience Scale	21.3 ± 4.4	18.7 ± 4.1	**<0.001**
Public Service Motivation	29.5 ± 6.5	26.9 ± 6.4	**0.006**
Utrecht Work Engagement Scale-9	27.5 ± 12.2	21.9 ± 10.2	**<0.001**
Psychiatric history			
Current psychological distress	19 (7.9%)	11 (17.2%)	**0.027**
Past psychiatric history	28 (11.7%)	13 (20.3%)	0.072

Married firefighters were older and had longer service years than unmarried firefighters, and singles were more likely to witness death. Married firefighters were more likely to be infected with COVID-19 or quarantined than unmarried firefighters. Single firefighters scored higher on PHQ-9 and ISI. PSM and UWES-9 were higher in married firefighters.

Table 5. Demographic and clinical characteristics of subjects (by Marriage)

Variable	Single (N=142)	Married (N=162)	P-value
Sex (male)	106 (74.6%)	134 (82.7%)	0.085
Age, years	30.6 ± 4.4	40.3 ± 8.3	**<0.001**
Years of service, years	3.5 ± 3.3	12.4 ± 9.0	**<0.001**
Witnessed death	107 (75.4%)	105 (64.8%)	**0.046**
Shift working			
3 days shift	104 (73.2%)	88 (54.3%)	
21 days shift	20 (14.1%)	49 (30.2%)	**<0.001**
None	18 (12.7%)	25 (15.4%)	
Roles			
Emergency Medical Service	44 (31.0%)	46 (28.4%)	
Rescue activity	5 (3.5%)	11 (6.8%)	**0.003**
Fire suppression	75 (52.8%)	60 (30.7%)	
Office work	18 (12.7%)	45 (27.8%)	
COVID-19 related experience			
Infected	83 (58.5%)	115 (71.0%)	**0.022**
Quarantined	92 (64.8%)	126 (77.8%)	**0.012**
Vaccinated	141 (99.3%)	157 (96.9%)	0.136

Table 6. Psychiatric symptoms of participants (by Marriage)

Variable	Single (N=142)	Married (N=162)	P-value
Rating scales			
Stress and Anxiety to Viral Epidemics-9	16.3 ± 7.9	16.6 ± 7.9	0.798
SAVE-9 ≥ 22	37 (26.1%)	48 (29.6%)	0.489
Patient Health Questionnaire-9	4.4 ± 5.3	3.2 ± 4.1	**0.030**
PHQ-9 ≥ 10	19 (13.4%)	15 (9.3%)	0.255
Generalized Anxiety Disorder-7	2.5 ± 4.1	2.0 ± 3.3	0.294
GAD-7 ≥ 10	11 (7.7%)	4 (2.5%)	**0.034**
Insomnia Severity Index	8.5 ± 6.3	3.9 ± 5.6	**0.020**
ISI ≥ 8	74 (52.1%)	59 (36.4%)	**0.006**
Brief Resilience Scale	20.6 ± 4.4	20.8 ± 4.5	0.717
Public Service Motivation	27.8 ± 6.0	29.9 ± 6.9	**0.006**
Utrecht Work Engagement Scale-9	24.6 ± 11.2	27.8 ± 12.4	**0.018**
Psychiatric history			
Current psychological distress	16 (11.3%)	14 (8.6%)	0.444
Past psychiatric history	20 (14.1%)	21 (13.0%)	0.775

In the case of witnessing death, there was no significant difference in gender, and there were many cases of witnessing death in the case of being young, single, and having worked for a short period of time. There were many cases of witnessing death in 3-days shift, and less in case of no shift working. Among the roles, those who worked in the emergency medical service were more likely to witness death. Those who witnessed death had higher SAVE-9 and ISI scores, and more often complained of psychological distress, and lower UWES-9 scores.

Table 7. Demographic and clinical characteristics of subjects (by Exposure to death)

Variable	Witnessed death		P-value
	Yes (N = 212)	No (N = 92)	
Sex (male)	164 (77.4%)	76 (82.6%)	0.302
Age, years	34.6 ± 7.5	38.5 ± 9.3	**<0.001**
Marital status (single)	107 (50.5%)	35 (38.0%)	**0.046**
Years of service, years	7.1 ± 7.3	10.9 ± 9.6	**<0.001**
Shift working			
3 days shift	146 (68.9%)	46 (50.0%)	
21 days shift	36 (17.0%)	9 (9.8%)	**<0.001**
None	30 (14.2%)	37 (40.2%)	
Roles			
Emergency Medical Service	83 (39.2%)	7 (7.6%)	
Rescue activity	12 (5.7%)	4 (4.3%)	**<0.001**
Fire suppression	91 (42.9%)	44 (47.8%)	
Office work	26 (12.3%)	37 (40.2%)	
COVID-19 related experience			
Infected	139 (65.6%)	59 (64.1%)	0.809
Quarantined	152 (71.7%)	66 (71.7%)	0.994
Vaccinated	208 (98.1%)	90 (97.8%)	0.869

Table 8. Psychiatric symptoms of participants (by Exposure to death)

Variable	Witnessed death		P-value
	Yes (N = 212)	No (N= 92)	
Rating scales			
Stress and Anxiety to Viral Epidemics-9	17.4 ± 7.6	14.3 ± 8.1	**0.002**
SAVE-9 ≥ 22	66 (31.1%)	19 (20.7%)	0.061
Patient Health Questionnaire-9	4.1 ± 4.9	3.0 ± 4.2	0.075
PHQ-9 ≥ 10	28 (13.2%)	6 (6.5%)	0.089
Generalized Anxiety Disorder-7	2.3 ± 3.9	2.0 ± 3.2	0.440
GAD-7 ≥ 10	11 (5.2%)	4 (4.3%)	0.756
Insomnia Severity Index	8.3 ± 6.2	6.1 ± 5.3	**0.003**
ISI ≥ 8	104 (49.1%)	29 (31.5%)	**0.005**
Brief Resilience Scale	20.7 ± 4.3	20.9 ± 4.8	0.677
Public Service Motivation	28.9 ± 6.2	29.0 ± 7.3	0.845
Utrecht Work Engagement Scale-9	25.0 ± 11.5	29.3 ± 12.6	**0.004**
Psychiatric history			
Current psychological distress	26 (12.3%)	4 (4.3%)	**0.033**
Past psychiatric history	33 (15.6%)	8 (8.7%)	0.107

Firefighters without shift work tend to be older, more years of service, and higher marriage rates. Firefighters with shift work were more likely to witness civilian death.

