Introduction

Does the availability of alcohol impact neighbourhood-level crime in cities? Does neighbourhood-level crime affect individual-level health? If we limit locational access to alcohol outlets will we see a decrease in crime and also improvements in health? These simple but interrelated questions have plagued social scientists and public health practitioners for the past few decades and resulted in a plethora of studies investigating these potential linkages. The consensus among this large body of research is that the availability of alcohol does affect neighbourhood-level crime (Gruenewald et al. 2002; Freisthler et al. 2004, 2005; Day et al. 2012), as well as mental and physical health (Morrall et al. 2010; Roberts et al. 2012; Pearson and Breetzke 2014), although the directionality and temporality of these relationships are currently under investigation, that is, as to whether a bi-directional relationship exists between alcohol use and crime as well as between fear of crime and health. An example of the latter is Foster et al. (2016), who examined the causal relationship between fear of crime and health in Perth, Australia and found that, while heightened fear of crime did lead to poorer mental health, poorer mental health also exacerbated individuals’ fear of crime. The researchers noted that the pathways connecting fear of crime and mental health appeared to be bi-directional and direct.

Despite lagging somewhat behind other countries in terms of crime–health research, studies investigating the relationships between the availability of alcohol, neighbourhood-level crime and individual-level health are increasingly forthcoming from New Zealand. Echoing findings from other countries, most New Zealand studies have shown a positive association between the availability of alcohol outlets and neighbourhood-level crime (Day et al. 2012), specifically violence (Cochrane et al. 2010), and harmful alcohol consumption, including among those with mental health diagnoses (Pearson et al. 2014). The impact of recorded crime on individual-level physical health has also been investigated by Lovasi et al. (2014), who found that, among New Zealand women, higher neighbourhood violent and night-time crime rates were cross-sectionally associated with poorer physical health. Additionally, a perceived lack of safety was associated with poorer physical health among both men and women. In another New Zealand study, Pearson and Breetzke (2014) found a significant effect of fear of crime on poorer mental and physical wellbeing, even after accounting for numerous individual- and area-level covariates including neighbourhood recorded crime. Interestingly, no independent effect of recorded crime on health was detected, after adjustment
for fear of crime. The similar findings of Pearson and Breetzke (2014) and Lovasi et al. (2014), that perceived safety declined with increasing recorded crime, may indicate that fear is indeed a significant aspect in understanding the crime–health relationship. Other New Zealand research has shown that the fear of crime–recorded crime relationship differs by neighbourhood social context. For example, neighbourhoods with high levels of social fragmentation exhibited larger effects of violent and drug-related recorded crime rates on fear of crime, in comparison to more socially cohesive neighbourhoods (Pearson et al. 2015). Breetzke and Pearson (2014) also found that it was not only crimes that occurred in an individual’s own neighbourhood that affected the individual’s fear of crime but, rather, crimes that occurred within the broader region of the individual’s immediate neighbourhood. Just as recorded crime is not uniformly distributed, neither is the fear of crime. In pre-earthquake Christchurch City, fear was found to be highest in neighbourhoods characterized by affluence, ethnic homogeneity, and residential stability (Breetzke and Pearson 2015a). In summary, recorded crimes occurring in both the immediate and the broader neighbourhood environment appear to influence fear of crime, and this fear may negatively impact mental and physical health. The link between recorded crimes and fear differs by neighbourhood social context. Additionally, crimes are higher as alcohol is more accessible, meaning that the neighbourhood becomes central to understanding the links between crime, alcohol and health.

While the alcohol–crime–health relationship has been extensively studied both internationally and in New Zealand, such associations have rarely been explored in a post-disaster city, allowing for the examination of changing neighbourhood conditions. Such exploration is critically important considering that natural (and economic, e.g., the City of Detroit, Michigan) disasters have been shown to impact attitudes towards life (see Burke et al. 1982) and the mental health (Ursano et al. 2009) of affected residents, but also to lead to a concomitant increase in risk-taking behaviours including harmful alcohol consumption and participation in criminal activities (Cameron and Shah 2015). Thus, the aim of the present study is to explore the associations between alcohol access and recorded crime, and the potential implications for health, utilizing pre- and post-disaster data from Christchurch, New Zealand.

