


ORIGINAL RESEARCH:
 EMPIRICAL RESEARCH - QUANTITATIVE

A longitudinal study on psychological reactions and resilience among young survivors of a burn disaster in Taiwan 2015–2018

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Funding information

Department of Health, New Taipei City Government, Taiwan, Grant/Award Number: 107M076

Abstract

Aim: To investigate the long-term psychological reactions and resilient process of the young survivors after a large-scale burn disaster of the Formosa Color Dust Explosion in Taiwan.

Design: Longitudinal study with follow-up interviews using standardized questionnaire during November 2015–June 2018.

Methods: The burn survivors received structured assessment in the four-wave interviews including the five-item Brief Symptom Rating Scale, nine-item Concise Mental Health Checklist, and two-item Patient Health Questionnaire for depressive symptoms and suicide risk assessment. Post-traumatic psychological symptoms were assessed through the four-item Startle, Physiological Arousal, Anger, and Numbness Scale, and six-item Impact of Event Scale.

Findings: The response rates were 65.1%, 74.2%, 76.9%, and 78.5% across the four-wave interviews among 484 burn survivors. The participants were mean-aged 23.1 years with just over half having 40% or more burn wounds in total body surface area. The respondents at each wave were similar in gender, age, and per cent of total body surface area burned. In the first 2 years of recovery, the respondents showed resilience in coping with stress of trauma under family and social support. While there was a decreasing trend of psychological symptoms over the first 2 years, hypnotic use and alcohol consumption remained at about 10% in the final interview, which were accompanied by psychological symptom recurrence.

Conclusion: Young burn survivors recovered both psychologically and physically under supportive care and personal resilience in 2 years after the burn event, yet post-traumatic mental distress and coping efforts after 2 years during community

The peer review history for this article is available at <https://publons.com/publon/10.1111/jan.14248>

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reintegration should be detected and managed. Early prevention and detection of mental health deterioration is needed even after 2 years of burn disasters.

Impact: The study demonstrated post-burn longitudinal changes on psychological reactions. Nursing staffs may help young burn survivors identify mental distress and stress management needs in the long-term psychological adaptation process.

KEYWORDS

burn, coping, disaster, longitudinal study, nursing, psychosocial assessment, resilience, stress, substance use, trauma

1 | INTRODUCTION

According to the World Health Organization, 180 000 deaths every year are caused by burns. Although the global prevalence, length of stay, and mortality rates have been decreasing in recent years, intentional or unintentional burns are the fourth most common type of trauma worldwide (Peck, 2019). Currently, the nursing literature of burn studies largely focused on the burn survivors' rehabilitation experience in hospital or retrospective review of inpatient risk factors. The psychological needs of burn survivors in large-scale disaster with hundreds of casualties in long-term community follow-up received less attention. The study investigated longitudinal psychological response and psychosocial functioning in the 3-year post-burn period among 484 young survivors of a burn disaster known as the 'Formosa Fun Park Powder Explosion' happened on the night of 27 June 2015.

1.1 | Background

Mental health problems have an impact on the trajectory of burn recovery by prolonging hospital length of stay, which was exacerbated by substance use (O'Brien & Lushin, 2019). Studies in the post-discharge period with longitudinal follow-ups were rare. However, mental health of burn survivors is a critical issue since it influences not only the quality of rehabilitation but also social integration at different stages of recovery. Post-burn psychological morbidity rates after discharge could be significantly higher at 3-month follow-up for PTSD and depression in minor burn trauma (Tedstone & Tarrier, 1997). Yet, even in severe burns with higher percentage of total burn surface area (TBSA) and longer time of exposure to the burning agent, resiliency gained better psychological adaptation of the survivors and promoted their relational strengths, positive coping, and resistance to trauma symptoms (Kornhaber, Bridgman, McLean, & Vandervord, 2016). Young survivors of burn injuries reconstruct the self from shifting thoughts of deficiency in life during the process of recovery (Lau & van Niekerk, 2011). Resilient children showed higher self-regard and better interpersonal skills, viewed other people as more cooperative and were more able to tolerate and control stress (Holaday & McPhearson, 1997). In addition, previous study showed that social support, cognitive skills, and psychological resources were key factors that influenced resiliency.

Despite potentially different levels of resilience in burn survivors with different ages, the long-term integration outcomes in the community may not differ significantly (Cartwright et al., 2016). In spite of the unknown pre-event psychological status, the event could lead to short-term or long-term psychiatric illness, including PTSD, depressive disorders, or anxiety states, with or without suicidal ideation. Among young burn survivors, 1-year quality of life was significantly correlated negatively with PTSD and positively with body image (Hsu, Chen, Chen, & Lu, 2017), indicating that psychiatric symptoms have a negative impact on the perceived quality of life throughout the recovery process. A longitudinal burn study indicated that resilient burn survivors were featured with decreased symptoms of post-traumatic stress symptoms (PTSD) over time in the recovery trajectory of 3, 6, and 12 months (Sveen, Ekselius, Gerdin, & Willebrand, 2011). However, evidence about long-term observations of resilience and psychiatric mental health symptoms were very limited.

