Tracking the Health and Wellbeing of Older New Zealanders affected by the Canterbury Earthquakes

Brendan Stevenson & Sally Keeling

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Health and Ageing Research Team

School of Psychology, Massey University, Palmerston North

Executive Summary

A series of earthquakes struck Canterbury, New Zealand starting on Saturday 4th September 2010. Aftershocks continued to be significant for eighteen months following the initial 7.1 earthquake, with a major aftershock of 6.3 magnitude occurring on 22nd February 2011 with its epicentre in Christchurch city. This event was catastrophic in terms of impact, damage and loss of life.

This research presents finding from a study that explored the effects of these earthquakes on the health and wellbeing of older people. Participants in this study were from the Health, Work and Retirement longitudinal survey cohort comprised of a nationally representative sample of older New Zealanders. In particular data from the 2012 and 2014 waves were investigated to address the following four aims:

1) explore the 'ripple effects' reported 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;
4) analyse subgroups affected in different ways, taking into account pre-existing circumstances.

Main findings

- Effects of the earthquake were reported by older people across different regions of New Zealand and these effects persisted over three years following the events. These effects generally decreased with greater distance from the most directly affected regions of NZ and over time.
- Diverse types of effects were reported. While the effects of loss of life, injury and providing social support decreased, emotional and economic impacts were more likely to be reported in the longer term.
- While the health and wellbeing of older people varied over time, there was no effect of exposure to earthquake effects on health. There was a short term benefit on emotional loneliness for those affected by the earthquake.
- There were no demographic predictors of reporting effects, when residence within the most affected area was accounted for.
- This report provides an overview of the effects of the Canterbury earthquakes in the broader New Zealand population. Further work examining predictors and consequences within Christchurch and Canterbury regions will be conducted to identify socio-demographic risk factors for local health and wellbeing impacts.

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Contents

INTRODUCTION

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 (Morgan, et al., 2015; Tuohy, Stephens, & Johnston, 2015a; Annear, Wilkinson, & Keeling, 2013; Davey & Neale, 2013). 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, thus limiting 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 report is based on such an opportunity using data from the Health, Work and Retirement longitudinal study.

The Events

A series of unpredicted earthquakes struck Canterbury, New Zealand, starting on Saturday 4th September 2010. There was no loss of life resulting from the first earthquake, of magnitude 7.1. However, there was considerable property damage. The damage continued with the subsequent aftershocks, of which there were more than 10,000. These aftershocks continued to be significant for eighteen months following Sept 2010, and as well as causing anxiety among Christchurch residents, included several further major events (above 5 on the Richter scale). One aftershock of 6.3 magnitude with its epicentre in Christchurch city, struck on 22nd February 2011. This event is now perceived as the major earthquake, in terms of impact, damage and loss of life. Although of lower magnitude than the first, some areas of the city recorded a maximum modified Mercalli magnitude of 10. This quake destroyed most of the central city, and because it occurred in the middle of a working day, led to 185 deaths and over 10,000 injuries (Johnston, Standring, Ronan, et al., 2014). The central city area remained closed for over a year, and it is estimated that some 80% of its building stock has or will be demolished. Outside the central city, entire suburbs were 'red-zoned' leading to the displacement of whole communities, with more than 6,000 residential properties demolished, and many thousands more being repaired (Stevenson, Humphrey & Brinsdon, 2014). Several years later, many households in Christchurch continue to live in difficult circumstances as policies for housing repair or rebuild are developed and enacted, communities are fighting to recover and adapt, as schools change and community members relocate, and some parts of the city are now 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 CERA (Canterbury Earthquake Recovery Authority). CERA also conducts a six monthly Wellbeing Survey, which monitors quality of life, social connectedness, health and wellbeing, along with impacts of the earthquakes, both positive and negative, with an

electoral-roll based sample of the population in Christchurch City, Selwyn, and Waimakariri Districts (CERA Wellbeing Survey, 2014).

In August of 2013, a magnitude 6.6 earthquake centred 10km south of Seddon, (a small township on the coastal main road through Marlborough) resulted in significant reports of severity across the Cook Strait and Wellington city area. Following protocols developed from the Canterbury sequence over the previous three years, for any event above a magnitude 5, public buildings were evacuated, and transport suspended, with engineering safety inspections required before being approved to re-open. This event triggered continuing attention being paid outside Canterbury, to discussion and actioning of earthquake strengthening requirements, insurance implications for earthquake-prone areas, and planning for emergency response and recovery.

This report presents findings from a study that explored the effects of the Canterbury earthquakes on the health and wellbeing of older people (with some comparisons available with the effects of the Seddon earthquake). Participants in this study were from an existing longitudinal survey of a nationally representative sample of older New Zealanders.

Background

Older Adults and Disasters

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 (WHO, 2008; Bolin & Klenow, 1988; Cutter, Boruff & Shirley, 2003; Perry & Lindell, 1997). Statistics from recent disasters support these suggestions: studies of Hurricane Katrina, which devastated New Orleans in 2005, demonstrated disproportionately poorer outcomes and higher death rates for older adults compared to other population groups (Roberto, Henderson, & Kamo, 2010; Fussell, 2006); the Aceh (Indonesia) tsunami in 2004, recorded the highest death rates for those over 60 years; the death rate was highest for those over 70 years during the Paris heat-wave in 2003; and over 50 per cent of the casualties in the 1995 Kobe earthquake were older adults who additionally accounted for 90 per cent of subsequent deaths (WHO, 2008).

Older persons may face different or additional risks from the general population in a disaster. During the disaster response, they are more likely to have multiple health and mobility problems, poorer financial resources, lack of transport, and reduced social networks. For example, during Hurricane Katrina, many older adults stayed at home as they felt safer and had no clear idea of where to go without assistance (Jenkins, Laska, & Williamson, 2007).

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, which will globally increase from 810 million in 2012 to a projected 2 billion by 2050 (United Nations Population Fund, & Help Age International, 2012). In New Zealand, by 2021, 90% of adults over 65 years are expected to be living at home, and 28% to be living alone (Statistics New Zealand, 2004). Faced with the greater number of older adults living in the community there is a need to recognise this group as being at-risk prior to a disaster event (Ngo, 2001). However, at

present there is a lack of data regarding older adults. Although there is a large volume of literature on disasters, few scholars have focused on older persons (Roberto et al., 2010).

Long-term Effects of Disasters

The United Nations defines a disaster as a serious disruption of the functioning of a community or society. In this way, natural disasters have immediate and widespread impacts on human health (Hartwell, 2014) but they also have long term effects. For example, 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. Al-rousan, et al., (2014) note that there are few studies of any long term effects for older people.

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, "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 the influence of existing social factors can impact on human lives and outcomes in a disaster. The natural and social environment is an integral part of the disaster event. Common characteristics associated with those who become vulnerable during a disaster are often reflections of existing social patterns operating within the everyday social environment. 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, 2014; 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). These upstream factors may be conceptualised in terms of pre-disaster resilience (Wild, Wiles, & Allen, 2013).

There is recognition in the area of traumatic stress that a major event affects those who directly experience the event and also those who are connected to them, in a sequence of ripple like effects that travel out to more remotely connected people. Taylor (1990) identified six categories of disaster victim according to the stressors they faced and the need for recovery strategies that are appropriate for them. These included direct or primary victims (including family and friends), responders, and widening circles of peripheral victims. Recognising and identifying more clearly the range of impacts and different ways in which a disaster may be experienced, will make it possible to identify vulnerable groups as part of recovery planning (Eyre, 2004). A resilience approach to traumatic stress such as that experienced in a disaster, recognizes the widespread impact of major trauma, attends to 'ripple effects' 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.