For 21-day shift work, genaralized anxiety was higher than no shift work, and resilence was higher in firefighters with shift work.

Table 9. Demographic and clinical characteristics of subjects (by Shift working)

Variable	3 days (N=192)	21 days (N=45)	None (N=67)	P-value	Post-hoc
Sex (male)	160 (83.3%)	32 (71.1%)	48 (71.6%)	0.049	
Age, years	34.7 ± 7.6	35.4 ± 8.2	39.6 ± 9.2	**<0.001**	N > 3, 21
Marital status (single)	104 (54.2%)	20 (44.4%)	18 (26.9%)	**<0.001**	3 > N
Years of service, years	6.8 ± 6.9	7.6 ± 8.6	12.8 ± 9.8	**<0.001**	N > 3, 21
Witnessed death	146 (76.0%)	36 (80.0%)	30 (44.8%)	**<0.001**	3, 21 > N
Roles				**<0.001**	
Emergency Medical Service	56 (29.2%)	29 (64.4%)	5 (7.5%)		
Rescue activity	14 (7.3%)	0 (0.0%)	2 (3.0%)		
Fire suppression	120 (62.5%)	14 (31.1%)	1 (1.5%)		
Office work	2 (1.0%)	2 (4.4%)	59 (88.1%)		
COVID-19 related experience					
Infected	125 (65.1%)	30 (66.7%)	43 (64.2%)	0.964	
Quarantined	136 (70.8%)	33 (73.3%)	49 (73.1%)	0.906	
Vaccinated	188 (97.9%)	45 (100%)	65 (97.0%)	0.529	

3, 3 days shift with 24 hours of work and 48 hours of break; 2, 21 days shift with a one week day-work followed by two weeks of alternate night-work and rest; N, no shift work with daytime work only and no break.

Table 10. Psychiatric symptoms of participants (by Shift working)

Variable	3 days (N=192)	21 days (N=45)	None (N=67)	P-value	Post-hoc
Rating scales					
Stress and Anxiety to Viral Epidemics-9	16.5 ± 7.7	15.4 ± 9.1	16.9 ± 7.6	0.640	
SAVE-9 ≥ 22	53 (27.6%)	12 (26.7%)	20 (29.9%)	0.919	
Patient Health Questionnaire-9	3.9 ± 4.9	2.5 ± 3.9	4.2 ± 4.7	0.082	
PHQ-9 ≥ 10	22 (11.5%)	3 (6.7%)	9 (13.4%)	0.527	
Generalized Anxiety Disorder-7	2.2 ± 3.8	1.3 ± 2.9	3.0 ± 3.9	**0.035**	21 > N
GAD-7 ≥ 10	8 (4.2%)	1 (2.2%)	6 (9.0%)	0.196	
Insomnia Severity Index	8.1 ± 6.1	7.5 ± 6.5	6.5 ± 5.1	0.146	
ISI ≥ 8	88 (45.8%)	22 (48.9%)	23 (34.3%)	0.198	
Brief Resilience Scale	20.9 ± 4.5	22.2 ± 4.7	19.2 ± 3.8	**0.001**	3, 21 > N
Public Service Motivation	28.9 ± 5.7	29.9 ± 7.7	28.2 ± 7.8	0.532	
Utrecht Work Engagement Scale-9	26.3 ± 11.0	29.6 ± 13.2	24.0 ± 13.3	0.098	
Psychiatric history					
Current psychological distress	20 (10.4%)	2 (4.4%)	8 (11.9%)	0.391	
Past psychiatric history	29 (15.1%)	3 (6.7%)	9 (13.4%)	0.329	

3, 3 days shift with 24 hours of work and 48 hours of break; 2, 21 days shift with a one week day-work followed by two weeks of alternate night-work and rest; N, no shift work with daytime work only and no break.

In case of role, fire suppression had the highest male ratio, and EMS had the highest female ratio. In the case of the office, the older, the more married, the longer the service years. Cases of witnessing death were highest in EMS and lowest in Office.

SAVE-9, GAD-7. There were significant differences by occupation in BRS, PSM, and UWES-9. Although there were differences between groups, in general, viral anxiety and generalized anxiety were low, and resilience, PSM, and work engagement were high.

Table 11. Demographic and clinical characteristics of subjects (by Roles)

Variable	EMS (N=90)	Rescue (N=16)	Fire (N=135)	Office (N=63)	P-value	post-hoc
Sex (male)	47 (52.2%)	15 (93.8%)	130 (96.3%)	48 (76.2%)	**<0.001**	F > O > E R > E
Age, years	33.1 ± 4.4	38.8 ± 10.9	35.4 ± 9.1	39.4 ± 8.7	**<0.001**	O > E, F R > E
Marital status (single)	44 (48.9%)	5 (31.2%)	75 (55.6%)	18 (28.6%)	**0.003**	E, F > O
Years of service, years	5.0 ± 3.7	11.3 ± 11.2	8.1 ± 8.7	12.4 ± 9.1	**<0.001**	O > E, F O, R > E
Witnessed death	83 (92.2%)	12 (75.0%)	91 (67.4%)	26 (41.3%)	**<0.001**	E > R, F >O
Shift working					**<0.001**	
3 days shift	56 (62.2%)	14 (87.5%)	120 (88.9%)	2 (3.2%)		
21 days shift	29 (32.2%)	0 (0.0%)	14 (10.4%)	2 (3.2%)		
None	5 (5.6%)	2 (12.5%)	1 (0.7%)	59 (93.7%)		
COVID-19 related experience						
Infected	66 (73.3%)	10 (62.5%)	84 (62.2%)	38 (60.3%)	0.277	
Quarantined	71 (78.9%)	11 (68.8%)	93 (68.9%)	43 (68.3%)	0.354	
Vaccinated	89 (98.9%)	16 (100%)	132 (97.8%)	61 (96.8%)	0.758	

