

# Ripples of Recovery and Resilience: Tracking the Effects of the Canterbury Earthquakes on Older New Zealanders

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## Abstract

*Participants from the longitudinal Health, Work and Retirement study of older New Zealanders (N=1,970), were surveyed in 2010, before the 2010 and 2011 Canterbury earthquake events, and again in 2012 and 2014. A variety of direct and indirect effects of the earthquakes were reported by older people across all of New Zealand and these persisted over three years. Although over a quarter of the study's participants reported effects of the earthquakes, these effects reduced with both physical and temporal distance from the earthquake events. Provision of social support to family and friends was widely reported, but decreased over time. Emotional and economic impacts were more likely to be reported in the longer term. After taking into account general changes in the health and wellbeing of older people over time, there was no effect of exposure to earthquake effects on health. However, there was a short term benefit on emotional loneliness for those affected by the earthquakes, with those who had experienced the earthquakes more likely to report reduced loneliness in 2012. This study is a reminder that through family and social connectedness, older people in New Zealand can be part of post-disaster recovery and resilience, in ways that are not simply related to immediate exposure.*

**Keywords:** *older people, longitudinal study, reported earthquake effects*

The investigation of the psychosocial and physical health effects of earthquakes, and the recovery process from a major natural disaster, poses considerable research challenges. In particular, the point in time at which outcomes are measured becomes a critical factor. Since the major Canterbury earthquakes occurred, a number of investigations have been undertaken into the impacts of the events on older people in particular (Annear, Wilkinson, & Keeling, 2013; Davey & Neale, 2013; Morgan et al., 2015; Tuohy, Stephens, & Johnston, 2014a). An understanding of the longer term effects of such events is also important. In addition, post-event investigations are often limited by a lack of understanding of the pre-existing psychosocial and socioeconomic experiences of individuals in an affected region. This limits the extent to which observations of the impact of adverse events can be made. However, there are cases where a pre-existing study provides a before and after picture of a defined population cohort. The current paper is based on such an opportunity, using longitudinal data from the New Zealand Health, Work and Retirement (HWR) study.

Several years after the start of the earthquake sequence in September 2010, many households in Christchurch continue to live in difficult circumstances. Policies for housing repair or rebuild are being developed and enacted, communities are fighting to recover and adapt, as schools change and community members relocate, and some parts of the city are subjected to additional events such as flooding as a result of the earthquakes. There has been continuous, centralised planning through the work of both the Christchurch City Council and Canterbury Earthquake Recovery Authority (CERA). CERA also conducted a six monthly Wellbeing Survey, to monitor quality of life, social connectedness, health and wellbeing, along with impacts of the earthquakes, both positive and negative. This was conducted with an electoral-roll based sample of the population in Christchurch City, Selwyn, and Waimakariri Districts (CERA, 2014). However, there has been a limited focus on identifying ways in which particular age cohorts of the population might have been differentially affected, apart from the Christchurch study by Spittlehouse, Joyce, Vierck, Schluter, and Pearson (2014), which refers to

participants in *middle age*, between 49 and 51 years of age, as at 2011.

The World Health Organisation (WHO) has identified older adults as a vulnerable population, and older adults are more likely to experience greater risks in a disaster (Bolin & Klenow, 1988; Cutter, Boruff, & Shirley, 2003; Perry & Lindell, 1997; WHO, 2008). The need to improve psychosocial and health outcomes for this age group has been driven by concern about the growing numbers of adults over 60. This population will increase globally from 810 million in 2012 to a projected 2 billion by 2050 (United Nations Population Fund, Help Age International, 2012). By 2021, 90 percent of New Zealand adults over 65 years are expected to be living at home, and 28 percent are expected to be living alone (Statistics New Zealand, 2004).

