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BASIC RESEARCH ARTICLE



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TRAUMATOLOGY

Latent profile analysis of post-traumatic stress and post-traumatic growth among firefighters

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ABSTRACT

Background: Due to the job characteristics, firefighters are repeatedly exposed to trauma incidents. However, not all firefighters exhibit the same level of post-traumatic stress disorder (PTSD) or post-traumatic growth (PTG). Despite this, few studies have looked into firefighters' PTSD and PTG.

Objective: This study identified subgroups of firefighters based on their PTSD and PTG levels, and investigated the influence of demographic factors and PTSD/PTG-related factors on latent class classification.

Method: Latent profile analysis was used to examine the patterns of PTSD and PTG among 483 firefighters in South Korea. Using a cross-sectional design, demographic factors and job factors were examined as group covariates through a three-step approach. PTSD-related factors such as depression and suicide ideation, as well as PTG-related factors such as emotion-based response were analysed as differentiating factors.

Results: Four classes were identified and named 'Low PTSD-low PTG (65.2%),' 'Mid PTSD-mid PTG (15.5%),' (Low PTSD-high PTG (15.3%),' and 'High PTSD-mid PTG (3.9%).' The likelihood of belonging to the group with high trauma-related risks increased with more rotating shift work and years of service. The differentiating factors revealed differences based on the levels of PTSD and PTG in each group.

Conclusions: 34.8% of firefighters experienced changes due to traumatic events while on the job, and some required serious attention. Modifiable job characteristics, such as the shift pattern, indirectly affected PTSD and PTG levels. Individual and job factors should be considered together when developing trauma interventions for firefighters.

Análisis de perfil latente de estrés postraumático y crecimiento postraumático entre bomberos

Antecedentes: Debido a las características del trabajo, los bomberos están expuestos repetidamente a incidentes traumáticos. Sin embargo, no todos los bomberos presentan el mismo nivel de trastorno de estrés postraumático (TEPT) o crecimiento postraumático (PTG). A pesar de esto, pocos estudios han investigado TEPT y PTG de los bomberos.

Objetivo: Este estudio identificó subgrupos de bomberos basados en sus niveles de TEPT y PTG e investigó la influencia de factores demográficos y factores relacionados con TEPT/PTG en la clasificación de clases latentes.

Método: Se usó análisis de perfil latente para examinar los patrones de TEPT y PTG entre 483 bomberos de Corea del Sur. Utilizando un diseño transversal, los factores demográficos y laborales se examinaron como covariables de grupo a través de un enfoque de 3 pasos. Los factores relacionados con TEPT, como depresión e ideación suicida, así como los factores relacionados con PTG como la respuesta basada en la emoción, se analizaron como factores diferenciadores.

Resultados: Se identificaron cuatro clases y se denominaron 'TEPT bajo- PTG bajo' (65,2%), 'TEPT medio-PTG medio' (15,5%), TEPT bajo- PTG alto' (15,3%), y TEPT alto-PTG medio' (3,9%). La probabilidad de pertenecer al grupo con alto riesgo relacionado con el trauma aumentaba con más turnos rotativos y años de servicio. Los factores diferenciadores revelaron diferencias basadas en función de los niveles de TEPT y PTG en cada grupo.

Conclusiones: 34,8% de los bomberos experimentaron cambios debido a eventos traumáticos en el trabajo y algunos requirieron atención especializada. Las características laborales modificables, como el patrón de turnos, afectaron indirectamente los niveles de TEPT y PTG. Los factores individuales y laborales deben considerarse juntos al desarrollar intervenciones de trauma para los bomberos.

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PALABRAS CLAVE

Bomberos; estrés postraumático; estrés; TEPT; crecimiento postraumático; análisis de perfil latente

关键词

消防员; 创伤后应激; PTSD; 创伤后成长; 潜在剖面分 析

HIGHLIGHTS

- Firefighters were classified into four groups based on their levels of PTSD and PTG. 65.2% of the participants belonged to the 'Low PTSD-low PTG' group.
- The shift pattern and years of service predicted the likelihood of group classification.
- This implies that, despite being frequently exposed to threatening events, not all firefighters experience trauma, and that job characteristics influence trauma-related vulnerabilities.

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消防员创伤后应激和创伤后成长的潜在剖面分析

背景:由于工作特点,消防员经常遭受创伤事件。然而,并非所有消防员都表现出相同程度的创伤后应激障碍 (PTSD) 或创伤后成长 (PTG)。然而,很少有研究考查消防员的 PTSD 和 PTG。

目的:本研究根据消防员的 PTSD 和 PTG 水平确定了消防员亚组,并调查了人口因素和 PTSD/PTG 相关因素对潜在类别分类的影响。

方法:使用潜在剖面分析来检查韩国 483 名消防员的 PTSD 和 PTG 模式。使用横截面设计,通过三步法将人口因素和工作因素作为组别协变量考查。将PTSD 相关因素(如抑郁和自杀意念)以及 PTG 相关因素(如基于情绪的反应)作为区分因素进行了分析。 结果:确定了四个类别并命名为"低 PTSD-低 PTG (65.2%)"、"中 PTSD-中 PTG (15.5%)"、"低

PTSD-高 PTG (15.3%)"和"高 PTSD-中" PTG (3.9%)'。随着轮班工作和服务年限增加,属于创伤相关高风险组的可能性增加。区分因素揭示了每组 PTSD 和 PTG 水平的差异。 结论: 34.8% 的消防员在工作中因创伤性事件经历过变化,其中一些需要引起高度重视。

可改变的工作性质,例如轮班模式,间接影响了 PTSD 和 PTG 水平。在为消防员制定创伤 干预措施时,应同时考虑个人和工作因素。

1. Introduction

Compared to the general population, firefighters are more frequently exposed to physical injury, life-threatening situations, and various direct and indirect trauma incidents during rescue and emergency services (Sabin-Farrell & Turpin, 2003; Shin et al., 2015). The vast majority of firefighters continue to live their lives normally, but some may experience significant trauma-related issues. In South Korea, firefighters have a substantially greater prevalence of post-traumatic stress disorder (PTSD) (6.3%) than the general public (0.6%) (Korean National Fire Agency, 2018). The number of firefighters seeking psychological treatment for mental health issues has increased 7.3 times in three years, from 6616 in 2016 to 48,026 in 2020 (Korean National Fire Agency, 2021). These psychological difficulties can worsen due to their job characteristics such as frequent trauma exposure and shift work, increasing the risk of depression and suicide (Boffa et al., 2017; Carey et al., 2011; Hom et al., 2016). All of this can have a negative impact on their job performance as well as their social life, resulting in increased interpersonal and family conflicts, lower job satisfaction, frequent missed workdays, and retirement (Del Ben et al., 2006; Shim et al., 2019).

