Predictors for psychological distress of young burn survivors across three years: A cohort study of a burn disaster in Taiwan

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Abstract

Purpose: The study aims to investigate long-term psychological distress and its risk factors in the burn survivors.

Design: A longitudinal study with follow-up interviews was conducted from November 2015–June 2018. A post-burn baseline interview was conducted 6 months after the event, followed by annual surveys for three years.

Methods: The burn survivors received structured assessment through telephone in the four-wave interviews, including the five-item Brief Symptom Rating Scale (BSRS-5); two-item Patient Health Questionnaire (PHQ-2); four-item Startle, Physiological Arousal, Anger, and Numbness Scale (SPAN-4); and six-item Impact of Event Scale (IES-6) alongside demographic data and other health-related assessment.

Findings: A total of 180 respondents with the mean age of 23 years old completed the four waves of interview. Using the BSRS-5 as the outcome, each variable had different input in psychological distress during the follow-up years. The main finding was that the SPAN-4 score could predict more than 62% of psychological distress between 6 months and 3 years after the disaster. The generalized estimating equation demonstrated that SPAN-4, IES-6, family functioning impairment, hypnotics use, adaptation to the event, and PHQ-2 could predict psychological distress. However, the variable of follow-up year did not exemplify significant estimation in the model.

Conclusions: The results indicated that different factors had various influences on psychological distress across the four follow-up stages. PTSD-like symptoms, depression, and anxiety were the most common psychological problems experienced by the young burn cohort in the longitudinal post-traumatic period.

Clinical relevance: Healthcare providers should be aware of psychological consequences of traumatic events within up to a 3-year post-burn period, particularly post-traumatic stress, depression, and anxiety symptoms.

KEYWORDS
anxiety, burn disasters, longitudinal study, psychological distress, Taiwan

BACKGROUND

A large explosion occurred at the Formosa Fun Coast Water Park on 27 June 2015 in Taiwan. The unfortunate incident was triggered when tons of flammable colored decorative powder ignited in the air, burning nearly five hundred young people, mostly aged under 25 years. A previous study found that the young survivors experienced salient mental distress as well as psychopathological consequences (Wu et al., 2020). Studies have demonstrated that psychological distress was likely to occur in the wake of disaster experiences (Jafari et al., 2020; Paton, 2019). Both pre-disaster psychological conditions and post-disaster variables have been identified as one of the predictors of health problems after disasters, however, post-disaster stress may have more impact on the mental well-being of survivors (Liu et al., 2020; Math et al., 2015). Moreover, post-disaster stress and its associated mental health problems were shown to be attributable to suicidal behaviors (Jafari et al., 2020).

A previous study suggested that over 15% of patients with burn injuries developed posttraumatic stress disorder (PTSD) and depression, which may be caused by altered appearance, stigmatization, and somatic symptoms (Su & Chow, 2020). It is fundamental for nurses to understand both physical and psychological concerns of different recovery stages. To date, most published articles have focused on the mortality of burn patients or the incidence of PTSD. The distinct contributing factors in different post-burn stages were seldom examined among young burn survivors. Young burn survivors experienced rapid biological, cognitive, and social change that may fluctuate after years of post-burn recovery process (Wu et al., 2020). Such normative developmental transformations may produce a higher level of stress, especially when adolescents and young adults take on new social roles. However, difficulties in coping with stress may eventually contribute to major mental health issues such as anxiety and depression (Chen et al., 2020; Marsh et al., 2018; Wu et al., 2020).

To date, limited research addressed the long-term consequences and psychological care needs among a group of young survivors after a burn disaster. Understanding more contributing factors of psychological distress may guide holistic care engagement with these people. Therefore, the aim of the study was to investigate long-term psychological distress and its critical risk factors across three years in a group of young burn survivors after the Formosa Fun Coast Water Park explosion.