Community recovery from the major Christchurch earthquake in 2011 is expected to take at least another decade (Stevenson, Humphrey, & Brinsdon, 2014). Although immediate outcomes of a disaster are often recorded in terms of mortality and injury or economic costs, the significance of the long term effects may be lost over this kind of period. Al-rousan, Rubenstein, and Wallace (2014) noted that there are few studies of any long term effects for older people. Studies concerning the outcomes or downstream effects of such major events must also take into account the upstream factors; the status of the individuals and their community before the disaster event. In addition to well established notions such as individual preparedness, there are other important aspects of a population and the environment which contribute to individual and community resilience and improved recovery. Rodriguez, Quarantelli, and Dynes (2006) suggest that, “the best way to understand disaster effects is to know what the community was like before the event” (p. xviii). In this way, the framing of disaster effects can be situated within a social context that explores how existing social factors impacts human lives and outcomes in a disaster. These social influences can be traced to more distant causes produced by social, economic and political processes, rather than the hazard threat alone (Tuohy, Stephens, & Johnston, 2014b; Wisner, Blaikie, Cannon, & Davis, 2004). For example, people earning lower incomes are more likely to be vulnerable to flood related hazards; this settlement pattern often arises because housing is more affordable near flood prone land (Tuohy & Stephens, 2011).

Such upstream factors may be conceptualised in terms of pre-disaster resilience. However, the term resilience

is also used in critical gerontology, meaning that these two research fields should not be combined without clarification (Wild, Wiles, & Allen, 2013). A resilience approach to traumatic stress such as that experienced in a disaster, recognizes the widespread impact of major trauma, attends to *ripple effects*, or outcomes extending across time and space, through relational networks and other supporters, and aims to strengthen family and community resources for optimal recovery (Eyre, 2004; Walsh, 2007). These recognitions within the disaster literature may be drawn upon to understand the vulnerability and resilience of older people in the general population including those beyond the earthquake zone, and taking into account other age-related changes which may also occur over the same period.

Preliminary data from the 2012 HWR study (Keeling, Alpass, Stephens, & Stevenson, 2014) showed that of the 2,986 older people surveyed in 2012, 15 percent were living in Canterbury and 11 percent directly experienced one or more earthquake events. Of this population sample, 30 percent reported some effects, ranging from significant direct personal effects, loss of life or injury within family, through relocation effects or housing consequences, to financial and other effects. In particular, aspects of control and self-realisation within a quality of life measure showed different trends based on location and exposure to earthquake effects. Other psychosocial measures of loneliness and depression also showed regional differences. Considerations of three dimensions of time, place and socio-cultural location, plus longer term and broader post disaster outcomes, led us to take note of the importance of the social context as a focus for investigation into resilience for older people. These initial results based on a small set of available items were the basis for the more focused study undertaken in 2014 and reported here.

The aims of the 2014 study were to: (1) explore the reported ripple effects, or ongoing impacts, from the earthquakes; (2) identify any groups whose health and wellbeing changed over the four years from the beginning of these events; (3) identify what factors have been most protective to those directly affected by the earthquakes; and (4) analyse subgroups affected in different ways, taking pre-existing circumstances into account.

## Method

The current study uses the existing HWR longitudinal cohort. For the full methodology used in this study

see Alpass et al (2007), Alpass et al (2013), and Towers and Stevenson (2014). The HWR study is a population-level study which aims to identify the health and social factors underpinning successful ageing in New Zealand's community dwelling population aged 55 to 70 as at 2006. This means participants were aged 63 to 78 when surveyed in 2014. Participants were initially sampled in 2006 using equal probability random sampling from the New Zealand Electoral Roll to achieve a nationally-representative sample of New Zealanders aged 55 to 70 ( $N = 6,662$ ). Over-sampling for Māori was specifically undertaken during participant selection for the HWR cohort to combat the historically poor research participation rates found in older ethnic minority populations (Moreno-John et al., 2004) and the lower life expectancy for Māori (Ministry of Health, 2011).

Participants have been surveyed biennially since, with an additional off-cycle survey in 2013. Surveys to date have covered many aspects of ageing including physical and mental health, quality of life, social support and network affiliations, work/retirement status, work stress and commitment, caregiving commitments, travel and safety issues, and various demographic characteristics. Since the 2011 Canterbury earthquakes, the 2012 and 2014 surveys included items addressing the effects of the earthquake.

## Measures

**Demographic variables.** Basic demographic information such as age, gender, ethnicity, marital status, education, work status and home ownership status were collected.

**Economic status.** The Economic Living Standards Index short form (ELSI-SF) (Jensen, Spittal, & Krishnan, 2005) was used to measure individuals' economic standard of living. The scale measures four different areas: restrictions in social participation, restrictions in ownership of assets, the extent to which respondents economise, and self-rated standard of living. Resulting scores were combined to categorise individuals into three ordinal groups: hardship, comfortable, and good.

