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First responder well-being following the 2011 Canterbury earthquake

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Abstract

Purpose – The role of first responders in mitigating the effects of earthquakes is vital. Unlike other disasters, earthquakes are not single events, and exposure to dangerous and trauma-inducing events may be ongoing. Understanding how first responders cope in the face of such conditions is important, for both their own well-being as well as the general public whom they serve. The paper aims to discuss these issues.

Design/methodology/approach – Using questionnaires, this study measured posttraumatic stress disorder (PTSD), psychological resilience, and reactive coping styles in a sample of first responders active during the 2011 Canterbury earthquake in New Zealand.

Findings – The prevalence of PTSD was similar to that reported in the literature. Psychological resilience, but not disaster exposure, was found to be associated with PTSD. Maladaptive coping strategies best predicted resiliency, but there were significant gender differences.

Originality/value – These findings can inform those managing first responder disaster workers through the consideration of preventive and treatment interventions.

Keywords Resilience, Posttraumatic stress disorder, Christchurch earthquake, Coping strategies

Paper type Research paper

1. Introduction

The 2011 Canterbury earthquake ranks as New Zealand's second-most destructive in terms of damage and fatalities. The magnitude 6.3 earthquake was directly responsible for 185 deaths and the declaration of a state of emergency. Previously, a 7.1 magnitude earthquake had struck Canterbury in 2010, causing widespread damage to residential and commercial buildings. Possibly due to this earlier event, the emergency management structures in place during the 2011 earthquake have been internationally praised (MOCDEM, 2012), and operational responses from police, ambulance, fire services, defence forces and other relevant agencies were rapid. Unlike the first earthquake in 2010, however, there were fatalities, and so those undertaking emergency operations were exposed to greater and more numerous experiences that were potentially trauma-inducing.

Previous studies have estimated psychological morbidity in earthquake survivors, in particular posttraumatic stress disorder (PTSD). PTSD may occur following exposure to an excessively stressful event or situation, and is characterised by persistent recall of the stressor (flash backs, vivid memories, recurring dreams) and/or extreme distress when

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exposed to circumstances that can be linked to the stressor (ICD-10; WHO, 2010). Reviewing previous studies, Zhang *et al.* (2014) report that the prevalence of PTSD is relatively high in earthquake survivors. A Taiwanese study suggested that up to 21 per cent of survivors suffered PTSD two years after the “Chi-Chi” (or “921”) earthquake (Kuo *et al.*, 2007), while a study undertaken five years after the Wenchuan earthquake in China indicated that 9 per cent of survivors had PTSD (Zhang *et al.*, 2015). Another study undertaken after the Wenchuan earthquake found high levels of PTSD, anxiety, depression and suicidality among both children and adults (Ying *et al.*, 2014).

There exists a multitude of studies estimating the psychosocial sequelae following earthquake experiences, but more so for civilians than those who have a specific “first responder” role, emergency service workers and those professionally obliged to provide human services in the aftermath of a disaster. First responders have been broadly defined as professionals obligated to protect the lives, property and overall safety of nearby citizens during an emergency (Arble and Arnetz, 2016). In the New Zealand context an example of first responder responders are police, ambulance workers, search and rescue personnel, and school teachers. The role of school teachers as first responders is not commonly acknowledged, however, their crucial role during the Canterbury earthquake’s disaster response phase has been well documented (O’Toole and Friesen, 2016; Mutch, 2015). Studies dedicated to the mental health of civilian survivors of the Canterbury earthquake have been published (e.g. Spittlehouse *et al.*, 2014; Greaves *et al.*, 2015), but research specifically targeting first responders is limited (but see Surgenor *et al.*, 2015). In the earthquake context a dearth of research on emergency and first responders has led Chang *et al.* (2003) to describe them as “[...] the hidden victims”, and Clohessy and Ehlers (1999) as “[...] ‘primary victims’ of disasters”. Being a first responder in disaster situations is often associated with greater exposure to life-threatening incidents that are more likely to bring on trauma-related symptoms (Weiss *et al.*, 2010). What limited research has been undertaken indicates elevated levels of PTSD in first responders (e.g. Maia *et al.*, 2007).