METHODS

Study setting and the sample

The study targeted the survivors of the 2015 'Formosa Fun Park Powder Explosion' which injured 499 people and caused 15 deaths. The 484 burn survivors whose physical conditions stabilized were followed up by the New Taipei City Government in Taiwan. A baseline interview was conducted at the 6th month (T0) after the event,

between November and December 2015. Then three follow-up surveys were conducted annually for three years (T1-T3), resulting in four-wave of interviews for analysis. Therefore, all the data were collected in the 3-year post-disaster duration. The participants were interviewed by telephone after initial informed consent was provided at the hospital. The study analysed the interviewees who completed all four interviews. Detailed descriptions of the cohort and ethical considerations were published in a previous article (Wu et al., 2020).

Instruments

The demographic data as well as the survivor's psychological and physical health information before and after the disaster were collected, including age, gender, and the use of hypnotics and alcohol. Measurements of both physical symptoms and psychological distress were used in the interview questionnaire, including the scales described below.

BSRS-5

The five-item Brief Symptom Rating Scale (BSRS-5) was used to assess the respondents' psychopathology and psychological distress levels. It is a brief and valid scale with five major items inquiring about past-week perceived distress including insomnia, anxiety, hostility, depression, or inferiority (Wu et al., 2016). An additional item inquires about the severity of suicide ideation in the past week. Different item was rated on a 5-point Likert scale (0–4) and summed to derive a total score, with higher scores indicating higher levels of mental distress. The internal consistency of Cronbach's α ranged from 0.77–0.90 (Lu et al., 2011; Wu et al., 2016), while in this study it was 0.90.

PHQ-2

The two-item Patient Health Questionnaire (PHQ-2) is a short screening tool that is used widely in identifying a patient's depression. Anhedonia and depressed mood were measured using a Likert scale range from 0–4. The Cronbach's α for this instrument was over 0.76 among the public (Yu et al., 2011). This study showed a Cronbach's α of 0.80.

SPAN-4

The four-item Startle, Physiological Arousal, Anger, and Numbness Scale (SPAN-4) was designed to evaluate the frequency and severity of four common symptoms of PTSD in the past week. The four variables were assessed by a 5-point Likert scale (0–4), with higher scores indicating severer stress response after major traumatic events. The tool demonstrated good internal consistency with a Cronbach's α of

0.80 in this study, which was consistent with other study that supports SPAN-4 as a good rapid screening tool with satisfactory psychometric properties (Seo et al., 2011).

IES-6

The respondents' psychological symptoms after a traumatic event were evaluated by the 6-item Impact of Event Scale (IES-6). Each item was a 4-point Likert scale with higher scores indicating a greater frequency of symptom clusters related to intrusion, hyperarousal, and avoidance of post-traumatic burn survivors. The Cronbach's α in this study was 0.86. The scale was found to be a reliable and valid scale, as supported in a previous study (Hosey et al., 2019).

Care needs

The care need assessments were designed to evaluate the victims' needs for legal service and rehabilitation and their needs to return to the community from government service. A total of 11 variables were assessed, including wound care, rehabilitation, care skills education, assistive devices, barrier-free environment, emotional support service, daily living assistance, schooling, occupation, economic, and law services. Each variable was rated from 0–2 (none, some, extremely), resulting in a total score ranging from 0–22. The total score and the demand of care needs represent a positive relationship. This study was the first to demonstrate the metric for the instrument.

Service satisfaction

This measurement assessed the respondents' satisfaction with government and non-government services. Four items representing different sources of service were inquired, including the local government medical service, social service, and post-burn services from a governmental and a non-profit organization. A participant could score from 0, which is extremely unsatisfied, to 4, which is extremely satisfied. This study was the first to demonstrate the metric for the instrument.

Family APGAR scale

The Family Adaptation, Partnership, Growth, Affection, and Resolve assessment (APGAR) was used to assess family function. It is a 5-item questionnaire with each item recorded from 0 to 2 (not at all, sometimes, often) in measuring five constructs of a family. A higher score indicates better family function. The Cronbach's α in a previous study was 0.75 (Cheng et al., 2017), while in this study it was 0.87.