In accordance with this unfortunate trend, posttraumatic growth (PTG) is an important topic to discuss in firefighter research. PTG is an important issue linked to mental health and occupational adaptability that has an impact on firefighters' performance (Paton, 2005). Tedeschi and Calhoun (1995), while advocating the concept of PTG, underlined the positive changes that can occur following trauma. According to the PTG model of Calhoun and Tedeschi (2013), trauma is an event that challenges a person's core beliefs and schemas. As a result, the person is overcome by negative emotions and experiences post-traumatic stress symptoms. However, the process of coming to understand and integrate the event may result in PTG, allowing the person to function better than before (Calhoun & Tedeschi, 2013).

As one might expect, PTSD and PTG are closely related but the association is not straightforward. Unintegrated trauma events cause invasive rumination and hypersensitivity, which are major symptoms of PTSD as well as major predictors of PTG (Cann et al., 2011; Michl et al., 2013). Invasive rumination and hypersensitivity can cause suffering, but at the same time may promote growth through the process of reevaluating one's life and relationships and integrating them with trauma events (Dekel et al., 2012). In this way, the post-traumatic adaptation process and response to pain have a multifaceted structure that reflects the individual's subjective interpretation, resources, and coping methods rather than the objective characteristics of the event (Calhoun & Tedeschi, 2006). Because of this complication, studies examining the relationship between PTSD and PTG produced inconsistent results, with their association being negative (Ssenyonga et al., 2013), positive (Zalta et al., 2017), independent (Joseph et al., 1993), and also varying in their relationship with other related variables (Dekel et al., 2012; Shigemoto & Poyrazli, 2013). Therefore, there is a need for research that takes into account individual differences when investigating the connection between PTSD and PTG.

In this light, this study examined the relationship between PTG and PTSD using latent profile analysis (LPA). LPA is an analytical tool that allows users to create latent classes and investigate variations between groups based on the features of similarly responding individuals in the data. LPA has been used in studies to predict the help-seeking behaviour of firefighters who have recently experienced trauma (Tamrakar et al., 2020) and to examine firefighters' psychological needs within their work context (Rouse et al., 2020), but no LPA study has been conducted to examine the relationship between PTSD and PTG (Table 1). Firefighters are frequently exposed to trauma experiences,

Table 1. Prior LPA studies on the relationship between PTSD and PTG (a partial list).

Study	Subjects (N)	Trauma type	Scale	Latent class		M (SD)
Zhou et al. (2019)	Women (1487)	Earthquake	PTGI	Moderate PTSD/moderate PTG	PTSD	2.13 (0.44)
				(39.4%)	PTG	2.74 (0.36)
				High PTSD/high PTG (21.1%)	PTSD	3.36 (0.51)
					PTG	3.63 (0.42)
				Mild PTSD/high PTG (17.5%)	PTSD	1.63 (0.41)
			PCL-C		PTG	4.02 (0.52)
				Mild PTSD/mild PTG (12.4%)	PTSD	1.80 (0.48)
					PTG	1.42 (0.49)
				High PTSD/moderate PTG (9.6%)	PTSD	3.63 (0.50)
					PTG	2.42 (0.40)
Birkeland et al.	Adult (1970)	Bombing attack	PTGI-	Low stress/low growth (47%)	PTSD	-
(2015)			SF		PTG	-
				Low stress/high growth (42%)	PTSD	-
			PCL-S		PTG	-
				High stress/high growth (11%)	PTSD	-
					PTG	-
Cao et al. (2018)	Adult (1063)	Earthquake	PTGI-X	Mild PTSD/high PTG (58.2%)	PTSD	-
					PTG	-
				High PTSD/high PTG (21.1%)	PTSD	-
			PCL-5		PTG	-
				Mild PTSD/mild PTG (20.7%)	PTSD	-
			DTC		PTG	-
Chen and Wu (2017)	Children and adolescents (618)	Earthquake	PTGI	Thriving (76.2%)	PTSD	10.24 (0.44)
					PTG	68.75 (1.07)
				Stressed and Growing (14.7%)	PTSD	23.96 (1.22)
			CPSS		PTG	63.79 (2.06)
				Resilient (9.1%)	PTSD	9.36 (0.88)
71 (2010)		F . 1	DTC	C 1 . (TO 10()	PIG	29.11 (3.15)
Zhou et al. (2019)	Adolescents (619)	Earthquake	PIGI	Coexistence group (50.1%)	PISD	20.13 (0.41)
					PIG	68.09 (1./1)
			CDCC	Growth group (39.6%)	PISD	7.53 (0.48)
			CPSS	(10.20/)	PIG	/6.45 (1.53)
				Low symptoms group (10.3%)	PISD	8.42 (0.88)
Chan and Tan a	A -L-1+ (422)	Demonstrate to COVID	DTCI	Madawata aswabina d (42,20()	PIG	28.51 (3.44)
Chen and Tang	Adult (422)	Bereaved due to COVID-	PIGI	Moderate-combined (42.2%)	PISD	40.43 (8.33)
(2021)		19			PIG	57.91 (11.28)
				High-combined (27.0%)	PISD	56.43 (7.34)
				Countly (20.10()	PIG	/9.4/ (/./5)
			PCL-5	Growin (20.1%)	PISD	19.57 (8.04)
				$\mathbf{D}_{\mathrm{rest}}$	PIG	/3./8 (10./3)
				Resilience (10.7%)	PISD	19.84 (8.90)
					PIG	30.09 (12.25)

Note: PTSD: posttraumatic stress disorder; PTG: posttraumatic growth; *M*: mean, *SD*: Standard deviation; PTGI: Posttraumatic Growth Inventory; PCL-C: PTSD Checklist-Civilian Version; PTGI-SF: Short form of the PTGI; PCL-S: PCL-Specific; PTGI-X: PTGI-expanded; PCL-5: PCL for DSM-5; CPSS: Child PTSD Symptom Scale.

both directly and indirectly, as a result of their job; however, not all firefighters experience PTSD and PTG (Song & Jung, 2018), and various factors such as work experience (Nydegger et al., 2011) and gender (Noor et al., 2019) appear to influence PTSD and PTG. Unlike variable-oriented studies that are conducted under the assumption that the population is equal, LPA may obtain differentiated results that reflect the multifaceted characteristics of trauma as well as job and personal characteristics of firefighters.