Coping style is an important factor when predicting the impact that a disaster may have on an individual’s psychological well-being, and may act as a mediator between stressful events and psychological outcome (Renck *et al.*, 2002). Coping refers to the strategies one puts in place to mitigate the impact of stressors and personal problems. Coping style has been found to predict earthquake-induced trauma (Carr *et al.*, 1997), and this may account for individual differences in PTSD and other psychiatric disorders found in earthquake survivors (Zhang *et al.*, 2014). There is no one single factor that explains an individual’s ability to cope with their experiences of a disaster (Feder *et al.*, 2013), and genetic, neurobiological, developmental, cognitive, cultural, psychosocial and personal factors have all been proposed (Feder *et al.*, 2013). Adaptive coping strategies, if successful, serve to reduce stress and promote physical and mental health (Folkman, 2008). Avoidance coping was found to be a better predictor of psychological morbidity than initial disaster exposure in a sample of Australian earthquake survivors (Carr *et al.*, 1997). Clohessy and Ehlers (1999), studying the association between PTSD and coping in first responder service ambulance workers, reported that negative (or “maladaptive”) coping strategies served to maintain PTSD. Further, in a large sample of Swedish first responders, approach coping styles were linked to increased well-being, while avoidance coping was not (Arble and Arnetz, 2016).

The ability to adopt successful coping strategies in the face of severe adversity defines psychological resiliency. Serious psychological sequelae need not necessarily follow traumatic experiences, and as a measure of successful stress-coping ability (Connor and Davidson, 2003), resiliency has begun to garner considerable attention in the disaster literature (Cretney, 2016; Ying *et al.*, 2014). Renck *et al.* (2002) found that a year and a half after a major rescue operation in a burning discotheque, less than 10 per cent of the engaged police officers reported psychological distress, while van der Velden *et al.* (2006) reported

similar levels of resilience in a sample of firefighters. Resilience has been associated with disaster victims' recovery (Cheng *et al.*, 2012), and is a strong predictor of PTSD symptoms in soldiers (King *et al.*, 2000). Because postdisaster resilience is associated with lower levels of PTSD (Ni *et al.*, 2015), it is of interest to investigate which coping strategies resilience is associated with. The general literature describes resilient individuals as more likely to adopt adaptive strategies such as cognitive reappraisal and goal-directed problem-focused coping. To date there is little published in the earthquake-related disaster literature directly relating resilience in first responders to their coping strategies.

Motivated by a review of the literature, this study sought to estimate the associations between PTSD, coping strategies and psychological resilience using data obtained from first responders active in the aftermath of the 2011 Canterbury earthquake. A negative relationship is hypothesised between resilience and PTSD, that is, as resilience increases, PTSD decreases. Furthermore, positive correlations were anticipated between psychological resilience and adaptive coping strategies, such as increased use of adaptive coping is associated with increased resilience. The relative contributions of initial exposure severity and subjective factors (e.g. resilience) to psychological outcomes are still being explored in the earthquake literature. To this end the analysis will determine the independent predictive value of disaster exposure, resilience and their interaction effect upon PTSD.

2. Method

2.1 Participants

Frontline workers ($n = 138$) active during the 2011 Canterbury earthquake were recruited with the assistance of their employers. Of the defined groups, response rates from those invited to participate were 28 per cent in police staff ($n = 16$), 23 per cent in teachers ($n = 91$) 13 per cent in ambulance staff ($n = 9$) and 11 per cent ($n = 8$) in firefighters. Some first responders from Canterbury were ineligible due to not having lived in the area on and from 4 September 2010, the date of the first earthquake. Table I can be consulted for the sample's demographic profile. The study was approved by the University of Otago Human Ethics Committee, with the Ngāi Tahu Research Consultation Committee providing a Maori health perspective. All participants signed consent forms prior to the administration of the questionnaires. Questionnaires were completed approximately six months after the earthquake.

2.2 Measures

The questionnaire consisted of a comprehensive suite of scales, and only those relevant to the current study will be described. Participants were asked to reference all responses to the last month.

