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Long-Term Psychological Outcome of Workers After Occupational Injury: Prevalence and Risk Factors

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Abstract *Introduction* This study aimed to examine the prevalence rates of both post-traumatic stress disorder (PTSD) and major depression at 12 months in workers experiencing different types of occupational injury in Taiwan. Demographic and injury-related risk factors for psychological symptoms were also evaluated. *Methods* Our study candidates were injured workers in Taiwan who were hospitalized for 3 days or longer and received hospitalization benefits from the Labor Insurance program. A two-staged survey study was conducted. A self-reported questionnaire including the Brief Symptom Rating Scale and Post-traumatic Symptom Checklist was sent to workers at 12 months after injury. Those who met the criteria were recruited for the second-stage phone interview with a psychiatrist using the Mini-international Neuropsychiatric Interview (MINI). *Results* A total of 1,233 workers completed the questionnaire (response rate 28.0 %). Among them, 167 (13.5 %) fulfilled the criteria for the MINI interview and were invited. A total of 106 (63.5 %) completed the phone interview. The estimated rate of either PTSD/PPTSD or major depression was 5.2 %. The risk factors for psychological symptoms were female gender, lower education level, loss of consciousness after occupational injury, injury affecting physical appearance, occupational injury experience before this event, life experience before and after this injury, length of hospital stay, self-rated injury severity, and percentage of income to the family. *Conclusions* These results showed that occupational injury can cause long-term psychological impact in workers. Key demographic and injury characteristics may enhance the identification of at-risk occupational injured workers who would benefit from targeted screening and early intervention efforts.

Keywords Major depression · Occupational injury · Partial post-traumatic stress disorder (PPTSD) · Post-traumatic stress disorder (PTSD) · Risk factor

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Introduction

A number of studies have addressed that natural disasters or traumatic events have been found to be associated with increased prevalence rate of psychiatric disorders, for example, post-traumatic stress disorder (PTSD), major depression, anxiety, sleep disorder, panic disorder, personality disorder, and substance abuse [1–5]. Among abundant psychiatric disorders, PTSD is the most common psychiatric disorder being studied after traumatic events or injury [6, 7].

Post-traumatic stress disorder develops after a traumatic event that involves actual or threatened death or serious injury, or a threat to physical integrity of self or others [8]. According to the Diagnostic and Statistical Manual of Mental Disorders 4th edition (DSM-IV), PTSD has three sub-forms: acute, chronic, and delayed onset. If duration of symptoms is 3 months or more, this is labeled chronic PTSD.

The prevalence rate of PTSD reported in survivors of natural disaster or traumatic events varies widely, ranging from 1.5 to 74 % [9, 10], whereas the rates of major depression in disaster survivors range from 13 to 52 % [11, 12]. Several studies showed that major depression was one of the most common psychiatric disorders occurring with PTSD [5, 13, 14].

In Taiwan, most of the extant studies on PTSD were focused on the survivors who experienced a major earthquake called Chi-Chi earthquake on September 21, 1999. Although researchers found that the prevalence rates of PTSD among survivors were gradually decreased after the earthquake [15–18], reports suggest that the psychological consequences of natural disaster or traumatic event are long lasting [19–22]. These studies also found that the risk factors of PTSD or other psychiatric disorders after the Chi-Chi earthquake were female, serious destruction of property, personality characteristics of nervousness, elderly, lower educational level, and previous traumatic experiences.

Previous study conducted by our research group found that the estimated rates of PTSD, PPTSD, major depression, and comorbid PTSD/PPTSD and major depression were 2.7, 4.1, 3.0, and 2.3 %, respectively, among injured workers from the same cohort in this study 3 months after occupational injury in Taiwan [23]. Although a decrease in the prevalences of PTSD in survivors over time has been studied after Chi-Chi earthquake, however, to the best of our knowledge, no study on the occurrence rates of chronic psychiatric disorders had been conducted after occupational injuries in Asian workers. Thus, the objectives of this study were to examine the prevalence rates of both PTSD and major depression at 12 months in workers after occupational injury in Taiwan and to evaluate the association between risk factors and the occurrence of psychological symptoms. We hypothesized that the rates of psychiatric disorders would decrease at 12 months after injury.

Methods

Between February 1 and August 31, 2009, a total of 4,403 workers who were hospitalized for 3 days or longer and received the Inpatient Hospitalization Benefit portion of Occupational Accident Medical Benefits from Labor Insurance program were utilized as subjects. The subjects were recruited consecutively. This study was approved by the Institutional Review Board of the National Taiwan University Medical Center.