Gender, age, years of service, and shift pattern were utilized to evaluate factors that influence the latent class classification because these characteristics are known to affect post-traumatic aspects. Prior studies have reported that older individuals engage in more deliberate rumination, and that women are more likely to experience PTG than men because women use more emotion-oriented coping strategies (Jin et al., 2014; Shakespeare-Finch & Lurie-Beck, 2014; Vishnevsky et al., 2010). Also, years of experience of firefighters is considered as one of the key variables that increase post-traumatic stress (Lee et al., 2008) and is expected to affect latent class classification. As their rank rises with years of service, the proportion of firefighters that reported PTSD symptoms have decreased from 13.5% (firefighter) to 10.6% (senior firefighter) and then soared again to 21.9% (fire sergeant) (Kwon et al., 2008).

Due to the multifaceted nature of trauma, distinguishing between latent classes based solely on PTG and PTSD levels may be difficult. Thus, as a result of reviewing previous research, depression, suicidal ideation, dissociation, intrusive rumination, deliberate rumination, emotion awareness, emotion processing and expression, mentalization, and acceptance were set as differentiating factors. Depression and suicidal ideation were examined to determine potential risk levels related to repeated exposure to traumatic events (Kim & Yook, 2018) and rigid job structure (Jo & Park, 2012). Dissociation, intrusive rumination, and deliberate rumination were used to identify the integration of fragmented traumatic memory (Ahn et al., 2013) and memory processing levels (Cann et al., 2011; Cloitre et al., 2002) in the

process of healing and change. Emotion awareness, processing and expression were used to assess the level of self-awareness, contact, and expression of the struggle for constructive processing of traumarelated emotions (Tedeschi & Calhoun, 2004). Mentalization – the capacity to perceive, understand, and imagine oneself and others – was used to gauge the level of reflective capacity that can develop as a result of traumatic experiences (Seo & Kim, 2018). Finally, acceptance was used to assess how well the trauma event's pain and emotion have been integrated and accepted as they are (Hass, 1994).

This study aims to investigate the differences in personal characteristics of firefighters based on the latent group classification in order to understand the impact of trauma experiences on firefighters more thoroughly. By analysing the differences in PTSDand PTG-related factors among the groups, it is possible to identify the type of group that requires intervention before serious risks such as suicide arise. Furthermore, by examining related factors, it will be possible to examine how individuals respond to and cope with trauma. This should provide specific information on the relationship between PTSD and PTG discovered in the firefighter group. This basic data that subdivides the characteristics of potential risk groups can help in the development of firefighter training curricula and programmes. The study's hypotheses are as follows.

- Potential firefighter groups will be classified based on the level of PTSD factors (intrusion, avoidance, hyperarousal, sleep, and numbness) and PTG factors (enhanced social resources).
- (2) Firefighters who are female, older, or have worked for a longer period of time are more likely to belong to a group with a higher level of PTG than other groups.
- (3) Firefighters with more rotating shifts are more likely to belong to a group with a higher level of PTSD than other groups.
- (4) Groups with higher PTSD levels will experience higher levels of intrusive rumination, deliberate rumination, dissociation, depression, suicidal ideation.
- (5) Groups with higher PTG levels will experience higher levels of emotion awareness, emotion processing and expression, mentalization, and acceptance.

2. Methods

2.1. Participants and procedures

The study received ethical approval and financial support from 4.16 Foundation and Community Chest of Korea. In terms of study design, we aimed for a sample

size of 500 by using a previous study as a guideline for appropriate sample size (Nylund et al., 2007). Following ethical considerations, a survey was conducted on 491 fire officials in the Busan area who have experienced traumatic incidents during work. In February 2021, the researchers visited the fire stations in Busan and clearly described the study's aim to the administrative officers. The data was acquired from participants who voluntarily provided informed consent for participation in the study. In return, the participants were given gift cards worth roughly \$3. Eight participants were excluded due to missing values. Thus, data from 483 participants were analysed. Included here was one participant who did not respond to demographic questions, but faithfully completed the rest of the survey. The demographic characteristics of the participants are shown in Table 2. The demographic factors surveyed included gender, age, years of service, service duty, shift pattern, and rank. In this case, 'age' was coded from 1 to 4 with 10 years per unit, 'years of service' from 1 to 8 with 5 years per unit, and 'rank' from 1 to 5 with each ascending rank. Table 3 summarizes the traumatic incidents experienced by participants while on duty in the previous year. More than half (59.4%) of firefighters have experienced two or more traumatic incidents in the past year. 46 (9.5%) have been involved in one case, while 150 (31.1%) said they did not experience any traumatic incident in the past year. Of the participants who said they had not experienced traumatic events in

Table 2. Demographic characteristics of study participants (N = 483).

Characteristics	Classification	Frequency	Per cent
	classification	(person)	(70)
lotal		482	98.8%
No response		1	0.2%
Gender	Male	443	91.7
	Female	39	8.1
Age	18–29	77	15.9
	30–39	188	38.9
	40–49	133	27.5
	50–59	84	17.4
Years of service	0–5	188	38.9
	6–10	80	16.6
	11–15	71	14.7
	16–20	63	13.0
	21–25	44	9.1
	26–30	30	6.2
	31–35	5	1.0
	36 and over	1	0.2
Service duty	Fire-suppression	188	38.9
	Emergency	110	22.8
	Rescue	29	6.0
	Office work	68	14.1
	Driving	78	16.1
	Etc.	9	1.9
Shift pattern	Fixed	70	14.5
	Rotating	411	85.1
	Etc.	1	0.2
Rank	Fire fighter	122	25.3
	Senior firefighter	92	19.0
	Fire sergeant	126	26.1
	Fire lieutenant	117	24.2
	Fire captain or	25	5.2
	higher		

Table 3. Traumatic events experienced in the past one year as firefighter.

Characteristics	Classification	Frequency (person)	Per cent (%)
	Survey completed	483	100
Traumatic events as firefighter	Handled a body of a suicide victim	258	53.4
	Witnessed or handled a dead body	257	53.2
	Witnessed victim or patient dying at the scene	222	46.0
	Felt one's life threatened; fear of serious injury	153	31.7
	None (no response)	150	31.1
	Exposed to toxic substances or risk of infection	106	21.9
	Rescued a severely damaged child or handled the body of a dead child	84	17.4
	Rescued or handled mass casualties	77	15.9
	Witnessed severe injury to colleague	68	14.1
	Threatened	62	12.8
	Physically assaulted	62	12.8
	Death of a colleague	49	10.1
	Threatened or attacked with a weapon	48	9.9
	Life-threatening injuries to oneself	23	4.8
	Sexually harassed	10	2.1
	Sexually assaulted	3	0.6
	Seriously injured or killed other(s)	3	0.6

the recent year, 95 participants still responded to questions for PTG and PTSD. In other words, these are individuals whose traumatic experiences took place earlier than a year ago.