Preliminary data from the Health, Work and Retirement study (Keeling, Alpass, Stephens & Stevenson, 2014) showed some significant effects (after controlling for baseline differences) on measures of living standards, as well as on physical and mental health, according to location, and degrees of recorded direct and indirect effects of the 2011 Canterbury earthquakes. In particular, aspects of control and self-realisation within the 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, lead us to take note of the importance of the social context as a focus for investigation into resilience for older people.

The Social Context of Disasters

Natural disasters are more than physical events; they occur within the context of everyday life and can have a disruptive and destructive impact on individuals and communities. Wisner et al. (2004) have argued that broader influences related to social, economic and political origins must be included in our understandings about disasters. Social factors that place people and places at risk of loss in a disaster include class, gender, ethnicity, socio-economic status, and age, which can contribute to increasing individual and group potential for adverse outcomes in a disaster (Bankoff, Frerks & Hilhorst, 2004; Bolin & Klenow, 1988; Enarson, Fothergill & Peek, 2006).

Assessment of vulnerability for older people must extend beyond age itself as the primary predictor variable for negative outcomes (Tuohy & Stephens, 2011). Bolin (2006) suggests that vulnerability should not be seen as an individual attribute, but as encompassing wider social processes that predispose certain population groups to becoming more vulnerable than others. This is because in a rapidly unfolding disaster event, people's responses are often influenced by social conditions as well as their individual vulnerability (Sorensen & Sorensen, 2006). Thus, an understanding of disasters as social phenomena includes both personal and social vulnerability within the realm of the social system itself (Perry, 2006). In a review of demographic indicators, which examined race/ethnicity, gender, socioeconomic status (SES), age and the distribution of traumatic and other stressful life events, Hatch and Dohrenwend (2007) found that losing homes due to natural disasters was more likely in lower SES groups. They concluded that groups living in vulnerable locations, and structural factors such as cheaper housing stock, rather than factors that related to individual actions had an influence on outcomes. Social factors were also identified in the Chicago heat wave of 1995 in which the fatalities for older adults were disproportionately greater than the rest of the population. Chicago recorded high temperatures, which posed a hazard to the city's inhabitants, but it was not a disaster until social factors such as reduced economic resources, poor neighbourhoods, reduced public assistance programmes and social isolation of older adults interacted with the hazard event (Klinenberg, 2002). In Japan, Tamura, Hayashi and Kimura (2006) surveyed elderly residents who experienced the 2004 Niigata flood, to examine which factors contributed to twelve residents' deaths resulting from the flood. Those interviewed were unaware an evacuation warning had been issued about two

hours earlier, so were unprepared for the rapidly rising floodwater. It was assumed that the residents would manage to self-evacuate based on the fact that the elderly lived independently; however, some of those who died needed assistance with walking. The Niigata flood research highlighted that residents in the study were less informed and less prepared to cope with the hazard they faced, than was anticipated by the community. Although there were no deaths, similar circumstances in New Zealand resulted in older people in social housing being evacuated too late to save their belongings (Tuohy & Stephens, 2011). Lack of information, assistance, and limited warning time meant the elderly residents were more vulnerable to negative outcomes.

Social networks, social isolation, socio-economic status, and access to resources may be insufficient to meet older adults' needs in the event of a disaster (WHO, 2008; Ngo, 2001; Wisner, et al., 2004; Fernandez, Byard, Lin, & Barbera, 2002; Peek, 2010). For some older adults independence brings isolation, and disengagement (Portacolone, 2011; Plath, 2008), which can contribute to social vulnerability in a disaster. Antonucci and Akiyama (1987) have shown that social networks and the provision of support generally decline with age, with the oldest (75 years to 95 years) providing and receiving support from the fewest people. Socially created vulnerabilities such as decreased social networks, social inequalities and socio-cultural influences also mean that older people become less visible in the community. A study of a sample of community dwelling older adults who experienced a flood, used narrative research to understand the influence of age-related personal and social resource loss to contextualize disaster response. The older people's stories about the flood linked health, social inequality and social norms of independence as having an influence on their response to the flood disaster, and their recovery outcomes (Tuohy, Stephens, & Johnston, 2015a; Tuohy, Stephens, & Johnston, 2015b; Tuohy & Stephens, 2011b).

In sum, there is recognition in the area of traumatic stress that a major event affects those who directly experience the event and also those who are connected to them, in a sequence of ripple like effects (across location and time) that travel out to more remotely connected victims. This recognition may be extended to understandings of the vulnerability of older people and the social context in which they live. The present study recognises the potential of these ripple effects by observing the effects of the major Christchurch earthquake events across a whole population of older New Zealanders.

Current Study

The current study uses the existing Health, Work and Retirement (HWR) longitudinal cohort (for full methodology see Alpass et al., 2007; Alpass et al., 2013; Towers & 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 55-70 (in 2006, aged 63 to 78 when surveyed in 2014). Surveys to date cover many aspects of ageing including physical and mental health, quality of life, social support and network affiliations, work/retirement status, work stress and commitment, care giving commitments, travel and safety issues, and various demographic characteristics.

Since the 2011 Canterbury earthquake, the 2012 survey included items pertaining to the effects of the earthquake. Preliminary analyses of these data demonstrated aspects the 'ripple effects' from the event. Initial results (Keeling, Stevenson, Alpass, & Stephens, 2014)

showed that of the N = 2,986 persons surveyed in 2012, 15% were living in Canterbury and 11% directly experienced one or more earthquake events. Of the whole population, 30% 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. Initial changes over time between 2010 and 2012 showed physical and mental health effects in the Canterbury sample compared to the rest of the population and differences in psychological changes. These initial results based on a small set of items were the basis for the more focussed study undertaken in 2014 and reported here.

The aims of the study were to:

1) explore the 'ripple effects' reported 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;
4) analyse subgroups affected in different ways, taking into account pre-existing circumstances.

METHOD

The Health, Work and Retirement (HWR) Study

In 2006, participants were sampled via equal probability random sampling from the New Zealand Electoral Roll to achieve a nationally-representative sample of New Zealanders aged 55-70 (N=6,659). 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). A general population sub-sample was first randomly selected from those on the electoral role eligible for the study (e.g., aged 55-70) then, using a 'Māori-descent' indicator on the electoral roll, a Māori sub-sample was selected.

Of the over 6,500 older New Zealanders surveyed in 2006, N = 3,281 consented to be part of the longitudinal study and have been surveyed biennially since. Additional persons were recruited over 2009-2012 as part of the New Zealand Longitudinal Study of Ageing (NZLSA) An additional panel study of the HWR sample was undertaken off-cycle in 2013 focusing on community participation.

Table 1. ***Study N over time*****.**

Year	**2006**	**2008**	**2010**	**2012**	**2013**	**2014**
HWR	6659	2473	1985	1865	1333	1423
NZLSA	-	-	1326	1121	-	547
Total N	**6659**	**2473**	**3311**	**2986**	**1333**	**1970**

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) was used to measure individuals' economic standard of living (Jensen, Spittal, & Krishnan, 2005). 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. Scores were combined to categorise individuals into 3 ordinal groups: "Hardship", "Comfortable" and "Good'.

Health

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 8 raw scales are generated: Physical Functioning, Role Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role Emotional, and Mental Health. These 8 scales are then standardised (z-scores) using means and standard deviations calculated from the Health, Work, and Retirement (HWR) 2006 study of older New Zealanders (Stephens, Alpass, Baars, Towers, & Stevenson, 2010) and the two primary scales Physical health and Mental health generated using the New Zealand Health Survey factor coefficients where the mean is set to 50 and the SD to 10. Higher scores indicate better health.