Experiencing burn events that result in significant bodily injury creates substantial stress. Considering the consequences of physical and psychological changes as well as potential social dysfunction following the burn, early assessment, and intervention should be in place to enhance the burn patient's self-esteem and family support (Jang, Park, Chong, & Sok, 2017). In addition, better family functioning is positively correlated with superior health-related quality of life, as shown among older patients in clinical service (Lim, Manching, & Penserga, 2012). Personal resilience can further help facilitate the burn survivor's ability to cope with stress during recovery (He, Cao, Feng, Guan, & Peng, 2013; Jang et al., 2017; Luthar, Cicchetti, & Becker, 2000). Previous cross-sectional observations of burn patients have shown that resilience plays a significant role in recovery; however, more evidence is needed regarding post-burn longitudinal mental health changes over time.

2 | THE STUDY

2.1 | Aims

The aim of the study was to investigate the long-term psychological reactions and resilient process of these burn survivors in the community setting.

2.2 | Design

This longitudinal study followed up the burn cohort for 3 years, during which period the participants were interviewed through telephone every 6–12 months to assess the post-burn physical and psychological responses in the recovery process.

2.3 | The setting and the participants

The study targeted at the victims of the 'Formosa Fun Park Powder Explosion' occurred in 2015, when a load of flammable cornstarch-based powder exploded midair and burned 499 young people mostly aged under 25 years. The disaster wounded 499 people and killed 15 in the first 6 months. The Taiwan Ministry of Health and Welfare responded to the disaster efficiently with on-site triage and hospital emergency triage to treat successfully the crucially burned patients (Wang, Jhao, Yeh, & Pu, 2017). Over the next 3 years, the New Taipei City Government in Taiwan provided integrated care via case management and medical services for the 484 burn survivors, most of whom eventually stabilized their physical conditions (Wu, Lin, & Lee, 2018). The participants were consisted of those who agreed to be followed up in the 3-year observation period under government funding. The study was funded by the local government with the aim of data analysis and policy formulation.

2.4 | Data collection

The 484 survivors received post-burn baseline interviews after 6 months of the event between November and December 2015, after which follow-up visits were offered together with case management service during 2015–2018. Totally, the participants were interviewed for four times (T0–T3, see Figure 1). A total of 57 case managers with psychological, social work, or nursing backgrounds offered proactive links to rehabilitation and medical services

according to the survivors' needs within 3 years, which included pain management, physiological training or exercises, and muscle relaxation for the recovery of body wounds. Meanwhile, the research team set up a questionnaire format and standardized procedure for the case managers to perform repeated measurements in the four-wave interviews. These interviewers received standardized training programme set up by the authors who worked at the Department of Health of the city government (LCH, KSC & TCC) to ensure consistency in data quality.

2.5 | Ethical consideration

All the participants agreed to take part in the study and receive research interviews during follow-up period. The Institutional Review Board in Fu-Zen Catholic University approved the ethical application and waived the requirement for informed consent because the study was nested within government service programme and was strictly adhering to anonymity and concealment of personal information. The research team followed the ethical considerations in data management and analysis. Those who rejected to be followed up were not recruited unless they were willing to get back for the next interview on contact by their case managers. The first author who performed data analysis was blinded to the names and contact information of the participants.

2.6 | Data analysis

First, the missing values that may potentially cause bias were inspected before data imputation. The top three reasons for missing values were loss to follow-ups (i.e., inability to contact the person within three calls), refusal to respond or recall difficulties. After confirming data completeness, descriptive analysis was then performed for each variable to check rationality. Numbers, percentages, means, and standard deviations were calculated for continuous or

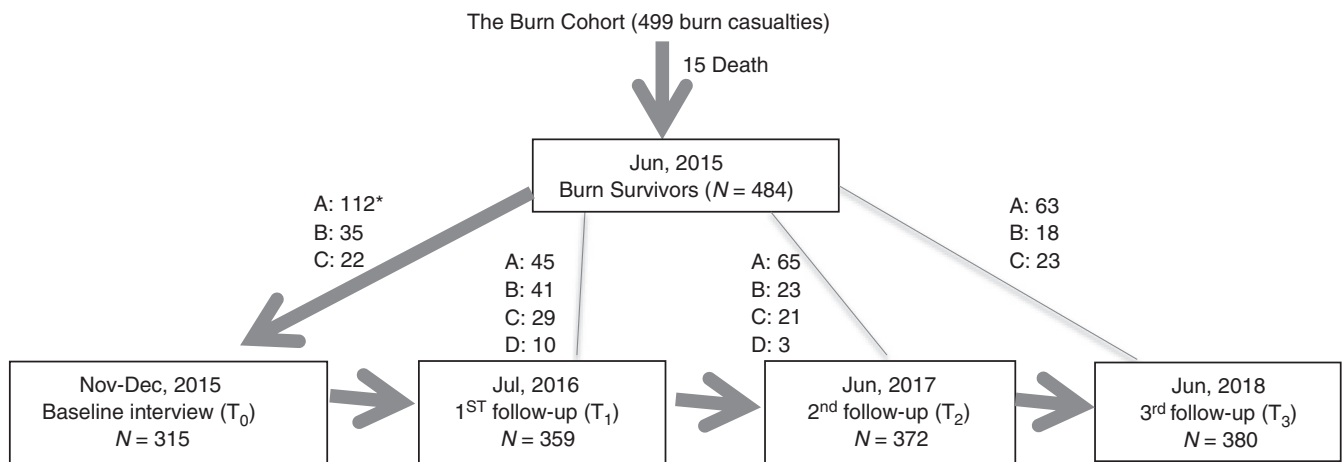


FIGURE 1 The flowchart of the study. *Reasons for attrition: (A) unable to finish; (B) refusal; (C) contact problems; (D) others

categorical variables. Differences in mean and percentage values were compared and changes evaluated across the four waves. In addition, continuous variables in the outcome measurements such as psychological symptoms including mental distress or depression underwent descriptive analysis and normality plotting to check their suitability in association statistics. The statistician of the research team assured that Pearson's Chi-squared test or analysis of variance (ANOVA) were adequate analytical methods after assessment of data normality. Pearson's correlations for crosstab values of percentage were applied and ANOVA was used to test the associations of continuous variables between groups. The significance level was set at 0.05. All data analysis was performed using the statistical package, SPSS 16.