2.2. Measures

Survey of possible trauma experiences as firefighter. Choi (2010) has produced a checklist of possible trauma experiences of firefighters by interviewing firefighters. The resulting survey asks the respondents to indicate traumatic events experienced in the recent year. It consists of 17 different types of trauma (e.g. life-threatening injuries). Respondents are asked to indicate whether they have experienced each type of trauma in the course of performing their duties. The items are in Table 3.

Intrusion, avoidance, and hyperarousal. Impact of Events Scale-Revised (IES-R) is a self-report scale developed to assess the major symptoms of PTSD based on the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) (Weiss & Marmar, 1997). In this study, the scale validated in Korea, Korean version of IES-R (IES-R-K), was used (Eun et al., 2005). IES-R-K is comprised of four subfactors: intrusion (i.e. 'I thought about it when I didn't mean to'), avoidance (i.e. 'I avoided letting myself get upset when I thought about it or was reminded of it'), hyperarousal (i.e. 'I felt irritable and angry'), sleep and numbness (i.e. 'I had trouble staying asleep'). Twenty-two items are rated on a 5-point Likert scale (0: Not at all, 4: Extremely). The total score of 17 or less is classified as normal, 18 or more and 24 or less as partial PTSD, and 25 or more as complete PTSD (Eun et al., 2005). In Eun et al. (2005)'s study, the internal consistency (Cronbach's α) of the entire scale was .83, intrusion .63, avoidance .70, and hyperarousal .87. In this study, four individual subfactors were used to assess PTSD in order to clarify the characteristics of each PTSD symptom and to increase

interpretability. Cronbach's α was .92 for intrusion, .94 for avoidance, .92 for hyperarousal, and .83 for sleep and numbress.

Dissociative experiences. To measure the dissociative symptoms related to trauma experience, the Dissociative Experience Scale (DES; Bernstein & Putnam, 1986) translated into the Korean language by Park et al. (1995) was used. DES has 28 items and 4 factors: absorption (i.e. able to ignore pain), amnesia (i.e. finding oneself dressed in clothes one can't remember doing), and depersonalizationderealization (i.e. other people and objects do not seem real), inattention (i.e. missing part of a conversation). A total score of 20 or higher gets classified as dissociative disorder (Park et al., 1995). Because the scoring of the original DES is more complicated than the second version, DES-II was used, where an 11point Likert scale ranging from 0% (never) to 100% (always) at 10% increments is used (Carlson & Putnam, 1993). The Cronbach's α for the scale was .94 in Park et al. (1995)'s study, and .97 in this study.

Post-traumatic growth. Stress Related Growth Scale-Revised Korean Version (SRGS-R-K; Shin, 2020) was used to assess growth after trauma. It is the translated and validated Korean version of SRGS-R (Boals & Schuler, 2018). SRGS-R-K is a 13item, 7-point Likert scale (-3: Intense negative changes, 0: No change, +3: Intense positive changes) that has two subfactors: enhanced personal resources (i.e. 'I experienced a change in the extent to which I work through problems and not just give up') and enhanced social resources (i.e. 'I experienced a change in the extent to which I listen when others talk to me'). The lower the total score, the more negative the change; the higher the score, the more positive the change. SRSG-R-K has demonstrated strong internal consistency (α = .93; Shin, 2020). In this study, Cronbach's α was .96 for enhanced personal resources and .97 for enhanced social resources.

Intrusive rumination and deliberate rumination. The Event Related Rumination Inventory (ERRI; Cann et al., 2011) assesses intrusive rumination and deliberate rumination of traumatic events. The Korean version of ERRI (K-ERRI; Ahn et al., 2013) was used in this study. K-ERRI is comprised of 10 intrusive rumination items (i.e. 'I thought about the event when I did not mean to') and 10 deliberate items (i.e. 'I thought about whether I could find meaning from my experience') that are rated on a 4-point Likert scale (0: Not at all, 3: Often). In Ahn et al. (2013)'s study, the Cronbach's α was .94 for the entire scale, and .93 for each subscale.

Depression. The Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977) was adapted to the Korean context by Chon et al. (2001) in Korea as the Integrated Korean CES-D. This scale consists of 20 items (i.e. 'I thought my life had been a failure') that are rated on a 4-point Likert scale (0: Rarely or none of the time, 3: Most or all of the time). A total score of 16 or higher indicates that the depression symptoms are severe. The Cronbach's α was .91 in Chon et al. (2001)'s study, and .86 in this study.

Suicidal ideation. The Scale of Suicidal Ideation (SSI; Beck et al., 1979) was translated in Korean by Park and Shin (1990). Korean SSI has a total of 19 items rated on a 3-point Likert scale. Each item consists of a question (i.e. Frequency of thinking about suicide) and response options (0: No ideation, 2: Strong ideation). A total score of 9–11 requires attention, 12–14 indicates risk, and 15 or higher signals high risk. The Cronbach's α was .87 in Park and Shin (1990)'s study, and .84 in this study.

Emotion-based response. Based on the theory of Greenberg and Safran (1987), emotion-based response consists of three sub-factors: emotion awareness (i.e. I usually know how I am feeling.), emotion processing (i.e. I closely monitor the reasons for my mood.) and emotion expression (i.e. I express my emotions well). To measure emotion awareness, a subscale of Salovey et al. (1995)'s Trait Meta-Mood Scale (TMMS) was used. The Korean version was created by Lee and Lee (1997) and the emotion awareness subscale consists of 11 items. For emotion processing and emotion expression, the Korean version (Kang & Yang, 2015) of Emotional Approach Coping Scale (EAC; Stanton et al., 2000)'s emotion processing and emotion expression subscales, each with 8 items, were used. Emotion awareness was rated on a 5-point Likert scale (1: Not at all, 5: Very much), and emotion processing and expression were rated on a 4-point Likert scale (1: Not at all, 4: Very much). The higher the total score, the better the ability that each factor represents. In Seo and Kim (2018)'s study, the Cronbach's α was .75 for emotion awareness, .88 for emotion processing, and .88 for emotion expression. In this study, the Cronbach's α was .64 for emotion processing, and .97 for both emotion processing and emotion expression.

Mentalization. Park and Chung (2019) have developed the Self-Rated Mentalization Questionnaire (SRMQ) based on the concept of mentalization defined by Fonagy (1991). SRMQ includes four subfactors: reflection of the self and other (i.e. I think about what I think), absolute certainty about other's mind, deficit of emotion awareness (i.e. I don't know how I feel), and concrete thinking (i.e. I can't be friends with people who think differently from me). In this study, the items for 'absolute certainty about other's mind' were excluded, based on the possibility that these items may be interpreted differently by person (Park & Chung, 2019). Thus, mentalization was assessed with the combined score of other three subscales. SRMQ was rated on a 5-point Likert scale (1: Not at all, 5: Very much), and the higher the total score, the higher the mentalization ability. The Cronbach's α was .77 in Park and Chung (2019)'s study, and .79 in this study.