2.3 Earthquake exposure severity

Participants completed a list of 21 questions (0 = no, 1 = yes) about their experiences during the earthquake response phase (see Table II). For each individual a total exposure score was obtained by summing the ratings to the 21 questions.

2.4 Posttraumatic stress disorder

The PTSD Checklist-Civilian (PCC) was used to assess posttraumatic stress symptoms. This self-report scale consists of 17 items representing the symptoms of PTSD according to the DSM-IV. The presence of symptoms during the last month was rated on a five-point Likert-type scale. In this study Cronbach's α for the scale was 0.935, indicating that the participants responded to it in a consistent manner.

| Variables | <i>n</i> | % ^a |
|------------------------------|----------|----------------|
| <i>Gender</i> | | |
| Male | 57 | 41.3 |
| Female | 81 | 58.7 |
| <i>Age (years)</i> | | |
| 21-30 | 11 | 7.9 |
| 31-40 | 24 | 17.1 |
| 41-50 | 42 | 30.0 |
| 51-60 | 45 | 32.1 |
| 60+ | 15 | 11.4 |
| <i>Ethnicity</i> | | |
| NZ European | 125 | 89.3 |
| Maori | 6 | 4.3 |
| Pacifica | 1 | 0.7 |
| Indian | 1 | 0.7 |
| Other | 9 | 6.4 |
| <i>Education (completed)</i> | | |
| Primary school | 1 | 0.8 |
| Secondary school | 22 | 17.1 |
| Technical college | 18 | 12.9 |
| University | 88 | 62.9 |
| <i>Occupation</i> | | |
| Firefighter | 8 | 5.7 |
| Police | 16 | 11.4 |
| Ambulance | 9 | 6.4 |
| Teacher (primary) | 50 | 35.7 |
| Teacher (secondary) | 41 | 29.3 |
| Other | 16 | 11.4 |
| <i>Experience (years)</i> | | |
| 0-5 | 19 | 13.6 |
| 6-10 | 31 | 22.1 |
| 11-15 | 14 | 10.0 |
| 16-20 | 17 | 12.1 |
| 21-25 | 16 | 11.4 |
| 26-30 | 10 | 7.1 |
| 30+ | 32 | 22.9 |
| <i>Household income (\$)</i> | | |
| 20,000-30,000 | 5 | 3.6 |
| 30,000-50,000 | 15 | 10.7 |
| 50,000-70,000 | 22 | 15.7 |
| 70,000-100,000 | 40 | 28.6 |
| 100,000+ | 52 | 37.1 |

Table I.
Demographic profile
of sample

Note: ^aPercentages may not total to 100 due to missing data

2.5 Coping strategies

Coping involves both cognitive and behavioural efforts at managing or reducing external demands and internal negative emotional reactions (Lazarus and Folkman, 1984). The Brief-COPE (Carver, 1997) is an abbreviated form of the COPE inventory consisting of 28-items that are categorised into 14 different reactive coping strategies (see Table V). Participants were required to rate how frequently they utilise these strategies when faced