Life disturbance/functional changes

Post-burn life disturbance or functional changes were measured by 10 questions, including pain, itchiness, work, socio-interpersonal problems, family function impairment, stress perception, socio-interpersonal relations, family relations, adaptation to the post-event life styles, and recovery to premorbid conditions. The questions were designed to measure its impact to life. Each question was rated on a Likert scale of 0–10, with 0 indicating no disturbance at all, while 10 indicating extremely disturbing. This Cronbach's α of the instrument was 0.90 (Wu et al., 2020).

Statistics

The Pearson correlation and ANOVA were used to analyse correlations between different variables. To predict major correlates of psychological distress, stepwise regression was applied with the BSRS-5 score (i.e., psychological distress) as the outcome variable. In addition, generalized estimating equation was conducted to estimate risk factors that impact psychological distress.

RESULTS

Participant characteristics

Among the 180 respondents, 109 were male and 71 were female. The mean age was 23 years old. About 30% of respondents had 40%–59% of burn area. The mean length of in-hospital stays was 57.78 days, and 78.3% suffered from pain and 87.2% suffered from itches (basic demographics will be offered on demand).

Burn responses in the four-wave interviews

The ANOVA of psychopathology, perceived changes in life disturbance, and functioning measurement in different time frames was conducted. Table 1 shows that most of the measurements revealed the relationship among T0, T1, T2 and T3 to be significant, except for IES-6, Family APGAR, and hospitalization. It is worth noting that the mean score of all measurements showed a steady favorable decrease or increase. However, measurements, such as 1-week suicide ideation, IES-6, SPAN-4, service satisfaction, hypnotics use, and positive family relation all demonstrated a rebound in mean score from T2-T3 compared with T0-T2. Table 1 also revealed that the mean score of hospitalization and rehabilitation were higher in T1.

After confirmation of the correlational matrix between psychological distress and each variable in the study, stepwise linear regression analysis was conducted to further investigate the influence of significant variables on psychological distress across the follow-up period. In Table 2, the key finding was that SPAN-4 scores could explain more than 62% of BSRS-5 score throughout T0 to T3.

TABLE 1 Mean score of psychopathology, perceived changes in life disturbance, and functioning of the respondents in the four interviews

	T0	T1	T2	T3	Significance[*]
BSRS-5	5.52	4.55	3.84	3.62	<0.01 (T2, T3 < T0)
One-week suicide ideation	0.13	0.04	0.04	0.09	0.258
IES-6	5.33	4.86	4.31	4.42	0.121
SPAN-4	2.96	2.56	1.84	2.22	<0.01 (T2 < T0)
Service satisfaction	13.59	12.79	12.70	13.03	<0.01 (T1, T2 < T0)
Care needs	3.78	4.06	2.95	1.75	<0.01 (T3 < T0, T1, T2; T2 < T1)
Family APGAR	7.54	7.79	7.97	7.98	0.301
PHQ-2	1.49	0.87	0.71	0.67	<0.01 (T1, T2, T3 < T0)
Hypnotics use	0.34	0.24	0.11	0.18	<0.01 (T0 < T2, T3)
Alcohol use	0.05	0.08	0.12	0.17	0.025 (T0 < T3)
Rehospitalization	0.08	1.37	0.33	0.83	0.167
Rehabilitation	0.57	0.68	0.46	0.26	<0.01 (T3 < T0, T1, T2; T2 < T1)
Pain-related distress	3.28	2.13	1.61	1.31	<0.01 (T1, T2, T3 < T0; T3 < T1)
Itch-related distress	5.37	4.32	3.90	3.17	<0.01 (T1, T2, T3 < T0; T3 < T1)
Working disturbance	6.47	4.96	4.53	3.46	<0.01 (T1, T2, T3 < T0; T3 < T1, T2)
Social/interpersonal problems	2.94	2.04	1.96	1.79	<0.01 (T1, T2, T3 < T0)
Family functioning impairment	3.69	1.72	1.46	1.08	<0.01 (T1, T2, T3 < T0)
Perceived stress	4.31	3.31	3.31	2.62	<0.01 (T1, T2, T3 < T0)
Positive socio-interpersonal relation	6.16	5.94	5.25	6.55	<0.01 (T2 < T0, T3)
Positive family relation	6.68	6.47	5.78	7.21	<0.01 (T2 < T3)
Adaptation to the event	6.35	7.14	7.40	7.61	<0.01 (T0 < T1, T2, T3)
Recovery to premorbid conditions	6.50	6.82	7.14	7.36	<0.01 (T0 < T1, T2, T3)

[*]ANOVA was applied with Scheffe post hoc analysis.