This study was a two-stage investigation. The details of the first stage of investigation were previously reported [23]. Briefly, the first stage involved a self-reported questionnaire including demographics, the Brief Symptom Rating Scale (BSRS-50), and the Post-traumatic Symptom Checklist (PTSC) for screening of mental conditions. The demographic part was designed by psychiatrists, a psychologist, and public health professionals to inquire about risk factors, including family history of psychiatric disorder, life events before and after the occupational injury, and financial burden as well as individual characteristics such as gender, age, and marital and educational status. The self-reported questionnaire with a cover letter explaining the purpose of our study was sent to the homes of all subjects at 12 months after injury. Completion and return of the questionnaire was considered the subject's consent to participate. However, if a subject did not respond to the questionnaire, we tried to make contact by phone, invited the subject to participate, and obtained oral informed consent after full explanation of the study procedures. At least 3 tries were made to encourage the study subjects before giving up. When the questionnaire was incompletely answered, a phone interview was performed to complete all questions. The candidates for the second-stage phone interview by Mini-international Neuropsychiatric Interview (MINI) received such interview within 2 weeks of the first-stage questionnaire screening. In this study, psychiatrists used the Taiwanese version of the MINI to assess the prevalence of different psychiatric disorders (including PTSD, suicidality within 1 month, and current major depression within 2 weeks). For the second-stage phone interview by psychiatrists using the MINI, we recruited those participants fulfilling the following criteria: (1) those with a general severity index (GSI) score for the BSRS of 2 standard deviations above the norm (i.e., 70) or higher, (2) those who had any item of PTSC reported at the "severe" level or higher, or (3) those who had any 2 items of PTSC reported at "moderate" levels or higher.

The BSRS-50 consists of a 50-item self-report rating scale that is used to measure 10 psychophysiological symptom groups and has been tested in Taiwan. The test–retest reliability coefficients ranged from 0.73 to 0.91. The rate of accurate classification for psychiatric and non-psychiatric cases was 75.8 %, with a sensitivity of 66.7 % and a specificity of 86.7 % [24]. For the BSRS, an adjusted T score was determined in accordance with a previous study to examine the severity of psychological symptoms in injured workers [25]. A T score of 50 was considered identical to the mean of the reference group, and the standard deviation (SD) was set at 10. A general severity index (GSI) score of greater than or equal to two SDs higher than the mean score of the reference group (i.e., GSI $\geq$ 70) was considered psychologically severe.

The PTSC is a 3-item checklist for quick screens of PTSD symptoms in the past one week, corresponding to the DSM-IV symptom clusters of PTSD, namely reexperiencing, numbness, and hyperarousal [8]. These items are "Has encountering a reminder of the injury event caused physical discomfort (including sweating, tremor, racing heart, tachypnea, nausea, or diarrhea)," "have you been unable to have sad or happy feeling after this event," and "have you become easily startled after this event?" The response to each item is rated on a five-point Likert scale, namely 0 (*no*), 1 (mild), 2 (moderate), 3 (severe), and 4 (very severe). The internal consistency of the PTSC as measured by Cronbach's α was 0.78, with a sensitivity of 89.5 % and a specificity of 98.8 % [23]. Respondents were asked to refer to the traumatic event caused at work.

The MINI, a short structured diagnostic interview instrument, has been used to evaluate the presence of DSM-IV and ICD-10 psychiatric disorders with a test–retest reliability of 0.75, sensitivity of 0.70 or higher, and specificity of 0.85 or higher [26]. Using data from the PTSD module of the MINI, the criteria for PTSD were defined as follows: (1) one positive response to the symptom of intrusion item; (2) at least three out of six symptoms of avoidance/numbing items; (3) at least two out of five symptoms of hyperarousal items; and (4) the presence of distress and impairment. Subjects who did not meet these criteria for PTSD but who endorsed the presence of a combination of two of the three clusters (intrusion, avoidance/numbing, hyperarousal) and endorsed distress or impairment were considered to have PPTSD. A previous study had defined partial PTSD (PPTSD) as the presence of a combination of two of the three criteria-B, C, and D [27].

All statistical analyses were conducted with JMP 5.0 (SAS Institute Inc.). The descriptive statistics were used to examine the prevalence rate of PTSD and other psychiatric disorders, the background demographic characteristics, and exposure characteristics among workers after occupational injury. The occurrence rates of psychiatric disorders at 12 months after the occupational injuries were estimated by multiplying the percentage of high scores in BSRS or the PTSC by the percentage diagnosed as having psychiatric disorders by the MINI interview among those who participated in the MINI interviews. The occurrence rates of psychiatric disorders at 12 months in a specific type (e.g., fracture) of occupational injuries were estimated by multiplying the percentage of high scores in the BSRS or PTSC in a specific type of occupational injuries by the percentage diagnosed as having psychiatric disorders by the MINI interview in that type of occupational injuries. The standard errors of estimated rates were estimated by the square root of p(1-p)/n, where p is an estimate proportion and n is total number of subjects. In order to test the difference in estimated rates of psychiatric disorders between workers sustaining intracranial injury and non-intracranial injuries, the test statistic is the 95 % confidence interval of the difference proportion P1 and proportion P2, which is the 95 % CI of $P1 - P2 = p1 - p2 + - 1.96 * \text{sqrt}(p1(1 - p1)/n1 + p2(1 - p2)/n2)$. Differences were considered significant if the confidence interval did not contain 0. Chi-square tests and one-way analysis of variance were used to analyze group differences. Linear regression model and logistic regression model were used for calculating the measures of association between risk factors and the occurrence of psychological symptoms. Differences were considered significant if the *P* value was smaller than 0.05.