Health Conditions: A sum of lifetime chronic health conditions, as diagnosed by a health professional, was calculated (range 0-8). These included: Diabetes, High blood pressure or hypertension, Heart trouble (e.g., angina or myocardial infarction), Respiratory condition (e.g., bronchitis, asthma), Arthritis or rheumatism, Sight impairment (that cannot be corrected by glasses), Hearing impairment, and Cancer

Social Indicies

Social support: The Social Provisions Scale (Cutrona, Russell, & Rose, 1986) is a 24-item additive measure which provides a total social provisions score containing 6 sub-scales or "provisions": Attachment (a sense of emotional closeness and security, 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, usually obtained from friends); Reassurance of Worth (acknowledgement of one1s competence and skill, usually obtained from co-workers); Reliable Alliance (the assurance that one can count on others for assistance under any circumstances, usually obtained from family members); Guidance (advice and information, usually obtained from teachers, mentors, or parent figures); Opportunity for Nurturance (a sense of responsibility for the well-being of another, 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 (Gierveld, van Groenou, Hoogendoorn, & Smit, 2009) is a 6-item additive measure and includes two sub-scales: Emotional Loneliness (range 0-6) and Social Loneliness (range 0-5). The main loneliness

scale (range from 0 to 6) can also be categorised into: “Not lonely', 'Moderately lonely', 'Severely lonely', and 'Very severely lonely'. A higher score indicates higher loneliness.

Earthquake Experiences and Effects

In the 2012 data wave collection of HWR, 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, as these events also potentially affected the population of the wider Cook Strait/ Wellington area.

Experienced Earthquake. A binary indicator of whether participants were exposed to a Canterbury region earthquake event (Yes/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’. The Wellington/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/No question.

Impacted by of the Christchurch Earthquakes in the past year. A binary response variable (Yes/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?”

Specific effects. 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 effect questions was asked in relation to each earthquake: Suffered significant direct personal effects; Loss of life or injury within my family/whanau or networks; Provided personal support to family/whanau 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/whanau and/ or friends; Experienced physical or emotional distress; and Other effects. These questions were asked for the Christchurch earthquakes in 2012 and 2014, and for the Wellington/Seddon earthquakes in 2014. Each item was scored on a 5-point likert scale with anchors at 1= ‘Not true for me at all’ and 5= ‘Definitely true for me’.

Analyses

Weights have been calculated based on the initial design weights (adjusting for the over-sampling of Māori descent) and adjusted further to account for attrition. Weighting groups are formed based on Maori descent, gender, age, and NZ Deprivation indices associated with area of residence when first sampled. These weights are 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 are not re-distributed among responding participants in the same weighting group.

To explore the earthquake 'ripple effects', that is, the impact of the events over time and those experienced inside compared to outside the most effected regions, the presence and nature of reported impacts experienced in the year to 2012 and the year to 2014 were described.

To identify groups who were most affected by the events, demographic, location of residence, chronic health conditions and economic living standards indices 2006-2014 were included in a MLM model to predict reporting of earthquake related effects at 2012 and 2014. Reporting of earthquake effects at 2012 was included as a covariate, as was exposure to the Marlborough region earthquakes of 2013. Interaction terms assessing whether the demographic correlates of reporting earthquake effects differed for those who were living in the Canterbury region during the 2012 earthquakes were also included.

To identify the long term health impacts of earthquake effect, MLM models were used to assess change in key health and wellbeing indicators (physical health, mental health, economic living standards, social integration) over 2006 to 2014. Main effects of demographic factors and reporting earthquake impacts were modelled along with interaction terms assessing whether demographic predictors of health outcomes over time differed for those reporting and nor reporting impacts from the 2012 and 2014 earthquake events.

RESULTS

2014 Sample Description

Demographic, economic and health information for respondents in 2012 and 2014 are presented in Table 2. The 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/Wellington region 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% of the sample reported residing in the Seddon/Wellington region at the time of this event and 5.4% of the sample reported experiencing impacts of this event in the past year.

Table 2. ***Participant demographic and health status over the post-event period.***

Unweighted Results	**2012**	**2014**
Demographic groups		
Age	66.3 (7.8)	67.4 (6.1)
Female	54.8%	55.0%
Māori Descent vs. not	36.3%	34.5%
12+ years of education vs. less	25.6%	28.1%
Partnered/Married vs. not	72.7%	72.9%
Working vs. not	48.1%	25.2%
Own Home vs. not	89.6%	88.9%
No. Health Conditions	2.5 (1.7)	2.6 (1.8)
Health & social indices		
SF 12 Physical Health	49.4 (10.9)	48.5 (10.4)
SF 12 Mental Health	49.3 (8.0)	49.6 (7.7)
Emotional loneliness	0.6 (0.9)	0.6 (0. 7)
Social loneliness	1.2 (1.2)	1.2 (1.2)
Social support	-	79.3 (9.8)
Seddon/Wellington earthquake		
Residing in region in 2013	-	13.0%
Impacted by earthquake in last year	-	5.4%

Aim 1: explore the 'ripple effects' reported from the earthquakes

Perceived Impacts of the Christchurch Earthquakes in the past year

Table 3 shows the distribution of respondents according to their location of residence within four geographic zones in 2012: Christchurch, Canterbury, South Island, and the North Island. In 2012, 8.6% of the sample was living in Christchurch, 6.7% in Canterbury (excluding Christchurch), 14% in the rest of the South Island, and most (70.5%) were living in the North Island. For each regional group, the percentage of those reporting experiencing impacts of the earthquakes in the past year for 2012 and 2014 are reported. There was an overall reduction of 4% of participants reporting impacts of the earthquakes between the 2012 and 2014 surveys.

However, in 2014, 81% of those living in Christchurch reported experiencing impacts in the last year, as did nearly 50% of those living in Canterbury and 16% of those living in the North Island. These reports indicate that the ripple effects of such a major event have an ongoing impact on populations outside the most affected area. A quarter of the whole population reported experiencing impacts in the year to 2014.

Table 3. ***Canterbury region earthquake effects by area for 2012 and 2014.***

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

Table 4 shows that reports of being affected by the earthquakes can change over time. The results suggest a moderate level of continuity in reporting being impacted in the past year by the earthquakes with 14% of the population reporting effects consistently across the two years.

Table 4. ***Concordance in reporting 'direct or indirect effects in the last year as a result of the Canterbury earthquakes' at 2012 and 2014.***

	n	%
Reported effects in 2012 & 2014	222	13.6
Reported effects in 2012 only	281	17.2
Reported no effects in 2012 & 2014	1052	64.4
Reported effects in 2014 only	79	4.8
Total	1634	100

Types of impacts reported 2012 and 2014.

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 of their lives. Table 5 summarises the effects of the Canterbury earthquakes on participants in 2012 and again in 2014. There was an increase in those reporting "significant direct personal effects"; from 12% who responded "definitely true" in 2012 to 16% in 2014. All positive responses increased from 17% in 2012 to 21.2% in 2014. These increased responses to the effects of the earthquake suggest that the effects play out over time. Table 5 also shows the different domains in which people reported these effects. Across the domains there is an increased reporting of personal effects including distress and problems related to housing and financial areas.

Two years on, there was a diminishing positive response to "Loss of life or injury within my family or networks" and a larger diminution of "Provided personal support to family and friends" by 10%. However, even by 2014, a third of the affected national participants continued to provide such support.