2.7 | The measurements, validity, and reliability

2.8 | Psychopathological features and suicide risk assessment

The Five-item Brief Symptom Rating Scale (BSRS-5) and the Nine-item Concise Mental Health Checklist (CMHC-9) were used to assess the respondents' psychopathology and suicide risks. The former inquired five questions plus suicide ideation over the past 7 days to draw responses of recent mental distress. Only the five items include insomnia, anxiety, hostility, depression, and inferiority were counted in total score ranged between 0 and 20. All the items were rated using a Likert scale of 0–4, with higher scores indicated higher levels of mental distress. The internal consistency (Cronbach's alpha values) of the BSRS-5 ranged from 0.77–0.90 while the coefficient of test–retest reliability was 0.82 (Lee et al., 2003). The BSRS-5 can be used to identify psychiatric morbidity or psychological distress levels in both medical practice and the community (Wu et al., 2016). A score of 6 or above was defined as psychiatric morbid or significantly distressed in the recent week (Lee et al., 2003). On the other hand, the CMHC-9 was used to further evaluate the respondents' overall risk of suicide. The Cronbach's alpha of the CMHC-9 was satisfactory ($\alpha = 0.79$) and it had a two-factor structure of psychopathology and suicidality by exploratory factor analysis. The optimal cut-off of 3/4 obtained from the ROC analysis represented a satisfactory sensitivity (92%) and specificity (82%) in identifying recent suicide ideation (Wu, Lee, Lin, & Liao, 2019).

2.9 | The two-item Patient Health Questionnaire (PHQ-2)

The PHQ-2 is a short screening tool that identifies two main depressive symptoms, anhedonia and depressed mood. The Cronbach's alpha for this instrument was 0.76 among the general public in Hong Kong (Yu, Stewart, Wong, & Lam, 2011), with 4.2% screening positive for major depressive disorder at the cut-off point of ≥ 3 .

2.10 | The four-item Startle, Physiological Arousal, Anger, and Numbness Scale (SPAN-4)

The SPAN-4 was derived from the 17-item Davidson Trauma Scale (DTS). The scale assesses the frequency and severity of four common symptoms of PTSD over the past week (Mouthaan, Sijbrandij, Reitsma, Gersons, & Olff, 2014) as shown in the acronym. Each item is rated on a 5-point Likert scale (from 0: not at all distressing to 4: extremely distressing). The Cronbach's alpha of SPAN-4 in this study for the four interviews were 0.78, 0.81, 0.79, and 0.77, respectively; these results were comparable to two other studies, revealing its good internal consistency (Chen, Shen, Tan, Chou, & Lu, 2003; Seo et al., 2011). The diagnosis accuracy was found to be 88% (Meltzer-Brody, Churchill, & Davidson, 1999). At the cut-off of 7 points suggested by Seo et al. (2011), the positive prediction rates of PTSD in this study for the first and final years were 37.2% and 34.8%, respectively, while the negative prediction rates were 86.3% and 90.8%, respectively ($p < .001$), which reflected the instrument's screening out feature for PTSD in major traumatic events.

2.11 | The 6-item Impact of the Event Scale (IES-6)

The IES-6 is a 6-item scale assessing psychological symptoms in the week after a traumatic event. The questions ask: (1) I thought about it when I didn't want to; (2) I felt watchful or on guard; (3) Other things kept me think about it; (4) I was aware that I still had a lot of feelings about it, but I didn't deal with them; (5) I tried not to think about it; and (6) I had trouble concentrating (Giorgi et al., 2015). Each item was rated on a 0–3 scale, with higher scores indicate greater frequency of symptoms. The inter-correlation between each item of the IES-6 was high, with the correlation coefficient lies between 0.72 and 0.93. Factor analysis revealed three main symptom groups, that is, intrusion (items 1 & 3), avoidance (items 4 & 5), and hyperarousal (items 2 and 6). The Cronbach's alpha of the IES-6 was between 0.80 and 0.88 in other studies (Giorgi et al., 2015; Thoresen et al., 2010). In this study, the Cronbach's alpha values were 0.997, 0.869, 0.878, 0.860, respectively, in the four-wave interviews.