Besides the SPAN-4 which represents the severity of common PTSD symptoms, different factors had contributed to BSRS-5 estimations in different time frames. In T0, SPAN-4 could estimate 70.05% of BSRS-5, followed by family function impairment ($\triangle R^2 = 0.071$) and adaptation to post-event life styles ($\triangle R^2 = 0.017$). As in T1, beside SPAN-4, PHQ-2 ($\triangle R^2 = 0.100$) and recovery to premorbid condition ($\triangle R^2 = 0.024$) together could add more than 11% of the estimation in BSRS-5. SPAN-4, hypnotics use, and PHQ-2 explained 72% of BRSR-5 in T2. In T3, SPAN-4 estimated 62.5% of BSRS-5 and PHQ-2 together explained 74% of psychological distress. Social/ interpersonal problems amounted to 4.6% of BSRS-5 estimation. The result demonstrated that each factor had different input in psychological distress in different follow-up years.

Furthermore, the result of generalized estimating equation (Table 3) indicated that none of the interactions between factors and follow-up years yielded significance, however, IES-6, SPAN-4, family functioning impairment, hypnotics use, adaptation to post-event life, and PHQ-2 significantly predicted the BSRS-5 score ($p < 0.01$). Different matrix structures were analysed with quasi-likelihood under the independence model criterion (QIC). The independent model shown in Table 3 was the best QIC, which showed that the variables of IES-6, SPAN-4, family functioning impairment, hypnotics use, adaptation to post-event life, and PHQ-2 were significant factors that predicted BSRS-5 within the 3-year period ($p < 0.01$).

DISCUSSION

The result of this study revealed that PTSD-like symptoms, depression, and anxiety were the most common psychological issues encountered by the young burn survivors in the 3-year post-traumatic period. Beside PTSD-like symptoms, family function impairment and adaption to post-event life had great influences in the first 6 months, while depression symptoms contributed to psychological distress up to 12 months. Until the 24th month after the disaster, hypnotics use would play a role in predicting distress, however, PTSD-like symptoms, depression symptoms, as well as social interaction problems could well impact personal distress beyond 36th months following the event.

One of the main findings was that different factors should be noted in various follow-up years regarding their influences toward mental distress. For example, SPAN-4, family function

TABLE 2 Stepwise linear regression models predicting psychological distress in burn survivors

Model	$\triangle R^2$ T0	T1	T2	T3
SPAN-4	0.701**	0.645**	0.667**	0.625**
Family functioning impairment	0.071**	—	—	—
Adaptation to the event	0.017**	—	—	—
IES-6	0.014**	—	0.020**	—
Age	0.009**	—	—	—
PHQ-2	—	0.100**	0.021**	0.115**
Recovery to premorbid conditions	—	0.024**	—	—
Hypnotics use	—	0.014**	0.037**	—
Family Apgar	—	0.007*	—	—
Rehabilitation	—	—	0.007*	0.018**
Social/interpersonal problems	—	—	—	0.046**
Alcohol use	—	—	—	0.017**

*$p < 0.05$; **$p < 0.01$ (2-tailed).

TABLE 3 Generalized estimating equation to estimate key variables predicting psychological distress across four waves of interview

Parameter	B[a]	Std. Error	95% Wald Confidence Interval Lower	Upper	Hypothesis Test Wald Chi-Square	df	Sig.
(Intercept)	0.97	0.12	0.73	1.21	61.73	1	0.00
Follow-up year	0.00	0.02	−0.05	0.05	0.00	1	0.99
Hypnotic use	0.16	0.04	0.08	0.25	14.23	1	0.00
SPAN-4	0.07	0.01	0.04	0.10	26.08	1	0.00
IES-6	0.06	0.01	0.04	0.08	41.98	1	0.00
Family functioning impairment	0.03	0.01	0.01	0.06	7.23	1	0.00
PHQ-2	0.12	0.03	0.07	0.17	20.49	1	0.00
Adaptation to post-event life	−0.08	0.01	−0.11	−0.05	33.23	1	0.00
(Scale)	2.18	—	—	—	—	—	—

