

Risk and protective factors for the course of post-traumatic stress disorder in frontline workers after the Christchurch, New Zealand earthquake

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Abstract

Purpose – The purpose of this paper is to describe risk and protective factors for symptoms of post-traumatic stress disorder (PTSD) experienced over a 1.5-year period among both frontline and “non-traditional” responders to the 2010 and 2011 earthquakes in Christchurch, New Zealand.

Design/methodology/approach – A longitudinal survey administered to Christchurch workers with referents from the city of Hamilton at 6, 12 and 18 months after the 2011 earthquake. Potential risk and protective determinants were assessed by questionnaire items at baseline and over time, the outcome being PTSD as assessed by the PTSD Checklist-Civilian version. A longitudinal latent class analysis identified groups with similar trajectories of PTSD.

Findings – A total of 226 individuals, 140 (26 per cent) from Christchurch and 86 (16 per cent) from Hamilton, participated at baseline, 180 at 12 and 123 at 18 months, non-traditional responders forming the largest single group. Two latent classes emerged, with PTSD (21 per cent) and without PTSD (79 per cent), with little



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change over the 18-month period. Class membership was predicted by high scores in the Social Support and Impact of Events scale items, Health-related Quality of Life scores being protective. PTSD scores indicative of distress were found in females, and predicted by burnout risk, behavioural disengagement and venting.

Practical implications – Non-traditional responders should be screened for PTSD. Social support should be considered with the promotion of adaptive coping mechanisms.

Originality/value – The strength was longitudinal follow-up over an 18-month period, with demonstration of how the potential determinants influenced the course of PTSD over time.

Keywords Risk, Earthquake, Risk assessment, First responders, Post-traumatic stress disorder

Paper type Research paper

1. Introduction

The setting for the study was the September 2010 and February 2011 earthquakes experienced in Christchurch, New Zealand. The former caused damage but no loss of life, the latter widespread damage and 185 fatalities. Liquefaction of sediments, and landslides caused by the seismic activity, generated severe infrastructure damage throughout the Christchurch metropolitan area. A majority of the casualties were due to injuries sustained from building collapses. Frontline workers undertaking emergency operations were exposed to potential trauma-inducing events as rescue efforts continued for over a week and the population at large was subjected to more than 361 aftershocks occurring in the first week after the earthquake.

Traditional frontline workers are those trained to respond, the emergency services and health care, especially ambulance, workers. Non-traditional responders include utility, demolition and construction workers who are expected to maintain and repair essential infrastructure. Another more overlooked group provides continuity of social services in the domains of welfare, health, education, justice, psychology and community outreach.

Consistently observed psychological reactions amongst frontline workers include anxiety, hyper-arousal, hyper-vigilance, painful recollections, grief and post-traumatic stress (Blevins *et al.*, 2015). In 1980, the American Psychiatric Association added “post-traumatic stress disorder” (PTSD) to the third edition of the *Diagnostic and Statistical Manual of Mental Disorders*. Trauma was conceptualized as a “catastrophic stressor outside the range of usual human experience” (Friedman, 2016), with the capacity to exceed the individual’s coping mechanisms.

Corresponding to the disaster phases, modifying factors can be positive or negative, occurring in the pre-, peri- and post-disaster periods (Alexander and Klein, 2009). Pre-disaster, the demographic factors of being single, older and of lower educational level have negative associations (Witteveen *et al.*, 2007), resilience being protective, but not a unitary construct, having been defined as a “complex repertoire of behavioural tendencies” (Agaibi and Wilson, 2005). Peri-disaster risk factors relate to the impact of the event, including critical incidents such as seeing, or handling, dead bodies or experiencing significant personal danger. Protective factors include good work organisation, and coping methods such as denial or humour may also be important, but not consistently so in all disaster phases (Alexander and Klein, 2009). During the post-disaster phase, responders are often faced with further stressful life events: in particular, cumulative exposure to work-related traumatic events has been shown to predict PTSD in first responders (Geronazzo-Alman *et al.*, 2017).