Table 12. Psychiatric symptoms of participants (by Roles)

Variable	EMS (N=90)	Rescue (N=16)	Fire (N=135)	Office (N=63)	P-value	Post-hoc
Rating scales						
Stress and Anxiety to Viral Epidemics-9	18.8 ± 8.1	18.2 ± 7.0	14.8 ± 7.5	16.3 ± 7.8	**0.003**	R > F
SAVE-9 ≥ 22	38 (42.2%)	6 (37.5%)	24 (17.8%)	17 (27.0%)	**<0.001**	E > F
Patient Health Questionnaire-9	4.3 ± 5.1	4.6 ± 7.7	3.0 ± 3.9	4.3 ± 4.8	0.100	
PHQ-9 ≥ 10	12 (13.3%)	2 (12.5%)	11 (8.1%)	9 (14.3%)	0.511	
Generalized Anxiety Disorder-7	2.4 ± 3.8	3.5 ± 6.3	1.5 ± 2.7	3.1 ± 4.4	**0.020**	O > F
GAD-7 ≥ 10	4 (4.4%)	2 (12.5%)	3 (2.2%)	6 (9.5%)	0.074	
Insomnia Severity Index	9.0 ± 6.3	8.3 ± 7.4	7.2 ± 5.6	6.6 ± 5.7	0.075	
ISI ≥ 8	52 (57.8%)	6 (37.5%)	55 (40.7%)	20 (31.7%)	**0.009**	E > F, O
Brief Resilience Scale	20.5 ± 4.2	20.8 ± 6.4	21.4 ± 4.5	19.6 ± 4.0	**0.040**	F > O
Public Service Motivation	27.7 ± 5.8	26.7 ± 7.8	30.5 ± 6.0	27.9 ± 7.8	**0.004**	F > E, O
Utrecht Work Engagement Scale-9	22.8 ± 10.2	32.7 ± 15.2	28.9 ± 11.5	24.2 ± 12.7	**<0.001**	F, R > E, O
Psychiatric history						
Current psychological distress	11 (12.2%)	3 (18.8%)	9 (6.7%)	7 (11.1%)	0.302	
Past psychiatric history	15 (16.7%)	3 (18.8%)	17 (12.6%)	6 (9.5%)	0.552	

When dividing the participants into top 25% and bottom 75% work engagement scale (UWES-9) groups, significant differences were found in sex ($p=0.004$), age ($p=0.012$), marital status ($p=0.007$), years of employment ($p=0.01$), and work roles ($p<0.001$). The bottom 75% group reported significantly higher scores in SAVE-9 ($p=0.006$), PHQ-9 ($p<0.001$), GAD-7 ($p<0.001$), and ISI ($p<0.001$), and lower scores in BRS ($p<0.001$) and PSM ($p<0.001$) compared to the top 25% group.

Table 13. Demographic and clinical characteristics of subjects (by Work engagement)

Variable	High WE (N=75)	Low WE (N=229)	P-value
Sex (male)	68 (79.7%)	172 (75.1%)	**0.003**
Age, years	38.1 ± 9.9	34.9 ± 7.6	**0.012**
Marital status (married)	50 (66.7%)	112 (48.9%)	**0.008**
Years of service, years	10.8 ± 10.3	7.4 ± 7.3	**0.010**
Witnessed death	40 (53.3%)	172 (75.1%)	**< 0.001**
Shift working			
3 days shift	46 (61.3%)	146 (63.8%)	
21 days shift	15 (20.0%)	30 (13.1%)	0.304
None	13 (18.7%)	53 (23.1%)	
Roles			
Emergency Medical Service	10 (13.3%)	80 (34.9%)	
Rescue activity	10 (13.3%)	6 (2.6%)	**< 0.001**
Fire suppression	42 (56.0%)	93 (40.6%)	
Office work	13 (17.3%)	50 (21.8%)	
COVID-19 related experience			
Infected	46 (61.3%)	152 (66.4%)	0.426
Quarantined	51 (68.0%)	167 (72.9%)	0.411
Vaccinated	73 (97.3%)	225 (98.3%)	0.619

Table 14. Psychiatric symptoms of participants (by Work engagement)

Variable	High WE (N=75)	Low WE (N=229)	P-value
Rating scales			
Stress and Anxiety to Viral Epidemics-9	14.0 ± 9.0	17.2 ± 7.3	**0.006**
SAVE-9 ≥ 22	18 (24.0%)	67 (29.3%)	0.379
Patient Health Questionnaire-9	1.3 ± 1.9	4.5 ± 5.1	**< 0.001**
PHQ-9 ≥ 10	0 (0.0%)	34 (14.8%)	**< 0.001**
Generalized Anxiety Disorder-7	0.8 ± 1.7	2.7 ± 4.0	**< 0.001**
GAD-7 ≥ 10	0 (0.0%)	15 (6.6%)	**0.023**
Insomnia Severity Index	5.0 ± 4.4	8.5 ± 6.2	**< 0.001**
ISI ≥ 8	17 (22.7%)	116 (50.7%)	**< 0.001**
Brief Resilience Scale	24.1 ± 4.6	19.6 ± 3.8	**< 0.001**
Public Service Motivation	32.6 ± 6.8	27.7 ± 6.0	**< 0.001**
Psychiatric history			
Current psychological distress	1 (1.3%)	29 (12.7%)	**0.004**
Past psychiatric history	3 (4.0%)	38 (16.6%)	**0.006**

Work engagement was found to be significantly associated with low depression levels, high resilience, and public service motivation through Spearman's correlation analysis. Work engagement was also weakly associated with old age, long years of employment, low levels of viral anxiety, anxiety, and insomnia, which needs to be interpreted with caution. Public service mindedness was significantly associated with older age, long years of employment, low depression, anxiety, and insomnia levels, and high resilience, with a weak degree of association. Resilience was associated with low levels of depression, anxiety, and insomnia.