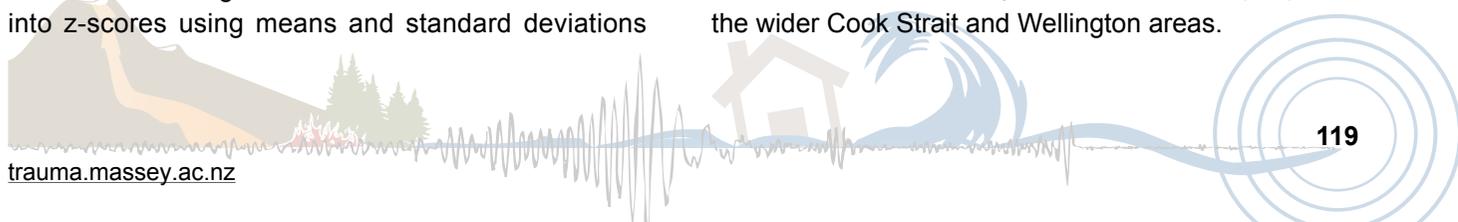
**Mental and physical health.** Health measures were derived from the SF-12 Health Survey (Ware, Kosinski, & Dewey, 2000). This is a short health survey measure from which eight raw scales are generated: physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional, and mental health. These eight scales are then standardized into z-scores using means and standard deviations

calculated from the 2006 data wave of the HWR study (Stephens, Alpass, Baars, Towers, & Stevenson, 2010) and the two primary scales, physical health and mental health, generated using New Zealand Health Survey factor coefficients, where the mean is set to 50 and the standard deviation to 10. Higher scores indicate better health.

**Social support.** The Social Provisions Scale (Cutrona, Russell, & Rose, 1986) is a 24 item additive measure which provides a total social provisions score containing six sub-scales or *provisions*: attachment, a sense of emotional closeness and security and usually provided by a spouse or lover; social integration, a sense of belonging to a group of people who share common interests and recreational activities and usually obtained from friends; reassurance of worth, acknowledgement of one's competence and skill and usually obtained from co-workers; reliable alliance, the assurance that one can count on others for assistance under any circumstances and usually obtained from family members; guidance, advice and information and usually obtained from teachers, mentors, or parent figures; opportunity for nurturance, a sense of responsibility for the well-being of another and usually obtained from one's children. A higher score indicates more support or provision of these social functions.

**Loneliness.** The de Jong Gierveld Loneliness scale (de Jong Gierveld, van Groenou, Hoogendoorn, & Smit, 2009) is a six item additive measure and includes two sub-scales: emotional loneliness (from 0 to 3) and social loneliness (from 0 to 3). A higher score indicates higher loneliness. The main loneliness scale (from 0 to 6) can also be categorised into: not lonely, moderately lonely, severely lonely, and very severely lonely.

**Earthquake experiences and effects.** In the 2012 collection of HWR data, the survey included a number of questions relating to the Christchurch and greater Canterbury region earthquakes. Questions included whether participants were living in the Canterbury region following each earthquake event, whether they had suffered direct or indirect effects of the earthquakes, and the nature of any effects they had experienced. In the 2014 survey, the HWR study repeated these questions and also included similar questions relating to the series of earthquake events centred on Seddon, in August 2013, because these may have also affected people in the wider Cook Strait and Wellington areas.



**Event exposure.** A binary indicator of whether participants were exposed to a Canterbury region earthquake event, yes or no, was computed by combining the Canterbury earthquake questions, “Were you living in Canterbury during the following (earthquake) events: 4/9/2010; 22/2/2011; 15/6/2011; 23/12/2011”, into a single ‘experienced a Canterbury earthquake’ variable. The Seddon earthquakes question, “Were you living in the Marlborough or Wellington region during the Seddon/Wellington earthquake on 16 August 2013” was asked as a yes or no question.

**Event effects.** A binary response variable, yes or no, was used in 2012 and 2014: “Have you suffered direct or indirect effects in the last year as a result of the Canterbury earthquakes of 2010 and 2011?” An additional question asked only in 2014 was “Have you suffered direct or indirect effects in the last year as a result of the Seddon/Wellington earthquake on 16 August 2013?”