2.12 | Life disturbance/functional changes

The level of post-burn life disturbance or functional changes was assessed in a pre-designed sheet of 10 items across the 3 years: the six negative changes of pain, itch, work, socio-interpersonal problems, family function impairment, and stress perception; and the four positive changes of socio-interpersonal relations, family relations, adaptation to the event, and adjustment to the premorbid condition. Each variable was originally recorded on a Likert scale of 0–10 according to self-report scores, followed by re-coding at three levels of 0 (0 points), 1 (1–3 points), and 2 (4–10 points) for table. We defined the adaptation and adjustment levels differently; the former implied the extent to which participants thought they had adapted to current

TABLE 1 Demographic and health information of the respondents in the four-wave interviews

N (%)	Total (N = 484)	T ₀ (N = 315)	T ₁ (N = 359)	T ₂ (N = 372)	T ₃ (N = 380)
Gender					
Males	241 (49.8)	141 (44.8)	166 (46.2)	176 (47.3)	183 (48.2)
Females	243 (50.2)	174 (55.2)	193 (53.8)	196 (52.7)	197 (51.8)
Age [mean(SD)]					
13–18	100 (20.7)	34 (10.8)	51 (14.2)	52 (14.0)	60 (15.8)
19–24	268 (55.4)	181 (57.5)	199 (55.4)	219 (58.9)	220 (57.9)
25–30	85 (17.6)	73 (23.2)	81 (22.6)	74 (19.9)	71 (18.7)
31–38	31 (6.4)	27 (8.6)	28 (7.8)	27 (7.3)	29 (7.6)
Burn area (TBSA)					
0%–19%	129 (26.7)	91 (28.9)	89 (24.8)	94 (25.3)	97 (25.5)
20%–39%	96 (19.8)	73 (23.2)	76 (21.2)	68 (18.3)	75 (19.7)
40%–59%	141 (29.1)	93 (29.5)	104 (29.0)	115 (30.9)	111 (29.2)
60%–79%	87 (18.0)	43 (13.7)	65 (18.1)	70 (18.8)	72 (18.9)
80%–100%	31 (6.4)	15 (4.8)	25 (7.0)	25 (6.7)	25 (6.6)
Service Use					
Hospitalization		275 (87.3)	0	0	0
Rehabilitation		184 (58.4)	245 (68.2)	188 (50.5)	114 (30.0)
Hypnotics use					
No		196 (62.2)	253 (70.5)	309 (83.1)	322 (84.7)
Remain		0	10 (2.8)	5 (1.3)	12 (3.2)
Increased use		118 (37.5)	96 (26.7)	58 (15.6)	46 (12.1)
Alcohol use					
No		303 (96.2)	327 (91.1)	343 (92.2)	331 (87.1)
Remain		0	16 (4.5)	14 (3.8)	19 (5.0)
Increased use		12 (3.8)	16 (4.5)	15 (4.0)	30 (7.9)

Abbreviations: SD: standardized deviation; TBSA: Total body surface area.

life at the time of interviews; the latter indicated how much the participants adjusted themselves towards life changes and returned to their premorbid condition. The Cronbach's alpha value was 0.90 for the measurement, which reflected its high internal consistency in the study. The correlation between negative life disturbance (1–6) and positive life changes (7–10) was significant ($r = 0.37, p < .001$) within the scale. In addition, the total score of life disturbance (negative minus positive changes) was associated with various psychological symptoms including depression, post-traumatic stress reactions, and need for physical or psychosocial care ($r = 0.32 \sim 0.65, p < .001$), indicating the validity of the measurement.

3 | RESULTS

3.1 | Respondent profile

The burn cohort was composed of 484 burn survivors who were followed up by the city government. The response rates for the four-wave interviews were 65.1%, 74.2%, 76.9%, and 78.5%, respectively. The demographics of the respondents did not differ significantly

across the four waves. Table 1 reveals that the gender proportions were nearly equal from T₀ - T₃ and the age distributions were comparable to the entire burn cohort, with 55–60% of the respondents aged 19–24 years. After deducting the 15 deaths in the first year, the main reasons for attrition were inability to finish the interview or refusal (Figure 1). During the follow-up period (T₁–T₃), the respondent cohort in each wave was similar in sex, age, and total body surface area of burn. Although the beginning hospitalization rate was high, those receiving rehabilitation services in the follow-up period decreased from 58.4% to 30.0%. However, the rate of substance use across the four interviews fluctuated, which meant that hypnotics use rate at baseline was initially 37.5% at T₀, then dropped to 12.1% at T₄; conversely, alcohol use steadily rose from 3.8–7.9% over the four waves of follow-ups.

3.2 | Burn responses and resilience in the four-wave interviews

Within the 3-year follow-up, respondents showed a decreasing trend for nearly all psychopathological indicators from T₀ - T₂,