Table 15. Correlation coefficients of each variables in all participants

Variables	Age	Year of employment	SAVE-9	PHQ-9	GAD-7	ISI	BRS	PSM
Year of employment	0.93**							
SAVE-9 total score	-0.03	-0.02						
PHQ-9 total score	-0.07	-0.06	0.35**					
GAD-7 total score	-0.03	-0.04	0.30**	0.81**				
ISI total score	0.06	-0.07	042**	0.66**	0.60**			
BRS total score	0.07	0.06	-0.36**	-0.51**	-0.51**	-0.41**		
PSM total score	0.17**	0.20**	0.001	-0.25**	-0.17**	-0.14*	0.22**	
UWES-9 total score	0.14*	0.14*	-0.15**	-0.46**	-0.32**	-0.27**	0.50**	0.54**

SAVE-9, Stress and Anxiety to Viral Epidemics-9 items; PHQ-9, Patients Health Questionnaire-9 items; GAD-7, Generalized Anxiety Disorder-7; ISI, Insomnia Severity Index; BRS, Brief Resilience Scale; PSM, Public Service Motivation; UWES-9, Utrecht Work Engagement Scale-9

* $p < 0.05$, ** $p < 0.01$

The logistic regression analysis showed that high work engagement among firefighters was expected with high levels of resilience (β=, $p<0.001$) and service motivation (β=, $p<0.001$), and without witnessing death ($p=0.005$).

Table 16. Logistic regression to explore predicting factors for work engagement

Predictor	B	S.E.	P-value	Exp(B)	95% CI	
					Lower	Upper
Age	-0.02	0.06	0.799	0.985	0.874	1.110
Year of employment	0.01	0.06	0.925	1.01	0.895	1.130
Sex (male)	0.45	0.65	0.493	1.560	0.437	5.569
Marital status (single)	-0.62	0.48	0.196	0.540	0.212	1.374
Roles						
EMS vs. office work	-1.09	1.38	0.428	0.335	0.023	5.001
Rescue vs. office work	2.86	1.37	**0.037**	17.366	1.182	255.135
Fire vs. office work	0.29	1.34	0.827	1.339	0.097	18.429
Shift working						
3 days vs. none	-1.06	1.37	0.441	0.348	0.024	5.099
21 days vs. none	-0.98	0.58	0.090	0.376	0.122	1.166
Past psychiatric history	-0.21	0.86	0.808	0.812	0.152	4.350
Current psychological distress	-0.90	1.48	0.542	0.406	0.022	7.346
Witnessed death	-1.12	0.40	**0.005**	0.327	0.149	0.717
Rating scales						
SAVE-9	0.02	0.03	0.593	1.015	0.961	1.072
PHQ-9	-0.14	0.11	0.193	0.872	0.710	1.071
GAD-7	0.01	0.13	0.929	1.012	0.783	1.308
ISI	-0.01	0.05	0.865	0.992	0.904	1.089
BRS	0.25	0.05	**< 0.001**	1.281	1.161	1.412
PSM	0.16	0.04	**< 0.001**	1.173	1.084	1.269

EMS, Emergency Medical Service; SAVE-9, Stress and Anxiety to Viral Epidemics-9 items; PHQ-9, Patients Health Questionnaire-9 items; GAD-7, Generalized Anxiety Disorder-7; ISI, Insomnia Severity Index; BRS, Brief Resilience Scale; PSM, Public Service Motivation

Part 2. Exposure to civilian death

Out of the 304 participants, 212 firefighters (70%) have experienced clients' death. Of those, 164 (77.4%) were male, the mean age was 34.6±7.5 years old, and mean years of employment was 7.1±7.3 years. 83 (39.2%) were in emergency medical service, 12 (5.7%) were in rescue activity, 26 (12.3%) were in office work, and 91 (42.9%) worked for fire suppression. 33 (15.6%) reported a history of depression, anxiety, or insomnia, and 26 (12.3%) reported current symptoms.

Table 17. Demographic and clinical characteristics of subjects (witnessed death)

Variable	Subjects (N=212) N(%), Mean ± SD
Sex (male)	164 (77.4%)
Age (years)	34.6 ± 7.5
Marital status, married	105 (49.5%)
Years of service (years)	7.1 ± 7.3
Shift working	
3 days shift	146 (68.9%)
21 days shift	36 (17.0%)
None	30 (14.2%)
Roles	
Emergency Medical Service	83 (39.2%)
Rescue activity	12 (5.7%)
Fire suppression	91 (42.9%)
Office work	26 (12.3%)
COVID-19 related experience	
Infected	139 (65.6%)
Quarantined	152 (71.7%)
Vaccinated	208 (98.1%)

Table 18. Psychiatric symptoms of participants (witnessed death)

Variable	Subjects (N=212) N(%), Mean ± SD
Rating scales	
Stress and Anxiety to Viral EPidemics-9	17.4 ± 7.6
SAVE-9 ≥ 22	66 (31.1%)
Patient Health Questionnaire-9	4.1 ± 4.9
PHQ-9 ≥ 10	28 (13.2%)
Generalized Anxiety Disorder-7	2.3 ± 3.9
GAD-7 ≥ 10	11 (5.2%)
Insomnia Severity Index	8.3 ± 6.2
ISI ≥ 8	104 (49.1%)
Brief Resilience Scale	20.7 ± 4.3
Public Service Motivation	28.9 ± 6.2
Utrecht Work Engagement Scale-9	25.0 ± 11.5
Pandemic Grief Scale	1.2 ± 2.3
Psychiatric history	
Current psychological distress	26 (12.3%)
Past psychiatric history	33 (15.6%)

Major stressors for these firefighters were physical and mental health deterioration due to overwork (120, 56.6%), Verbal abuse and assault from civilians (84, 39.6%), conflict with colleagues (37, 17.5%), and colleagues' deaths (30, 14.2%).