In the area of housing, there was an increase from 15.3% (2012) to 22% (2014) in those who reported that they "Experienced direct housing consequences."

There was only a slight reduction in the reporting of direct business or employment consequences over the two year period. The proportion of those who reported experiencing financial consequences is sustained, and increasing from 20.3% in 2012 to 25.6% in 2014. Combining the 'true and definitely true' responses, shows an increase in reported financial consequences from 27.2 % in 2012 to 35% in 2014.

Similarly to issues raised by housing, the 'affected by relocation' question increased by 4% in those who reported this kind of effect over the two years between 2012 and 2014. The experience of physical or emotional distress attributed to the effects of the earthquakes shows a divergent pattern, if the two extreme responses are considered: both the groups saying this was 'not true at all', and 'definitely true' increased. However, when the two lowest levels are combined, the 'not true' group is more consistent (from 57.2% in 2012 to 56.7% in 2014), while the two levels of "true" increased very slightly from 25.3% in 2012 to 26.6% in 2014.

Table 5. ***Percentage of those reporting specific effects of the Canterbury earthquakes for 2012 and 2014.***

Canterbury Earthquakes			**Not true for me at all**				**Definitely true for me**
	N	**%**	**1**	**2**	**3**	**4**	**5**
Significant direct personal effects	715	**2012**	60.8	11.3	10.8	5.0	12.0
	383	**2014**	61.1	7.8	9.9	5.5	15.7
Loss of life/injury within my family/networks	714	**2012**	80.5	4.1	3.6	2.7	9.1
	386	**2014**	88.3	1.3	2.3	0.5	7.5
Personal support to family and friends	825	**2012**	21.7	6.3	16.2	14.2	41.6
	416	**2014**	35.1	5.3	12.7	14.9	32.0
Experienced direct housing consequences	726	**2012**	65.6	7.2	7.2	4.8	15.3
	391	**2014**	60.6	3.6	7.4	6.4	22.0
Direct business or employment	722	**2012**	71.2	3.2	6.8	4.4	14.4

consequences	383	**2014**	73.6	3.1	4.7	5.0	13.6
Financial consequences through any above	749	**2012**	57.4	6.4	8.9	6.9	20.3
	406	**2014**	51.5	3.9	9.6	9.4	25.6
Relocation of self, or family and/ or friends	723	**2012**	65.3	4.6	6.6	4.6	18.9
	391	**2014**	62.4	3.8	6.4	5.6	21.7
Experienced physical or emotional distress	752	**2012**	43	14.2	17.6	9.6	15.7
	398	**2014**	48.2	8.5	16.6	8.0	18.6
Other effect	266	**2012**	33.8	3.4	6.0	6.0	50.8
	123	**2014**	56.9	-	5.7	8.1	29.3

Table 6 contrasts the portion of persons indicating that the specific impacts of the earthquake were felt in 2012 and 2014 by combining the two levels of effects (4 and 5, namely 'true and definitely true for me').

Table 6: ***Increase (I), decrease (D) and stability (S) of types of effects reported 2012 to 2014.***

	% impacted		Change* in impact
% True for me (4 or 5)	2012	2014	
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,

These results indicate that the 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 persons reporting 'business and employment' impacts as well as 'distress' were stable.

Finally, to assess the concordance or continuance of impacts over time, participants who answered that they reported effects in either or both 2014 and 2012 study waves, the summary is provided in Table 7. For all the participants, there was a reduction in the number saying an effect was true two years later. The largest reduction was for participants reporting loss of life or injury, with 65% fewer (5% in 2012 reducing to 2% in 2014) reporting this as being true for them. A second level of effect reduction (between 41% and 45%) was found in a cluster of effects: physical or emotional distress (12% in 2012 down to 7% in 2014), significant direct personal effects (13% in 2012 down to 7% in 2014), and other effects (13% down to 8% in 2014). A third group reported a 36% reduction in positive responses to: Direct job consequences (12% in 2012 down to 8% in 2014), relocation (12% reducing to 8%), and

financial consequences (12% down to 8%). Perhaps most importantly, a quarter (74%) of those who reported providing personal support to family and friends (32% in 2012 & 23% in 2014) and those experiencing direct housing consequences (10% in 2012 & 8% in 2014) were still reporting these consequences as being true for them.

Table 7. ***Effects of Canterbury earthquakes for those reporting as true in 2012 and changes for their reporting in 2014.***

		In 2014			
True for me (4 or 5)	True in 2012	Still true	No longer true	Now true	Total True
Personal support to family and friends	31.6%	23.4%	8.2%	3.0%	26.4%
Significant direct personal effects	13.0%	7.2%	5.8%	4.6%	11.8%
Direct business/employment consequences	12.4%	8.1%	4.4%	4.4%	12.4%
Financial consequences through above	12.1%	7.6%	4.5%	6.0%	13.5%
Physical or emotional distress	11.9%	6.7%	5.2%	4.5%	11.3%
Relocation	11.5%	7.5%	4.0%	4.8%	12.3%
Direct housing consequences	10.4%	7.7%	2.6%	4.9%	12.7%
Loss of life or injury	4.8%	1.7%	3.2%	1.8%	3.5%
Other	12.9%	7.6%	5.3%	3.0%	10.6%

Aim 2: identify any groups whose health and wellbeing changed over the four years from the beginning of these events; and

Aim 3: identify what factors have been most protective to those directly affected by the earthquakes

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 (ELSI), physical health, mental health, social integration and loneliness. Demographic indices and reported earthquake effects were included and interaction terms for reporting of effects in the past 12 months were included for all factors. A bivariate effect of whether health and wellbeing varied before vs. after the earthquake events in Christchurch was also included. Trend lines of outcomes over time were produced. Detailed analyses are presented in Appendix 2.

ELSI.

There were no significant differences in living standards between those who reported effects and those who did not. The important finding here is that there was no drop in living standards for any participants who experienced the earthquakes, but rather a general increase in living standards for all across the years from 2008 and continuing to rise after the earthquake events (Rho AR(1)=0.827, p<.001; Figure 1). Many demographic factors predicted ELSI, however these did not vary for those who were exposed to the event compared to those who were not.

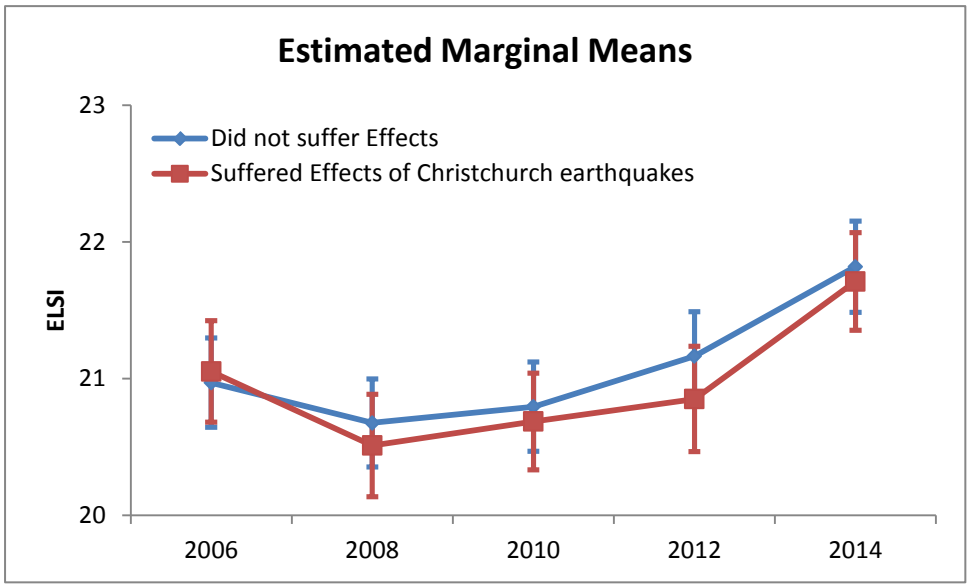

Figure 1. **Marginal Means for Economic living Standards over time by earthquake exposure.**

Physical health.