Results

At the time of the survey 12 months after occupational injury, a total of 1,233 injured workers completed the first stage of investigation, with a response rate of 28.0 %. A total of 3,170 (72.0 %) of the injured workers did not complete the questionnaire survey. While we tried to contact them by phone, 1,739 (39.5 %) did not answer the phone, 1,035 (23.5 %) refused to answer the questionnaire, and 396 (9.0 %) could not be reached because we had the wrong phone number. Among those who completed the questionnaire, the majority were males (71.5 %) and the average age was 42 years (SD = 11.8). Most were married (64.1 %) and had an education level of high school or above (43.6 %). Moreover, the majority had no family history of psychiatric morbidity (99.4 %) and no previous occupational injury experience before this event (86.2 %). The average percentage of family income contributed by the injured worker before injury was 64.2 %. Regarding injury-related variables, the most frequent type of occupational injury was fracture (56.6 %), followed by intracranial injury (12.1 %), open wound of upper limb injury (6.8 %), etc. Most of the subjects did not lose

Table 1 Characteristics of injured workers who completed the questionnaire (total = 1,233)

Characteristics	*N*	%
Gender		
Female	352	28.5
Male	881	71.5
Age (years)	(Mean ± SD)	42.6 ± 11.8
17–29	214	17.3
30–44	456	37.0
45–59	476	38.6
≧60	87	7.1
Education		
Elementary school or below	143	11.6
Junior high school	231	18.7
High school	537	43.6
College or above	322	26.1
Marital status		
Single	324	26.2
Married	814	64.1
Divorced/separated/widowed	95	7.7
Family history of psychiatric morbidity		
Yes	8	0.6
No	1,225	99.4
% of family income contributed by the injured worker before injury (mean ± SD)	64.2	29.3
Previous occupational injury experience before this event		
Yes	170	13.8
No	1,063	86.2
Related to this injury		
Injury types		
Fracture	698	56.6
Intracranial injury	149	12.1
Open wound of upper limbs	84	6.8
Crushing injury	64	5.4
Burns	27	2.2
Others[a]	208	16.9
Loss of consciousness as a result of this injury		
Yes	187	15.2
No	1,046	84.8
Self-rated severity		
Minor	196	15.9
Moderate	423	34.3
Serious	233	18.9
Severe	248	20.1
Critical	133	10.8
Length of hospital stay after injury, days		
Immediately after injury (mean ± SD)	9.8	11.6
Total for 12 months (mean ± SD)	13.5	23.2
Whether this injury affected physical appearance		
Yes, minor	535	43.4
Yes, major	235	19.0
No	463	37.6
Previous occupational injury experience before this event		
Yes	170	13.8
No	1,063	86.2
Life event within one month before this injury		
Yes	34	2.8
No	1,199	97.2
Life event in the one-year follow-up period after this injury		
Yes	206	16.7
No	1,027	83.3

[a] Including dislocation, sprain and strain of joints and ligaments, cellulitis, traumatic amputation, injury of muscle and tendon, injury of nerves or superficial injury

consciousness as a result of their injury (84.8 %) and had a serious injury severity or above. The average length of hospital stay immediately after injury was about 9 days, and the average total length of stay in 12 months was about 14 days. Furthermore, about 62 % of the injured workers believed the injury affected their physical appearance, 97.2 % had no life event within one month before this injury, and 83.3 % had no life event after this injury (Table 1).

Approximately 10.5 % of the participants scored 70 or higher on the BSRS-50, and the most important psychophysiological symptoms were psychoticism, paranoid ideation tendency, and phobic anxiety. Approximately 9.9 % fulfilled the criteria of the PTSC, and the most frequently reported symptoms were "physical discomfort (including sweating, tremor, racing heart, tachypnea, nausea, or diarrhea) caused by encountering a reminder of the injury event and becoming easily startled." A total of 167 (13.5 %) scored high on either the BSRS-50 or PTSC and were candidates for a phone interview. Among these candidates, 105 respondents (63.5 %) completed the MINI interview. Among the 61 injured workers who did not complete the second-stage interview, 36 (58.4 %) did not answer the phone, 19 refused to participate in the interview (31.1 %), and 6 (10.5 %) could not be reached because we had the wrong phone numbers. The responders and non-responders to the MINI had similar scores in the BSRS-50 and PTSC.

Among the 106 workers who completed the MINI interview at 12 months after their occupational injury, the

Table 2 Prevalence rates of psychiatric disorders among Mini-international Neuropsychiatric Interview (MINI) interviewees and estimated prevalence rates of psychiatric disorders 12 months after occupational injuries

Psychiatric disorders	MINI interviewees ($N = 106$)		% with high score in screening by BSRS and PTSC	Estimated rates ($N = 1,233$)
	N	% (95 % CI)		% (95 % CI)
Post-traumatic stress disorder	25	23.6 (16.1, 31.1)	13.5	3.2 (2.2, 4.2)
Partial post-traumatic stress disorder	15	14.2 (7.6, 20.8)		1.9 (1.1, 2.7)
Major depression	16	15.1 (8.3, 21.9)		2.0 (1.2, 2.8)
Both PTSD/PPTSD and major depression	16	15.1 (8.3, 21.9)		2.0 (1.2, 2.8)
Either PTSD/PPTSD or major depression	40	37.7 (28.5, 46.9)		5.1 (3.9, 6.3)

BSRS brief symptom rating scale; *PTSC* post-traumatic symptom checklist; *PTSD* post-traumatic stress disorder; *PPTSD* partial post-traumatic stress disorder

prevalence rates of PTSD, PPTSD, major depression, and comorbid PTSD/PPTSD and major depression were 23.6, 14.2, 15.1, and 15.1 %, respectively (Table 2). Since 13.5 % of injured workers scored high in the first-stage screening, the estimated rates of PTSD, PPTSD, major depression, and comorbid PTSD/PPTSD and major depression of the 1,233 injured workers were 3.2, 1.9, 2.0, and 2.0 %, respectively (Table 2).