| | Firefighter (n = 8) | Police (n = 16) | Ambulance (n = 9) | Teacher (n = 91) | Other ^a (n = 16) |
|--|------------------------|--------------------|----------------------|---------------------|--------------------------------|
| 1. Participate in rescue operations | 5 (63%) | 8 (50%) | 5 (56%) | 6 (7%) | 1 (6%) |
| 2. Witness rescue operations | 8 (100%) | 6 (23%) | 6 (67%) | 15 (16%) | 7 (44%) |
| 3. See that buildings were about to collapse | 6 (75%) | 7 (44%) | 2 (22%) | 22 (24%) | 6 (23%) |
| 4. See buildings collapse | 5 (63%) | 4 (25%) | 1 (11%) | 17 (19%) | 2 (13%) |
| 5. Witness dead bodies | 6 (75%) | 8 (50%) | 4 (44%) | 22 (24%) | 2 (13%) |
| 6. Witness injured people | 6 (75%) | 8 (50%) | 7 (78%) | 52 (57%) | 3 (19%) |
| 7. Witness people searching for close or loved ones | 6 (75%) | 8 (50%) | 4 (44%) | 22 (24%) | 4 (25%) |
| 8. Witness children abandoned by their parents | 1 (13%) | 1 (6%) | 9 (100%) | 11 (12%) | 16 (100%) |
| 9. Think you were in danger of losing your life | 5 (63%) | 3 (19%) | 4 (44%) | 29 (32%) | 4 (25%) |
| 10. Think family and friends are in danger of losing their lives | 6 (75%) | 9 (56%) | 6 (67%) | 51 (56%) | 7 (44%) |
| 11. Get injured at the moment of or in the immediate aftermath | 0 (0%) | 1 (6%) | 0 (0%) | 9 (10%) | 0 (0%) |
| 12. Have impressions of breathing toxic air | 2 (25%) | 1 (6%) | 1 (11%) | 8 (9%) | 1 (6%) |
| 13. Care for the injured | 3 (38%) | 4 (25%) | 6 (67%) | 5 (6%) | 3 (19%) |
| 14. Recover dead bodies | 4 (50%) | 5 (31%) | 2 (22%) | 0 (0%) | 1 (6%) |
| 15. Identify dead bodies | 0 (0%) | 4 (25%) | 1 (11%) | 0 (0%) | 0 (0%) |
| 16. Communicate to others about the dead, injured and missing | 1 (13%) | 11 (69%) | 3 (33%) | 12 (13%) | 6 (23%) |
| 17. Have somebody significant to you (family, friend, colleague) die | 1 (13%) | 2 (13%) | 2 (22%) | 14 (15%) | 1 (6%) |
| 18. Have anybody significant to you (family, friend, colleague) injured | 2 (25%) | 0 (0%) | 2 (22%) | 9 (10%) | 0 (0%) |
| 19. Have anybody significant to you (family, friend, colleague) missing in immediate aftermath | 1 (13%) | 1 (6%) | 1 (11%) | 10 (11%) | 1 (6%) |
| 20. Have damage to your home | 7 (88%) | 0 (0%) | 8 (89%) | 83 (91%) | 13 (81%) |
| 21. Have damage to your workplace | 7 (88%) | 10 (63%) | 5 (56%) | 55 (60%) | 10 (63%) |

Note: ^aIncludes search and rescue teams, dog handlers, etc

Table II.
Earthquake exposure
frequencies and
percentages

with a stressor on a four-point Likert-scale ranging from 1 (I Haven't Been Doing This At All) to 4 (I've Been Doing This A Lot). Cronbach's α 's were not calculated for each copying style as they only consist of two items each.

2.6 Psychological resilience

The Connor-Davidson Resilience Scale (CD-RISC) defines resilience as the personal ability to adapt to changes and cope with stressors (Connor and Davidson, 2003). The CD-RISC presents 25 items to be rated on a five-point Likert-type scale ranging from 0 ("not true at all") to 4 ("true nearly all the time"). Summing the 25 items provides an indicator of the level of individual resilience. Cronbach's α was 0.934 for this scale.

2.7 Procedure

An invitation to participate was initially sent out to workers via employers and union membership lists. Additionally, a general invitation to participate was posted at the various workplaces. Service Managers were also approached for support, and a member of the research team visited work sites to provide information – verbally and in writing – and informed consent was sought at this time. The survey was initially electronic and paper copy; both forms being self-administered. There were a number of issues with the electronic version as workers in Canterbury were often in relocated buildings and internet access was unreliable. Consequently, the electronic

version was abandoned and paper copy and postal return was instead employed. Participants filled in the pack of questionnaires at their convenience and returned them anonymously.