For those reporting that they had suffered direct or indirect effects in the last year as a result of an earthquake, a set of specific response options was provided in relation to the effects of each earthquake: suffered significant direct personal effects; loss of life or injury within my family/whānau or networks; provided personal support to family/whānau and friends; experienced direct housing consequences; experienced direct business or employment consequences; experienced financial consequences through any of the above; affected by relocation of self, or family/whānau and/or friends; experienced physical or emotional distress; and other effects. These response options were provided concerning the Christchurch earthquakes in 2012 and 2014 data collection, and for the Wellington/Seddon earthquakes in 2014. Each item was scored on a five point Likert scale with anchors at 1, not true for me at all, and 5, definitely true for me.

A weighting variable for analyses was calculated based on the initial design weights, adjusting for the oversampling of Māori descent, and adjusted further to account for attrition. Weighting groups were formed based on Māori descent, gender, age, and NZ deprivation indices associated with area of residence when first sampled. These weights were adjusted for attrition at each successive sampling wave using a fair shares method: Responding participants with the same characteristics as non-responding participants are weighted up to compensate for non-responders. Where it is known that the participant is deceased or too unwell

to continue in the study, their corresponding weights were not re-distributed among responding participants in the same weighting group.

## Results

### Sample

Demographic, economic and health information for respondents in 2012 and 2014 are presented in table 1. A decrease in proportion of persons working between 2012 and 2014 may be expected as the cohort ages. Overall, the population health and social indices were within normal ranges. The exposure to the Seddon earthquakes of 2013 was included in later models as a covariate to control for impacts on health conditions which may be attributable to this event. In 2014, 13 percent of the sample reported residing in Seddon and Wellington areas, directly affected by this event, and 5.4 percent of the sample reported experiencing impacts of this event in the past year.

Table 2 shows the distribution of respondents according to their location of residence in 2012 and 2014. These effects were highest for Christchurch residents, then reducing over both both time and distance across the country as a whole.

The participants in 2012 (29%) and 2014 (25%) who reported experiencing effects of the Canterbury region earthquakes went on to answer more detailed questions about what impact the earthquakes had on aspects

Table 1. *Participant Demographic and Health Status over the Post-Event Period (Unweighted Results)*

	2012	2014
<i>Demographic Groups</i>		
Age	66.3 (SD 7.8)	67.4 (SD 6.1)
Female	54.8%	55.0%
Māori Descent	36.3%	34.5%
12+ Years of Education	25.6%	28.1%
Partnered/Married	72.7%	72.9%
Working	48.1%	25.2%
Own Home vs. Not	89.6%	88.9%
<i>Health &amp; Social Indices</i>		
SF 12 Physical Health	49.4 (SD 10.9)	48.5 (SD 10.4)
SF 12 Mental Health	49.3 (SD 8.0)	49.6 (SD 7.7)
Emotional Loneliness	0.6 (SD 0.9)	0.6 (SD 0.7)
Social Loneliness	1.2 (SD 1.2)	1.2 (SD 1.2)
Social Support	not included	79.3 (SD 9.8)
<i>Seddon/Wellington Earthquake</i>		
Residing in Region in 2013	not included	13.0%
Impacted by Earthquake in Last Year	not included	5.4%

Table 2. Canterbury Region Earthquake Effects by Area for 2012 and 2014.

Area of residence in 2012	Sample %	Area % reporting having suffered effects of Canterbury earthquake in the past year	
		2012	2014
Christchurch	8.6	90.0	80.7
Wider Canterbury (excluding Christchurch)	6.7	64.2	49.1
Wider South Island (excluding Canterbury)	14.2	32.0	25.6
North Island	70.5	19.0	16.2
Total	100.0	29.4	25.1

of their lives. To assess how different impacts were described in 2012 and 2014, we combined the two levels of effect recorded as levels 4, true, and 5, definitely true for me, and considered whether the rate of reporting over this two year interval was increasing, decreasing or stable, as shown in table 3.

These results indicate that specific effects experienced in the past year differed over time. The proportion of persons reporting economic impacts, such as direct housing consequences, direct financial consequences, and affected by relocation increased over time while reporting of loss of life, provision of social support and other effects decreased. The proportion of impacted

Table 3. Increase, Decrease, and Stability of Types of Effects Reported between 2012 and 2014.