TABLE 2 Psychopathology of the respondents in the four-wave interviews

N (%) / mean (SD)	T ₀ (N = 315)	T ₁ (N = 359)	T ₂ (N = 372)	T ₃ (N = 380)	p value*
Psychological distress (BSRS-5)					
Insomnia	92 (29.2)	81 (22.6)	62 (16.8)	62 (16.3)	<.001
Anxiety	33 (10.5)	32 (8.9)	28 (7.6)	37 (9.7)	.581
Hostility	59 (18.7)	60 (16.7)	46 (12.4)	50 (13.2)	.068
Depression	46 (14.6)	32 (9.0)	35 (9.5)	37 (9.7)	.066
Inferiority	48 (15.2)	48 (13.4)	37 (10.0)	49 (12.9)	.220
Total score (Q ₁)	5.7 (5.2)	4.9 (5.0)	4.2 (4.8)	4.3 (4.9)	<.001 [^] (T ₂ ,T ₃ < T ₀)
Moderate distress (Q ₁ ≥ 6)	141 (44.8)	139 (38.7)	124 (33.3)	127 (33.4)	.005
Severe distress (Q ₁ ≥ 10)	78 (24.9)	72 (20.1)	55 (14.8)	68 (17.9)	.009
Depressive symptoms (PHQ-2 ≥ 3)	88 (27.9)	54 (15.0)	53 (14.2)	51 (13.4)	<.001
Suicide risk					
One-week suicide ideation	25 (7.9)	17 (4.7)	14 (3.8)	13 (3.4)	.027
Lifetime suicide ideation	77 (24.4)	43 (12.0)	19 (5.1)	25 (6.6)	<.001
Lifetime suicide attempt	5 (1.6)	17 (4.7)	4 (1.1)	4 (1.1)	.001
Future suicide intention	15 (4.8)	13 (3.6)	9 (2.4)	11 (2.9)	.356
CMHC-9 score at 6month (Q ₂)	3.2 (2.2)	2.8 (2.2)	2.5 (2.3)	2.5 (2.2)	<.001 [^] (T ₂ ,T ₃ < T ₀)
CMHC-9 high-risk (Q ₂ ≥ 4)	46 (14.6)	37 (10.3)	28 (7.5)	31 (8.2)	.010
Post-traumatic stress symptoms: IES-6					
Intrusion-1.Thoughts about the event	90 (28.5)	81 (23.5)	66 (17.8)	76 (20.0)	.005
Intrusion-2.Kept think about it	152 (48.3)	163 (45.4)	107 (29.1)	140 (36.8)	<.001
Avoidance-1.Not dealing with feelings	69 (21.9)	79 (22.0)	77 (20.7)	93 (24.5)	.652
Avoidance-2.Not to think about it	112 (35.6)	114 (31.8)	101 (27.1)	118 (31.1)	.128
Hyperarousal-1.Felt watchful	73 (23.1)	82 (23.8)	64 (17.2)	85 (22.4)	.161
Hyperarousal-2.Trouble concentrating	76 (24.1)	58 (16.1)	78 (21.0)	87 (20.2)	.080
IES-6 total score	5.6 (4.7)	5.2 (4.6)	4.3 (4.6)	4.8 (4.6)	.003 [^] (T ₂ < T ₀)
SPAN-4					
Startle	78 (24.8)	71 (19.8)	49 (13.2)	90 (23.7)	<.001
Physiological arousal	60 (19.0)	68 (18.9)	63 (16.9)	69 (18.2)	.877
Anger	92 (29.2)	90 (25.1)	66 (17.7)	77 (20.3)	.002
Numbness	44 (14.0)	37 (10.3)	34 (9.1)	37 (9.7)	.178
SPAN-4 total score	3.5 (6.6)	2.7 (3.3)	2.1 (2.9)	2.5 (3.1)	<.001 [^] (T ₂ < T ₀)

Abbreviations: BSRS-5, The 5-item Brief Symptom Rating Scale; CMHC-9, The 9-item Concise Mental Health Checklist; PHQ-2, The two-item Patient Health Questionnaire; IES, Impact of Event Scale; SPAN, Startle, Physiological arousal, Anger, and Numbness Scale

*The p values of categorical variables were derived from Chi-square test throughout the table, except for other indicators ([^]) where ANOVA with Scheffe post hoc analysis was applied on continuous variables.

including psychological distresses assessed by the BSRS-5, suicide risk factors, and post-traumatic symptoms assessed by IES-6 and SPAN-4 (Table 2). However, at the final interview in the third year (T₃), nearly all the above-mentioned indicators were significantly increased compared with measures at T₀, with percentages of all items of psychopathology increased since T₂. These changes indicated potential rebound in psychiatric symptoms as manifested in common mental disorders such as anxiety and stress-related symptoms. Moreover, about one in five respondents still suffered from significant insomnia at T₂. Notably, apart from future suicide intention, all the other suicide risk factors (i.e., previous ideation or attempt)

showed instability across the follow-up period. About one in four revealed lifetime suicide ideation at T₀ (24.4%), then the rate dropped into half in each follow-up till T₂ and somehow increased at T₃ (6.6%).

3.3 | Changes in life disturbance and functioning

The decreasing trend of negative changes in all items was noted in contrast with the fluctuated changes in positive aspects of life disturbance. Among all negative aspects of change, working disturbance and itch-related distress were the most prevalent for the

TABLE 3 Perceived changes in life disturbance and functioning in the four-wave interviews