2.8 Analysis

All descriptive and inferential statistics were obtained using SPSS (v.22), with statistical significance being reported if $p < 0.05$. Regarding key measures such as PTSD, coping and resilience, preliminary analyses determined no statistically significant links between teachers and the combined data of firefighters, ambulance workers, police, and “Others” (see Table I). On this basis the two sets of data were combined to augment statistical power. Associations between key measures were assessed using Pearson’s correlation coefficients. For a pair of measures (e.g. PTSD and resilience) a positive coefficient indicates that as the score on one measure increases so too does the score on the other. A negative coefficient indicates that as one score increases, the other decreases. Pearson’s correlation coefficients range between -1 and 1 , and the greater the coefficient diverges from zero the stronger the relationship between the two measures, with a coefficient of zero indicating no relationship. Partial correlation coefficients were used to estimate the linear relationships between two variables while controlling for the effects of potential confounds such disaster work experience (Chang *et al.*, 2003) and age. Comparisons across group scores, for example, gender, were performed using independent samples *t*-tests, with adjusted *p*-values consulted if Levene’s test for equality of variances proved significant. Here, a *p*-value below 0.05 indicates that the means of the two groups (e.g. males vs females) are significantly different in a statistical sense.

To further examine the relationship between resilience and PTSD, a hierarchical multiple linear regression analysis was conducted to investigate the independent and moderating effects of exposure severity and psychological resilience (CD-RISC) upon PTSD (PCC). For this analysis, potential confounds (age, gender, job experience) were simultaneously entered into Step 1, followed by exposure severity and psychological resilience in Step 2. In Step 3 the exposure severity \times psychological resilience interaction term was entered.

3. Results

Table II presents a summary of exposure scores to earthquake-related trauma-inducing events, categorised by service affiliation. Individual responses to these 21 binary-response items were summed to obtain an overall exposure score. Without regards to service affiliation, most reported damage to their homes and places of work, and worried that their family or friends were in danger. With reference to Table III, the mean scores for the PTSD and resilience scales were 30.918 (SD = 12.94) and 69.39 (SD = 14.3), respectively. First-order correlation coefficients between these two variables and gender, age, service length,

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|----------------------------------|----------|---------|---------|---------|-------|----------|-------|
| 1. Gender (0 = male, 1 = female) | 1.00 | | | | | | |
| 2. Age | -0.097 | 1.00 | | | | | |
| 3. Service length | -0.240* | 0.724** | 1.00 | | | | |
| 4. Education | 0.230* | -0.120 | -0.206* | 1.00 | | | |
| 5. Exposure | -0.323** | -0.223* | -0.013 | -0.185* | 1.00 | | |
| 6. PTSD | 0.176* | -0.072 | 0.002 | 0.133 | 0.043 | 1.00 | |
| 7. Resilience | -0.113 | 0.059 | -0.013 | -0.034 | 0.063 | -0.453** | 1.00 |
| Mean | - | 43.25 | 3.99 | 3.50 | 5.87 | 51.12 | 69.39 |
| SD | - | 9.158 | 2.175 | 0.802 | 5.13 | 12.91 | 14.30 |

Table III.
Inter-correlations,
means, and standard
deviations for
key variables

education, and exposure are presented in Table III. Of note is that exposure was linked with gender, age, and education, but not PTSD. Here, well-educated young males were more likely to be exposed to trauma-inducing earthquake-related events. A moderate negative correlation between PTSD and resilience was also uncovered.

A hierarchical multiple linear regression analysis (see Table IV) was performed to determine the independent predictive value of exposure, resilience, and their interaction effect upon PTSD. In the first step of the regression analysis, gender, age and professional experience (in years) were entered simultaneously to control for potential confounding. In Step 2, resilience and exposure were simultaneously entered, while in the final step their interaction term was entered. Overall, the variability in PTSD scores explained by gender, age and professional experience was not significantly greater than zero. This suggests that these factors do not co-vary with PTSD. In the second step of the model, exposure failed to significantly account for the variability in PTSD scores, in contrast to resilience, which independently explained significant proportions of the variance in PTSD. The addition of the interaction effect failed to improve the model, indicating the absence of a moderating effect between resilience and disaster exposure. However, while the composite value for exposure to trauma-inducing events failed to reach significance as a predictor of PTSD, it was noted that certain unique events were significant. With reference to Table II, independent samples *t*-tests revealed that those who responded “yes” to Items 5, 9, 10, 11, 13, 14, 15, 19 had significantly higher PTSD scores ($p < 0.05$) than those who responded “no”.