Major earthquakes struck Christchurch, the major city in the Canterbury region on the South Island of New Zealand, in September 2010 and February 2011. The first earthquake of the sequence, a moment magnitude (Mw) 7.1 earthquake, struck on 4 September 2010 and is referred to as the Darfield Earthquake. The second, an Mw 6.3 earthquake, occurred on 22 February 2011, and is called the Christchurch Earthquake. Over the next few years, Canterbury experienced over 10,000 aftershocks that registered greater than Mw 3.0 (GeoNet 2016). We use this unique context to examine the impact that these earthquakes have had on alcohol availability (measured in number of outlets), recorded crime and health in the city. First, we provide a brief overview of the Canterbury Earthquakes and their effect from both a social and a built environment perspective on Christchurch neighbourhoods. Next, we describe existing research that has examined the relationship between alcohol, crime and health in post-disaster settings. Then we describe our data, methods and results, concluding with a discussion of our findings and their implications.

The Canterbury Earthquakes
The effects of the Canterbury Earthquakes on the city of Christchurch were substantial. From a built environment perspective, the seismic load of the Canterbury Earthquakes resulted in a wide range of building damage, varying from the superficial cracking of walls to extreme structural damage and, in some cases, the complete collapse of buildings. The spatial distribution of the damage was uneven, with the most severe damage occurring in the central business district (CBD) and in the neighbourhoods immediately surrounding the CBD—particularly the poorer, eastern suburbs, as well as those along the Avon River. Just over 150,000 homes were damaged, with about one-fifth
of those exceeding NZ$100,000 in damage (Parker and Steenkamp 2012). Liquefaction and lateral spreading severely affected the city’s infrastructure, effectively disrupting telecommunications, power supply, water and sewerage services for many months. Since February 2011, Christchurch has been in an ever-changing state of demolition, rebuild and recovery. Over 1,200 buildings have been demolished, mostly in the CBD and in a portion of Christchurch now designated as the residential red zone (CERA 2015). The red zone is a non-continuous area of the city where damage was severe and the land deemed unsafe for future habitation or rebuilding. Over 60% of the roughly 6,000 businesses located in the Christchurch CBD—which employed almost 30% of the Christchurch workforce—were forced to close at least temporarily (Stevenson et al. 2011). This included a total of 297 alcohol outlets, or approximately 37% of all alcohol outlets previously located in Christchurch. The New Zealand Treasury estimates the total repair and rebuild costs of the Canterbury Earthquakes to be roughly NZ$40 billion, or approximately 20% of New Zealand’s gross domestic product (GDP) (New Zealand Treasury 2014).

In regard to the social environment, the earthquakes resulted in 185 fatalities and 1,500–2,000 injuries, the country’s second deadliest natural disaster in history. Johnston et al. (2014) related the disparity in number of deaths between the two earthquakes to the timing and location of the epicentre of each event. The earlier Darfield Earthquake occurred at 4.35 a.m. on a Saturday morning, with the epicentre located outside of Christchurch City, minimizing the population exposed to falling debris and building collapse, whilst the Christchurch Earthquake occurred near midday on a working day (Friday), with the epicentre near the CBD, maximizing the exposed population. In the aftermath of the Canterbury Earthquakes, an estimated 55,000 residents fled the city (Nissen and Potter 2011). Intra-city movement also took place as residents whose homes had been severely damaged were forced to stay with friends and family or move to other temporary accommodation in the city. The population exodus from Christchurch has since continued, driven largely by dissatisfaction over post-earthquake living conditions, fear of further earthquake events, and demolition work on residences. However, according to the 2013 census, the overall population has only declined 3%, largely owing to the large numbers of workers who have moved to Christchurch to repair and rebuild (CERA 2013).

The Canterbury Earthquakes also had substantial acute, long term impacts on the mental and physical health of residents. Increased stress, anxiety and depression have been observed in residents (see Sullivan and Wong 2011; Osman et al. 2012; Renouf 2012; Gawith 2013), with females, the elderly, and couples married with children the most susceptible (see Osman et al. 2012). Residents in neighbourhoods that sustained greater physical damage have also been found to be at an increased risk of mental health problems (see Renouf 2012). In terms of physical health, Pearson, Kingham et al. (2013) found a positive relationship between the presence of liquefaction ejecta dust and clusters of those diagnosed with pneumococcal pneumonia, and an increase in heart attacks was also reported immediately after the Darfield Earthquake (CERA 2013). Other impacts on the social environment related to education (Newell et al. 2012), community cohesiveness (Osborne and Sibley 2013) and specific effects on Māori and other populations (Osman et al. 2012) have been noted by researchers but are not discussed in greater detail here.