N (%) ^a / mean (SD)	T ₀ (N = 315)	T ₁ (N = 359)	T ₂ (N = 372)	T ₃ (N = 380)	p value*
Negative aspects of changes (item 1–6 ^c)	26.6 (15.6)	19.5 (14.6)	17.5 (14.1)	14.9 (13.4)	<.001 ^a (T ₁ ,T ₂ ,T ₃ < T ₀)
1.Pain-related distress					
0	79 (25.1)	142 (39.6)	177 (47.6)	218 (57.4)	<.001
1	97 (30.8)	125 (34.8)	122 (32.8)	104 (27.4)	
2	139 (44.1)	92 (25.6)	73 (19.6)	58 (15.3)	
2.Itch-related distress					
0	38 (12.1)	61 (17.0)	76 (20.4)	97 (25.5)	<.001
1	46 (14.6)	92 (25.6)	100 (26.9)	119 (31.3)	
2	231 (73.3)	206 (57.4)	196 (52.7)	164 (43.2)	
3.Working disturbance					
0	37 (11.7)	78 (21.7)	99 (26.6)	123 (32.4)	<.001
1	38 (12.1)	65 (18.1)	59 (15.9)	71 (18.7)	
2	240 (76.2)	216 (60.2)	214 (57.5)	186 (48.9)	
4.Social/interpersonal problems					
0	127 (40.3)	175 (48.7)	194 (52.2)	194 (51.1)	.001
1	60 (19.0)	76 (21.2)	77 (20.7)	91 (23.9)	
2	128 (40.6)	108 (30.1)	101 (27.2)	95 (25.0)	
5.Family functioning impairment					
0	101 (32.1)	199 (55.4)	223 (59.9)	246 (64.7)	<.001
1	64 (20.3)	73 (20.3)	74 (19.9)	74 (19.5)	
2	150 (47.6)	87 (24.2)	75 (20.2)	60 (15.8)	
6.Perceived stress					
0	54 (17.1)	101 (28.1)	121 (32.5)	151 (39.7)	<.001
1	79 (25.1)	97 (27.0)	86 (23.1)	83 (21.8)	
2	182 (57.8)	161 (44.8)	165 (44.4)	146 (38.4)	
Positive aspects of changes (item 7–10 ^c)	25.2 (7.9)	26.8 (8.6)	25.4 (8.4)	27.8 (8.5)	<.001 ^a (T ₃ > T ₀)
7.Positive socio-interpersonal relation					
0	42 (13.3)	47 (13.1)	77 (20.7)	44 (11.6)	.005
1	23 (7.3)	26 (7.2)	37 (9.9)	32 (8.4)	
2	250 (79.4)	286 (79.7)	258 (69.4)	304 (80.0)	
8.Positive family relation					
0	42 (13.3)	43 (12.0)	76 (20.4)	44 (11.6)	.007
1	15 (4.8)	27 (7.5)	23 (6.2)	24 (6.3)	
2	258 (81.9)	289 (80.5)	273 (73.4)	312 (82.1)	
9.Adaptation to the event					
0	13 (4.1)	5 (1.4)	6 (1.6)	1 (0.3)	<.001
1	31 (9.8)	20 (5.6)	18 (4.8)	15 (3.9)	
2	271 (86.0)	334 (94.0)	348 (93.5)	364 (95.8)	
10.Recovery to pre-morbid conditions					
0	13 (4.1)	8 (2.2)	8 (2.2)	8 (2.1)	.014
1	29 (9.2)	21 (5.8)	27 (7.3)	12 (3.2)	
2	273 (86.7)	330 (91.9)	337 (90.6)	360 (94.7)	

(Continues)

TABLE 3 (Continued)

N (%) ^a / mean (SD)	T ₀ (N = 315)	T ₁ (N = 359)	T ₂ (N = 372)	T ₃ (N = 380)	p value*
Level of family support ^b					
0	6 (1.9)	6 (1.7)	10 (2.7)	6 (1.6)	.140
1	19 (6.0)	14 (3.9)	7 (1.9)	19 (5.0)	
2	290 (92.1)	337 (94.4)	354 (95.4)	354 (93.4)	

^aEach variable was recoded into three levels of symptoms/performance according to their original scores (0–10 points), with 0 denotes score 0, 1 denotes score 1–3, and 2 denotes 4–10 points.

^bFamily support was assessed using the Family APGAR scale.

^cThe total score was calculated using the original self-report score of each item rated on a 0–10 Likert scale.

*The p values of categorical variables were derived from Chi-square test throughout the table, except for other indicators (^) where ANOVA with Scheffe post hoc analysis was applied on continuous variables.

burn survivors across the four waves of interviews, for example, the change in working disturbance dropping from 76.2% at T₀ to 48.9% at T₃ (Table 3). The other negative changes including pain-related distress, social/interpersonal problems, family functioning also decreased gradually from approximately 40–20%. The combined negative scores for items 1–6 in Table 3 differed significantly over time, with negative influences decreasing gradually from T₀ - T₃ ($p < .001$). In contrast, all positive functioning measures remained high at 80%–96% throughout T₀-T₃, indicating good recovering and resilient features for respondents in terms of personal resilience, family support, and social relations.

3.4 | Psychosocial care needs and service satisfaction

The life disturbance and functioning changes in Table 4 reflect the participants' care needs over time. Among all the self-reported care needs across four interviews, the increasing trend for each variable between T₀ and T₁ was noted consistently. The top two prevalent perceived needs were legal service and rehabilitation. However, the respondents perceived fewer and fewer needs at T₂ and T₃. The only exception was mental health service needs, where approximately 5–7% of the burn survivors revealed the highest level of need at T₀ - T₃ without significant difference across the years. In addition, the care needs of these people did not correspond to their satisfaction with government or non-government services. They had a consistently high level of satisfaction towards medical and burn services (90–94%), but relatively low satisfaction rates on case management service (73–85%) and government assessment and referrals (32–45%).