	% Impacted		Change* in Impact
	2012	2014	
% True for me (4 or 5)			
Suffered significant direct personal effects	17.1	21.1	I
Loss of life or injury within my family or networks	11.8	8.0	D
Provided personal support to family and friends	55.8	46.9	D
Experienced direct housing consequences	20.1	28.4	I
Direct business or employment consequences	18.8	18.5	S
Experienced financial consequences through above	27.2	35.0	I
Affected by relocation of self, or family and/ or friends	23.5	27.4	I
Experienced physical or emotional distress	25.3	26.6	S
Other	56.8	37.4	D

\* Change defined as a movement greater than +/- 3%; I = increase; D = decrease; S = stable rate of reporting.

persons reporting business and employment impacts as well as distress were stable.

To assess the impacts of these earthquake effects on health and wellbeing, multivariate multi-level models (MLM) were conducted to predict key outcomes: Economic Living Standards (ELS), physical health, mental health, social integration and loneliness. Demographic indices and reported earthquake effects were included and interaction terms for reporting effects in the past 12 months were included for all factors. A bivariate effect of whether health and wellbeing varied before versus after the earthquake events in Christchurch was also included. There were no significant differences in living standards, physical and mental health, social loneliness or social support between those who reported effects and those who did not. Overall, emotional loneliness increased from 2012 to 2014 ( $\beta = -0.071$ ,  $t = -2.468$ ,  $p = .014$ ). As shown in figure 1, there was also a significant difference in emotional loneliness between those exposed and not exposed to the earthquakes ( $\beta = -.121$ ,  $t = -2.364$ ,  $p = .018$ ), suggesting those exposed to the earthquakes were less lonely. There was also an interaction of exposure to earthquake effects on emotional loneliness before (2010) compared to after (2012 to 2014) the events. This may reflect the sharp drop in emotional loneliness in 2012 which returned to pre-earthquake levels in 2014.

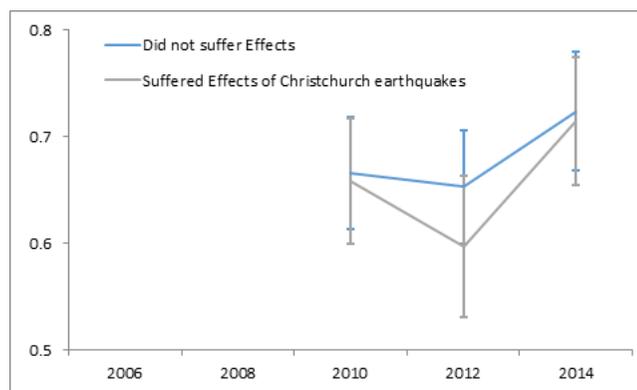


Figure 1. Emotional loneliness over time by earthquake exposure.

To identify groups who were most affected by the events, multi-level models assessing the association of demographic, earthquake exposure and time were used to predict reporting of earthquake related impacts in 2012 and 2014 HWR surveys. Overall, residing within the most impacted areas accounted for the greatest proportion of the model variance, with those living in and around Christchurch more likely than those living in the north island to report being impacted by the earthquake

in the past year. When controlling for geographic location, there were few subgroups that were more likely to report these impacts. Being affected by the Seddon earthquake (odds ratio = 11.735,  $\beta = 2.463$ ,  $p = .002$ ) and being divorced/separated compared to partnered (odds ratio = 1.117,  $\beta = .111$ ,  $p = .028$ ) were associated with increased likelihood of reporting impacts from the Canterbury earthquake in the previous year.

In summary, the proportion of 2014 survey participants reporting impacts from the Canterbury earthquakes had both reduced and changed in terms of types of effects reported, when compared to 2012 results. Participants in the 2014 survey still reported loss of life or injury, to family, friends or others, and providing social support, but these reports appeared to decrease over time. Emotional and economic impacts were more likely to be reported in the longer term context of 2014.

## Discussion

This paper presents findings from the HWR study of self-reported impacts of the Canterbury earthquakes, their national distribution among older people, and their change over time in a national sample of older people. The relationships of these effects to earthquake exposure, and demographic differences, such as socioeconomic status, were taken into account. The analysis utilised measures repeated from data waves obtained in 2010, 2012, and 2014. The ability to locate participants geographically, and to describe their circumstances across a range of psychosocial domains of wellbeing, and social and economic circumstances, has enabled an assessment of the continuing ripple effects from the Canterbury earthquakes.