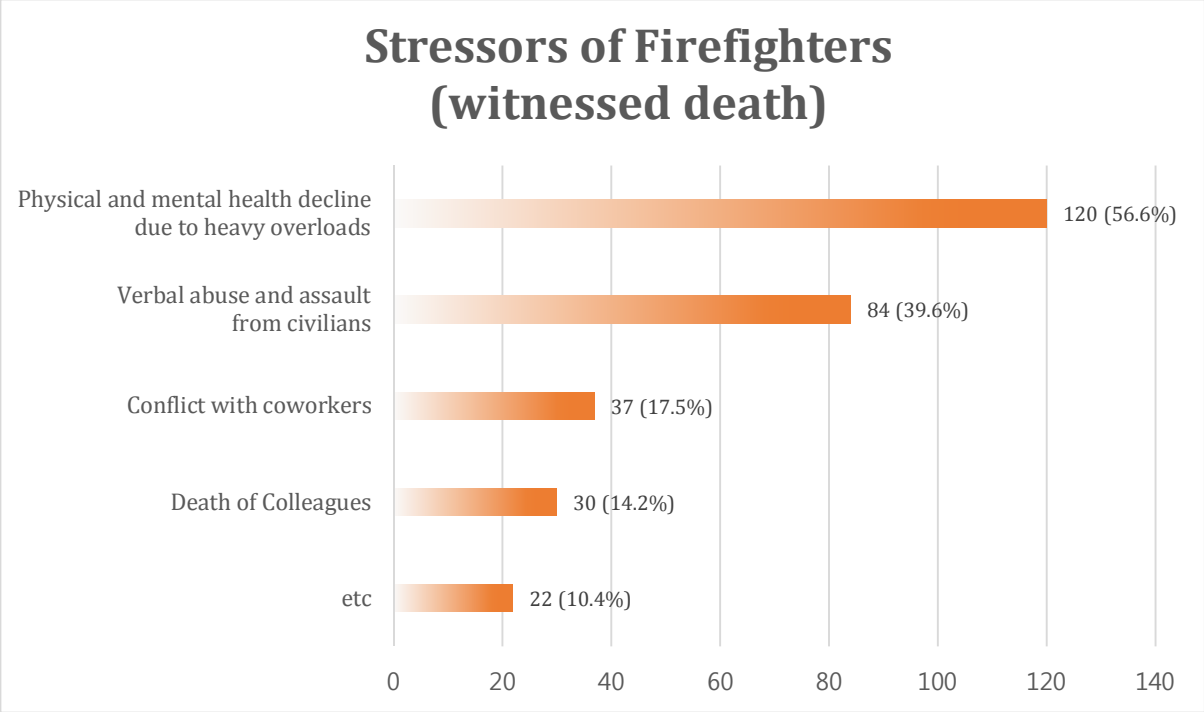

Figure 2. Stressors of Firefighters (witnessed death)

When participants were grouped based on their degree of work engagement (UWES-9) into top 25% and bottom 75% groups (Table 6), there were significant differences in sex ($p=0.003$), age ($p=0.03$), years of employment ($p=0.027$), and work roles ($p<0.001$). Compared to the top 25% group, the bottom 75% group reported significantly higher scores of PHQ-9 ($p<0.001$), GAD-7 ($p<0.001$), and ISI ($p<0.001$), and lower scores of BRS ($p<0.001$) and PSM ($p<0.001$). There were no significant differences in PGS between the two groups.

Table 19. Demographic and clinical characteristics of subjects (witnessed death)

Variable	High WE (N=40)	Low WE (N=172)	P-value
Sex (male)	38 (95.0%)	126 (73.3%)	**0.003**
Age (years)	37.5 ± 9.7	33.9 ± 6.8	**0.030**
Marital status, married	25 (62.5%)	80 (46.5%)	0.068
Years of service (years)	10.2 ± 10.1	6.4 ± 6.3	**0.027**
Shift working			
3 days shift	29 (72.5%)	117 (68.0%)	
21 days shift	6 (15.0%)	30 (17.4%)	0.859
None	5 (12.5%)	25 (14.5%)	
Roles			
Emergency Medical Service	8 (20.0%)	75 (43.6%)	
Rescue activity	7 (17.5%)	5 (2.9%)	
			< 0.001
Fire suppression	4 (10.0%)	22 (12.8%)	
Office work	21 (52.5%)	70 (40.7%)	
COVID-19 related experience			
Infected	23 (57.5%)	116 (67.4%)	0.233
Quarantined	26 (65.0%)	126 (73.3%)	0.296
Vaccinated	38 (95.0%)	170 (98.8%)	0.108

Table 20. Psychiatric symptoms of participants (witnessed death)

Variable	High WE (N=40)	Low WE (N=172)	P-value
Rating scales			
Stress and Anxiety to Viral EPidemics-9	15.3 ± 8.9	17.9 ± 7.3	0.091
SAVE-9 ≥ 22	11 (27.5%)	55 (32.0%)	0.582
Patient Health Questionnaire-9	1.3 ± 2.2	4.7 ± 5.2	**<0.001**
PHQ-9 ≥ 10	0 (0.0%)	28 (16.3%)	**0.006**
Generalized Anxiety Disorder-7	0.8 ± 1.9	2.7 ± 4.2	**<0.001**
GAD-7 ≥ 10	0 (0.0%)	11 (6.4%)	0.100
Insomnia Severity Index	5.5 ± 4.6	9.0 ± 6.3	**<0.001**
ISI ≥ 8	10 (25.0%)	94 (54.7%)	**<0.001**
Brief Resilience Scale	24.6 ± 4.4	19.8 ± 3.8	**<0.001**
Public Service Motivation	33.6 ± 5.1	27.8 ± 6.0	**<0.001**
Pandemic Grief Scale	0.8 ± 2.0	1.3 ± 2.3	0.147
Psychiatric history			
Current psychological distress	1 (2.5%)	25 (14.5%)	**0.037**
Past psychiatric history	2 (5.0%)	31 (18.0%)	**0.041**

Spearman's correlation analysis (Table 7) showed that grief was significantly associated with high levels of depression, anxiety, and insomnia. Grief reaction was also weakly associated with high levels of viral anxiety and low levels of resilience, public service mindedness, and work engagement, which should be interpreted with caution.