4 | DISCUSSION

The four-wave investigation of the 484 young burn survivors of this catastrophic burn disaster in Taiwan revealed psychological resilience during the recovery process, including a constant decreasing trend in various life disturbances and negative functional changes

over the 3-year follow-up. While psychological distress levels subsided gradually, the recovery status appeared to be impeded by an alarming percentage of sleep disturbance (16.3%), depressive symptoms (13.4%), and hypnotic (15.3%) or alcohol (12.9%) use at the third year. Meanwhile, the post-burn positive meanings perceived by participants from personal, familial, or social functioning changes highlighted a high and consistent level of protection over the 3 years and the resilient features of these survivors. However, quite a few psychopathological features like anxiety and stress-related symptoms also re-emerged at the third year, indicating changes in psychological health during long-term follow-up. In addition, self-reported care needs increased at the first year and then steadily decreased at the end; however, the participants' care needs did not correspond to their satisfaction with government or non-government services. Based on the above results, we inferred that the mechanism used by the participants to manage post-burn life difficulties involved balancing unhealthy coping behaviours and psychopathological symptoms while keeping resilient features through positive functioning of life during the long-term community adaptation and adjustment course.

As more people survived traumatic burn injuries in past decades, mental health problems became more important in the trajectory of burn recovery during hospitalization (O'Brien & Lushin, 2019). Our study showed that, following hospital discharge, the important psychological factor of resilience helped sustain longer-term recovery, with burn survivors gaining from both perceived improvement and a balance between post-burn distress and environmental support. Our finding is consistent with other studies which identified changes in psychophysiological health post-discharge (Jochai et al., 2012) and the key function of family members in burn survivor recovery and societal reintegration (Houng et al., 2016; Jang et al., 2017). Positive family relations and high levels of family support were salient for the participants of this study, indicating that better family functioning was an important aspect of psychological resilience. In addition, government rehabilitation and medical services may provide indirect support by increasing knowledge and positive cognition towards recovery of body-and-mind, which helped survivors cope by increasing their resilience. Another factor that may have an impact on post-burn mental health outcomes is positive coping behaviour and the

TABLE 4 Psychosocial care needs of the respondents in the four-wave interviews

N(%) ^a / mean (SD)	T ₀ (N = 315)	T ₁ (N = 359)	T ₂ (N = 372)	T ₃ (N = 380)	p value*
Wound care					
0	232 (73.7)	274 (76.3)	307 (82.5)	344 (90.5)	<.001
1	42 (13.3)	60 (16.7)	41 (11.0)	26 (6.8)	
2	41 (13.0)	25 (7.0)	24 (6.5)	10 (2.6)	
Rehabilitation need					
0	199 (63.2)	214 (59.6)	250 (67.2)	306 (80.5)	<.001
1	48 (15.2)	58 (16.2)	81 (21.8)	47 (12.4)	
2	68 (21.6)	87 (24.2)	41 (11.0)	27 (7.1)	
Education need for care					
0	259 (82.2)	293 (81.6)	326 (87.6)	365 (96.1)	<.001
1	33 (10.5)	47 (13.1)	35 (9.4)	11 (2.9)	
2	23 (7.3)	19 (5.3)	11 (3.0)	4 (1.1)	
Mental health services					
0	249 (79.0)	282 (78.6)	289 (77.7)	312 (82.1)	.581
1	48 (15.2)	50 (13.9)	62 (16.7)	47 (12.4)	
2	18 (5.7)	27 (7.5)	21 (5.6)	21 (5.5)	
Employment preparation					
0	246 (78.1)	237 (66.0)	267 (71.8)	303 (79.7)	<.001
1	28 (8.9)	58 (16.2)	43 (11.6)	41 (10.8)	
2	41 (13.0)	64 (17.8)	62 (16.7)	36 (9.5)	
Schooling need					
0	281 (89.2)	284 (79.1)	328 (88.2)	353 (92.9)	<.001
1	22 (7.0)	42 (11.7)	22 (5.9)	15 (3.9)	
2	12 (3.8)	33 (9.2)	22 (5.9)	12 (3.2)	
Economic need					
0	202 (64.1)	197 (54.9)	227 (61.0)	263 (69.2)	.001
1	54 (17.1)	93 (25.9)	72 (19.4)	69 (18.2)	
2	59 (18.7)	69 (19.2)	73 (19.6)	48 (12.6)	
Law services					
0	169 (53.7)	171 (47.6)	214 (57.5)	238 (62.6)	<.001
1	67 (21.3)	74 (20.6)	65 (17.5)	76 (20.0)	
2	79 (25.1)	114 (31.8)	93 (25.0)	66 (17.4)	
All care needs (total score)	3.7 (4.6)	4.5 (5.0)	3.3 (4.1)	2.2 (3.1)	<.001 [^] (T3 < T0)
Satisfaction with services					
Government A&R	n = 248	n = 311	n = 300	n = 337	
	111 (44.8)	129 (41.5)	95 (31.7)	116 (34.4)	.004
Government medical services	n = 314	n = 358	n = 368	n = 380	
	275 (87.6)	333 (93.0)	338 (91.8)	349 (91.8)	.072
Local CM service centre	n = 228	n = 347	n = 363	n = 375	
	166 (72.8)	262 (75.5)	286 (78.8)	318 (84.8)	.002

(Continues)

TABLE 4 (Continued)

N(%) ^a / mean (SD)	T ₀ (N = 315) n = 266	T ₁ (N = 359) n = 316	T ₂ (N = 372) n = 337	T ₃ (N = 380) n = 353	p value*
Burn service centre (NGOs)	238 (89.5)	294 (93.0)	314 (93.2)	330 (93.5)	.228

Abbreviations: A&R: Assessment and Referral; CM: Case management; NGO: Non-government organization.