Assessing causation demands a longitudinal approach, with a more recent emphasis on post-disaster PTSD “symptom trajectories”, advances in statistical techniques allowing more complex predictive models to be developed (Peleg and Shalev, 2006). The most substantive body of evidence of symptom trajectories, in both traditional and non-traditional responders, relates to the September 2001 (9/11) attack on the World Trade Centre (WTC). The study of Pietrzak *et al.* (2014) exemplifies this approach by assessing 10,385 traditional and non-traditional WTC responders. A latent growth model

determined patterns of PTSD symptom trajectories, along with their potentially modifiable determinants. Traditional responders displayed, in order of prevalence, resistant (78 per cent); delayed onset; recovering, and severe chronic (5.3 per cent) trajectories. Non-traditional responders were found to have a 58 per cent prevalence of resistant trajectory and 9.5 per cent prevalence of severe chronic trajectory, with two additional patterns, subsyndromal increasing and moderate chronic. Factors consistently related to symptomatic PTSD trajectories in both groups of responders were female sex, Hispanic race/ethnicity, lower education, prior psychiatric history, greater life stressors prior to 9/11, increased severity of WTC exposure and a greater number of WTC-related medical conditions. In both groups of responders, family support while working at the WTC site was negatively associated with a severe chronic PTSD trajectory. Similarly, work support while working at the site was negatively associated with a delayed-onset trajectory in police responders, and severe chronic and moderate chronic trajectories in non-professional responders. The authors stress that their results “underscore the importance of prevention, screening and treatment efforts that target high-risk disaster responders, particularly those with prior psychiatric history, high levels of trauma exposure and work-related medical morbidities”.

Also relevant is the fact that traumatic events triggering PTSD can have adverse long-term physical and psychological consequences (McFarlane, 2010; Pacella *et al.*, 2013). If it was possible to identify persistent PTSD symptoms, vulnerable populations could be identified, interventions designed and long term health consequences avoided.

The aim of this study was therefore to characterize risk and protective factors for PTSD symptoms among frontline workers, both traditional and non-traditional, responding to the 2010 and 2011 Christchurch earthquakes. We identified workers with and without persistent PTSD symptoms over an 18-month follow-up period, and described risk and protective factors for responders with different PTSD symptom profiles over time.

2. Methods

The method chosen was a longitudinal design, the sampling frame those providing emergency, infrastructure and social support services in the Christchurch city area after the earthquake. The North Island city of Hamilton was selected as a referent area because of its distance from Christchurch, with fewer workers likely to have been involved in relief work in Christchurch, similar terrain, similar demographic composition and comparable socio-economic diversity.

The sampling included traditional and non-traditional responders. Traditional responders were defined as those in the ambulance, fire and police services, military personnel and rescue workers. The non-traditional responder frame included utility workers, construction and demolition workers, Māori Wardens, Red Cross workers, school teachers and non-government service organisation staff.

We planned to use the electoral roll to identify a systematic sample of individuals in the targeted population. The strategy involved making postal contact, giving options for a self-completed survey either online or by post. In view of the considerable disruption, displacement of individuals and interruption of services in the immediate months following the earthquake, we subsequently elected to distribute paper questionnaires to individuals and worksites. We therefore enlisted the help of local executives, managers, trades unions and service leaders from organisations providing emergency, infrastructure and social support services. An invitation to participate in the study was sent out to the workers via union membership lists and employers. A general invitation to participate for non-union members and non-unionised workforces was also posted at the various worksites.

Power calculations indicated that 550 from each city would allow 80 per cent power for detecting difference in proportions of 0.1 between cities overall, and 0.2 for subgroups consisting of at least one-fifth of the sample from each city at the two-sided 0.05 level.

Those eligible were the residents in Christchurch or Hamilton at the time of both 2010 and 2011 earthquake events, the referent group being matched on occupation using the New Zealand electoral roll. A self-administered questionnaire was then distributed to consenting individuals at the workplace and by post with a post-paid return envelope at 6 (baseline), 12- and 18-month intervals after the 2011 earthquake.

2.1 Main outcome measure

The main outcome was assessed through the PTSD Checklist-Civilian version (PCL-C) developed by Weathers and colleagues (Weathers *et al.*, 1993). This self-report assessment has been shown valid (Blevins *et al.*, 2015; Palmieri *et al.*, 2007), and has a high accuracy of PTSD diagnosis both before, and after treatment (Forbes *et al.*, 2001).

2.2 Moderating factors

Potential protective factors were identified through those instruments in which a high score is indicative of a positive attribute. These included overall wellbeing, assessed by the World Health Organization Quality of Life-BREF (WHOQoL) questionnaire (WHOQoL group, 1996), measuring the respondents' overall perception of quality of life and health in four domains with 26 total questions. The 24-item Social Provisions Scale (SPS) assessed social relationships and various dimensions of social supports (Cutrona and Russell, 1987). The Inventory of Socially Supportive Behaviours (ISSB) assessed how frequently respondents received different forms of social support since the earthquake. (Barrera and Aina, 1983) and the Connor-Davidson Resilience Scale measured respondents' resilience, that is to say the ability to cope with stress (Connor and Davidson, 2003).