Figure 2 shows that physical health initially rose to 2012 (Rho (AR1)=.638, p<.001) after which physical health dropped again in 2014 (B=.876, p=.013; Reference=2014) for both groups, with no significant difference between those suffering and those not suffering earthquake effects.

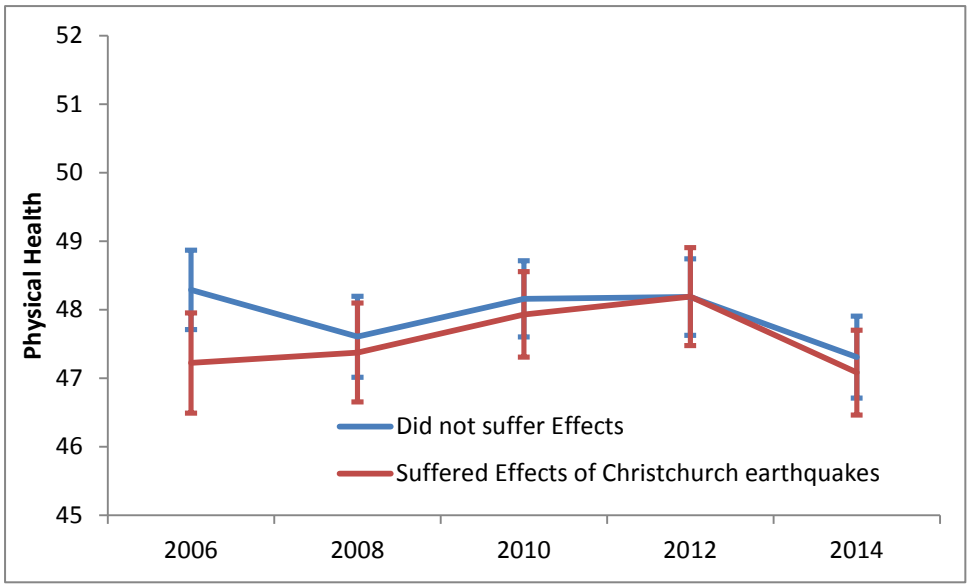

Figure 2. **Marginal Means for Physical health over time by earthquake exposure.**

Mental health.

Mental health scores reduced over time for all participants (Rho (AR1)=.513, p<.001). As illustrated in Figure 3, this was irrespective of reporting earthquake effects or not.

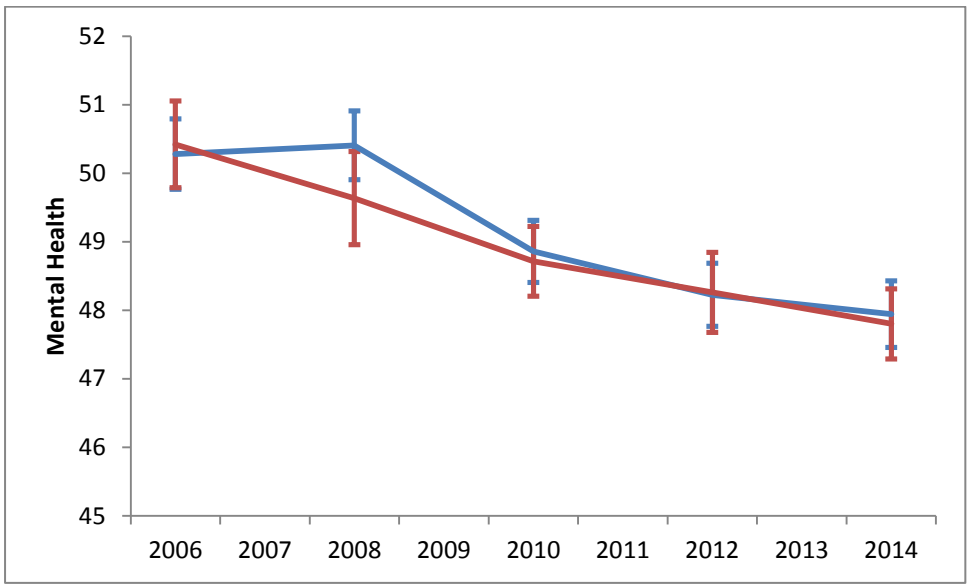

Figure 3. **Marginal Means for Mental health over time by earthquake exposure.**

Social support and loneliness.

Overall, emotional loneliness increased for 2012 to 2014 (B=-0.071, p=.014, Reference=2014). There was also a significant difference in emotional loneliness between those exposed and not exposed to the earthquakes Figure 4, B=-.121, 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 (2012-2014) the events. This may reflect the sharp drop in emotional loneliness in 2012 which returned to comparable levels in 2014.

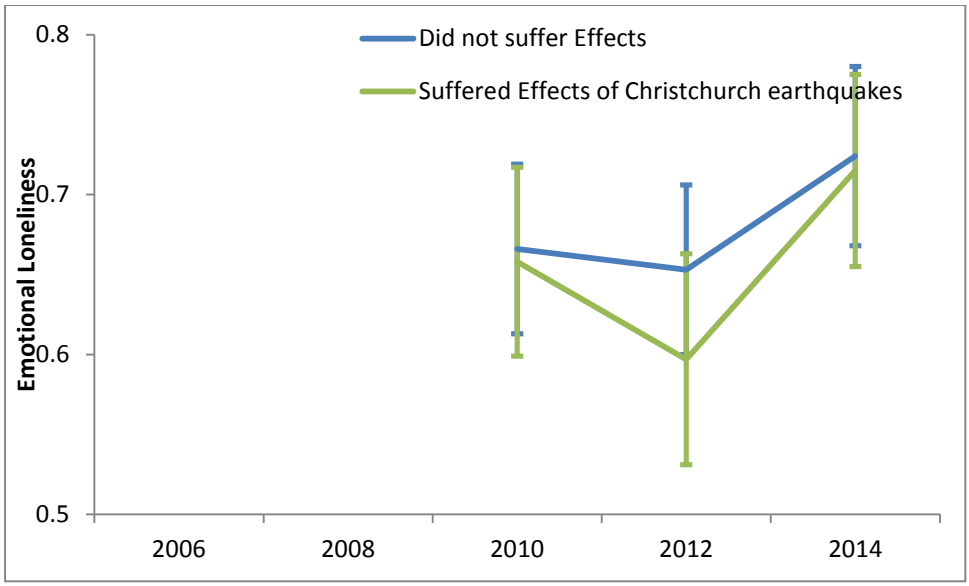

***Figure 1*. Emotional loneliness over time by earthquake exposure.**

In 2010 respondents were more socially lonely than in 2014 (Figure 5, B=0.109, p=.016, Reference=2014). Reporting effects of the earthquake was not associated with social loneliness.