In 2014, three years following the initial event, 25 percent of the whole sample reported that they had still been affected by the Canterbury earthquakes in the last year. This amounted to 81 percent of those living in Christchurch, 50 percent of those living in Canterbury and 16 percent of those living in the North Island. These results indicate that ripple effects from such a major event have an ongoing impact including an impact on older New Zealanders living outside of the affected area. These reported effects of the Canterbury earthquakes generally decreased over time and with greater distance from the most affected areas. However, by 2014, a large proportion of Christchurch dwelling participants (81%) continued to report being affected by the earthquakes in the previous year. Three years post-quake is less than a third of the time predicted for community recovery

(Stevenson et al., 2014). With this in mind, these effects can be expected to continue for some time. Importantly, some specific types of effects are more likely to diminish and some effects are reported by a higher percentage of respondents.

Being affected by providing support to family and friends decreased across time, however, after four years from the initial event, a third of the affected national participants continued to provide such support, demonstrating an enduring and indirect effect. There was an increase in reports of personal impacts including distress and problems related to housing and financial areas over time. These findings show the need for on-going attention to these important aspects of older people's lives. The reports of an increase in those who reported that they "experienced direct housing consequences" and were "affected by relocation" is consistent with other findings (CERA, 2014) illustrating secondary impacts from the lengthy time period for resolution of residential housing claims, and continuing disturbances from housing movement within the city throughout 2013 and 2014. The pressure on temporary and alternative accommodation while repairs are conducted has been focused in the city. However, wider-ranging disturbances are a reminder that older people outside Christchurch have also been affected by these issues (CERA, 2014).

The proportion of those reporting business or employment consequences remained stable and this may reflect the economic impact of the rebuild in Christchurch city. The proportion of the sample reporting financial consequences rose to over a third of the sample over the two year period. From the comments made in the 2012 survey, the rising cost of house insurance is likely to be a primary factor. This factor has affected all New Zealand home-owners, due to the changes to sum insured policies introduced in 2013 by all the major insurance companies.

These results point to the need for ongoing consideration of personal and emotional distress experienced by older people. In particular, issues arising from housing problems need to become an important focus of support. Alongside this need, we can consider a benefit observed in the short term for diminished emotional loneliness among those impacted upon by the earthquake. This appears to reflect the considerable increase in the provision of social support that occurred in the immediate aftermath of the earthquake events.

Older adults have been identified as a vulnerable population and are more likely to experience greater risks in a disaster due to these vulnerabilities (Bolin & Klenow, 1988; Cutter et al., 2003; Perry & Lindell, 1997; WHO, 2008). The current research data did not include longitudinal impacts from the earthquake on key outcome measures of health and quality of life. It could be that the worst affected Canterbury residents are not being reached by the HWR population survey and that more focused data collection is needed.

It is also possible that Christchurch residents were well supported and resilient to many impacts of the 2010 and 2011 earthquakes. The decrease in reports of loneliness directly following the earthquakes suggests that there were high levels of social support available at the time. There were no differential effects for different demographic groups when accounting for residence within the most affected areas. Previous research has found social factors such as class, gender, ethnicity, socio-economic status, and age can contribute to potentials for adverse, individual and group, outcomes in a disaster (Bankoff, Frerks & Hilhorst, 2004; Bolin & Klenow, 1988; Enarson, Fothergill & Peek, 2006).

In any case, as outlined above, the survey method may not have reached the most affected portions of the population and this must be considered in more detail. The current study provides an overview of the effects of the earthquakes in the New Zealand older population. Further work examining particular predictors and consequences within Christchurch and the Canterbury region may now be necessary to identify socio-demographic risk factors for health and wellbeing impacts.

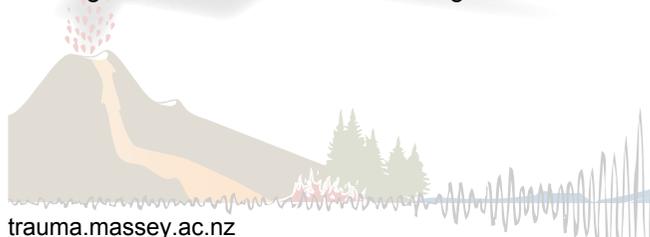
By focusing on resilience and the contribution of older people in New Zealand communities, the current study shows that regional disasters also have national impacts. In particular, the continuing connections of older people to family, friends and communities of interest across the country means that disaster preparedness and recovery will ideally incorporate all levels from local to regional to national, for maximum effectiveness. For older people in particular, it is important to note how social ties appear to surround the provision of support, in the ways that they manage continuing relocation effects, decisions about housing and maintain overall wellbeing.

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