Risk factors included emotional distress and possible psychiatric morbidity screened for by the General Health Questionnaire-28 (GHQ-28) (Goldberg, 1978). Exposure to "critical incidents" were quantified using a series of 45 questions, and the Impact of Event Scale-Revised (IES-R) assessed subjective distress to these incidents (Weiss, 2007).

Composite measures include those measuring both positive and negative constructs. The 28-item Brief COPE measures 14 conceptually differentiable coping reactions (Carver, 1997). The Compassion Fatigue Professional Quality of Life Scale (ProQOL) assesses the quality of life one feels in relation to work as a helper (Stamm, 2010), higher scores in the compassion satisfaction scale representing greater satisfaction related to effective caregiver ability, higher scores in the burnout risk and secondary traumatic stress scales indicating adverse reactions. Finally, the modified Maslach Burnout Inventory (MBI) is a 22-item measure used to assess three aspects of burnout, the positive being personal accomplishment, the negative emotional exhaustion and depersonalisation (Maslach and Jackson, 1981).

2.3 Ethical considerations

Ethics approval was received from the University of Otago Human Ethics Committee.

2.4 Statistical methods

Comparisons of demographic characteristics or psychological instrument responses among the participants grouped by PTSD status were performed using χ^2 tests for categorical variables, and *t*-tests for continuous variables. We had no a priori assumptions regarding the distribution of PTSD in the population, using two methods to identify those with high levels of PTSD, first by longitudinal latent class analysis (LLCA), and second by using a PCL-C criterion score of

greater than or equal to 30. The LLCA identified groups with a level of PTSD that did not change over time, a unique PTSD trajectory (Jones and Nagin, 2007; Nagin, 2005). The “Proc Traj” procedure in SAS was used with PCL-C scores obtained from each data collection round to determine latent class membership. Model selection was performed by comparing Bayesian information criterion statistics among successive models with differing subgroup numbers, allowing for identification of the latent class number with the most parsimonious fit. A two-group, first-order model was initially selected, and unchanging covariates (sex and ethnicity) were then added to the model to further shape the group trajectories over time. The final selection of the number of latent classes was based on the best model fit and minimum group sizes containing ≥ 10 per cent of the study population.

The demographic and psychometric characteristics of individuals assigned to each latent class were then compared using generalised linear mixed models (Proc GLIMMIX in SAS). Covariates for inclusion were initially identified from an examination of the bivariate relationships among those in the high and low PCL-C latent groups, selecting those with a p -value < 0.15 . Selected covariates were then combined in a single model and manual backwards elimination was used to identify only covariates that independently predicted PCL-C latent class membership at $p \leq 0.10$.

A generalised linear mixed model was used in a more traditional method of assessing the risk factors by defining a “cut point” for PTSD, a PCL-C score of greater than or equal to 30: this is suggested as appropriate for population screening (National Center for PTSD, 2012). This was used in a similar longitudinal manner as described above to identify demographic and psychometric characteristics that differed among those with and without elevated PCL-C scores.

3. Results

The baseline demographics of the sample are shown by PTSD status in Table I.

A total of 226 individuals, 140 (26 per cent) from Christchurch and 86 (16 per cent) from Hamilton, in aggregate 19 per cent of those sampled, completed the questionnaire at baseline (Round 1), 180 at six months and, and 123 at 12 months. Of the defined groups, 33 per cent of police staff ($n = 39$) returned the questionnaire, 17 per cent of teachers and “non-traditional” responders ($n = 141$) 29 per cent of ambulance staff ($n = 37$) and 7 per cent ($n = 9$) of fire-fighters. The participants were predominantly female (59 per cent) and of NZ European race (93 per cent). A majority of the participants were aged 41-50 (29 per cent) or 51-60 years old (30 per cent), and approximately 62 per cent had tertiary education. At baseline, most participants indicated that they had experienced damage to their home (57 per cent) or their workplace (40 per cent). On an average, the participants at baseline were exposed to at least 7 of 45 critical incidents included in the survey, and this trend remained relatively constant across subsequent data collection rounds.

Table II shows the psychometric measures at baseline by PTSD status.