[a]Independent model with log as link function.

impairment, and adaptation to life were the most influential factors for distress. This supported the adolescent development theory of Bronfenbrenner (2005), which posits that family system, social system, and school system are the three most important systems supporting the development of adolescents. According to Bernstein and Pfefferbaum (2018), disaster survivors would immediately be influenced by their own environment. In the case of adolescent burn survivors, their immediate environment would be their family and adaptation to post-event life situation. Thus, the result in T0 demonstrated that for young adult survivors, trying to adapt to their new life and family usually played a crucial role in the first six months after the disaster. Kranke et al. (2017) stated that family stability could be one of the stressors for adolescents who experience disasters. Participants would also rely on families to assist them in activities of daily living alongside to provide safety, stability, and security, which were basic needs especially after being discharged from the hospital (Bayuo et al., 2020). Once these basic needs were fulfilled, other psychological distress could be more salient. The finding of

Kranke et al. (2017) was consistent with the result of this study, which found that family function impairment had more influence in the first six months after the disaster. However, in their result the effect of family function impairment persisted after T0.

Moreover, it is of note that follow-up year did not have a significant effect on psychological distress as illustrated in Table 2. This indicates that although the BSRS-5 score displays a gradual decrease from T0-T3, the follow-up year was not a predictor of psychological distress. However, factors have different levels of influence on BSRS-5 in each time frame. It was found that SPAN-4, which was designed to evaluate the frequency and severity of shock, physiological arousal, anger, and numbness symptoms in PTSD, plays an important role in assessing participant's psychological distress during T0-T3 ($\triangle R^2 > 0.625$, $p < 0.01$) (Table 2). Although the measurement SPAN-4 did not represent the diagnosis of PTSD, it offered a glimpse into PTSD-like symptoms. The result is consistent with the finding of Weems et al. (2016) and Guo et al. (2017) that PTSD symptoms are particularly salient in psychological distress after a disaster,

especially 6 months after the disaster. The result of this study presented that the psychological distress followed by PTSD-like symptoms could still be an influence 3 years after the disaster.

One year after the explosion, however, SPAN-4 ($\triangle R^2 = 0.645$), PHQ-2 ($\triangle R^2 = 0.100$) and recovery to premorbid conditions ($\triangle R^2 = 0.024$) were the top three risk factors that could impact psychological distress. It is worth noting that PHQ-2 also had potent impact in T2 ($\triangle R^2 = 0.021$) and T3 ($\triangle R^2 = 0.115$) (Table 2). This result revealed that for young adult survivors, depression became a risk factor one year after the burn disaster, which resonates with other studies of young burn survivors (Lee et al., 2020; Thombs et al., 2008). Post-traumatic distress is highly comorbid with depression and anxiety (Keane et al., 2002). The "Anniversary reactions" affirmed by Pollock (1972) revealed that the anniversary date itself might trigger memories of the traumatic event, including anxiety, flashbacks, depression, and fear. The finding of Lee et al. (2020) was consistent with this study, as the victim's depression became more influential one year after the disaster. Thombs et al. (2008) suggested that recovery of adolescent burn survivors coincides with scar maturation. They found that at 2 years, physiological symptoms subsided as the patients' physical illness had stabilized, which resonated with the result of these data that recovery to premorbid conditions had more impact in T1. Furthermore, Thombs et al. (2008) found that it is important to follow up on the persisted depressive symptoms, as they are crucial indicators of distress. This result of Thombs et al. (2008) reverberated with this study. As in Table 2, the change of R^2 of PHQ-2 had significantly increased in T3, which was 36 months after the burn disaster. In addition, hypnotics use was another factor that had a significant ($p < 0.01$) role between T1 and T2 follow-ups. It is worth noting that, in Table 3, the result of generalized estimating equations showed an estimate of B of hypnotics use was 0.16 with the S.E = 0.04. This revealed that the use of hypnotics was a good predictor evaluating BSRS-5. Yet, the result demonstrated that the hypnotics use had more influence from 12–24 months after the disaster significantly (Table 2). This was consistent with the finding of Lee et al. (2017) that burn survivors suffered from sleep disturbance after burn injury, which was strongly associated with psychological distress in the first 36 months of disaster.