Table 21. Correlation coefficients of each variables in participants (witnessed death)

Variables	Age	Year of employment	SAVE-9	PHQ-9	GAD-7	ISI	BRS	PSM	PGS
Year of employment	0.77**								
SAVE-9 total score	0.01	0.07							
PHQ-9 total score	-0.09	-0.03	0.47**						
GAD-7 total score	-0.02	0.05	0.42**	0.76**					
ISI total score	-0.04	0.01	0.43**	0.60**	0.60**				
BRS total score	-0.01	-0.10	-0.30**	-0.45**	-0.47**	-0.42**			
PSM total score	0.05	0.07	0.01	-0.17*	-0.08	-0.09	0.15*		
PGS total score	-0.002	0.03	0.42**	0.46**	0.43**	0.47**	-0.29**	-0.01	
UWES-9 total score	-0.01	-0.10	-0.18*	-0.43**	-0.33**	-0.24**	0.47**	0.53**	-0.18**

SAVE-9, Stress and Anxiety to Viral Epidemics-9 items; PHQ-9, Patients Health Questionnaire-9 items; GAD-7, Generalized Anxiety Disorder-7; ISI, Insomnia Severity Index; BRS, Brief Resilience Scale; PSM, Public Service Motivation; PGS, Pandemic Grief Scale; UWES-9, Utrecht Work Engagement Scale-9;
* $p < 0.05$, ** $p < 0.01$

The logistic regression analysis revealed that high levels of work engagement in firefighters were expected by high levels of resilience (β=, p< 0.001) and public service motivation (β=, p< 0.001), which is consistent with the findings from the total firefighter group. However, pandemic grief reactions did not have an effect on work engagement in the group that experienced clients' death.

Table 22. Logistic regression among participants (witnessed death)

Predictor	B	S.E.	P-value	Exp(B)	95% CI	
					Lower	Upper
Age	0.03	0.09	0.759	1.028	0.860	1.229
Year of employment	0.03	0.09	0.739	1.030	0.866	1.225
Sex (male)	-1.51	1.21	0.213	0.222	0.021	2.376
Marital status (single)	-0.25	0.70	0.723	0.779	0.196	3.098
Roles						
EMS vs. office work	0.89	2.30	0.700	2.433	0.027	222.321
Rescue vs. office work	4.46	2.39	0.062	86.846	0.799	94412.0
Fire vs. office work	1.52	2.27	0.504	4.549	0.053	387.657
Shift working						
3 days vs. none	1.37	2.26	0.546	3.942	0.047	330.412
21 days vs. none	0.05	0.87	0.957	1.047	0.192	5.728
Past psychiatric history	-0.58	1.18	0.622	0.560	0.056	5.601
Current psychological distress	-2.16	2.42	0.371	0.115	0.001	13.121
Rating scales						
SAVE-9	0.02	0.04	0.717	1.016	0.932	1.108
PHQ-9	-0.26	0.18	0.151	0.774	0.545	1.098
GAD-7	-0.06	0.22	0.779	0.940	0.613	1.444
ISI	0.01	0.07	0.897	1.010	0.874	1.166
BRS	0.28	0.07	**< 0.001**	1.322	1.146	1.526
PSM	0.24	0.07	**< 0.001**	1.276	1.124	1.448
PGS	0.16	0.20	0.408	1.177	0.801	1.730

EMS, Emergency Medical Service; SAVE-9, Stress and Anxiety to Viral Epidemics-9 items; PHQ-9, Patients Health Questionnaire-9 items; GAD-7, Generalized Anxiety Disorder-7; ISI, Insomnia Severity Index; BRS, Brief Resilience Scale; PSM, Public Service Motivation; PGS, Pandemic Grief Scale

Part 3. Mediation model

Based on the mediation analysis, it was found that the entire pathway, starting from depression of firefighters (independent variable), passing through their resilience and PSM (mediator), to work engagement (dependent variable) was significant ($Z=-6.63$, $p<0.001$). This result indicates that the impact of depression on work engagement is partially mediated by firefighters' resilience and PSM (see Figure 2).

Table 23. The results of mediation analysis

Effect	Standardized Estimator	S.E.	Z-value	p	95% CI
Direct effect:					
PHQ-9 → UWES-9	-0.20	0.05	-3.99	< 0.001	-0.29 to -0.10
Indirect effect:					
PHQ-9 → BRS → UWES-9	-0.15	0.03	-5.32	< 0.001	-0.21 to -0.10
PHQ-9 → PSM → UWES-9	-0.11	0.03	-4.07	< 0.001	-0.16 to -0.06
Total indirect effect:					
PHQ-9 → UWES-9	-0.26	0.04	-6.63	< 0.001	-0.34 to -0.18
Path coefficients:					
PHQ-9 → BRS	-0.51	0.05	-10.18	< 0.001	-0.60 to -0.41
BRS → UWES-9	0.30	0.05	6.23	< 0.001	0.21 to 0.40
PHQ-9 → PSM	-0.25	0.06	-4.47	< 0.001	-0.35 to -0.14
PSM → UWES-9	0.43	0.04	9.86	< 0.001	0.34 to 0.51
Total effect:					
PHQ-9 → UWES-9	-0.46	0.13	-8.90	< 0.001	-1.40 to -0.90