In addition, the estimated rates of either PTSD/PPTSD or major depression among workers suffered from intracranial injury, burn, fracture, open wound of upper limbs, and crushing injury were 9.6, 7.4, 4.8, 1.6, and 0 %, respectively (Table 3). Comparison of the rates of either PTSD/PPTSD or major depression occurring after intracranial injuries to those after non-intracranial injuries showed that the former were significantly higher than those occurring after non-intracranial injuries.

Table 4 showed that female, lower education level, loss of consciousness after occupational injury, injury severely affecting physical appearance, occupational injury experience before this event, and life experience before and after this injury significantly increased the risk of psychiatric morbidity and post-traumatic stress symptoms. Furthermore, after adjusting for all possible risk factors (gender, age, education, marital status, family history of psychiatric morbidity, loss of consciousness, injury affected physical appearance, occupational injury experience before this event, and life experience before and after this injury), longer length of hospital stay, self-reported injury severity, and higher percentage of income to the family significantly turned out to be risk factors of increasing BSRS score and PTSC score (Table 5). These are the important factors that increased the occurrence of psychological symptoms among injured workers at 12 months after occupational injury.

Discussion

Despite the knowledge that PTSD and major depression are common psychiatric sequels following occupational injury [28, 29], this is the first study on the long-term psychological impact of occupational injury on the Asian workers. This study found that the prevalence rates of PTSD, PPTSD, major depression, and comorbid PTSD/PPTSD and major depression at 12 months after injury were 3.2, 1.9, 2.0, and 2.0 %, respectively. As a total, 5.1 % suffered from any of these chronic psychiatric disorders.

Table 3 Estimated prevalence rates of psychiatric conditions 12 months after different occupational injuries

Mental condition	Fracture ($N = 698$)	Intracranial injury ($N = 149$)	Open wound of upper limbs ($N = 84$)	Crushing injury ($N = 67$)	Burns ($N = 27$)
% with high score in screening by BSRS and PTSC	14.7	16.1	9.5	10.4	7.4
	Prevalence, % (95 % CI)	Prevalence, % (95 % CI)	Prevalence, % (95 % CI)	Prevalence, % (95 % CI)	Prevalence, % (95 % CI)
PTSD	2.6 (1.4, 3.8)	7.5 (3.3, 11.7)	1.6 (−1.1, 4.3)	0	3.7 (−3.4, 10.8)
PPTSD	2.2 (1.1, 3.3)	2.1 (−0.2, 4.4)	0.0	0	3.7 (−3.4, 10.8)
Major depression	1.7 (0.8, 2.6)	4.3 (1.0, 7.6)	1.6 (−1.1, 4.3)	0	3.7 (−3.4, 10.8)
(PTSD/PPTSD and major depression)	1.7 (0.8, 2.6)	4.3 (1.0, 7.6)	1.6 (−1.1, 4.3)	0	3.7 (−3.4, 10.8)
Either PTSD/PPTSD or major depression	4.8 (3.2, 6.4)	9.6[a] (4.9, 14.3)	1.6 (−1.1, 4.3)	0	7.4 (−2.5, 17.3)

BSRS brief symptom rating scale; *PTSC* post-traumatic symptom checklist; *PTSD* post-traumatic stress disorder; *PPTSD* partial post-traumatic stress disorder

[a] Significantly different from those after non-intracranial injuries ($P = 0.01$)

Table 4 Risk factors of psycho-physiological symptoms and post-traumatic stress disorder symptoms by BSRS and PTSC in multiple logistic regression model