Psychological acceptance. The Korean version (Heo et al., 2009) of the Acceptance and Action Questionnaire II (AAQ-II; developed by Hayes et al., 2004; revised by Bond et al., 2011) was used to assess psychological acceptance (i.e. I worry about not begin able to control my worries and feelings.) AAQ-II is a single factor scale with 8 items rated on a 7-point Likert scale (1: Never true, 7: Always true). The higher the score, the greater the capacity for psychological acceptance. The Cronbach's α was .85 in Heo et al. (2009)'s study, and .69 in this study.

2.3. Data analysis

First, the mean, standard deviation, and range of the factors used in this study were examined. Following that, confirmatory factor analysis was performed using SPSS 21.0 and AMOS 21.0 to determine whether the scales used in this study adequately explained the psychological constructs they sought to assess. To determine whether the covariance matrix of the collected data and the estimated covariance matrix of the research model were appropriate, Tucker-Lewis fit index (TLI), comparative fit index (CFI), and root mean square error of approximation (RMSEA) indices were used. TLI, TLI and CFI values of >.90 indicate good fit. RMSEA value of <.05 indicates good fit, <.08 suggests reasonable fit, and >.10 indicates poor fit (Browne & Cudeck, 1993). Results showed TLI = .93, CFI = .95, and RMSEA = .07, enabling LPA. The LPA was conducted using the SPSS 21.0 and Mplus 8.0 statistics tools to see how many different latent groups firefighters exist when it comes to PTSD (intrusion, avoidance, hyperarousal,

dissociation) and PTG (enhanced personal resources, enhanced social resources) subfactors. A type of latent class analysis, LPA has several advantages over traditional clustering. First, unlike traditional clustering, LPAs can harness statistical criteria in determining the number of latent groups (Bergman & Magnusson, 1997). Second, LPA, a model-based method based on relatively easy-to-understand probability theory, appears to outperform clustering in classification accuracy (Magidson & Vermunt, 2002). Third, for cluster analysis, all factors must be standardized in advance because results are heavily influenced by factors with big variations; LPA is not affected by factors with large variations (Magidson & Vermunt, 2002). The determination of the number of latent groups was based on the information criteria indices such as Bayesian Information Criterion (BIC), sample size adjusted BIC (saBIC), as well as likelihood-based tests, such as Lo-Mendell-Rubin likelihood ratio test (LMR) and bootstrap likelihood ratio test (BLRT). The proportion and interpretability of each group were also taken into account (Tofighi & Enders, 2006; Yang, 2006). The lower the BIC, saBIC indices; when LMR and BLRT was p < .05; and when the size of a group was greater than 1% of the sample size, the number of latent groups was considered adequate (Hill et al., 2000). For the convenience of interpretation, each factor score was converted to a standardized value (T-score), and a three-step analysis was conducted to compare age, gender, years of service, and shift pattern (fixed, rotating) for each latent group classified through LPA. The three-step approach is a method for identifying the effects of latent group-specific covariates, which uses the posterior distribution of latent groups to perform a multinomial logistic regression that takes into account the probability of misclassification (Asparouhov & Muthén, 2014). At this time, tolerance and variance inflation factors (VIFs) were calculated to assess multicollinearity. It can be assumed that there is no problem of multicollinearity if the tolerance is more than 0.1 and the VIF is less than 10 (Field, 2013). Then, the differences in group averages for dissociation, suicidal ideation, intrusive rumination, deliberate rumination, depression, emotion-based response, mentalization, and psychological acceptance were compared using the DCON command (Asparouhov & Muthén, 2014).

3. Results

3.1. Descriptive statistics and confirmatory *factor analysis*

The mean (standard deviation, range) for each factor was as follows: PTSD factors 1.42-2.11 (2.42-3.60, 14-18), PTG factors 3.09-3.78 (5.85-6.86, 36-42), dissociative symptom 11.61 (20.29, 141), intrusive rumination 3.95 (5.77, 30), deliberate rumination 5.04(6.63, 29), depression 11.22 (6.81, 48), suicidal ideation 1.83 (3.00, 26), emotion awareness 38.73 (6.66, 36), emotion processing and expression 42.19 (12.24, 64), mentalization 71.66 (8.73, 67), and acceptance 47.36 (5.56, 38).

Confirmatory factor analysis revealed that the values of all factors were β (.50–.98), SE (.024–.127), and C.R. (8.67–63.54, *p* < .001), confirming that they appropriately explained the factors being assessed.

3.2. LPA according to PTSD and PTG

The goodness-of-fit indices for LPA are shown in Table 4. We investigated the goodness of fit, class sizes, and interpretability of each LPA model from 2-class to 6-class models. BIC and saBIC declined as the number of classes increased, and LMR was significant for 2-class and 4-class models. In terms of group size, both models met the criteria. However, the 4-class model looked to be more interpretable, as the degrees of PTG and PTSD were more clearly differentiated by class (Table 5). The plot of the scores (T-scores) for the 4-class model is shown in Figure 1.

Class 1, comprised of 15.3% of entire sample, has the highest level of PTG and the lowest level of PTSD. This class was named as 'Low PTSD-high PTG' as it represented individuals who have experienced adaptive PTG. Class 2 included 65.2% of the participants, whose PTG and PTSD levels were very low. This class was named as 'Low PTSD-low PTG.' Class 3 was the smallest class, representing only 3.9% of the entire sample. This class was named as 'High PTSD-mid PTG' because individuals in this class had very high levels of PTSD but showed average levels of growth. Class 4, named 'Mid PTSD-mid PTG,' represented 15.5% of the participants who experienced moderate levels of PTSD and PTG.

Table 4. Fit indices by latent class model.

Model	BIC	saBIC	LMR	BLRT			Proportion by class				
2	14,307.279	14,246.975	**	***	.82	.18					
3	13,565.251	13,482.729	0.1590	***	.80	.16	.04				
4	13,325.685	13,220.945	*	***	.65	.16	.15	.04			
5	13,188.500	12,991.543	0.1914	***	.56	.14	.13	.13	.04		
6	12,942.784	12,793.609	0.1060	***	.54	.14	.13	.13	.04	.02	

Note: BIC: Bayesian Information Criterion; saBIC: the adjusted BIC; LMR: Lo-Mendell-Rubin likelihood ratio test; BLRT: Bootstrapped Likelihood Ratio Test. **p* < .05; ***p* < .01; ****p* < .001.

Table 5. PTSD and PTG scores by latent class.