The prevalence of PTSD (PCL-C score ≥ 30) was 37, 24 and 24 per cent during the first, second and third rounds of data collection, respectively. At baseline, PTSD cases were more likely to be female, a teacher or exposed to more than 11 critical incidents relative to those without PTSD. Each of the psychometric measures in Table II had at least one sum score with statistically significant differences by PTSD status. PTSD cases had higher scores in all items of the GHQ, IES-R, WHOQoL and lower scores in the CDRISC. Higher scores were also observed in 9 of 13 Brief COPE measures, four of five subscales in the ISSB, and both of the risk items on the ProQol instrument, burnout risk and secondary traumatic stress. Those with distress also had higher scores in the overall SPS, and two of its subscales, social integration and reliable alliance.

Figure 1 presents the results from the latent class analysis, identifying two distinct groups with linear trajectories of PCL-C scores across all data collection rounds; one group

Characteristic	Overall	PTSD	No PTSD	<i>p</i> -value
<i>Age (years)</i>				
21-40	56 (25%)	19 (23%)	37 (26%)	0.16
41-50	65 (29%)	31 (38%)	34 (24%)	
51-60	66 (30%)	22 (27%)	44 (31%)	
61+	36 (16%)	10 (12%)	26 (18%)	
<i>Sex</i>				
Female	132 (59)	56 (68%)	76 (54%)	0.03
Male	92 (41)	26 (32%)	66 (46%)	
<i>Race</i>				
NZ European	192 (93%)	68 (94%)	124 (93%)	0.60
Pacific Islander/Other	14 (7%)	4 (6%)	10 (7%)	
<i>Marital status</i>				
Married	178 (79%)	63 (76%)	115 (82%)	0.31
Other	46 (21%)	20 (24%)	26 (18%)	
<i>Education</i>				
Primary and secondary	41 (20%)	11 (14%)	30 (23%)	0.34
Technical	37 (18%)	15 (20%)	22 (17%)	
University	130 (62%)	50 (66%)	80 (61%)	
<i>Income</i>				
20-50 K	31 (14%)	13 (16%)	18 (13%)	0.15
50-70 K	50 (23%)	22 (27%)	28 (21%)	
70-100 K	57 (26%)	25 (30%)	32 (24%)	
100 K+	79 (36%)	22 (27%)	57 (42%)	
<i>Occupation</i>				
Frontline	48 (21%)	9 (11%)	39 (27%)	< 0.01
Ambulance	37 (16%)	11 (13%)	26 (18%)	
Teachers and non-traditional	141 (62%)	63 (76%)	78 (55%)	
<i>Centre</i>				
Christchurch	140 (62%)	57 (69%)	83 (58%)	0.11
Hamilton	86 (38%)	26 (31%)	60 (42%)	
<i>Volunteer</i>				
No	178 (89%)	67 (91%)	111 (89%)	0.70
Yes	21 (11%)	7 (9%)	14 (11%)	
<i>Years of job experience</i>				
0-5 years	39 (17%)	17 (21%)	22 (15%)	0.72
6-10 years	51 (23%)	18 (22%)	33 (23%)	
11-20 years	45 (20%)	17 (21%)	28 (20%)	
21-30 years	39 (17%)	15 (18%)	24 (17%)	
30+ years	51 (23%)	15 (18%)	36 (25%)	
<i>History of psychological therapy</i>				
No	210 (94%)	75 (90%)	135 (96%)	0.06
Yes	13 (6%)	8 (10%)	5 (4%)	
<i>Total no of critical incidents^a</i>				
<11	159 (70%)	49 (59%)	110 (77%)	<0.01
≥11	67 (30%)	34 (41%)	33 (23%)	
Mean (SD)	7.1 (6.4)	6.7 (6.7)	7.7 (6.0)	0.29
Note: ^a 11 represents the 75th percentile of critical exposures encountered at baseline				