Variables	*N*	No. of high GSI in BSRS (%)[a]	No. of positive PTSC (%)[b]	BSRS aOR (95 % CI)[c]	PTSC aOR (95 % CI)[c]
Gender					
Female	352	43 (12.2)	46 (13.0)	1.1 (0.7–1.7)	1.5 (1.1–2.3)*
Male	881	86 (9.7)	76 (8.6)	1.0	1.0
Age (years)					
17–29	214	23 (10.7)	24 (11.2)	1.0	1.0
30–44	456	58 (12.7)	47 (10.3)	1.2 (0.7–2.1)	0.9 (0.5–1.4)
45–59	476	37 (7.7)	37 (7.8)	0.7 (0.4–1.2)	0.7 (0.4–1.2)
≧60	87	11 (12.6)	14 (16.0)	1.2 (0.5–2.5)	1.5 (0.7–3.1)
Education					
Elementary school or lower	143	21 (14.7)	21 (14.7)	1.9 (1.0–3.4)*	1.6 (0.9–2.8)
Junior high school	231	16 (6.9)	17 (7.4)	1.2 (0.7–2.1)	0.7 (0.4–1.3)
High school	537	61 (11.3)	52 (9.7)	1.3 (0.8–2.2)	1.1 (0.6–1.7)
College or above	322	31 (9.6)	32 (9.9)	1.0	1.0
Marital status					
Single	324	33 (10.1)	37 (11.4)	1.0	1.0
Married	814	85 (10.4)	72 (8.8)	1.0 (0.6–1.4)	0.7 (0.4–1.4)
Divorced/separated/widowed	95	11 (11.6)	13 (13.7)	1.4 (1.1–4.0)	1.1 (0.4–2.8)
Family history of psychiatric morbidity					
Yes	8	2 (25.0)	2 (25.0)	1.7 (0.2–9.3)	2.0 (0.3–10.5)
No	1,225	127 (10.4)	120 (9.8)	1.0	1.0
Loss of consciousness after occupational injury					
Yes	187	36 (19.2)	35 (18.7)	2.1 (1.3–3.4)*	2.2 (1.3–3.4)*
No	1,046	93 (8.9)	87 (8.3)	1.0	1.0
Injury affecting physical appearance					
Yes	770	111 (14.4)	104 (13.5)	3.8 (2.3–6.7)*	3.6 (2.2–6.3)*
No	463	18 (3.9)	18 (3.9)	1.0	1.0
Previous occupational injury experience before this event					
Yes	170	21 (12.3)	24 (14.1)	1.4 (0.8–2.3)	1.9 (1.1–3.1)*
No	1,063	108 (10.2)	98 (9.2)	1.0	1.0
Life event within one month before this injury					
Yes	34	5 (14.7)	10 (29.4)	1.5 (0.5–3.6)	2.5 (1.0–5.7)*
No	1,199	124 (10.3)	112 (9.3)	1.0	1.0
Life event in the one-year follow-up period after this injury					
Yes	206	56 (27.2)	48 (23.3)	4.5 (2.9–6.7)*	3.1 (2.0–4.7)*
No	1,027	73 (7.1)	74 (7.2)	1.0	1.0

BSRS brief symptom rating scale; *PTSC* post-traumatic symptom checklist

* $P < 0.05$

[a] General severity index (GSI) score for the BSRS of 2 standard deviations above the norm or higher

[b] Any item of PTSC reported at the "severe" level or higher or had any 2 items of PTSC reported at "moderate" levels or higher

[c] *aOR* adjusted OR. Adjusted for all above variables

The occurrence rates of PTSD/PPTSD and depression 12 months after occupational trauma found in this study were lower than previously reported in Western countries. O'Donnell et al. [13] found that the prevalence of PTSD and major depression 12 months after physical injury requiring admission to a trauma service in Australia were 10.4 and 10.1 %, respectively. On the other hand, Shih et al. [5] reported that the rates of PTSD and major depression among 677 individuals experiencing different types of trauma were 28 and 29 %. Comparison with the current study showed that the prevalence of PTSD and major depression was higher than the rates found in this study. Injury severity and injury

Table 5 Risk factors of psycho-physiological symptoms and post-traumatic stress disorder symptoms by BSRS and PTSC in linear regression model

Variables	BSRS score		PTSC score	
	β^a	*P* value	β^a	*P* value
Gender (female vs. male)	1.2	0.02	1.5	0.05
Age	0.01	0.7	0.02	0.9
Education (elementary school vs. other)	1.0	0.2	0.08	0.3
Marital status (divorced/separated/widowed vs. other)	1.3	0.2	0.1	0.1
Family history of psychiatric morbidity (yes vs. no)	6.7	0.02	0.9	0.01
Loss of consciousness (yes vs. no)	3.6	<0.0001	0.5	<0.0001
Injury affecting physical appearance (yes vs. no)	3.7	<0.0001	0.5	<0.0001
Previous occupational injury experience before this event (yes vs. no)	1.1	0.08	0.09	0.2
Life event within one month before this injury (yes vs. no)	2.5	0.07	0.3	0.09
Life event in the one-year follow-up period after this injury (yes vs. no)	6.2	<0.0001	0.7	<0.0001
Length of hospital stay				
After injury	0.2	<0.0001	0.02	<0.0001
Total (until now)	0.1	<0.0001	0.01	0.0001
Self-rated injury severity	3.0	<0.0001	0.4	<0.0001
% of family income contributed by the injured worker before injury	0.03	0.08	0.004	0.01

BSRS brief symptom rating scale; *PTSC* post-traumatic symptom checklist

[a] Adjusted for all above variables

type may contribute significantly to prevalence differences. Participants in the study of O'Donnell et al. had a longer average length of stay, 10.13 days (SD = 9.64), in the Trauma Center; moreover, 56 % of the participants met criteria for a mild traumatic brain injury. On the other hand, in the study of Shih et al., 48 % of the participants reported losing consciousness as a result of their injury. Compared with the participants in the previous study, length of hospital stay after injury 12.1 % of the subjects in our study suffered intracranial injury, 15.2 % of the subjects had loss of consciousness as a result of the injury, and they had an average length of stay immediately after the injury, 9.8 days (SD = 11.6). Furthermore, the lower rates found in this study might be attributed to the general lower prevalence rates of PTSD and any psychiatric disorders in Asian countries [30–32], comparing with the western countries [33–36]. It was believed that Asian people still have the impression that psychiatric disorders carry a stigma, which makes them hesitate to search for optimal treatment. Therefore, the lower prevalence rates of PTSD and major depression in Taiwan possibly resulted from methodological, cultural, and social factors as well as cross-national differences.