Crime in general was reported to have increased in the period immediately following the Canterbury Earthquake (see Gates 2012; Anderson 2013). Driven mainly by the media, incidences of burglary and arson, in particular, were reported to have ‘spiked’ in the city post-earthquake, with Christchurch even labelled ‘Arson City’ by one media outlet amid the apparent targeting of damaged and abandoned homes in the red zone (Heather and Lynch 2012; Dally 2013; Young 2014). These anecdotal reports are in contrast with official crime statistics released by New Zealand Police, which indicated a decrease in most offence categories post-earthquake, with the notable exception of domestic violence (New Zealand Police 2015). However, to our knowledge no studies have evaluated the interdependent changes in alcohol outlet density and reported crime in a post-disaster city.
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Literature Review

The association between alcohol, crime and health has been well established in the literature; studies find that residing in a neighbourhood with greater alcohol accessibility and/or high crime (or perceived high crime) can adversely affect individual-level health (Wilkinson et al. 1998; Sundquist et al. 2006; Lovasi et al. 2014). The relationship between alcohol and crime has also been acknowledged, with results that suggest that greater numbers of on- and off-premise outlets are directly associated with greater rates of neighbourhood-level violence (Nelson et al. 2001; Lipton and Gruenewald 2002) and an increased number of assaults in hospital emergency rooms (Gruenewald and Remer 2006). The impact of a natural disaster on alcohol consumption, neighbourhood-level crime and physical and mental health has also been extensively studied, although, as previously mentioned, the interdependence of these factors in a post-disaster setting is largely unknown.

In terms of the impact of a natural disaster on alcohol use and abuse, there is considerable evidence linking the effects of a natural disaster to increased alcohol consumption (Schroeder and Polusny 2004; Cepeda et al. 2010) and alcohol abuse (Rohrbach et al. 2009), although this has been found to vary by culture (Shimizu et al. 2000). The causal pathways underlying this relationship are myriad, but generally attributed to the psychosocial stressors experienced by residents in the immediate aftermath of such an event. Post-disaster stressors, such as relocation and the loss of social and capital resources, may magnify the distress caused by a disaster and thus lead to increased post-disaster alcohol abuse.

When investigating the relationship between the occurrence of natural disasters and crime, results are mixed, with some studies finding an increase in crime post-disaster (see Siman 1977; Gray and Wilson 1984; Zhou 1997; LeBeau 2002; Leitner and Helbich 2011; Walker et al. 2014), while others indicate a decrease (see Cromwell et al. 1995; Watanabe and Tamura 1995; Barsky et al. 2006; Zahran et al. 2009; Leitner et al. 2011). The mixed findings of the impact of natural disasters on crime are thought to be related to the underlying socio-economic conditions of each geographic locale (Harper and Frailing 2012), inter- and intra-migration patterns (Varano et al. 2010), and the severity of the disaster itself (Prelog 2016).

Exposure to natural disasters also has major, direct mental and physical health consequences. For example, natural disasters have been found to lead to increased rates of post-traumatic stress disorder (PTSD) (North et al. 2004), major depressive disorders (Maguen et al. 2009; Tracy et al. 2011) and somatization (Mellman et al. 1995; Ursano et al. 2009) among residents of disaster areas. Longitudinal research indicates that mental health problems related to a disaster peak in the year following the disaster, although symptoms can persist for months and even years for some affected individuals (Norris et al. 2002). In terms of natural disasters and physical health, most studies document the prevalence of various types of short term physical ailments, including heart palpitations (Trevisan et al. 1992) and respiratory and musculoskeletal problems (Zock et al. 2007), as well as nausea, vomiting and dizziness (Carrasco et al. 2006). Research also indicates that mental health symptoms may help explain the association between natural disasters and physical health symptoms—specifically, those that overlap with somatic complaints (see Ososky et al. 2015). Some studies note, however, that most post-disaster health-related problems are relatively short-lived, with survivors recovering from the initial shock and trauma within a relatively short period after the event (see Cook and Bickman 1990; Salzer and Bickman 1999; Sundin and Horowitz 2003). However, this is likely to differ in circumstances where the disaster is not a singular event, such as occurred with the thousands of aftershocks in Christchurch City.