Factor	Class1 'Low PTSD- high PTG' class <i>M</i> (SD)	Class2 'Low PTSD- low PTG' class <i>M</i> (SD)	Class3 'High PTSD- mid PTG' class <i>M</i> (SD)	Class4 'Mid PTSD- mid PTG' class <i>M</i> (SD)
Intrusion	0.81 (1.35)	0.98 (1.49)	11.37 (2.34)	5.52 (1.73)
Sleep and numbness	0.60 (1.06)	0.67 (1.01)	9.37 (2.22)	4.53 (1.59)
Hyperarousal	0.27 (0.71)	0.27 (0.69)	10.58 (2.67)	5.08 (1.76)
Avoidance	0.62 (1.25)	0.61 (1.24)	13.79 (2.07)	6.84 (2.48)
Enhanced personal resources	14.70 (3.91)	1.29 (4.50)	4.42 (7.10)	3.27 (6.89)
Enhanced social resources	12.54 (3.56)	0.88 (3.68)	3.84 (5.62)	2.84 (5.93)

Note: PTSD: posttraumatic stress disorder; PTG: posttraumatic growth; *M*: mean; *SD*: Standard deviation.

3.3. Multicollinearity

Tolerance and VIF values were identified to assess multicollinearity of. Tolerance values (.22–.90) and VIFs (1.12–4.47) were within acceptable limits.

3.4. Demographic factors by latent class

We looked at the impact of gender, age, years of service and shift pattern on class classification using the

three-step analysis (Tables 6 and 7). First, comparisons were made with the 'Low PTSD-high PTG' class as the baseline. Individuals with rotating shift work were 2.61 times more likely to belong to the 'Low PTSD-low PTG' class than those with fixed shift work (*Est* = 0.96, *p* < .05). In addition, individuals with long service years were 1.52 times more likely to belong to the 'High PTSD-mid PTG' class (Est = 0.42, p < .01). In the case of shift pattern, rotating shift individuals were 3.73 times more likely to belong to the 'High PTSD-mid PTG' class than those with fixed shifts (*Est* = 1.32, p < .05). In the case of the 'Mid PTSD-mid PTG' class, individuals with long service years were 1.28 times more likely to belong to the class (*Est* = 0.25, p < .05), and individuals with rotating shifts were 3.37 times more likely to belong to the class than fixed shifts (*Est* = 1.21, p < .01).

Next, comparison among 'Low PTSD-low PTG' class, 'High PTSD-mid PTG' class, and 'Mid PTSD-mid PTG' class was made (Table 7). Individuals with longer years of service were 1.41 times more likely to be in the 'High PTSD-mid PTG' class (*Est* = 0.35, p < .01), and 1.19 times more likely to be in the 'Mid PTSD-mid PTG' class (*Est* = 0.25, p < .05) than the 'Low PTSD-low PTG' class. Lastly, there were no significant differences in the demographic factors



Figure 1. Four-class model according to PTSD and PTG. Note: PTSD: posttraumatic stress disorder; PTG: posttraumatic growth.

	Table 6.	Class	classification	covariates	analysis	with th	ne 'Low	PTSD-high	PTG'	class as	the	baseline.
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		'Low PTSD-high PTG'									
	ʻL	'Low PTSD-low PTG' class			'High PTSD-mid PTG' class			'Mid PTSD-mid PTG' class			
	Est	SE	OR (95% CI)	Est	SE	OR (95% CI)	Est	SE	OR (95% CI)		
Gender	0.40	0.56	1.49 (0.50, 4.47)	1.30	0.95	3.66 (0.57, 23.71)	0.88	0.64	2.41 (0.68, 8.53)		
Age	0.41	0.09	1.04 (0.87, 1.25)	0.10	0.09	1.11 (0.94, 1.31)	0.05	0.08	1.06 (0.90, 1.24)		
Years of service	0.07	0.09	1.07 (0.90, 1.29)	0.42**	0.15	1.52 (1.14, 2.01)	0.25*	0.10	1.28 (1.05, 1.55)		
Shift pattern	0.96*	0.38	2.61 (1.23, 5.51)	1.32*	0.55	3.73 (1.28, 10.85)	1.21**	0.46	3.37 (1.36, 8.34)		

Note: PTSD: posttraumatic stress disorder; PTG: posttraumatic growth; *Est*: Estimate; *SE*: Standard error; OR: Odds Ratio; Gender: 1 = Male, 2 = Female; Age: 1 = 18-29, 2 = 30-39, 3 = 40-49, 4 = 50-59; Years of service: 1 = 0-5, 2 = 6-10, 3 = 11-15, 4 = 16-20, 5 = 21-25, 6 = 26-30, 7 = 31-35, 8 = 36 and over; Shift pattern: 1 = Fixed, 2 = Rotating.

p* < .05; *p* < .01; ****p* < .001.

Table 7. Class classification covariates analysis with the 'Low PTSD-low PTG' class and 'High PTSD-mid PTG' class as the baseline.

			LOW PISD-10	High PISD-mid PIG class						
	Ή	'High PTSD-mid PTG' class			'Mid PTSD-mid PTG' class			'Mid PTSD-mid PTG' class		
	Est	SE	OR (95% CI)	Est	SE	OR (95% CI)	Est	SE	OR (95% CI)	
Gender	0.90	0.86	2.46 (0.45, 13.32)	0.48	0.48	1.62 (0.63, 4.16)	-0.02	0.91	0.66 (0.11, 3.94)	
Age	0.06	0.06	1.06 (0.94, 1.20)	0.01	0.06	1.01 (0.91, 1.13)	-0.05	0.04	0.95 (0.88, 1.04)	
Years of service	0.35**	0.13	1.41 (1.09, 1.83)	0.17*	0.08	1.19 (1.03, 1.38)	-0.17	0.13	0.84 (0.65, 1.09)	
Shift pattern	0.36	0.47	1.43 (0.57, 3.57)	0.26	0.36	1.29 (0.63, 2.63)	-0.10	0.42	0.90 (0.40, 2.05)	

Note: PTSD: posttraumatic stress disorder; PTG: posttraumatic growth; *Est*: Estimate; *SE*: Standard error; OR: Odds Ratio; Gender: 1 = Male, 2 = Female; Age: 1 = 18-29, 2 = 30-39, 3 = 40-49, 4 = 50-59; Years of service: 1 = 0-5, 2 = 6-10, 3 = 11-15, 4 = 16-20, 5 = 21-25, 6 = 26-30, 7 = 31-35, 8 = 36 and over; Shift pattern: 1 = Fixed, 2 = Rotating.

p* < .05; *p* < .01; ****p* < .001.

between the 'High PTSD-mid PTG' class and the 'Mid PTSD-mid PTG' class.