PHQ-9, Patient Health Questionnaire-9 items; UWES-9, Utrecht Work Engagement Scale - 9; BRS, Brief Resilience Scale; PSM, Public Service Motivation

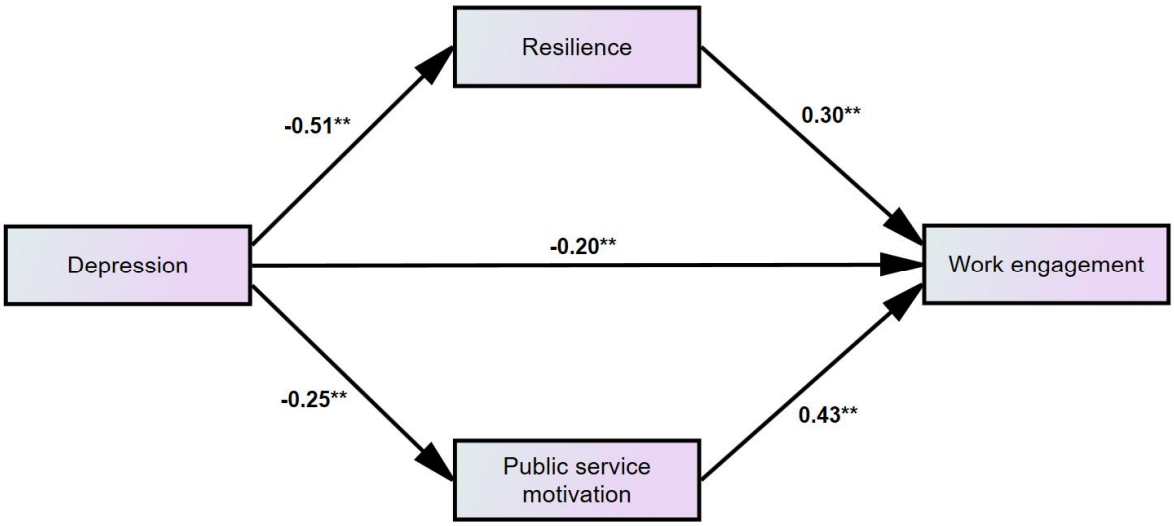

Figure3. Mediation model showing that the effect of depression on work engagement is mediated by resilience and public service motivation

4. DISCUSSION

This study investigated the work immersion of firefighters during the COVID-19 pandemic and determined how resilience, PSM, and grief reactions affected work engagement. According to the results of logistic regression analysis, high levels of resilience and PSM are important predictors of work engagement. This finding is consistent with a previous study on public workers, indicating that resilience and PSM affected work engagement during the COVID-19 pandemic[59]. Because work engagement is closely linked to work ability[29], it can be inferred that highly engaged firefighters are more likely to take risks and protect civilians. Considering these points, firefighters with high resilience and PSM are more likely to participate in their work despite the risk of virus exposure or fear of disease transmission. These findings suggest that not only infrastructure and government policies but also the psychological dispositions of the firefighters on the frontlines are important factors in coping with a pandemic crisis such as COVID-19.

Interestingly, resilience and PSM were found to partially and negatively mediate the effects of depressive symptoms on work engagement. The COVID-19 pandemic has brought about significant mental health issues in the form of depressive symptoms, with first-line workers experiencing exhaustion owing to their excessive pandemic-response-related workload, which can lead to depressive symptoms. The study found that the biggest stress factor for firefighters was “physical and mental health decline due to heavy workload (46.4%).” Excessive workload can lead to depressive symptoms, especially for first-line workers such as firefighters, because these symptoms can reduce their work performance and impact their professional response during a pandemic. Therefore, the results of this study suggest that resilience and PSM can play a protective role in mitigating the negative effects of depressive symptoms on work engagement. However, Figure 1 shows the proportion of responses to questions on stressor, not the severity of the stressor. For

example, though the proportion of responses as “death of colleagues” was low, but it does that means the stressor is not severe. Interpretation needs to be done with caution.

Exposure to death and grief reaction

Another notable finding of this study was that exposure to death can decrease work engagement of firefighters. This is a salient finding, considering that majority of firefighters reported being exposed to civilian deaths. Witnessing a death can lead to psychological distress, and firefighters are frequently exposed to death because of the nature of their work. Exposure to death during the COVID-19 pandemic may impact firefighter mental health, and subsequently reduce their work engagement. This emphasizes the need for interventions to help firefighters cope with distress related to death exposure, thus preventing a decrease in work engagement.

The results of this study did not show a significant effect of PGS on work engagement, which was contrary to the expectation with the study design. As an indicator of dysfunctional grief related to death experienced during the pandemic, PGS was found to be significantly correlated with viral anxiety, depression, generalized anxiety, and insomnia symptoms in the correlation analysis of this study. It also showed a negative correlation with work engagement; however, the correlation coefficient was minimal. Previous studies on PGS have mostly investigated reactions related to the death of loved ones, which were found to be associated with higher levels of grief, social isolation, and loneliness[77, 78]. However, firefighters are exposed primarily to civilian deaths, who are not intimately close enough to cause a grief reaction in firefighters. In this context, grief reactions may not directly cause decreased work engagement. However, given the significant impact of exposure to death on the psychological well-being of firefighters, it is likely that it affects their work engagement through different pathways, such as post-traumatic distress. Firefighters who face the deaths of civilians are highly likely to experience trauma, particularly when they vividly witness gruesome scenes, including serious injury or death, instead of feeling sorrow or grief for a stranger. The more they

are exposed to such situations, the more they experience negative emotions, such as recurring flashbacks and excessive arousal symptoms. These symptoms of PTSD may lead to a decrease in firefighter work engagement. It is well known that firefighters have a high PTSD incidence, which can contribute to their burnout [79, 80]. Further research is necessary to explore the trauma experienced by firefighters and the impact of exposure to death on work engagement, particularly during the pandemic.