Table V presents the associations between resilience and PTSD scores and each of the 14 coping styles. For the entire sample, negative relationships between resilience and maladaptive coping styles (denial, venting, self-blame, behavioural disengagement) dominate. Of the adaptive (or constructive) coping styles, only acceptance has a significant positive correlation. A more refined analysis is obtained by scrutinising these associations at the level of gender. Here, males have predominantly negative associations, with acceptance and humour (both non-significant) being the exceptions to the rule. For females, there is a mix of negative and positive correlations between coping style and resilience, presenting a very different pattern overall to those found with males. For example, while greater levels of reliance are associated with greater levels of emotional support, instrumental support and religious coping in females, the opposite is noted for males (i.e. resilience is inversely associated with these strategies).

4. Discussion

The prevalence of PTSD in this sample of first responders active during the 2011 Canterbury earthquake is similar to those reported elsewhere for earthquake survivors. Zhang *et al.* (2014) reported a mean PTSD score of 28.47 (SD = 10.65) using the

Table IV.
Results of hierarchical multiple linear regression analysis, where PTSD was the dependent variable

| Predictors | <i>R</i> | <i>R</i> ² | ΔR^2 | B (SE) | β |
|------------------------------|----------|-----------------------|--------------|--------------|---------|
| Step 1 | 0.23 | 0.05 | 0.05 | | |
| Gender | | | | 5.41 (2.33) | 0.21* |
| Age | | | | -2.08 (1.39) | -0.20 |
| Experience | | | | 0.98 (0.767) | 0.17 |
| Step 2 | 0.49 | 0.24 | 0.19** | | |
| Resilience | | | | -0.39 (0.07) | -0.44** |
| Exposure | | | | 0.32 (214) | 0.13 |
| Step 3 | 0.49 | 0.24 | 0.00 | | |
| Resilience \times Exposure | | | | 0.0 (0.02) | 0.03 |

Notes: * $p < 0.05$; ** $p < 0.001$

Table V.
Partial correlation
coefficients
(controlling for age
and years of
experience) between
resilience and the 14
coping subscales

| Coping subscale | All | | Males | | Females | |
|-------------------------------|------------|---------|------------|---------|------------|---------|
| | Resilience | PTSD | Resilience | PTSD | Resilience | PTSD |
| 1. Positive reframing | -0.047 | 0.161 | -0.387* | 0.526** | 0.108 | -0.082 |
| 2. Self-distraction | -0.167* | 0.361** | -0.388* | 0.508** | -0.056 | 0.223* |
| 3. Active coping | 0.058 | 0.163* | -0.255* | 0.351* | 0.182 | 0.033 |
| 4. Denial | -0.428** | 0.367** | -0.482** | 0.544* | -0.404** | 0.214* |
| 5. Substance abuse | -0.163* | 0.207* | -0.082 | 0.221 | -0.234* | 0.155 |
| 6. Emotional support | 0.127 | 0.123 | -0.222* | 0.279* | 0.349* | -0.042 |
| 7. Instrumental support | 0.074 | 0.151 | -0.292* | 0.288* | 0.275* | 0.018 |
| 8. Venting | -0.420** | 0.416** | -0.471** | 0.561** | -0.414* | 0.352* |
| 9. Planning | -0.065 | 0.147 | -0.437** | 0.252 | 0.056 | 0.099 |
| 10. Humour | 0.122 | -0.170* | 0.130 | -0.170 | 0.117 | -0.194 |
| 11. Acceptance | 0.223* | -0.147 | 0.076 | -0.140 | 0.315* | -0.256* |
| 12. Religion | 0.086 | 0.014 | -0.205 | 0.361* | 0.232* | -0.185 |
| 13. Self-blame | -0.414** | 0.450** | -0.449** | 0.658** | -0.388* | 0.338* |
| 14. Behavioural disengagement | -0.474** | 0.470** | -0.387* | 0.514** | -0.495** | 0.443** |

Notes: Coefficients are calculated for the entire data set, and for males and females separately.
* $p < 0.05$; ** $p < 0.001$