Table I.
Baseline demographic
characteristics by
PTSD Status

Characteristic	Overall	PTSD	No PTSD	<i>p</i> -value
<i>Social provisions</i>				
Overall score	60.5	61.5	59.9	<0.01
Attachment	10.3	10.4	10.3	0.43
Social integration	9.8	10.0	9.7	0.03
Reassurance of worth	9.9	10.0	9.7	0.08
Reliable alliance	10.1	10.3	10.0	0.04
Guidance	10.4	10.4	10.3	0.64
Opportunity for nurturance	11.8	12.0	11.7	0.10
<i>Brief COPE</i>				
Self-distraction	5.6	6.4	5.2	< 0.01
Active coping	6.3	6.7	6.1	0.02
Denial	2.9	3.7	2.5	< 0.01
Substance use	2.9	3.3	2.6	0.01
Use of emotional support	5.7	5.9	5.6	0.36
Use of instrumental support	4.9	5.4	4.7	0.01
Behavioural disengagement	2.7	3.3	2.4	< 0.01
Venting	4.0	4.9	3.5	< 0.01
Positive reframing	6.2	6.6	6.0	0.01
Humour	5.3	5.0	5.4	0.14
Acceptance	7.0	6.9	7.0	0.78
Religion	4.0	4.0	4.1	0.77
Self-blame	3.4	4.4	2.8	< 0.01
<i>Inventory of Socially Supportive Behaviours</i>				
Overall score	91.6	97.8	88.1	0.01
Directive guidance	29.0	31.1	27.8	0.02
Tangible assistance	20.5	22.2	19.5	0.00
Positive social exchange	13.9	14.8	13.4	0.04
Nondirective support	14.7	15.0	14.5	0.52
<i>Connor-Davidson Resilience Scale</i>				
Overall score	95.0	88.4	98.9	< 0.01
Personal competence	31.6	29.7	32.8	< 0.01
Trust in ones instincts	25.4	23.5	26.4	< 0.01
Positive acceptance of change	20.0	18.5	20.8	< 0.01
Control	12.0	11.1	12.6	< 0.01
Spiritual influences	7.9	7.2	8.3	< 0.01
<i>Measurement of experienced burnout</i>				
Emotional exhaustion	10.2	12.7	9.7	< 0.01
Personal accomplishment	17.3	17.3	17.3	0.96
Depersonalisation	5.8	6.5	5.4	0.04
<i>Compassion Satisfaction Test (ProQol)</i>				
Compassion satisfaction	39.7	38.8	40.2	0.08
Burnout risk	21.9	25.7	19.7	< 0.01
Secondary traumatic stress	21.4	25.1	19.1	< 0.01
<i>General Health Questionnaire</i>				
Overall score	6.7	9.6	4.9	< 0.01
Somatic symptoms	2.0	2.5	1.7	0.01
Anxiety/insomnia	1.9	3.4	1.0	< 0.01
Social dysfunction	1.3	2.0	0.8	< 0.01
Severe depression	1.5	1.8	1.4	0.05

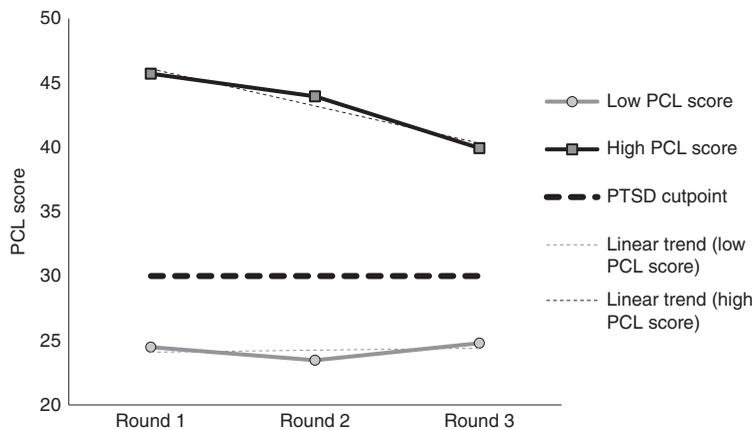
(continued)

Table II.
Psychometric measures at baseline by PTSD status

Table II.

Characteristic	Overall	PTSD	No PTSD	<i>p</i> -value
<i>Impact of event scale</i>				
Overall score	17.9	29.5	10.4	< 0.01
Intrusion	7.4	11.9	4.5	< 0.01
Avoidance	6.0	9.9	3.5	< 0.01
Hyper-arousal	4.5	7.9	2.4	< 0.01
<i>WHO Quality of Life</i>				
Overall Score	69.8	61.8	74.4	< 0.01
Physical	67.7	60.5	71.8	< 0.01
Psychological	69.3	59.8	74.8	< 0.01
Social	71.8	60.9	77.9	< 0.01
Environment	71.3	65.1	74.8	< 0.01

Figure 1.
Trajectories of PCL-C scores among frontline workers, Christchurch, 2011



with PCL-C scores exceeding the criterion (≥ 30) for PTSD screening (mean \pm SD: 45.3 \pm 8.4, 21 per cent of the study population) and another with scores below the criterion (mean \pm SD: 23.9 \pm 6.3, 79 per cent).