While comparing with the previous study that found out the estimated rates of PTSD, PPTSD, major depression, and comorbid PTSD/PPTSD and major depression were 2.7, 4.1, 3.0, and 2.3 %, respectively, among injured workers 3 months after occupational injury in Taiwan [23], this study found that the estimated rates of PTSD, PPTSD, major depression, and comorbidity were gradually decreased after the injury; however, PTSD, major depression, and comorbidity were still prevalent 12 months after occupational injury. In addition, the rate of PTSD at 12 month after the injury was slightly higher than the rate found in 3 months. Some psychological symptoms may not yet have developed because of a lack of exposure to trauma triggers. In this case, trauma triggers could be return to work. After returning to work, the symptoms of avoidance would make injured workers afraid of working at worksite where injury took place, even afraid of going to work because of phobia, which might increase the severity of PTSD symptoms [37]. Besides, the rate of PPTSD was dramatically decreased from 4.1 to 1.8 %. This result might be attributed to the increased rate of PTSD, which means those participants with PPTSD might become more severe which turns into the development of PTSD. Another reason could be delay onset. According to DSM-IV, delayed-onset PTSD does not develop until at least 6 months after trauma [8].

Moreover, in this study, we found that the estimated rates of either PTSD/PPTSD or major depression in workers with intracranial injury were higher than workers with non-intracranial injuries (fracture, open wound of upper limbs, crushing injury, and burns) at 12 months after the injury. Previous study has documented workers sustaining intracranial injuries did have a higher risk of having psychiatric disorders 3 months after injury as compared with those sustaining non-intracranial injuries [23]. Individuals with TBI seemed had higher risk of developing a psychiatric disorder after the injury because of cognitive and severe physical impairment [38, 39].

Another finding of this study was that the risk factors for psycho-physiological symptoms and PTSD symptoms were female, lower education level, loss of consciousness after occupational injury, injury affecting physical appearance, occupational injury experience before this event, life experience before and after this injury, the length of hospital stay, self-reported injury severity, and percentage of income to the family significantly. Several studies reported that female sex, elderly, low education level, divorced/separated/widowed marital status, number of previous traumatic experiences, and lower income were significantly predicted PTSD and other psychiatric disorders after traumatic events [5, 10, 17, 22, 40–42]. This study, however, did not show the tendency of elderly and divorced/separated/widowed marital status as significant risk factors for psycho-physiological symptoms and PTSD symptoms. Additionally, loss of consciousness after occupational injury, injury severely affecting physical appearance, having occupational injury experience before this event, longer length of hospital stay, injury severity, and percentage of income to the family were also the important factors that significantly increased the likelihood of psycho-physiological symptoms and PTSD symptoms.

These results indicate the importance of providing aftercare to address the mental health problems of injured workers. Effective interventions would treat injured workers with PTSD and major depression, and these conditions would be less likely to become chronic conditions with early treatment. Based on the approximately 14,000 workers who received inpatient benefits due to occupational injuries annually in Taiwan, we calculated that 5.1 %, or 714 workers may still have a likely need for the treatment of either PTSD, PPTSD, or major depression at 12 months after the injury, using the 12 months prevalence rate data in this study. In addition, results identified risk factors that can help with early identification of workers at greatest risk of requiring subsequent mental health services. Screening programs administered as early as possible after injury could monitor the psychological needs of injured workers and could be targeted to those who appear to be at greatest risk of developing chronic psychiatric disorders after the injury. We should note that longer length of hospital stay is highly correlated with more severe injury. Although screening programs may appear costly in terms of finances and resources, some evidence suggests that these conditions, if left undiagnosed and untreated, have high societal costs [43, 44].

Several limitations in this study should be noted. First, the response rate to the questionnaire was low. It is possible that those who were still hospitalized, those who suffered from severe occupational injuries, or those with more severe psychological distress had more difficulty responding to the questionnaire survey. This may lead to a bias toward underestimation of the psychiatric conditions in this study. However, the gender proportion and types of injuries were similar between those completed the questionnaire and those who did not. The scores of the BSRS and PTSC were not different between respondents and non-respondents. Therefore, the possible underestimation and problematic representativeness might not be very serious. In addition, to minimize the selection bias of HWE, among those who did not respond to the questionnaire, we had randomly selected and invited 40 injured workers to participate in the MINI interview at 12 months after occupational injury. As a result, among 40 injured workers completed MINI interview, only one of them (2.5 %) suffered from PTSD and another one (2.5 %) suffered from major depression. The occurrence rates of psychiatric disorders among randomly selected non-respondents were comparable to the estimated rates we found in the respondents. Although the response rate was low, the results of this study, which includes a large sample of injured workers, can serve as a practical assessment for identifying those at risk of psychiatric disorders. Second, the study is lack of a control group (of non-injured workers) who might provide an estimate of the base rate of psychiatric disorders in the underlying population. To the best of our knowledge, no investigation on PTSD after non-occupational injuries is available in Taiwan for comparison. On the other hand, major depression lifetime prevalence was estimated to be 1.14 % by Compton et al. [33] using integrated data sets from the National Institute of Mental Health Epidemiologic Catchment Area survey and the Taiwan Psychiatric Epidemiological Project according to DSM-III criteria. Our observed prevalence rate of major depression at one point (2.0 %) was much higher than the lifetime prevalence in the general population. Thus, despite lacking of direct comparisons in mental conditions, higher risk of developing psychiatric disorders was quite likely after occupational injuries. Third, workers who were not covered by the Labor Insurance Hospitalization Benefits portion of the Occupational Accident Medical Benefits were not included as candidates for participation. Forth, because the MINI survey was conducted by phone interview and not by face-to-face evaluation by a psychiatrist, the observed morbidity was only based on epidemiological criteria.