Chinese-version of the PCC, comparable to the mean score of 30.92 determined in this study. Individual scores greater than 50 can be taken as indicators of clinical PTSD, with this diagnostic cut-off yielding a sensitivity in the region of 80 per cent (Forbes *et al.*, 2001). Applying this criterion to the current study classifies eleven (8.1 per cent) individuals as PTSD cases, comparable to Zhang *et al.*'s (2015) rate of 9.2 per cent for Chinese earthquake survivors. Surgenor *et al.* (2015), reporting on New Zealand police personnel active during the Christchurch earthquakes, noted that participants had equivalent levels of PTSD as those found in other non-clinical samples. The mean resilience score in the present study was higher than other scores reported in the earthquake disaster literature, potentially explained by a focus on first responders, who as part of their jobs are confronted daily with stressors of varying degrees. Using the Chinese-version of the CD-RISC, a study on adolescent Survivors of the Wenchuan earthquake reported a mean score of 55 (Ying *et al.*, 2014), while another study on adult survivors (Ni *et al.*, 2015) reported means of 61.25 and 58.00 for males and females, respectively.

Correlational analyses (Table III) showed significant moderate negative correlations between PTSD scores and psychological resilience (Ying *et al.*, 2014), but not so for PTSD and length of service. Chang *et al.* (2003) reported that more experienced first responders were at greater risk of developing PTSD, though this finding is not replicated in this study. Furthermore, no significant correlation between PTSD and exposure scores was found. This finding was echoed in a subsequent regression analysis (Table IV), after controlling for potential confounds. Interestingly, Surgenor *et al.* (2015) reported that greater levels of PTSD in police personnel active during the Canterbury earthquakes was associated with personal material (i.e. damage to home) and emotional (e.g. death or injury to significant others) losses. However, on the basis of other reports (e.g. Zhang *et al.*, 2014) it would be untoward to downplay the importance of exposure as an important predictor value of PTSD. There is a plethora of evidence suggesting that individual differences in PTSD can be partly explained by the objective elements of an individual's trauma experience, such as witnessing death or injuries (Ying *et al.*, 2014). The finding that this exposure variable (i.e. a "Total Score") failed to predict PTSD is contrasted by a subsequent battery of *t*-tests performed on the composite variable's individual constituents and PTSD scores. Using a single item as an index of exposure has precedence in the literature (e.g. Chang *et al.*, 2003), and evidently a standardised approach to quantifying disaster exposure is still needed.

Carr *et al.* (1997) demonstrated that dispositional factors may have a greater influence on PTSD following an earthquake than level of disaster exposure. Psychological resilience is the ability to adapt to stressors by the deployment of protective resources (Ni *et al.*, 2015), and reflects an individual's capacity to cope with adversity. As resilience may buffer the psychological effects of a traumatic event, it is useful to explore the coping mechanisms associated with resilience. Yates *et al.* (2011) classified Carver's (1997) Brief-COPE subscales as problem-focussed coping (active coping, instrumental support, planning), emotion-focussed coping (acceptance, humour, positive reframing, religion, seeking emotional support, self-distraction), and maladaptive coping (behavioural disengagement, denial, self-blame, substance use, venting). We found that resilience was negatively correlated with maladaptive coping styles, and subsequently, maladaptive coping styles positively correlated with PTSD. In terms of emotion-focussed coping, acceptance and self-distraction were both associated with resilience, but only self-distraction was significantly related to PTSD. Consistent with other reports (Ying *et al.*, 2014), these findings suggest that resilience can act as a buffer against PTSD, with this relationship mediated by coping styles.

It could be hypothesised that different patterns of resilience and coping between males and females emerges from the expectations that males adopt more problem-focussed styles while females more readily deploy emotion-focused strategies (Brannon and Feist, 2009). However, our results do not conform to this stereotype. Remarkably, for males, all correlation coefficients between resilience and coping strategies were negative, indicating that for males resilience may not be related to coping strategies *per se*. Interpreting this finding is a challenge, and perhaps for males resilience exists as a trait (or phenotype?) that is largely uninfluenced by the management of stressors, or that those males who are more resilient simply do not engage coping strategies or seek support. Contrastingly, resilience in women was positively associated with seeking help and advice (i.e. instrumental support), where such problem-solving coping strategies are linked to better adaptation to trauma (Zhang *et al.*, 2014). Unlike males, females also exhibited positive correlations between resilience and emotion-focussed skills, expected given that resilience itself has been linked to adaptive processes such as emotional flexibility (Waugh *et al.*, 2011). In relation to maladaptive coping strategies and resilience, males and females showed equivalent negative relationships with the exception of substance abuse, which was only significant for women. Taken at large, these results indicate that resilience is associated with different coping styles across the genders, and future research into these relationships will need to account for these gender differences.

