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Major depressive disorder, panic disorder, and post-traumatic stress disorder in Korean subway drivers

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Abstract

Purpose   The purposes of this study are to investigate the prevalence of major depressive disorder, panic disorder, and post-traumatic stress disorder (PTSD) in Korean subway drivers, and find the association between these disorders and the drivers' person-under-train (PUT) experiences.

Methods   A total of 826 subway drivers who participated in a cross-sectional work and health survey were included for this study. The Korean version of the Composite International Diagnostic Interview 2.1 was applied to assess major depressive disorder, panic disorder, and PTSD. The date of PUT, whether victim died, and how many PUTs the drivers experienced were asked using a structured questionnaire.

Results   The standardized prevalence ratios (SPRs) for lifetime prevalence of panic disorder and PTSD in subway drivers were 13.3 (95 % confidence interval [CI] 6.6–22.4) and 2.1 (95 % CI 1.1–3.4), respectively. In lifetime prevalence, after adjusting for age, education, income, and working career, the drivers who experienced PUT had significantly higher risks for panic disorder (odds ratio [OR] = 4.2, 95 % CI 1.2–16.6) and PTSD (OR = 4.4, 95 % CI 1.3–16.4). In 1-year prevalence, the drivers who experienced PUT had a significantly higher risk for PTSD (OR = 11.7, 95 % CI 1.9–225.8). There was no significant value of SPR and OR in major depressive disorder.

Conclusions   This study suggests that Korean subway drivers are at higher risk for panic disorder and PTSD compared to the general population, and PUT experience is associated with panic disorder and PTSD. Drivers who have experienced PUT should be treated quickly, sympathetically, and sensitively by a psychological professional and their colleagues, so they can return to work soon.

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Introduction

Psychiatric disorders are commonly found among subway drivers who have witnessed "person-under-train" (PUT)

events by accidental falls from the platform or suicide attempts (Weiss and Farrell 2006). These situations are extremely stressful experiences for drivers and occur without any forewarning or controllability. In addition, drivers might have feelings of guilt despite the fact that the drivers had no way of preventing the occurrence (Theorell et al. 1994). Farmer et al. (1992) found that 16.3 % of the drivers involved in PUT developed post-traumatic stress disorder (PTSD) when evaluated 1 month after the incident. In French study, when evaluated immediately after the event, the prevalence of post-traumatic stress was 4 % in the drivers experienced PUT (Cothereau et al. 2004). Like the above studies, in particular, PTSD has been reported frequently among subway or train drivers who witnessed persons being seriously injured or killed by a train (Malt et al. 1993; Tang 1994; Theorell et al. 1994; Weiss and Farrell 2006; Yum et al. 2006). However, little is known about other psychiatric disorders, such as major depressive disorder and panic disorder, in subway drivers who have experienced PUT accidents. Major life events can be associated with panic attacks and depression. A prospective cohort study of adults living in New York City on the day of the September 11, 2001 terrorist attacks revealed that stressor exposure was related to perievent panic attacks and depression onset after the World Trade Center attacks (Adams and Boscarino 2011). Considering that PUT experience is also a major life event that influences drivers' mental health, other psychiatric diseases in addition to PTSD should be examined.

In most previous studies conducted in Western countries, psychiatric disorders were measured with screening tools such as the Impact of Event Scale. The main strengths of this screening tool are that it is short, is easily administered and scored, and can be used repeatedly to assess progress. Nonetheless, the Impact of Event Scale is limited because it is a screening tool rather than a comprehensive test (Weiss and Marmar 1997). Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)-based interview tools, such as the Composite International Diagnostic Interview (CIDI), has been rarely used in subway driver studies. Furthermore, it is not yet known whether subway drivers have a greater risk of psychiatric disorders when compared to the general population. Additionally, few epidemiological studies have examined the associations between psychiatric disorders and PUT accidents in Asian countries. Generally, sociocultural influences relating to the concept of psychiatric disorders may have contributed to the differences of prevalent disease in some cultures (Weissman et al. 1996). Chang et al. (2008) commented that the low prevalence of depression in Korea seems to be due to a higher threshold for affirmative answers to depressive

mood in Korean culture. It is very important to focus on ethnic differences within this issue.