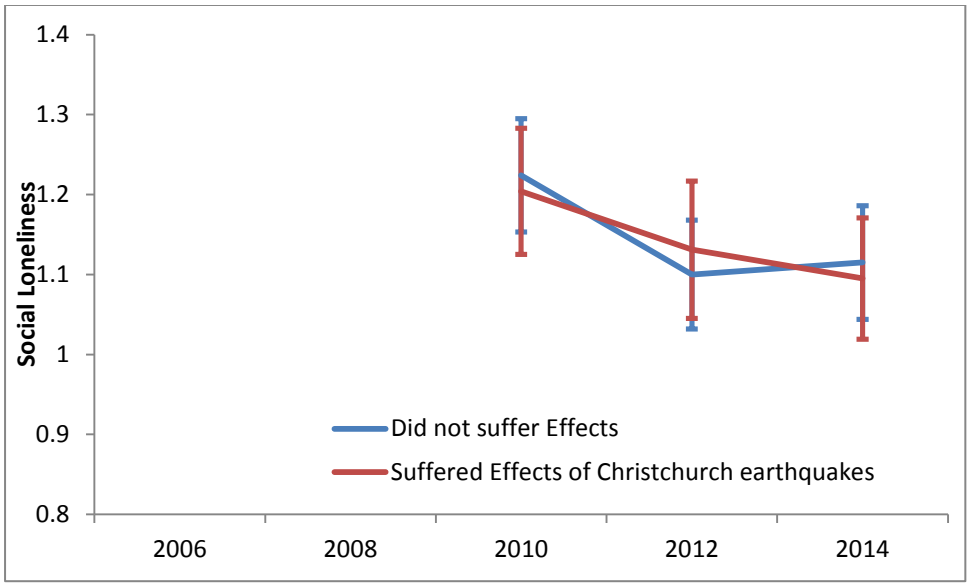

***Figure 2*. Social loneliness over time by earthquake exposure.**

There was no significant difference reported in social support between the two groups over time. There was a significant reduction in levels of social support for all participants between 2010 and 2014 (B=0.936, p=.003, Reference=2014), as Figure 6 shows.

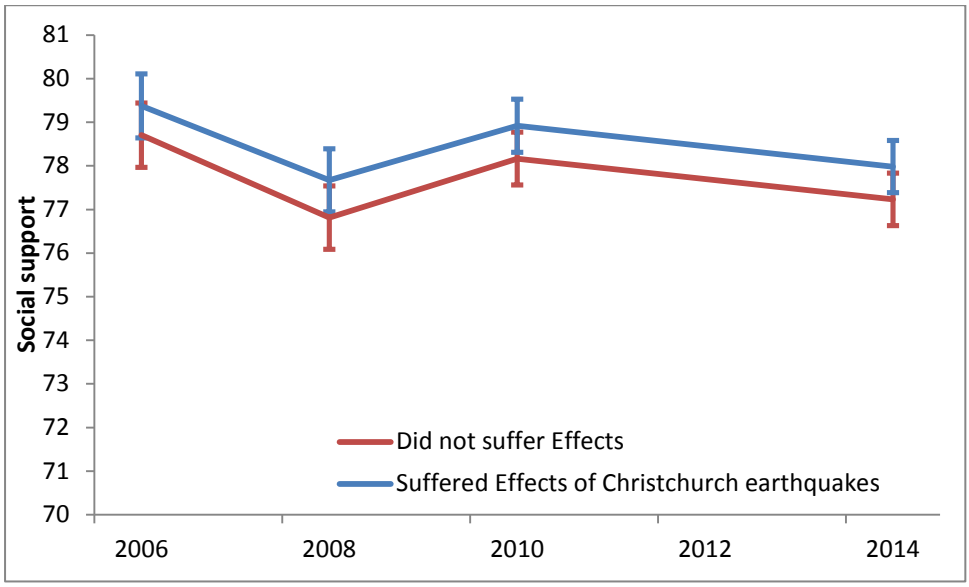

***Figure 3.* Social Provisions over time by earthquake exposure.**

Aim 4: analyse subgroups affected in different ways, taking into account pre-existing circumstances.

To identify groups who were most affected by the events, multi-level models (MLM) assessing the association of demographic, earthquake exposure and time were used to predict reporting of earthquake related impacts at 2012 and 2014. These analyses are presented in Appendix 1. 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 (Figure 7). When controlling for geographic location, there were few subgroups that were more likely to report these impacts. Being affected by the Wellington/Seddon earthquake (OR=11.735, B=2.463, p=.002) and being divorced/separated compared to partnered (OR=1.117, B=.111, p=.028) were associated with increased likelihood of reporting being impacted by the Canterbury earthquake in the previous year.

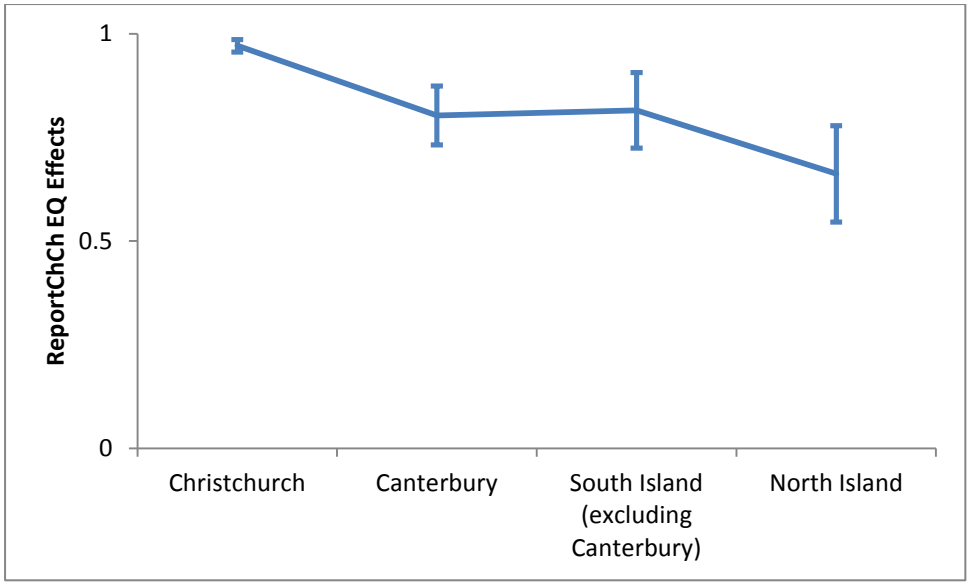

Figure 4. **Likelihood of reporting effects of the Canterbury region earthquakes in the past year by geographic location.**

Summary

- Effects of the earthquake were reported by older people across different regions of New Zealand and these effects persisted over three years following the events. These effects generally decreased with greater distance from the most directly affected regions of NZ and over time.
- Diverse types of effects were reported. While the effects of loss of life, injury and providing social support decreased, emotional and economic impacts were more likely to be reported in the longer term.
- While the health and wellbeing of older people varied over time, there was no effect of exposure to earthquake effects on health. There was a short term benefit on emotional loneliness for those affected by the earthquake.
- There were no demographic predictors of reporting effects, when residence within the most affected area was accounted for.
- This report provides an overview of the effects of the Canterbury earthquakes in the broader New Zealand population. Further work examining predictors and consequences within Christchurch and Canterbury regions will be conducted to identify socio-demographic risk factors for local health and wellbeing impacts.

DISCUSSION

This report describes a preliminary analysis of the self-reported effects 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 utilises 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" of the Canterbury earthquakes.