In conclusion, a significant proportion of workers suffered from chronic psychiatric disorders at 12 months after occupational injury. The prevalence rates varied significantly among different types of injuries, with the highest rate after intracranial injuries. Risk factors identified in this study may be useful indicators of subsequent PTSD or major depression for clinicians in early identification efforts. Development of an early intervention program to detect and manage chronic psychiatric disorders following occupational injuries is warranted.

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References

1. Rubonis AV, Bickman L. Psychological impairment in the wake of disaster: the disaster–psychopathology relationship. Psychol Bull. 1991;109:384–99.
2. Maj M, Starace F, Crepet P, Lobrace S, Veltro F, De Marco F, et al. Prevalence of psychiatric disorders among subjects exposed to a natural disaster. Acta Psychiatr Scand. 1989;79:544–9.
3. Goenjian AK, Steinberg AM, Najarian LM, Fairbanks LA, Tashjian M, Pynoos RS. Prospective study of posttraumatic stress, anxiety, and depressive reactions after earthquake and political violence. Am J Psychiatry. 2000;157:911–6.
4. Dersh J, Gatchel RJ, Polatin P, Mayer T. Prevalence of psychiatric disorders in patients with chronic work-related musculoskeletal pain disability. J Occup Environ Med. 2002;44:459–68.
5. Shih RA, Schell TL, Hambarsoomian K, Belzberg H, Marshall GN. Prevalence of posttraumatic stress disorder and major depression after trauma center hospitalization. J Trauma. 2010;69:1560–6.
6. North CS, Nixon SJ, Shariat S, Mallonee S, McMillen JC, Spitznagel EL, et al. Psychiatric disorders among survivors of the Oklahoma City bombing. JAMA. 1999;282:755–62.
7. Norris FH, Friedman MJ, Watson PJ. 60,000 disaster victims speak: part II. Summary and implications of the disaster mental health research. Psychiatry. 2002;65:240–60.
8. Diagnostic and statistical manual of mental disorder. 4th ed. (DSM-IV). American Psychiatry Association; 1994. p. 427–9.
9. Garrison CZ, Bryant ES, Addy CL, Spurrier PG, Freedy JR, Kilpatrick DG. Posttraumatic stress disorder in adolescents after Hurricane Andrew. J Am Acad Child Adolesc Psychiatry. 1995;34:1193–201.
10. Goenjian AK, Najarian LM, Pynoos RS, Steinberg AM, Manoukian G, Tavosian A, et al. Posttraumatic stress disorder in elderly and younger adults after the 1988 earthquake in Armenia. Am J Psychiatry. 1994;151:895–901.
11. Goenjian A. A mental health relief programme in Armenia after the 1988 earthquake. Implementation and clinical observations. Br J Psychiatry. 1993;163:230–9.
12. Armenian HK, Morikawa M, Melkonian AK, Hovanesian A, Akiskal K, Akiskal HS. Risk factors for depression in the survivors of the 1988 earthquake in Armenia. J Urban Health. 2002;79:373–82.
13. O'Donnell ML, Creamer M, Pattison P, Atkin C. Psychiatric morbidity following injury. Am J Psychiatry. 2004;161:507–14.
14. Maes M, Mylle J, Delmeire L, Altamura C. Psychiatric morbidity and comorbidity following accidental man-made traumatic events: incidence and risk factors. Eur Arch Psychiatry Clin Neurosci. 2000;250:156–62.
15. Hsu CC, Chong MY, Yang P, Yen CF. Posttraumatic stress disorder among adolescent earthquake victims in Taiwan. J Am Acad Child Adolesc Psychiatry. 2002;41:875–81.
16. Guo YJ, Chen CH, Lu ML, Tan HK, Lee HW, Wang TN. Posttraumatic stress disorder among professional and non-professional rescuers involved in an earthquake in Taiwan. Psychiatry Res. 2004;127:35–41.
17. Yang YK, Yeh TL, Chen CC, Lee CK, Lee IH, Lee LC, et al. Psychiatric morbidity and posttraumatic symptoms among earthquake victims in primary care clinics. Gen Hosp Psychiatry. 2003;25:253–61.
18. Chou HC, Wu HC, Chou P, Su CY, Tsai KY, Chao SS, et al. Epidemiologic psychiatric studies on post-disaster impact among Chi-Chi earthquake survivors in Yu-Chi, Taiwan. Psychiatry Clin Neurosci. 2007;61:370–8.
19. Wu HC, Chou P, Chou FH-C, Su CY, Tsai KY, Ou-Yang WC, et al. Survey of quality of life and related risk factors for a Taiwanese village population 3 years post-earthquake. Aust N Z J Psychiatry. 2006;40:355–61.
20. Bland SH, O'Leary ES, Farinaro E, Jossa F, Trevisan M. Long-term psychological effects of natural disasters. Psychosom Med. 1996;58:18–24.
21. Fleminger S. Long-term psychiatric disorders after traumatic brain injury. Eur J Anaesthesiol Suppl. 2008;42:123–30.
22. Chen CHTK, Laio LR, Chen HH, Chan CC, Cheng JJS, Chen CY, Wang TN, Lu ML. Long-term psychological outcome of 1999 Taiwan earthquake survivors: a survey of a high-risk sample with property damage. Compr Psychiatry. 1999;2007(48):269–75.
23. Lin KH, Guo NW, Liao SC, Kuo CY, Hu PY, Hsu JH, et al. Psychological outcome of injured workers at 3 months after occupational injury requiring hospitalization in Taiwan. J Occup Health. 2012 (epub ahead of print).
24. Lee MB, Lee YJ, Yen LL. Reliability and validity of using a brief psychiatric symptom rating scale in clinical practice. J Formos Med Assoc. 1990;89:1081–7.
25. Lee MB, Lee YJ. A cross-sectional epidemiological study of psychiatric comorbidity in hospitalized medically ill. Chin Psychiatry. 1990;4:10–26.
26. Shalev AY, Freedman S, Peri T, Brandes D, Sahar T, Orr SP, et al. Prospective study of posttraumatic stress disorder and depression following trauma. Am J Psychiatry. 1998;155:630–7.
27. Blanchard EB, Hickling EJ, Taylor AE, Loos W. Psychiatric morbidity associated with motor vehicle accidents. J Nerv Ment Dis. 1995;183:495–504.
28. Asmundson GJ, Norton GR, Allerdings MD, Norton PJ, Larsen DK. Post-traumatic stress disorder and work-related injury. J Anxiety Disord. 1998;12:57–69.
29. MacDonald HA, Colotla V, Flamer S, Karlinsky H. Post-traumatic stress disorder (PTSD) in the workplace: a descriptive study of workers experiencing PTSD resulting from work injury. J Occup Rehabil. 2003;13:63–77.
30. Chien IC, Chou YJ, Lin CH, Bih SH, Chou P. Prevalence of psychiatric disorders among National Health Insurance enrollees in Taiwan. Psychiatr Serv. 2004;55:691–7.
31. Jeon HJ, Suh T, Lee HJ, Hahm BJ, Lee JY, Cho SJ, et al. Partial versus full PTSD in the Korean community: prevalence, duration, correlates, comorbidity, and dysfunctions. Depress Anxiety. 2007;24:577–85.
32. Chen CN, Wong J, Lee N, Chan-Ho MW, Lau JT, Fung M. The Shatin community mental health survey in Hong Kong. II. Major findings. Arch Gen Psychiatry. 1993;50:125–33.
33. Compton WM 3rd, Helzer JE, Hwu HG, Yeh EK, McEvoy L, Tipp JE, et al. New methods in cross-cultural psychiatry: psychiatric illness in Taiwan and the United States. Am J Psychiatry. 1991;148:1697–704.
34. Breslau N, Peterson EL, Poisson LM, Schultz LR, Lucia VC. Estimating post-traumatic stress disorder in the community: lifetime perspective and the impact of typical traumatic events. Psychol Med. 2004;34:889–98.
35. Marshall RD, Olfson M, Hellman F, Blanco C, Guardino M, Struening EL. Comorbidity, impairment, and suicidality in subthreshold PTSD. Am J Psychiatry. 2001;158:1467–73.
36. Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CB. Posttraumatic stress disorder in the National Comorbidity Survey. Arch Gen Psychiatry. 1995;52:1048–60.
37. Mason S, Wardrope J, Turpin G, Rowlands A. Outcomes after injury: a comparison of workplace and nonworkplace injury. J Trauma. 2002;53:98–103.