The purposes of this study are to investigate whether the prevalences of major depressive disorder, PTSD, and panic disorder in Korean subway drivers are higher than those of the Korean general population and find the association between these disorders and subway drivers' PUT experiences.

Methods

Study population

The study was performed during March and August in 2007. For 3 years before that time, many psychiatric cases were claimed to Industrial Accident Compensation Insurance among subway drivers. The trade union of subway workers reported this issue to the Ministry of Labor in Korea, and the Ministry recommended that the subway company named the Seoul Metropolitan Rapid Transit Corporation (SMRTC) investigate the prevalence of psychiatric disorders and work-related risk factors. This study was conducted under the auspices of the workers' union and the management of SMRTC. All participants were subway drivers who work for SMRTC. Among 961 subway drivers in this company, 833 drivers participated in the study (86.7 %). There was no age difference between the mean age of participants and non-participants (37.9 vs. 36.8 years). We could not obtain data concerning PUT experiences of non-participants; therefore, the reasons for non-participation were surveyed in 63 drivers. The most common reasons were "I am healthy, so it is not necessary to be surveyed" (54 %) and "I have no time to be surveyed" (27 %). We did not find any tendencies to distort the results in non-participants. Seven women drivers were excluded in the analysis because they were a small group and very newly employed. Written informed consent was obtained from all participants. This study was approved by the Institutional Review Board of St. Mary Hospital.

Diagnostic instruments of psychiatric disorders and PUT experience

The Korean version of the CIDI 2.1 (K-CIDI 2.1) was used to measure major depressive disorder, panic disorder, and PTSD. The CIDI (WHO 1990) is a fully structured diagnostic interview tool designed to make psychiatric diagnoses using the definition and criteria of the DSM-IV (American Psychiatric Association 1994). The K-CIDI was developed and validated by Cho et al. (2002) according to World Health Organization (WHO)

guidelines (WHO 1997a). The characteristics of PUT experiences (i.e., the date of PUT, whether victim died, and how many PUTs they experienced) were measured with questionnaire items.

Interviewer training

Four interviewers received a 5-day training session that included didactic sessions concerning general interview skills and the interview instruments, mock interviews, and role-playing exercises using standard protocols and training materials developed by WHO (1997b, c).

Statistical analysis

Lifetime prevalence and 1-year prevalence of major depressive disorder, panic disorder, and PTSD were examined. The standardized prevalence ratios (SPRs) of major depressive disorder, panic disorder, and PTSD in the sample of subway drivers were calculated based on the age-standardized prevalence of major depressive disorder, panic disorder, and PTSD in the 2006 Korean National Epidemiologic Survey data (Cho et al. 2010). The SPRs were calculated by dividing the observed number in subway drivers by the expected number, with a 95 % confidence interval (CI). Fisher's exact test was performed to compare the prevalence of major psychiatric disease according to the characteristics of PUT experiences. Multiple logistic regressions were used to determine which PUT characteristics were related to the prevalence of major psychiatric disease. Age, education, income, marital status, working career, and economic difficulties were adjusted. SAS version 9.3 was used for all analyses.

Results

Prevalence and SPR of major depressive disorder, PTSD, and panic disorder

Table 1 shows the sociodemographic characteristics of the survey participants. Most participants were in their 30s and 40s. Over 50 % of the participants had more than 10 years of train-driving experience. The lifetime prevalence of major depressive disorder, panic disorder, and PTSD were 2.8, 1.3, and 1.5 %, respectively (Table 2), and 1-year prevalence of these disorders was 1.3, 0.6, and 0.9 %, respectively. The SPRs for lifetime panic disorder and PTSD were 13.3 (6.6–22.4) and 2.1 (1.1–3.4), respectively. The SPR (95 % CI) for lifetime major depressive disorder was 0.8 (0.5–1.1). There were no differences between subway drivers and the general population in the SPR for 1-year major depressive disorder and PTSD.