Table III presents the marginal structural model from the LLCA.

After adjustment for other covariates, the participants in the latent group with elevated PCL-C scores were more likely to have elevated scores for perceived social support, OR 1.17, 95 per cent CI 1.01-1.35, and impacts of events OR 1.08, 95 per cent CI 1.04-1.11, relative to the group with lower PCL-C scores. Individuals in the group with elevated PCL-C trajectories tended to be female (74 per cent), married (81 per cent), university educated (68 per cent), have moderately high annual incomes (NZ\$70,000-100,000, 38 per cent), and

Table III.
Odds of latent class membership in the high PCL-C group

Characteristic	Odds ratio (95% CI)	<i>p</i> -value
Social provisions score	1.17 (1.01, 1.35)	0.04
Burnout risk – compassion satisfaction test	1.09 (0.98, 1.22)	0.11
Impact of event scale score	1.08 (1.04, 1.11)	<0.01
WHO Quality of Life Score	0.96 (0.91, 1.01)	0.13

be working as teachers (74 per cent, data not shown). Most individuals in this group were exposed to fewer than 11 critical incidents (55 per cent), with an average of 8 ± 6 exposures (data not shown).

Table IV presents the factors that predicted increased odds of PTSD status among participants, based solely on PCL-C scores ≥ 30 , after adjusting for covariates.

Predictive factors included age between 41 and 50, being female, and certain maladaptive coping strategies including behavioural disengagement, venting and burnout risk. Measures of experienced burnout did not predict PTSD case status, although a measure of the potential for burnout (ProQOL scale), as well as the severity of stress exposure (IES-R), were predictive of an elevated PCL-C score. PTSD cases also had lower WHOQoL scores relative to those with lower PCL scores.

4. Conclusions

4.1 Main findings

Just two trajectories emerged from the LLCA: individuals with and without PCL-C scores indicative of PTSD. The model of best fit predicted that 21 per cent of participants belonged to the high PTSD trajectory, with no one changing groups over time. The distress persisted over the 12-month follow-up period, with mean PCL-C scores of 47 at Round 1 and a final score of 44. The LLCA identified a simple two class trajectory, with the Social Provisions

Characteristic	Odds ratio (95% CI)	p-value
Data collection round		0.12
Round 1	1.37 (0.51, 3.60)	
Round 2	0.49 (0.16, 1.55)	
Round 3 (reference)	–	–
Age group		0.08
21-40 yrs	2.25 (0.56, 9.00)	
41-50 yrs	4.72 (1.33, 16.73)	
51-60 yrs	1.93 (0.57, 6.56)	
61+yrs (reference)	–	–
Sex		0.04
Female	2.49 (1.03, 6.03)	
Male (reference)	–	–
Social provisions score	1.10 (0.99, 1.23)	0.08
<i>Brief COPE</i>		
Denial	1.30 (0.98, 1.74)	0.07
Behavioural disengagement	1.40 (1.02, 1.94)	0.04
Venting	1.30 (1.03, 1.64)	0.03
Humour	0.85 (0.71, 1.02)	0.09
Connor-Davidson Resilience Score	1.04 (1.00, 1.08)	0.06
<i>Measure of experienced burnout</i>		
Emotional exhaustion	0.89 (0.79, 1.01)	0.07
Depersonalisation	0.89 (0.78, 1.01)	0.07
<i>Compassion Satisfaction Test</i>		
Burnout Risk	1.28 (1.12, 1.45)	< 0.01
General Health Questionnaire Score	1.10 (0.99, 1.21)	0.07
Impact of Event Scale Score	1.09 (1.05, 1.12)	< 0.01
WHO Quality of Life Score	0.94 (0.90, 0.99)	0.01

Notes: Best fit generalized linear mixed model; PTSD status defined using a PCL-C score of ≥ 30 relative to those with a PCL-C < 30. PTSD, post-traumatic stress disorder

Table IV.
Odds of PTSD case status based on PCL-C score ≥ 30

Score, burnout risk from the ProQol and the IES-R contributing, the latter as a measure of severity of distress.