In 2011 a largely economic way of considering the relative impacts of the Canterbury earthquakes on New Zealand nationally, was expressed in a Parliamentary Research Paper (2011): "The Canterbury earthquakes of 2010 and 2011 have had a major economic and fiscal impact on the region itself and on New Zealand as a whole. The earthquakes rank as one of the most costly natural disasters for insurers worldwide, since 1950. Treasury's assumption is that the rebuild will cost the equivalent of around 10 percent of Gross Domestic Product (GDP), which represents a 'very large shock' in relative terms." These observations highlight the long term and national economic effects of the earthquake events. The current study complements this commentary by tracking the longitudinal experiential impacts of the earthquakes in a national study of health and ageing in New Zealand.

In 2014, three years following the event, 25% of the whole sample (81% of those living in Christchurch, 50% of those living in Canterbury and 16% of those living in the North Island) reported that they were still affected by the Canterbury earthquakes in the last year. These reports indicate that the ripple effects of 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 regions of New Zealand. 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, Humphrey, & Brinsdon, 2014) and so 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 effects 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 data (CERA, 2014) showing the lengthy time period for resolution of residential housing claims, and the continuing 'churn' of housing movement in the city throughout 2013 and 2014. While the process of settling 'red-zone' housing claims occurred largely in 2012, the Fletchers/ EQC Repair project was scheduled to be completed by the end of 2014. The pressure on temporary and alternative accommodation while repairs are conducted has been focussed in the city, but this response is 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 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, a primary factor noted here is likely to be the rising cost of house insurance which has affected all New Zealand home-owners, due to the changes to 'sum insured' policy changes introduced in 2013 by all the major insurance companies.

These results point to the need for ongoing consideration of the personal and emotional distress experienced by older people. In particular, the issues arising from housing problems will become an important focus of support. There was a benefit observed in the short term for emotional loneliness for those impacted upon by the earthquake, reflecting 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 (WHO, 2008; Bolin & Klenow, 1988; Cutter, Boruff & Shirley, 2003; Perry & Lindell, 1997). In this sample there were no effects over time of exposure to the earthquake events on the key outcome measures

of health and quality of life. It could be that the worst effected Canterbury residents are not being reached by this population survey, and more focussed inquiry is needed. It is also possible that Christchurch residents were well supported and resilient to such effects. 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 residence within the most affected area was accounted for. Previous research has found social factors such as class, gender, ethnicity, socio-economic status, and age can contribute to increasing individual and group potential for adverse outcomes in a disaster (Bankoff, Frerks & Hilhorst, 2004; Bolin & Klenow, 1988; Enarson, Fothergill & Peek, 2006). Again, it could be that the survey method did not reach the most affected portions of the population and this must be considered in more detail.

This report provides an overview of the effects of the earthquakes in the New Zealand older population. Further work examining predictors and consequences within Christchurch and Canterbury regions will be conducted to identify socio-demographic risk factors for health and welling impacts.

The focus on the resilience of older people, living within New Zealand's communities, rather than the care of the very old and frail (as noted in other disaster studies reviewed earlier) is an important contribution of this study. Although many older disabled people do require attention and care, increasing numbers of older people remain living independently in the community and may be ignored for this very reason. As the world populations age, it is particularly important to focus on the needs of older people and their ability to be able to survive disaster experiences, and continue to function and contribute to society in the years following such events.

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APPENDIX 1 Multi-level Model coefficients for model predicting reporting earthquake effects in the past year

Fixed Coefficientsa

Model Term	Coefficient	Std. Error	t	Sig.	95% Confidence Interval		Exp(Coefficient)	95% Confidence Interva Exp(Coefficient)	
					Lower	Upper		Lower	U
Intercept	0.468	0.8334	0.562	0.575	-1.17	2.107	1.597	0.31	
SufferWellEQ=1	**2.463**	**0.6485**	**3.797**	**0.002**	**1.058**	**3.867**	**11.735**	**2.882**	
SufferWellEQ=2	0b	.	.	.	.	.	.	.	.
DistanceFromCanterbury04=0	**3.008**	**0.8935**	**3.366**	**0.001**	**1.249**	**4.766**	**20.238**	**3.488**	
DistanceFromCanterbury04=1	0.089	0.8731	0.102	0.919	-1.649	1.828	1.093	0.192	
DistanceFromCanterbury04=2	0.826	1.1861	0.696	0.487	-1.509	3.161	2.283	0.221	
DistanceFromCanterbury04=3	0b	.	.	.	.	.	.	.	.
ExperiencedChChEvent=0	**-1.953**	**0.8624**	**-2.265**	**0.024**	**-3.652**	**-0.254**	**0.142**	**0.026**	
ExperiencedChChEvent=1	0b	.	.	.	.	.	.	.	.
MaoriDescent=1	0.584	0.838	0.697	0.494	-1.159	2.326	1.793	0.314	
MaoriDescent=2	0b	.	.	.	.	.	.	.	.
Gender=1	-0.171	0.637	-0.269	0.796	-1.692	1.35	0.843	0.184	
Gender=2	0b	.	.	.	.	.	.	.	.
Age	-0.009	0.0057	-1.637	0.152	-0.023	0.005	0.991	0.977	
Employment=1	-0.013	0.023	-0.552	0.582	-0.058	0.033	0.987	0.944	
Employment=2	0.011	0.0312	0.367	0.714	-0.05	0.073	1.012	0.951	
Employment=3	-8.00E-03	0.0113	-0.737	0.461	-0.031	0.014	0.992	0.97	
Employment=4	0b	.	.	.	.	.	.	.	.

ELSI	-4.57E-05	0.0015	-0.03	0.976	-0.003	0.003	1	0.997
Education=1	0.074	0.0481	1.536	0.125	-0.02	0.168	1.077	0.98
Education=2	0.07	0.0435	1.611	0.108	-0.015	0.156	1.073	0.985
Education=3	0.051	0.0461	1.097	0.273	-0.04	0.141	1.052	0.961
Education=4	0b	.	.	.	.	.	.	.
Partnered=1	0.019	0.037	0.522	0.602	-0.053	0.092	1.02	0.948
Partnered=2	0.044	0.0338	1.302	0.194	-0.023	0.111	1.045	0.978
Partnered=3	**0.111**	**0.0504**	**2.203**	**0.028**	**0.012**	**0.21**	**1.117**	**1.012**
Partnered=4	0b	.	.	.	.	.	.	.
OwnHome=1	-0.006	0.0371	-0.159	0.874	-0.08	0.068	0.994	0.923
OwnHome=2	0b	.	.	.	.	.	.	.
TotalHealthConditions	0.006	0.0091	0.698	0.488	-0.012	0.025	1.006	0.988
Vision=0	-0.004	0.026	-0.147	0.883	-0.056	0.048	0.996	0.945
Vision=1	0b	.	.	.	.	.	.	.
Hearing=0	0.018	0.0216	0.854	0.396	-0.025	0.062	1.019	0.976
Hearing=1	0b	.	.	.	.	.	.	.
[ExperiencedChChEvent=0]*[DistanceFromCanterbury04=0]	-0.351	1.0924	-0.321	0.748	-2.502	1.801	0.704	0.082
[ExperiencedChChEvent=1]*[DistanceFromCanterbury04=0]	0b	.	.	.	.	.	.	.
[ExperiencedChChEvent=0]*[DistanceFromCanterbury04=1]	1.286	0.9883	1.301	0.197	-0.683	3.254	3.617	0.505
[ExperiencedChChEvent=1]*[DistanceFromCanterbury04=1]	0b	.	.	.	.	.	.	.
[ExperiencedChChEvent=0]*[DistanceFromCanterbury04=2]	-0.028	1.2514	-0.023	0.982	-2.51	2.453	0.972	0.081
[ExperiencedChChEvent=1]*[DistanceFromCanterbury04=2]	0b	.	.	.	.	.	.	.
[ExperiencedChChEvent=0]*[DistanceFromCanterbury04=3]	0b	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[DistanceFromCanterbury04=3]	0b	.	.	.	.	.	.	.
[ExperiencedChChEvent=0]*[MaoriDescent=1]	-0.637	0.9408	-0.677	0.507	-2.619	1.345	0.529	0.073
[ExperiencedChChEvent=0]*[MaoriDescent=2]	0b	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[MaoriDescent=1]	0b	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[MaoriDescent=2]	0b	.	.	.	.	.	.	.
[ExperiencedChChEvent=0]*[Gender=1]	0.093	0.7122	0.13	0.9	-1.622	1.808	1.097	0.197
[ExperiencedChChEvent=0]*[Gender=2]	0b	.	.	.	.	.	.	.