3.5. Differences in PTSD and PTG factors among latent classes

The differences in PTSD and PTG-related factors between classes are shown in Table 8. Dissociation was higher for the 'High PTSD-mid PTG' and 'Mid PTSD-mid PTG' classes than the 'Low PTSD-high PTG' and 'Low PTSD-low PTG' classes ($\chi^2 = 30.73$, p < .001). Intrusive rumination was higher for the 'Mid PTSD-mid PTG' class than the 'Low PTSDhigh PTG' and 'Low PTSD-low PTG' classes, and higher for the 'High PTSD-mid PTG' class than the 'Mid PTSD-mid PTG' class ($\chi^2 = 166.85$, p < .001). Deliberate rumination was the highest for the 'High PTSD-mid PTG' and 'Mid PTSD-mid PTG' classes and was higher for the 'Low PTSD-high PTG' class than the 'Low PTSD-low PTG' class (χ^2 = 122.77, p < .001). Depression ($\chi^2 = 59.81$, p < .001) and suicidal ideation ($\chi^2 = 18.78$, p < .001) were both the highest for the 'High PTSD-mid PTG' class, followed by in the order of the 'Mid PTSDmid PTG,' 'Low PTSD-low PTG' class, and 'Low PTSD-high PTG' class. Emotion awareness was higher for 'Low PTSD-high PTG' and 'Low PTSDlow PTG' classes than 'High PTSD-mid PTG' and 'Mid PTSD-mid PTG' classes ($\chi^2 = 13.09$, p < .01). Emotion processing and expression was higher for the 'Low PTSD-high PTG' than 'Low PTSD-low

Table	8.	PTSD	and	PTG	factors	hv	latent	class
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PTG,' 'High PTSD-mid PTG,' and 'Mid PTSD-mid PTG' classes ($\chi^2 = 23.40$, p < .001). Lastly, mentalization ($\chi^2 = 39.83$, p < .001) and acceptance ($\chi^2 = 40.81$, p < .001) were both higher for the 'Low PTSD-low PTG' class than 'High PTSD-mid PTG,' and 'Mid PTSD-mid PTG' classes, and higher for the 'Low PTSD-high PTG' class than the 'Low PTSD-low PTG' class.

4. Discussion

This study examined the latent classes for PTSD and PTG in firefighters using LPA. The LPA revealed a four-class model based on the subfactors of PTSD and PTG: 'Low PTSD-low PTG (65.2%),' 'Mid PTSD-mid PTG (15.5%),' 'Low PTSD-high PTG (15.3%),' 'High PTSD-mid PTG (3.9%).' Although direct comparison of clinical scores with other research is difficult because the measures used in each study differ, the findings of this study appear to be consistent with other research (Chen & Tang, 2021; Zhou et al., 2019). In this study, the class with the highest percentage was 'Low PTSD-low PTG' (65.2%); however, previous studies indicated that the largest group was 'Moderate PTSD/PTG' (39.4% in Chen & Tang, 2021; 42.2% in Zhou et al., 2019). This may be due to the resilience of Korean firefighters. Resilience is a dynamic process in which individuals change in the context of interaction with the environment (Laureys & Easton, 2020). Previous studies of firefighters' resilience suggested that it is

	s factors by fatche c					
Factor	Class1 'Low PTSD-high PTG' class <i>M</i> (SE)	Class2 'Low PTSD-low PTG' class <i>M</i> (<i>SE</i>)	Class3 'High PTSD-mid PTG' class <i>M</i> (SE)	Class4 'Mid PTSD-mid PTG' class <i>M</i> (SE)	Overall test	Difference between class
Dissociation	8.84 (1.55)	7.65 (0.75)	41.95 (9.40)	23.27 (3.45)	30.73***	1, 2 < 3, 4
Intrusive rumination	2.95 (0.52)	2.13 (0.23)	14.90 (1.26)	9.81 (0.69)	166.85***	1, 2 < 4 < 3
Deliberate rumination	6.89 (0.90)	2.94 (0.27)	12.37 (1.77)	10.20 (0.82)	122.77***	2 < 1 < 3, 4
Depression	8.31 (0.58)	10.45 (0.33)	20.47 (2.86)	14.99 (0.76)	59.81***	1 < 2 < 4 < 3
Suicidal ideation	0.78 (0.12)	1.66 (0.15)	5.37 (1.36)	2.69 (0.42)	35.54***	1 < 2 < 4 < 3
Emotion awareness	39.91 (0.78)	39.02 (0.38)	36.84 (1.57)	36.84 (0.66)	13.09**	3, 4 < 1, 2
Emotion processing and expression	47.30 (1.50)	40.85 (0.68)	42.10 (1.58)	42.83 (1.36)	23.40***	2, 3, 4 < 1
Mentalization	76.35 (1.06)	71.64 (0.47)	67.42 (1.84)	68.33 (0.94)	39.83***	3, 4 < 2 < 1
Acceptance	49.19 (0.47)	47.96 (0.30)	42.84 (1.75)	44.21 (0.68)	40.81***	3, 4 < 2 < 1

Note: PTSD: posttraumatic stress disorder; PTG: posttraumatic growth; *M*: mean; *SE*: Standard error. *p < .05; **p < .01; ***p < .01.

important to consider the impact of socio-cultural contexts such as the job environment and social resources of the country of firefighters (Blaney & Brunsden, 2015; Kehl et al., 2015). Since 2012, South Korea's National Fire Agency has increased its support for PTSD and depression prevention and management through resilience programmes. Since 2015, mental health counselling, testing, and medical expense reimbursement have also been provided (Korean National Fire Agency, 2021). This helps to explain why PTSD and PTG do not always appear in jobs with frequent traumatic events, and it is clear that there is a need for LPA research on firefighters' trauma that takes the socio-cultural context into account.

Among the covariates, the rotating shift pattern increased the likelihood of belonging to a class with a higher risk of trauma-related stress. This can be viewed in the same light as previous studies that have linked firefighters' shift work to depression, poor sleep quality, and stress (Billings & Focht, 2016; Carey et al., 2011; Lilly, 2019). Rotating shift workers may experience sleep disturbances due to melatonin production from lighting during night-time work (Czeisler et al., 1986) and irregularities in the sleepwake circulatory rhythm that result in unstable cortisol output (Lim, Jang, et al., 2020). This can lead to oversleeping and depression due to daytime sleepiness (Kim et al., 2017; Plante et al., 2017), and appears to contribute to an increase in occupational injury or PTSD, both of which are strong risk indicators in the course of post-traumatic events (Germain, 2013; Sopp et al., 2021). Also, a day off from work following a rotating shift is insufficient for catching up on sleep and recovering from fatigue, which may have had a long-term negative effect on the circadian rhythm, making growth more difficult (Åkerstedt & Kecklund, 2017; Jang et al., 2020). Therefore, interventions that alter the working environment of firefighters with severe PTSD symptoms may contribute to changes in vulnerability, PTSD, and PTG.