The odds of achieving a PCL-C score of greater than 30 over time (Table IV) were most strongly predicted by age and sex; three adverse items from the Brief COPE, denial, behavioural disengagement and venting; and burnout risk from the ProQol. The SPS, burnout risk and IES-R scores were statistically significant in both models, i.e., that which addressed the odds of being in the high PTSD group over time, and that which addressed the odds of having a PTSD score greater than 30.

The only protective factor in the model was a good WHOQoL score. The CDRISC score did not predict lower odds of distress.

Many of the baseline univariate associations between risk factors for PTSD conform to the pattern expected from the instrument constructs, the social support measures being the exception. Those with distress had higher overall ISSB and SPS scores, the latter appearing in both models of best fit.

4.2 Strengths and weaknesses

The strengths of the study included the longitudinal follow-up with demonstration of the persistence of PTSD over time. The benefit of the LLC analysis was that it did not place any a priori restrictions on the outcome, allowing the data to define the groups and determine the cut-off score. The average “high trajectory” score of 47 indicates a moderate level of distress. The generalised linear model (GLM) used a cut-off value of 30, suggested as being suitable for population screening. This increased the prevalence of PTSD and allowed more variables to emerge as potential risk factors. The significant variables in both models were the IES-R, SPS and the ProQol “compassion fatigue” burnout risk. There is value in comparing the two sets of results, the GLM (Table IV) showing factors indicative of distress, chief among these being female and aged between 41 and 50 years of age.

The limitations were the opportunistic sampling method and the low response rate. The sampling strategy, as designed, was systematic. In reality, a disaster situation, it developed an ad hoc dimension because it proved difficult to recruit potential participants by post. We needed, in Christchurch, to recruit at the workplace. This strategy meant that we had an opportunity sample, also that response rates were determined by comparing the numbers of questionnaires accepted to the proportion actually returned, which was low. There was a particular problem in engaging with the uniformed services: thus the sample is probably not fully representative. Of the non-traditional participants, the majority were teachers, and those achieving a high PTSD score were female, married and well-educated. These individuals may be more vulnerable to stressor impacts or PTSD induction in comparison to those self-selected into the traditional “frontline worker” group. There is almost certainly a selection effect at play: we cannot generalize to the population of frontline workers.

Although the response rates were low, they were typical of other studies using questionnaires, being 26 per cent after the Enschede fireworks disaster (Dirkzwager *et al.*, 2006) and 30 per cent, also predominantly female, for university teachers after the Christchurch event (Bell *et al.*, 2016). We were also reassured by an analysis of the Enschede responders which showed that, despite the existence of selective participation (Grievink *et al.*, 2006), the selection effect was not substantial enough to bias the prevalence estimates. We therefore consider that teachers have suffered distress in the disaster aftermath.

4.3 Comparisons with other studies

An earlier analysis of these data (Shepherd *et al.*, 2017) focussed on the Christchurch group of 138 individuals at baseline, and sought to determine the independent predictive value of disaster exposure, resilience and their interaction effect upon PTSD. Because of the small sample size, multivariate analyses were not possible. There were significant moderate

negative correlations between PTSD scores and resilience, and no significant correlation between resilience and exposure scores. Coping style was positively associated with PTSD except for humour and, for women only, acceptance. The strongest correlations were between maladaptive coping styles and PTSD, both genders showing significant positive relationships between PTSD and behavioural disengagement coping. Exploratory baseline data analyses failed to distinguish teachers from the other groups.

Our findings are also consistent with other Christchurch studies. In terms of prevalence, one study reported PCL scores at seven months after the earthquake in the 210 students (83 per cent of the total) in the fourth, fifth and sixth year of study at the Christchurch School of Medicine (Carter *et al.*, 2014). This revealed a mean PCL-S (the PCL questionnaire for a specific event) score of 28.8. A year 5 group stood out as having the highest score, 31.7 (SD: 12.8). This indicates that 15 per cent in this group would have exceeded our “high trajectory” score of 45. They also had high scores in measures of anxiety, depression and stress. The ecological relationship in the fifth-year students was greater exposure to earthquake events and the pressure of final exams.