[ExperiencedChChEvent=1]*[Gender=1]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Gender=2]	0b	.	.	.	.	.	.	.	.	.
Age*[ExperiencedChChEvent=0]		0.012	0.0065	1.82	0.121	-0.004	0.028	1.012		0.996
Age*[ExperiencedChChEvent=1]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=0]*[Employment=1]		0.017	0.0241	0.711	0.478	-0.03	0.065	1.017		0.97
[ExperiencedChChEvent=0]*[Employment=2]		-0.031	0.0355	-0.876	0.381	-0.101	0.039	0.969		0.904
[ExperiencedChChEvent=0]*[Employment=3]		0.006	0.0129	0.448	0.654	-0.02	0.031	1.006		0.981
[ExperiencedChChEvent=0]*[Employment=4]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Employment=1]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Employment=2]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Employment=3]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Employment=4]	0b	.	.	.	.	.	.	.	.	.
ELSI*[ExperiencedChChEvent=0]		0.001	0.0018	0.611	0.541	-0.002	0.005	1.001		0.998
ELSI*[ExperiencedChChEvent=1]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=0]*[Education=1]		-0.032	0.0646	-0.498	0.62	-0.16	0.095	0.968		0.852
[ExperiencedChChEvent=0]*[Education=2]		-0.023	0.0552	-0.414	0.679	-0.132	0.086	0.977		0.876
[ExperiencedChChEvent=0]*[Education=3]		0.004	0.0545	0.079	0.937	-0.103	0.112	1.004		0.902
[ExperiencedChChEvent=0]*[Education=4]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Education=1]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Education=2]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Education=3]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Education=4]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=0]*[Partnered=1]		0.028	0.0523	0.536	0.592	-0.075	0.131	1.028		0.928
[ExperiencedChChEvent=0]*[Partnered=2]		-0.048	0.0471	-1.012	0.315	-0.141	0.046	0.953		0.868
[ExperiencedChChEvent=0]*[Partnered=3]		**-0.119**	**0.0535**	**-2.22**	**0.027**	**-0.224**	**-0.014**	**0.888**		**0.799**
[ExperiencedChChEvent=0]*[Partnered=4]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Partnered=1]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Partnered=2]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Partnered=3]	0b	.	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[Partnered=4]	0b	.	.	.	.	.	.	.	.	.

[ExperiencedChChEvent=0]*[OwnHome=1]		0.007	0.044	0.149	0.882	-0.08	0.094	1.007	0.923
[ExperiencedChChEvent=0]*[OwnHome=2]	0b	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[OwnHome=1]	0b	.	.	.	.	.	.	.	.
[ExperiencedChChEvent=1]*[OwnHome=2]	0b	.	.	.	.	.	.	.	.

APPENDIX 2. **Multi-level Model coefficients for model predicting health & wellbeing outcomes**

	ELSI	Physical	Mental	Emotional loneliness	Social loneliness	Social Provisions
Intercept	17.587***	59.14***	31.386***	1.89***	2.24***	75.803***
2006	-0.945***	0.981*	2.333***			1.473***
2008	-1.236***	0.297	2.462***			-0.417
2010	-1.104***	0.848**	0.913***	-0.058	0.109*	0.936**
2012	-0.755***	0.876**	0.28	-0.071*	-0.015	
2013	-0.597***	0.689	0.284	-0.078*	-0.01	
2014	Reference	Reference	Reference	Reference	Reference	Reference
ChCh Effects	-0.22	-0.238	-0.209	0.052	0.014	0.897
No ChCh Effects	Reference	Reference	Reference	Reference	Reference	Reference
Māori Descent	-1.62***	-0.826	-0.281	-0.012	-0.169**	0.106
Not of Māori Descent	Reference	Reference	Reference	Reference	Reference	Reference
Male	0.801***	0.022	-0.802**	0.114***	0.24***	-2.205***
Female	Reference	Reference	Reference	Reference	Reference	Reference
Age	0.089***	-0.312***	0.131***	-0.005	-0.003	-0.094***
Employed Other	-1.58***	-3.873***	-1.924***	0.114*	-0.005	-0.121
Unemployed	-2.781***	-0.79	-1.929	-0.015	-0.136	0.027
Retired	-0.585***	-1.434***	-0.228	-0.02	-0.035	0.286
Working	Reference	Reference	Reference	Reference	Reference	Reference
ELSI		0.351***	0.412***	-0.044***	-0.051***	0.422***
Tertiary	1.77***	3.034***	-0.195	-0.044	0.251***	2.424***
Post-Secondary	1.058***	1.902***	0.202	0.018	0.224***	1.137*
Secondary School	0.812***	1.516**	-0.035	0.003	0.178**	0.827
No Qualifications	0b	0b	0b	0b	0b	0b
Single	-2.176***	-1.956**	-0.279	0.237**	0.227*	-4.915***
Widowed	-1.145***	-0.69	-0.729	0.219***	0.042	-2.732***

Separated	-1.876***	-0.286	-0.633	0.163**	0.148*	-3.208***
Partnered	0b	0b	0b	0b	0b	0b
Own Home	1.468***	1.295*	-0.044	0.023	0.11	-0.507
Don't own home	0b	0b	0b	0b	0b	0b
[ChCh Effects]*[Before EQ]	0.135	0.025	0.132	-0.121*	-0.068	-0.287
[ChCh Effects]*[After EQ]	0b	0b	0b	0b	0b	0b
[No ChCh Effects]*[Before EQ]	0b	0b	0b	0b	0b	0b
[No ChCh Effects]*[After EQ]	0b	0b	0b	0b	0b	0b
[2006]*[ChCh Effects]	0.189	-0.841	0.285			-0.084
[2006]*[No ChCh Effects]	0b	0b	0b			0b
[2008]*[ChCh Effects]	-0.066	-0.005	-0.629			0.101
[2008]*[No ChCh Effects]	0b	0b	0b			0b
[2010]*[ChCh Effects]	0b	0b	0b	0b	0b	0b
[2010]*[No ChCh Effects]	0b	0b	0b	0b	0b	0b
[2012]*[ChCh Effects]	-0.082	0.233	0.179	-0.048	0.051	
[2012]*[No ChCh Effects]	0b	0b	0b	0b	0b	
[2013]*[ChCh Effects]	-0.174	-0.313	-0.397	-0.033	-0.032	
[2013]*[No ChCh Effects]	0b	0b	0b	0b	0b	
[2014]*[ChCh Effects]	0b	0b	0b	0b	0b	0b
[2014]*[No ChCh Effects]	0b	0b	0b	0b	0b	0b
AR1 Diagonal	35.324	101.1476	65.776	0.776	1.557	95.873
AR1 Rho	0.827	0.637872	0.513	0.572	0.589	0.589