Table 3 demonstrated that in T3 follow-up period, social/interpersonal problems amounted to 4.6% of BSRS-5 estimation. The result indicated that in young adults, social interaction problems might be noticed after 36 months following the disaster. The result differs slightly from the burn research finding of Ajoudani et al. (2018) that social interaction problems had more impact in the beginning of the first year of the burn injuries. Ohrtman et al. (2018) showed that different age groups had different levels of concern about social activities and social interactions. It was found that those who were younger or married/living with a significant other had better performance in social activities and social interaction. In this study, the mean age of participants was 22.94 years, with about 50% of the participants aged between 18–22 years-old. Therefore, in the beginning of the injury, these young adults may have still been "guarded"

by their families or relatives. After two years, as they became more dependent which is a natural part of young adulthood growth, more social interaction was needed. On the other hand, they were also concerned about how individuals in society might view them (Twenge et al., 2019). Further research should be conducted to examine the difficulties young adult burn survivors face in their social interactions in depth.

Several studies have demonstrated that elevated psychological distress was commonly observed following disasters (Jafari et al., 2020; Liu et al., 2020). The major mental health symptoms that impacted post-burn distress including depression or anxiety have been found to have a significant correlation with suicide (Johnson et al., 2018). Suicide risk can be an aftermath of psychological distress from burn disasters. Therefore, it is important for healthcare workers to identify the suicide risk factors associated with psychological distress in the survivors' pre- and post-disaster life experiences, especially when rehabilitation and the goal of returning to society are long-term expectations for them. Nurses as the front-line healthcare workers should be able to utilize available resources in collaboration with other professionals, especially in nursing care after disaster, as the survivor care needs can be complicated and the level of care provided might be varied. Accordingly, disaster nursing core competencies were developed to carry out nursing activities during and after a disaster. Disasters worldwide have led to changes in disaster policies, raising the need to improve nurses' competencies in disaster response (Loke & Fung, 2014; Park and Kim, 2017). The result of this study demonstrated that each factor had different inputs in psychological distress in different follow-up years. Therefore, nurses need to monitor the patient's emotional well-being and recommend additional mental healthcare interventions when appropriate in order to provide a holistic care for patients with burn in the long-term trajectory.

The study extended prior study findings that the care of burn survivors should be focused on different risk factors according to the recovery phase. Moreover, the long-term follow-up care after disasters is needed. Future healthcare policy could focus on long-term health surveillance of the survivors. However, this study is a secondary analysis which focused on participants who had completed the four-wave interview survey. It could, therefore, be argued that the 180 participants may have certain characteristics or personality traits which could have had an impact on the result. Hence, generalization of the findings should be cautious.

Conclusions

The study findings suggested that anxiety related psychological distress was the main concern for young survivors of a burn disaster in the 3-year recovery phase. Different factors had various degree of influences on psychological distress across the four follow-up stages. The PTSD-like symptoms, depression, and anxiety were the most common psychological problems experienced by the young burn cohort in the longitudinal post-traumatic period. Mental health

well-being of these survivors should be supported with potential suicide risk protected by timely intervention. Healthcare providers should be aware of psychological consequences of traumatic events within up to 3-year post-burn period.

CLINICAL RESOURCES

- 2015 New Taipei water park fire. https://en.wikipedia.org/wiki/2015_New_Taipei_water_park_fire
- Burn Survivor Resources of the American Burn Association. https://ameriburn.org/public-resources/burn-survivor-resources/
- Measuring Social Recovery in Burn Survivors, Public Health Post. https://www.publichealthpost.org/news/measuring-social-recovery-in-burn-survivors/

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