As previously reported elsewhere (e.g. Chang *et al.*, 2003; Ying *et al.*, 2014; Zhang *et al.*, 2014), coping style was significantly correlated to PTSD, but in the present study only negatively for humour and, for women only, acceptance. All other significant correlations between PTSD and coping were positive. The strongest positive relationships with PTSD involved maladaptive coping styles, indicating that either the trauma is amplified by the poor choice of coping mechanism, or that the trauma itself is driving an individual towards suboptimal choices. Gender differences were again noted, with the magnitude of the significance coefficients generally larger for males than females. Interestingly, for males, a significant positive relationship between PTSD and religious coping was noted, albeit a more adaptive relationship than that reported by Feder *et al.* (2013) in a sample of Pakistani earthquake survivors. However, both the genders yielded significant positive relationships between PTSD and behavioural disengagement coping, echoing the results of Zhang *et al.* (2014), who noted that such "passive" coping skills were implicated in the development of PTSD over time.

The results of this study must be interpreted with respect to a number of limitations. First, our study was cross-sectional, and so any indication of causal relationships between

the variables must be treated as speculative. Furthermore, the study used self-report measures and, in some parts, relied on retrospective judgements. The sample size was modest, and this eliminated the possibility of more sophisticated multivariate analyses. The inclusion of teachers may be seen as problematic by some, though the role of teachers as first responders during the Canterbury earthquakes has been well documented (O'Toole and Friesen, 2016; Mutch, 2015) and our preliminary statistical analyses failed to separate the teachers from the other groups. Further, the work of Surgenor *et al.* (2015) indicates that personal loss (material and emotional) may be the important factor which drives PTSD, which for all groups can be considered shared experiences (Table II), and broad and inclusive definitions of first responders have been encouraged by others (Arble and Arnetz, 2016). Finally, due to item wording there may have been some conceptual overlap between items in the PCC scale and the Brief-COPE scale, which may have inflated correlation coefficients marginally.

5. Conclusion

The prevalence of PTSD in first responders active in the 2011 Canterbury earthquake was found to be comparable to previous studies. Psychological resilience is considered an index of PTSD, and in this study a significant negative relationship between the two was uncovered, and resilience explained more variability in PTSD scores than exposure scores. It was noted that a validated and standardised disaster exposure scale would aid future researchers active in this area. Coping was associated with both resilience and PTSD, though the current design did not afford conclusions about cause-and-effect relations, and suggested that future studies need to carefully consider gender differences. Furthermore, little research has gone into frontline workers who are not categorised as emergency workers but yet play important roles in the immediate aftermath of a disaster. School teachers and utility workers, for example, may be active during emergency situations, though may not have sufficient training to cope with the situation they find themselves.

In line with others (e.g. Ni *et al.*, 2015), the present findings indicate the value of determining resilience in first responders to aid in the design of postdisaster therapy for this group, and in programmes that amplify resilience as part of ongoing training. As resilience involves an individual's ability to cope with extreme stressors, then proactive coping skills training for first responders may offer an additional buffer to ward off, or treat, PTSD (Kirby *et al.*, 2011). Noting that school teachers exposed to greater degrees of earthquake trauma was associated with increased emotion regulation, O'Toole and Friesen (2016) recommended increasing both emergency response training prior to disasters as well as assisting with emotional recovery postdisaster. The findings of our study reinforce the recommendations found in the disaster literature, pertinently that work-related trauma exposure can have a negative impact on first responders whatever their station, and that timely and appropriate interventions be put in place to treat psychological distress and enhance well-being.

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Further reading

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