38. Warriner EM, Rourke BP, Velikonja D, Metham L. Subtypes of emotional and behavioural sequelae in patients with traumatic brain injury. J Clin Exp Neuropsychol. 2003;25:904–17.
39. Eslinger PJ, Zappala G, Chakara F, Barrett AM. Cognitive impairments after TBI. In: Zasler ND, Katz DI, Zafonte RD, editors. Brain injury medicine: principles and practice. New York: Demo Medical Publishing; 2007. p. 779–90.
40. Lai TJ, Chang CM, Connor KM, Lee LC, Davidson JRT. Full and partial PTSD among earthquake survivors in rural Taiwan. J Psychiatr Res. 2003;38:313–22.
41. Chang CM, Connor KM, Lai TJ, Lee LC, Davidson JRT. Predictors of post-traumatic outcomes following the 1999 Taiwan earthquake. J Nerv Ment Dis. 2005;193:40–6.
42. Kuo HW, Wu SJ, Ma TC, Chiu MC, Chou SY. Post-traumatic symptoms were worst among quake victims with injuries following the Chi-Chi quake in Taiwan. J Psychosom Res. 2007;62:495–500.
43. Pincus HA, Pettit AR. The societal costs of chronic major depression. J Clin Psychiatry. 2001;62:5–9.
44. Kessler RC. Posttraumatic stress disorder: the burden to the individual and to society. J Clin Psychiatry. 2000;61:4–12.