Some comparisons are possible with Kuntz *et al.* (2013), who engaged with 125 Christchurch teachers the year following the earthquake, 2012. They had a focus on burnout, measured by two core items from the “MBI Educators Survey” (Maslach *et al.*, 1996), emotional exhaustion and cynicism, the latter being equivalent to depersonalisation, but framed in a teaching specific context. Personal accomplishment was omitted, the argument being that it develops independently of exhaustion and cynicism. Disaster-related antecedents included personal disaster impact, school disaster impact and school responsiveness to the disaster, along with two personal stressors, role conflict and role overload. The outcome was not PTSD but, ‘turnover intention’, defined as intent to exit the profession. The disaster variables showed a strong relationship with cynicism, role overload being strongly related to emotional exhaustion and intent to exit. This contrasts with our finding that both emotional exhaustion and cynicism (depersonalisation in our context) failed to show associations with PTSD. It did however lead the authors to a practical conclusion, the need to “implement supportive strategies to mitigate feelings of emotional exhaustion, and restore higher levels of engagement with the school and the professional”.

O’Toole and Friesen (2016) also emphasized the frontline role of teachers, examining the roles of emotional labour and regulation in Christchurch teachers. Interestingly, teachers who experienced danger during the earthquake reported greater emotional regulation and teacher efficacy in what might have been post-traumatic growth. Less experienced teachers tended to report more negative emotions.

Surgenor *et al.* (2015) carried out a survey of police staff working in the Canterbury region, using the IES-R as an outcome measure with the identification of pre-, peri- and post-earthquake factors. A univariate analysis showed associations with those identifying as Māori, being a member of non-sworn, or auxiliary support, staff, reliance on dysfunctional coping, working in more earthquake events and acting in the first responder roles of search and rescue, media contact and dispatch communications. A final regression model showed the independent contribution of seven variables: pre-disaster, a reliance dysfunctional coping; peri-disaster a dispatch communications role; and post-disaster high distress following exposure to resource losses, grotesque scenes, personal harm and concern for significant others. The coping resource of optimism was the sole variable associated with a lower impact of events score.

4.4 Interpretation

The major implication is finding that the majority of those with PTSD were non-traditional responders, many being teachers. Although not widely recognized, social services providers do have a role in disaster recovery as part of a community network that mobilizes to provide

emotional and social support (Walsh, 2007), with a specific role in assessing and supporting child mental health. Non-traditional responders do therefore have leadership and management roles in crisis, both during the acute event and in the much longer recovery phase. Mutch (2014) wrote in particular of the role of school principals and teachers in recovery, also how schools support the emotional recovery of “staff students and families”.

The SPS score did not stand out as a predictor a predictor of distress in either the univariate baseline analyses (Table I) or the GLM (Table IV) but proved the strongest predictor of a persistent high PCL-C score in the latent class analysis. The SPS did not however predict a decrease in risk, in fact the opposite. This is conceptually counter-intuitive, as social support should reduce the risk of PTSD. While an elevated SPS score represents a greater degree of perceived support, an alternative interpretation, supported by the high baseline scores that we found for emotional exhaustion, anxiety and social dysfunction, may be that these individuals also experienced a greater need for support systems, which, according to Kuntz *et al.* (2013), in regard to teaching, were materially lacking in the long term. Those engaged in seeking support are more impacted by adverse experiences associated with the disaster, and expression of high support may not necessarily be a positive sign.

4.5 Social implications

In addressing the public health implications, the most important observation from this study was that one subgroup of disaster workers had persistent PTSD symptoms over the entire 18-month period. This group was mostly female, married, well-educated, working as teachers, and possibly more vulnerable to stressor impacts or PTSD induction. Another explanation could be those who were not included in that group tended to be self-selected, “hardened”, or otherwise acclimated to the impacts of psychological stress. The persistence of PTSD symptoms in this population does however suggest that preventive measures are required. Education about how to recognize maladaptive coping strategies do seem to be a logical avenue of approach. The positive relationship between perceived social support and high levels of PTSD may have been due to at least in part to the development of maladaptive coping strategies.

Screening is not onerous, and could be applied in the community or occupational setting. This would facilitate the early identification of those at risk. Intervention would, in some cases, include giving clinical support. In all cases, there is a strong argument for giving appropriate social support based on adaptive coping mechanisms. Occupationally, the employer should recognize the social and emotional needs of employees and have a social support plan. The most important thing is that this can be a relatively long term challenge and should be approached as such.

Future directions should be more comprehensive in addressing the role of social support as a risk factor. Guay *et al.* (2006) point out that aetiologic models of PTSD hold social support to be an intermediate variable influencing how the stress disorder develops. An in-depth analysis of PTSD illustrates that this can be a bi-directional process: the search for support in the environment may be an active stress reduction strategy possibly indicative of an elevated stress response, whereas the support from “significant others”, either actually received or perceived to be so, can be instrumental in decreasing stress levels.

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