Table 1 General characteristics of 826 subway drivers

Characteristics	Classification	n (%)
Age, year	20–29	37 (4.5)
	30–39	559 (67.7)
	40–49	190 (23.0)
	≥50	40 (4.8)
Education, year	12	148 (17.9)
	13–15	251 (30.4)
	≥16	427 (51.7)
Marital status	Never married	131 (15.9)
	Married	684 (82.8)
	Divorced/separated	11 (1.3)
Monthly income, $	2,000–2,999	277 (33.5)
	3,000–3,999	370 (44.8)
	≥4,000	179 (21.7)
Years of train driving, year	<1	43 (5.2)
	1–4	106 (12.8)
	5–9	232 (28.1)
	10–19	376 (45.5)
	≥20	69 (8.4)
Economic difficulties	No	74 (9.0)
	Sometimes	451 (54.6)
	Frequently	301 (36.4)

Major depression, panic disorder, and PTSD according to demographic factors and PUT characteristics

Table 3 shows the prevalence of major depression, panic disorder, and PTSD according to PUT characteristics. Two hundred and sixty-six drivers experienced PUT during their working careers (32.2 %). In lifetime prevalence, the drivers who experienced PUT had a higher prevalence of panic disorder and PTSD than the prevalence in those who did not experience PUT (2.6 vs. 0.7 % in panic disorder, 3.0 vs. 0.5 % in PTSD). In 1-year prevalence, only PTSD was different according to their PUT experience (2.3 vs. 0.2 % in drivers with PUT experience and those without, respectively). The recent PUT experience (within the last year) influenced the higher prevalence of 1-year PTSD. If victims' injuries were mortal, the prevalence of lifetime panic disorder was high.

Risk of major depression, panic disorder, and PTSD by PUT characteristics

Multiple logistic regressions were applied to find the odds ratio (OR) of major psychiatric disorders by PUT characteristics. Tables 4 and 5 show the ORs for the risk of major depression, panic disorder, and PTSD according to PUT experience adjusted for age, education, income, marital

Table 2 Lifetime and 1-year prevalence and SPRs of MDD, panic disorder, and PTSD in 826 subway drivers

Characteristics	Lifetime prevalence			1-Year prevalence		
	Subway drivers	National data (2006)	SPR (95 % CI)	Subway drivers	National data (2006)	SPR (95 %CI)
MDD	2.8[a]	3.6 (2.6–4.6)[b]	0.8 (0.5–1.1)	1.3	1.7 (0.9–2.5)	0.8 (0.4–1.3)
Panic disorder	1.3	0.1 (0.0–0.3)	13.3 (6.6–22.4)	0.6	–	–
PTSD	1.5	0.7 (0.3–1.1)	2.1 (1.1–3.4)	0.9	0.5 (0.3–0.7)	1.7 (0.7–3.2)

SPR standardized prevalence ratio, *MDD* major depressive disorder, 1-year panic disorder was not detected in national data

[a] Percent

[b] Percent (95 % CI)