Viral anxiety and firefighter work engagement in the pandemic era

In this study, logistic regression analysis did not identify the SAVE-9 scale as a factor influencing work engagement. At the time of the investigation, most firefighters had been vaccinated and just recovered from a period of excessive anxiety that started in the early days of the COVID-19 pandemic. Nevertheless, previous studies have shown that viral anxiety can affect quality of life and induce depression[6], which could lead to changes in work engagement. Moreover, in this study, viral anxiety was significantly correlated with depression, generalized anxiety, insomnia, and PGS. Therefore, it is still possible that viral anxiety is a factor that affects firefighter mental health, including their work-related motivation.

Currently, global lockdowns and quarantine measures are being lifted in many parts of the world owing to decreasing COVID-19 cases and increasing vaccination rates. However, it is important to note that another pandemic can occur at any time. Similar studies on mental health and well-being were conducted during the SARS epidemic, with individuals experiencing distress similar to that during COVID-19[81]. As these crises continue to recur, it is crucial to prepare for potential threats based on these experiences and studies.

Firefighters play an important role during these crises. Considering the extreme situations they face, it is essential to maintain their work engagement and motivation to ensure public safety. Therefore, it is necessary to conduct a detailed study on psychological factors, such as trauma, depression, resilience, and PSM, which can affect firefighter work commitment and motivation. Based on the results of this study, interventions could be developed to support the mental health of firefighters. Future research should explore other psychological factors that affect work engagement and identify strategies to promote mental health and well-being among firefighters.

Limitations

This study has several limitations. First, data collection for this study was conducted in August 2022, 30 months after the initial outbreak of the COVID-19 pandemic. In Korea, most firefighters were vaccinated and social lockdown and quarantine for confirmed cases were lifted in April 2022. As a result, the level of anxiety and distress about the virus among the firefighters may have been lower than that at the peak of the pandemic. This may have influenced some measures used in this study, such as viral anxiety. Second, this study relied on self-reported data collected through an anonymous web-based survey. This may have led to response and selection bias. Third, the study targeted firefighters only in Gyeonggi-do, Korea, which may limit the generalizability of the findings. Although Gyeonggi-do is a representative region with a large population in South Korea, the level of pandemic-related distress may be different in other regions, particularly in densely populated urban environments like Seoul or in low-populated areas. Therefore, caution is needed when generalizing these findings to other regions or countries. Fourth, detailed information on cases of firefighters witnessing death was not collected. This may include time elapsed since the death was experienced, the directness of exposure to the subject of death, the cause of death, or the relationship with the deceased. In the same context, the impact of death on work engagement, specifically through post-traumatic

distress, was not thoroughly examined in this study. Although grief reactions were not found to be significant predictors of work engagement, a more detailed investigation of the mental health effects of exposure to civilian death on firefighters could have been achieved by including measures of PTSD symptom severity in the questionnaire. Future research should include more detailed information to better understand the grief reactions and traumatic aspects of the firefighter experience.

5. CONCLUSION

In conclusion, we observed that work engagement of firefighters is affected by resilience, PSM, and exposure to death. Work engagement was increased with high levels of resilience and PSM, whereas exposure to civilian deaths decreased their work engagement. Furthermore, resilience and PSM played protective roles in mitigating the negative effects of depression on work engagement among firefighters, as they partially mediated the relationship.

This study sheds light on the factors that may help prevent a decrease in work engagement among firefighters during crisis situations. Based on these findings, interventions increasing resilience or providing personalized support to those with low PSM may be effective in improving their job performance. We hope that this study will pave the way for targeted interventions that can help enhance firefighter work engagement and job satisfaction, maintain their mental health, and enable them to respond more effectively to crises such as COVID-19.

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국문 요약

서론

본 연구는 COVID-19 대유행 상황에서 소방관의 업무 몰입에 영향을 주는 요인들을 탐색하고자 하였으며, 특히 회복탄력성, 공직봉사동기 및 애도 반응이 얼마나 영향을 미치는지를 목표로 하였다.

연구대상 및 방법

2022 년 10 월 27 일부터 28 일까지 경기도 소방관 304 명을 대상으로 익명의 온라인 설문조사를 진행했다. 연령, 성별, 결혼 여부, 정신과적 증상 과거력, 현재 증상 등 인구통계학적 정보를 수집하였으며, 또한 직업, 근무교대, 근속연수, 민간인 사망경험, 주요 스트레스 요인 등 업무 관련 데이터를 수집하였다. 기분, 불안, 불면증 증상 및 업무 관련 태도를 평가하기 위해 Patient's Health Questionnaire-9, Generalized Anxiety Disorder 7, Brief Resilience Scale, Public Service Motivation scale, Stress and Anxiety to Viral Epidemics-9, Pandemic Grief Scale, and Utrecht Work Engagement Scale - 9 항목들을 평가하였다.

결과

소방관 스트레스의 주요 원인은 과중한 업무로 인한 신체적·정신적 건강 저하(46.4%), 민간인의 폭언·폭행(33.9%), 동료와의 갈등(18.4%), 동료의 사망(13.2%) 순이었다. 로지스틱

회귀 분석 결과, 회복탄력성, 공직봉사동기 및 민원인의 죽음을 목격한 경우가 소방관의 업무 몰입을 예측하는 요인으로 확인되었다. 또한 업무 중 민원인의 사망을 경험한 소방관들 사이에서도 회복력과 공직봉사동기가 업무 몰입에 영향을 미치는 주요 요인으로 확인되었다.

결론

소방관의 업무 몰입은 회복탄력성, 공직봉사동기 및 민원인의 죽음을 목격한 경우에 의해 영향을 받는다.

중심단어: 소방관, 코로나 19, 스트레스, 불안