While prior research has analysed many aspects of the effect of a natural disaster on alcohol consumption, crime and health-related outcomes, the interdependence of these factors in a post-disaster setting is less clear. For example, how does the accessibility of alcohol change in the aftermath of a natural disaster? What neighbourhood features attract the relocation of alcohol outlets? Do changes
in alcohol outlet locations affect subsequent neighbourhood-level recorded crime? And, importantly, what are the potential health impacts of this new landscape of alcohol and crime distribution?

Prior research has demonstrated how the spatial distribution of alcohol outlets is important for understanding the relationship between neighbourhood contexts, harmful alcohol consumption and recorded crime (Day et al. 2012; Pridemore and Grubesic 2013; Ayuka et al. 2014; Brands et al. 2014; Conrow et al. 2015). However, to apply this knowledge and best address these effects in the future, we require a more comprehensive understanding of how these features change from pre- to post-disaster. Thus, an examination of the changing spatial distribution of alcohol outlets and recorded crime from pre- to post-disaster will allow us 1) to explore what socio-demographic and environment factors may influence this redistribution, and 2) to speculate on the effect the redistribution is likely to have on health.

**The Current Study**

The current study examines the changes in alcohol outlet distribution and crime between pre- and post-quake Christchurch, New Zealand, and the implications for health. We do this by first examining how the spatial distribution of alcohol outlets and crime changed in the aftermath of the Canterbury Earthquakes. We then highlight various neighbourhood-level factors that ‘pulled’ alcohol outlets to certain parts of the city and investigate whether crime rates changed in the neighbourhoods that experienced a change in alcohol outlet density. Finally, we draw on previous recent research to examine the likely impact of the change in alcohol availability and crime on mental and physical health of the residents of those neighbourhoods in Christchurch in the aftermath of the Canterbury Earthquakes. The findings of this work can potentially highlight the post-disaster socio-demographic and built environments that are conducive to positive health outcomes of residents affected by natural disasters.

**Data**

**Alcohol Outlet Data**

Alcohol outlet (both on- and off-licence types) location data for Christchurch were obtained from the Alcohol Regulatory and Licensing Authority (ARLA), which has statutory authority to collect licensing information. Data were obtained for two periods: pre-earthquake (December 2009) and post-earthquake (December 2014). The data provided by ARLA were verified by a team of ten computer-assisted telephone interviewers, who used voice over internet protocol (VOIP) phones to contact all liquor licence holders recorded by ARLA as having operating alcohol outlets from 2009 to 2014. The verified alcohol outlet address data were then geocoded and a density measure (outlets/km²) calculated for each census area unit (CAU) for each time period. A CAU is the second smallest unit of dissemination of census data in New Zealand, representing approximately 2,300 people, and is often used to represent a neighbourhood. There were 117 CAUs covering the spatial extent of greater Christchurch. A continuous variable was then developed to measure the difference in alcohol outlet density (AOD) pre- and post-quake per CAU, by subtracting the 2014 density from the 2009 density. This yielded positive values for increased density post-quake, negative values for decreasing density, and 0 values for neighbourhoods with no change.

**Recorded Crime Data**

Crime data were obtained from New Zealand Police’s record of reported crime. This included reported offenses within Christchurch from 1 July 2008 to 30 June 2013 (five years). Each offence included a coordinate (easting, northing) and an estimated time of the offense, as well as a description
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and classification. The crime data were then divided into a pre-earthquake period of two years (1 July 2008 to 30 June 2010) and a post-earthquake period of two years (1 July 2011 to 20 June 2013). The one-year interim period was excluded in the analysis since this period covered the two major earthquake events in the sequence, separated by five months (i.e., September 2010 and February 2011). A total of 37,087 offences were reported to the police across these two periods (pre-earthquake = 20,423; post-earthquake = 16,664). For each period, the crime data were aggregated to the neighbourhood level and a mean annual crime rate per 1,000 population calculated using the 2006 and 2013 census data. Next, a mean crime rate over the two-year period was calculated pre- and post-earthquake to minimize the effects of outliers or variability in the crime data. A continuous variable was developed to measure the difference in neighbourhood crime rates pre- and post-quake by subtracting the mean pre-earthquake rate (2008–2010) from the mean post-earthquake rate (2011–2013). This yielded positive values for increased crime rates post-quake and negative values for decreasing crime rates.