Table 3 DSM-IV mental disorders by PUT experience of subjects

Characteristics	Classification	n	Lifetime prevalence frequency (%)			1-Year prevalence frequency (%)		
			MDD	Panic	PTSD	MDD	Panic	PTSD
PUT experience	Never	560	16 (2.9)	4 (0.7)	4 (0.5)	5 (0.9)	2 (0.4)	1 (0.2)
	Yes	266	7 (2.6)	7 (2.6)	8 (3.0)	6 (2.3)	3 (1.1)	6 (2.3)
	P value[a]		ns[b]	0.045	0.023	ns	ns	0.005
When PUT was experienced	No	560	16 (2.9)	4 (0.7)	4 (0.7)	5 (0.9)	2 (0.4)	1 (0.2)
	Over 1 year	229	6 (2.6)	6 (2.6)	7 (3.1)	5 (2.2)	2 (0.9)	5 (2.2)
	Within 1 year	37	1 (2.7)	1 (2.7)	1 (2.7)	1 (2.7)	1 (2.7)	1 (2.7)
	P value		ns	0.043	0.030	ns	ns	0.006
No. of experiences	Never	560	16 (2.9)	4 (0.7)	4 (0.7)	5 (0.9)	2 (0.4)	1 (0.1)
	1	161	4 (2.5)	5 (3.1)	6 (3.7)	4 (2.5)	3 (1.9)	4 (2.5)
	≥2	105	3 (2.9)	2 (1.9)	2 (1.9)	2 (1.9)	0 (0.0)	2 (1.9)
	P value		ns	0.037	0.012	ns	ns	0.006
Severity of victim's injury	No	560	16 (2.9)	4 (0.7)	4 (0.7)	5 (0.9)	2 (0.4)	1 (0.2)
	Not death	104	2 (1.9)	2 (1.9)	5 (4.8)	1 (1.0)	0 (0.0)	4 (3.9)
	Death	162	5 (3.1)	5 (3.1)	3 (1.9)	5 (3.1)	3 (1.9)	2 (1.2)
	P value		ns	0.037	0.008	ns	ns	0.002

PUT person under train, *MDD* major depressive disorder, *Panic* panic disorder, *PTSD* post-traumatic stress disorder

[a] By Fisher's exact test

[b] Non-significant

status, working career, and economic difficulties. In lifetime prevalence, there was a significantly higher risk for panic disorder (OR = 4.2, 95 % CI 1.2–16.6) and PTSD (OR = 4.4, 95 % CI 1.3–16.4) in subway drivers who experienced PUT than in drivers who did not experience PUT. However, in 1-year prevalence, only PTSD was highly prevalent in subjects who experienced PUT than in those who did not experience PUT (OR = 11.7, 95 % CI 1.9–225.8). Those with more recent experience (less than 1 year) and repeated experiences (more than one) did not show higher risks than the reference group. However, the drivers who experienced fatal cases of PUT had a higher prevalence of lifetime panic disorder (OR = 5.6, 95 % CI 1.4–23.8), 1-year major depressive disorder (OR = 3.9, 95 % CI 1.0–15.4), and 1-year panic disorder (OR = 8.1, 95 % CI 1.3–65.9).

Discussion

In this study, 2.8 % of the subway drivers had lifetime major depression. Lifetime prevalence of PTSD and panic disorder were 1.5 and 1.3 %, respectively. Compared to the 2006 Korean National Epidemiologic Survey (Cho et al. 2010), the lifetime prevalence of PTSD and panic disorder were higher, but the lifetime prevalence of major depression was lower, than in the general population (1.5 vs. 0.7 % in PTSD, 1.3 vs. 0.1 % in panic disorder, and 2.8 vs. 3.6 % in major depression). Generally, although psychiatric disorders are less prevalent in the working population due to the healthy worker effect, PTSD and panic disorder are highly prevalent in this group. The working environment might be a cause of the higher prevalence. Subway drivers have potential exposure to PUT when driving

Table 4 Adjusted odds ratios (95 % CI) of lifetime MDD, panic disorder, and PTSD by PUT experience

Characteristics for PUT	MDD	Panic disorder	PTSD
PUT[a] (vs. never)			
Yes	1.1 (0.4–2.7)	4.2 (1.2–16.6)	4.4 (1.3–16.4)
When PUT was experienced (vs. never)			
Over more than 1 year	1.1 (0.4–2.9)	4.3 (1.2–17.6)	4.4 (1.3–17.6)
Within 1 year	0.9 (0.1–4.6)	3.7 (0.2–27.3)	3.4 (0.2–24.9)
No. of PUT experience (vs. never)			
1	0.9 (0.3–2.6)	4.6 (1.2–19.1)	5.1 (1.4–20.2)
≥2	1.5 (0.3–5.0)	3.3 (0.4–19.1)	2.6 (0.3–15.1)
Severity of victim's injury (vs. never)			
Not death	0.7 (0.1–2.6)	2.6 (0.4–14.1)	5.7 (1.4–23.8)
Death	1.4 (0.4–3.9)	5.6 (1.4–23.8)	2.9 (0.5–13.9)