^aThe response of each variable was one of the three categories of none (0), slightly (1), or much need (2).

*The p values of categorical variables were derived from Chi-square test throughout the table, except for other indicators (^) where ANOVA with Scheffe post hoc analysis was applied on continuous variables.

associated personality traits (Jochai et al., 2012). These all support the notion that both external and psychosocial factors affect mental health in the long-term burn recovery process (Tedstone & Tarrier, 1997).

On the other hand, personal resilience in the face of long-term physical or psychological pain is also a significant target for evaluation in young burn survivors. The importance of resilience in the recovery process after major burn injuries has been validated in previous studies as it may reinforce survivors' perceived strengths, growth, and support (Abrams, Ogletree, Ratnapradipa, & Neumeister, 2015; Lau & van Niekerk, 2011). Our study showed that burn survivors improved consistently in overall mental health during the first 2 years of rehabilitation. However, the changes of psychological health in the community were not found in previous retrospective studies, particularly in terms of anxious mood related to thinking about the event or certain stress reactions such as startle or anger. Although not pervasively deteriorating, these minor psychological changes at the third year have reminded healthcare providers of the long-term negative consequences following major burn injuries. This delayed psychological response may result from the aftermath of the trauma itself, a decrease in peer or family support, or it may simply reflect individual personality traits. Whatever the cause, it should be noted during the recovery trajectory. In particular, the later death of members of the burn cohort may demoralize survivors and reduce their psychological resilience. This finding was reinforced by the results about substance use, which indicated a higher percentage used alcohol in the third year (3.8%–12.9%) and a constantly high percentage used hypnotics (15.3%–37.5%) throughout the 3-year study period. These rates may reflect either self-medication for mental health problems or a heightened need for psychological interventions at later stage of burn recovery process.

The study results have implications for the clinical care of young burn survivors during the long-term recovery trajectory. The findings highlight the importance of post-event psychological resilience, which lasts for up to 2 years, after which the rebound effect of anxiety or stress-related symptoms may re-emerge and lead to substance self-medication (e.g., alcohol) or delayed help-seeking. Nursing care should not only be reactive towards the multifaceted needs of burn patients during the acute and adaptation period but also be proactive in terms of longer-term mental health interventions, including active assessment and referral in response to psychological changes

during long-term recovery. For future nursing research, more longitudinal studies of burn cohorts should be collected to validate the findings of resilience and psychological reactions identified in this study. Differences in gender and age or predictors of better psychological resilience should also be examined in longitudinal studies of burn survivors. Furthermore, the role of family support for young burn survivors could be explored to clarify its mediating or moderating effect on psychological responses in different cultures.

4.1 | Limitations

The study analysed the longitudinal psychosocial changes in a large number of young burn survivors in a huge disaster. Multiple follow-ups benefit the explanations of psychological resiliency during recovery. But interpretation of the findings was confined to those who participated to government services but not the non-responders, which may lead to some extent of selection bias. Failed to have adopted resilience scales or qualitative study towards mechanisms used by the participants to manage the post-burn life difficulties were limitations of the study, but we adopted the concept that resilience represents the recovery or coping process from short-term or long-term adversity like burns. We collected functional changes and various psychological symptoms in the four-wave interviews to compare and infer the long-term psychological resilience across the years. The descriptive statistics showed the resilient process in itself that facilitated interpretation of the concept. Moreover, the response rates and sample size were satisfactory and higher than other burn studies. Since studies of this kind were limited, our findings provided the evidence-based knowledge for nursing practice and academics.

5 | CONCLUSION

The young burn survivors showed psychological resilience during the first 2 years of the recovery process. The longer-term post-traumatic psychological response and unhealthy coping efforts should be noticed, given initial resilience out of stress and burn injuries. Early prevention and detection of mental health deterioration is needed even after 2 years of burn disasters.

CONFLICT OF INTEREST STATEMENT

There is no conflict of interest by the authors in relation to the study itself.

FUNDING STATEMENT

This project was financed by the New Taipei City Government in 2018, entitled, 'The Bah-Shien Dust Explosion Burn Casualty-Case Management Research Project'. The project number is 107M076. The funder designed the study and performed data collection. The researchers of this study were responsible for data analysis, interpretation, and/or manuscript writing. All the authors agreed to submit the report for publication.

ACKNOWLEDGEMENTS

Funding from the 2018 research project offered by the Department of Health, New Taipei City Government is acknowledged. The authors thank all the participants who contributed to this study.

AUTHOR CONTRIBUTIONS

Wu CY, Lee MB, Lin CH, Kao SC, and Tu CC: Made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; Wu CY, Lee MB, and Lin CH: Involved in drafting the manuscript or revising it critically for important intellectual content; Wu CY, Lee MB, Lin CH, Kao SC, Tu CC, and Chang CM: Given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content; Wu CY, Lee MB, Lin CH, Kao SC, Tu CC, and Chang CM: Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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How to cite this article: Wu C-Y, Lee M-B, Lin C-H, Kao S-C, Tu C-C, Chang C-M. A longitudinal study on psychological reactions and resilience among young survivors of a burn disaster in Taiwan 2015–2018. *J Adv Nurs*. 2020;76:514–525. <https://doi.org/10.1111/jan.14248>

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