Next, firefighters with longer years of service were more likely to be part of a group experiencing both PTSD and PTG. Kwak and Bae (2017) speculated that increased familiarity and proficiency in work may promote PTG, but other studies (Martin et al., 2017; Morris et al., 2016) suggest that the accumulation and chronicity of trauma stress that comes with more work experience may lead to the findings of this study. Because research findings vary, work experience cannot simply be viewed as a factor that promotes PTSD or PTG.

Meanwhile, age and gender were not significant covariates of class classification by PTSD and PTG in this study. In a study that conducted LPA on earthquake survivors (Cao et al., 2018), the older the survivors were, the more likely they were to be in the high PTSD/high PTG group. Some studies have suggested that being female and older increased the likelihood of using emotion-focused coping, and this can lead to a struggle to make sense of the trauma experience (Folkman et al., 1987; Tedeschi & Calhoun, 2004). Although it is generally true that firefighters who have longer work experience are older, age itself was not a covariate in this study, suggesting that their job characteristics have a greater impact on PTSD and PTG. The effect of gender on PTG has also been found to be inconsistent in earlier investigations. Studies on general population (Cao et al., 2018; Kim et al., 2020) found that women engage in more deliberate rumination than men and tend to show greater PTG. Studies on firefighters showed mixed results, with some reporting significant effect (Noor et al., 2019) and some reporting no effect (Kim, 2012). Thus, instead of simply linking gender, age, and years of service with PTSD and PTG, more in-depth research on PTSD and PTG in similar cultures, occupational groups, and trauma types is warranted.

The study's findings on class differences were mostly consistent with previous research findings (Calhoun & Tedeschi, 2013; Ford & Gómez, 2015; Kim et al., 2011; Oehlman Forbes et al., 2020; Post et al., 2021). However, it is worth looking into the differences between two groups of people who are suffering from PTSD: the 'high PTSD-mid PTG' class and the 'mid PTSD-mid PTG' class. Intrusive rumination, depression, and suicidal ideation were all higher for the 'high PTSD-mid PTG' class than the 'mid PTSD-mid PTG' class, while deliberate rumination showed no difference. Differentiation from other groups is thought to be due to a variety of factors, including individual responses to trauma events, internal or social resources, and changes over time. Previous research has shown that anxiety sensitivity (Stanley et al., 2017), sleep disorders (Healy & Vujanovic, 2021), and alcohol (Bing-Canar et al., 2019) can all reduce the risk of posttraumatic PTSD, depression, and suicide. What is certain is that the 'mid PTSDmid PTG' class has relatively fewer PTSD symptoms than the 'high PTSD-mid PTG' class, but they both exert similar efforts to understand trauma events. More research into this finding could lead to the discovery of important factors influencing the severity of symptoms.

5. Limitations

The following are the study's limitations, and the research findings should be interpreted taking these into account. First, The LPA results of this study suggested a 4-class model for firefighters. However, depending on their line of duty, firefighters may be subjected to varying levels of work stress and traumatic experiences. According to statistics, firefighters in the field experience more job stress than office workers, and those assigned to fire suppression duties face a larger chance of accidents and injuries than those assigned to other responsibilities (Choi & Song, 2018; Kim et al., 2010). Furthermore, the effect of gender differed from earlier studies. The proportion of women among the subjects of this study was 8.1%, which may be insufficient to see that gender affects group classification. Second, this study was a onetime cross-sectional study. It is unclear how the four defined latent groups will change in the future, or how the different characteristics presented by each group may affect PTSD symptoms or growth. Moreover, the level of PTSD and PTG, as well as the relationship between various factors, were discussed based on prior findings; however, even in prior studies, it was difficult to assume causal relationships among factors, so it was not possible to investigate whether these results were actually due to PTSD and PTG. Third, among the latent class classification factors examined in this study, factors that influence the classification between 'High PTSD-mid PTG' and 'Mid PTSD-mid PTG' classes were not found. Fourth, the IES-R-K, a measure was used in this study to assess the main symptoms of PTSD, was based on the DSM-IV. Because there were no fundamental changes in the phenotype of PTSD in the DSM-5, the most recent version, assessing PTSD through symptom screening remains valid (Hosey et al., 2019). However, it should be noted that changes in symptom criteria may lead to a lack of clarity in PTSD assessment.

6. Significance

This is the first study to examine the relationship between PTSD and PTG in firefighters while taking personal characteristics into account. In addition, this study empirically demonstrated that job characteristics can affect PTSD and PTG levels. The findings of the study suggest that trauma intervention should be customized based on the firefighter's job environment and personal characteristics. In particular, job characteristics are linked to event shock (Kim et al., 2013), decreased psychological stability (Ryu et al., 2018), sleep cycle (Billings & Focht, 2016), and neurological factors such as melatonin (Kazemi et al., 2018) and cortisol (Lim, Jang, et al., 2020). Therefore, job characteristics, along with other factors, must be thoroughly examined as their effects on firefighters' PTSD and PTG are investigated.

7. Clinical implications

Of the 483 Korean firefighters who participated in this study, more than 50% of them witnessed the death or serious injury of others, and 59.4% had multiple trauma experiences. Studies show that the frequency of traumatic events is linked to PTSD and PTG (Armstrong et al., 2014; Harvey et al., 2016), implying that a substantial number of firefighters are exposed to the impacts of traumatic events while on the job. Meanwhile, 95 people reported PTSD and PTG despite responding that they had no experience of traumatic events in the past year. It can be assumed that these firefighters were not subjected to traumatic events in the previous year due to a change in work environment (i.e. service duty or department), but they have been exposed to trauma in the past and their effects are still being felt. Therefore, it is essential to enhance the working conditions for firefighters, particularly the shift pattern. Special attention must also be paid to preventing serious depression and suicide among those who are suffering from PTSD.

8. Future studies

Future research can improve sample representativeness before investigating the differences in latent classes by job duty, gender, and age. Also, reflecting the multidimensional nature of trauma, it is suggested that an LPA study be carried out focusing on specific trauma experiences or targets. Furthermore, using methods such as latent transition analysis, it is possible to investigate what factors influence transition patterns by class for a follow-up investigation. Finally, factors that can influence posttraumatic patterns directly or indirectly, such as physical leisure activities (Lim, Jeong, et al., 2020) and social support (Sattler et al., 2014), can be investigated for class prediction. This will enable a more thorough investigation of the factors that contribute to differences at the latent class level.

Disclosure statement

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Data availability statement

The data that support the findings of this study are openly available in Harvard Dataverse at https://doi.org/10.7910/DVN/I5RSTL.

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