Adjusted by age, education, income, marital status, working career, and economic difficulties

[a] Person-under-train experience in their whole working career, *MDD* major depressive disorder

Table 5 Adjusted odds ratios (95 % CI) of 1-year MDD, panic disorder, and PTSD by PUT experience

Characteristics for PUT	MDD	Panic disorder	PTSD
PUT[a] (vs. never)			
Yes	2.6 (0.7–9.4)	4.2 (0.7–33.0)	11.7 (1.9–225.8)
When PUT was experienced (vs. never)			
Over more than 1 year	2.5 (0.6–9.6)	3.3 (0.4–29.1)	11.7 (1.8–229.7)
Within 1 year	3.0 (0.2–19.7)	8.0 (0.4–89.7)	12.0 (0.5–317.1)
No. of PUT experience (vs. never)			
1	2.7 (0.7–10.7)	5.8 (0.9–45.2)	13.4 (1.9–265.3)
≥2	2.2 (0.3–11.9)	–	8.7 (0.7–201.7)
Severity of victim's injury (vs. never)			
Not death	1.0 (0.1–6.3)	–	17.9 (2.5–357.4)
Death	3.9 (1.0–15.4)	8.1 (1.3–65.9)	6.6 (0.6–147.3)

Adjusted by age, education, income, marital status, working career, and economic difficulties

[a] Person-under-train experience in their whole working career, *MDD* major depressive disorder

trains. In Korea, subway drivers also experience PUT frequently. According to Seoul Metro Cooperation statistics in 2007, 363 PUT accidents occurred from 2001 to 2006. Furthermore, the currently worse economic condition in Korea may contribute to railway suicides among the general public and cause a slight increase in PUT accidents (Yum et al. 2006).

These accidents occur unexpectedly, and drivers who experience PUT suffer from psychological health problems. Table 3 shows higher lifetime and 1-year prevalence of PTSD in drivers who experienced PUT (3 and 2.3 % in lifetime and 1-year prevalence, respectively). However, considering that previous studies reported 4–17 % of the PTSD prevalences among drivers experienced PUT, this study's PTSD prevalences might be low (Cothereau et al. 2004; Farmer et al. 1992; Malt et al. 1993; Theorell et al. 1994; Weiss and Farrell 2006). This difference might be due to using different measurement tools and various evaluating times after PUT. It means that most previous studies used screening tools that make higher prevalence, and prevalence can be varied depending on evaluating time.

Furthermore, lifetime panic disorder was more prevalent in PUT-experienced drivers. One-year prevalence of major depressive disorder was high in PUT-experienced drivers, but it was not statistically significant. In the study of London subway drivers, diagnoses other than PTSD (e.g., neurotic depression and phobic state) were present in approximately 32 % of drivers (Tranah and Farmer 1994). Research has also shown that pre-existing psychopathology can be exacerbated by exposure to traumatic events and contribute to mental health problems following such exposures (Norris et al. 2002; Rubonis and Bickman 1991). This means that we should be interested in other psychiatric disorders, such as panic disorder and depression, as well as PTSD in PUT-experienced drivers. However, depression is different from PTSD in that PTSD is a kind of anxiety disorder that is directly related to stressful events, but depression generally occurs due to multiple factors, including personality traits. Therefore, the direct causality between a stressful event and depression cannot be strongly linked. Panic disorder also occurs through unexpected causes, but seldom stems from a specific stressful event. However, people who have panic disorder are very

vulnerable to stress. Therefore, although panic disorder is related to stressful events, the association seems to be weaker than that for PTSD. It is possible that the higher prevalence of panic disorder among drivers who experienced PUT is related to their vulnerability to stress.

Tables 4 and 5 show the association between PUT characteristics and major psychiatric disorders. Even after adjusting for other demographic factors, PUT experience was associated with lifetime panic disorder, lifetime PTSD, and 1-year PTSD. In particular, PUT experience was highly associated with 1-year PTSD (OR = 11.73, 95 % CI 1.90–225.84). In other PUT characteristics, drivers in the group with dead victims had a higher prevalence of lifetime panic disorder, 1-year major depressive disorder, and 1-year panic disorder than drivers in the group without PUT experience. The victim's injury severity seemed to be an aggravating factor for these psychiatric disorders. If drivers experienced a victim's death, the drivers may experience additional psychological trauma after a PUT experience. Currently, Korean drivers are investigated as a suspect by the police when they experience a victim's death. This process can also be a factor for aggravating psychiatric disorders.

In a Swedish study, drivers with two or more previous accident experiences showed the highest symptoms of distress at follow-up (Karlehagen et al. 1993). Drivers with previous PUT experience seem to worry about being involved in another PUT experience, which could aggravate their symptoms. However, in the present study, drivers with two or more PUT experiences did not have a higher risk of major psychiatric disorders than drivers with just one PUT experience. Considering that several subway drivers who had a psychiatric disorder left the company before this study, a healthy worker survivor effect seems to be shown.

The prevalence of major mental disorders was not higher in drivers who experienced PUT within 1 year than in drivers who experienced PUT more than 1 year before. In 1-year prevalence, most psychiatric disorders were more prevalent in drivers who experienced PUT in within the last year, but their risks were not statistically significant. In most studies, psychological symptoms disappeared within 1 year after a PUT experience (Cothereau et al. 2004; Theorell et al. 1994; Tranah and Farmer 1994). However, in this study, even drivers who experienced PUT more than 1 year before had a higher prevalence than the drivers without a PUT experience. Lack of proper interventions for drivers with a PUT experience might result in more long-term psychiatric problems. In addition, in previous research, it was possible to miss the cases due to short follow-up time and improper diagnosing tools. Therefore, long-term follow-up is needed to identify delayed development of psychiatric disease for drivers with a PUT

experience, and valid interview tools such as the CIDI should be applied to this kind of high-risk group.

This study has several limitations. First, in this study, we could not identify drivers in the pre-disease stage. Even though the CIDI was used to define psychiatric disorders, a screening tool for early detection and prevention should also be applied simultaneously or step by step. Second, we did not consider mediating factors such as supporting systems. Another factor involved in increased risk is the support system provided just after the accident (Limosin et al. 2006). Providing drivers who experienced a PUT with a consultation with a psychiatric physician could be an example of the support system. However, in the present study, only 4 % of drivers with PUT experience visited a psychiatric physician after the accident. Thus, we did not consider this factor because the effects of the support system could not be analyzed. Third, we did not include other possible related diseases as outcome variables (e.g., somatoform disorders, general anxiety disorders, and substance-related disorders). These conditions may also reflect reactions to severe psychosocial stressors. Future studies dealing with these diseases among subway drivers are needed. Lastly, a lower prevalence of psychiatric disorders resulted in wide CIs. So, it means the results of this study can be unstable depending on one or two cases variation. However, we used CIDI which target disease can be diagnosed correctly, but makes low prevalence of mental disease.

This study has several strengths. First, most subway drivers participated in this study (86.7 %). Second, we used CIDI, which is based on the DSM-IV and has good validity. It takes 30–90 min to administer this tool to the subject, depending on their symptoms.

The present study suggests that subway drivers have a higher prevalence of PTSD and panic disorder, and PUT experience is related to this higher prevalence. In this study, 266 subway drivers (32.2 %) had experienced PUT. It seems to be a very common occurrence considering the relatively short history of this subway company (SMRTC was founded in 1994). Nevertheless, there have been no epidemiological studies or intervention plans for the drivers. Drivers who have experienced PUT should be treated quickly, sympathetically, and sensitively for them to return to work feeling supported by psychological professionals and their colleagues. Education for the general public and establishing platform screen doors to prevent PUT are also necessary.

Conflict of interest The authors declare that they have no conflict of interest.

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