Census Data

Census data from 2013 were obtained from Statistics New Zealand and used to construct a number of neighbourhood-level variables for Christchurch that have previously been shown to play an important role in the availability of alcohol and crime both internationally and in New Zealand (see Hay et al. 2009; Day et al. 2012; Ayuka et al. 2014). These six variables were percentage unemployed, percentage non-partnered, percentage male, percentage residents aged 15–29 years, percentage foreign born, and percentage resided in the neighbourhood for less than five years.

Analytical Methods

A number of analyses were undertaken in this study. First, we mapped and tabulated how the patterning of alcohol outlets and crime changed before and after the Canterbury Earthquakes. Next, we used linear regression models to identify socio-demographic factors which ‘pulled’ alcohol outlets into neighbourhoods post-earthquake, controlling for a number of ‘push’ factors, and used the results of this analysis to identify whether the change in neighbourhood alcohol outlet density was associated with a concomitant change in neighbourhood crime rates. Again, linear regression models were used to examine this association.

Statistical Analyses

Initial descriptive and spatial statistics were run on the alcohol and crime data in order to investigate the change in distribution of these phenomena pre- to post-earthquake. Moran’s I with rook’s second order contiguity was used to represent the spatial structure of the data and determine whether any significant spatial clustering was evident across both periods.

Two linear regression models were then fitted to test the association between the change in neighbourhood alcohol outlet density (AOD) and various socio-demographic variables. Preliminary analysis was undertaken to screen for associations between the dependent variable (AOD) and the six independent variables, as well as between the independent variables themselves. As expected, the results revealed a high degree of inter-correlation between the independent variables, a situation that could produce spurious results. Multicollinearity makes determining the importance of any given predictor difficult, because the effects of the predictors are confounded. To deal with the problem of multicollinearity, the variables were used as input into a principal components analysis (PCA) with varimax rotation. One component was identified, which accounted for 71% of the total variance in the data. This component had high loadings on four variables: percentage aged 15–29 years (0.56); percentage
lived in neighbourhood less than five years (0.52); percentage non-partnered (0.50); and percentage foreign born (0.41). Thus, this component could be considered an indicator of neighbourhoods with young, single, foreign newcomers, and this factor was used as the independent variable of interest in subsequent regression analyses, called the ‘pull factor’. Importantly, three key control variables were also considered, which represent ‘push factors’. These were the change in total neighbourhood homes and population (pre- and post-earthquake), as well as the level of land damage recorded, calculated as the proportion of the neighbourhood that was in the red zone. The first model included the continuous measure of change in neighbourhood alcohol outlet density as the dependent variable and the ‘pull factor’ as the independent variable of interest. The second model included the same variables as the first model but also controlled for the three ‘push factors’.

Three linear regression models were also fitted to test the association between the change in neighbourhood crime rates and the change in AOD, adjusting for covariates. The first model included the change in neighbourhood crime rate as the dependent variable and the change in AOD as the independent variable. The second model included the same variables as the first model but also controlled for the ‘pull factor’ and neighbourhood deprivation, while the third model included the same variable as Model 2 but also controlled for the three ‘push factors’ identified earlier.

**Results**

Figure 25.1 shows the difference in the spatial distribution of AOD and crime in Christchurch after the Canterbury Earthquakes. There are noticeable shifts in both alcohol outlet densities and crime post-earthquake, with outlets and crime generally moving away from the central city and towards neighbourhoods to the west and north of the CBD. Notably, there appears to be greater clustering of both densities of outlets and crime immediately surrounding the CBD post-disaster.

Table 25.1 shows descriptive statistics of neighbourhood alcohol outlets and densities pre- and post-earthquake. Throughout the city, there was a decline of 101 licensed alcohol outlets after the Canterbury Earthquakes. The number of alcohol outlets in the pre-earthquake period range from 0 to 233 outlets per neighbourhood, whilst in the post-earthquake period they range from 0 to a more

![Figure 25.1](image-url)
modest 89 outlets. Across both periods, the neighbourhood which contained the greatest amount of outlets was Cathedral Square, located in the CBD. Interestingly, only 24% of registered alcohol outlets that were open in the CBD before the earthquake returned to the CBD after extensive structural assessments were undertaken in the central city. The remaining alcohol outlets (76%) either relocated permanently or closed down.

Table 25.2 shows the results of the linear regression models, examining the association between the change in AOD and the independent variable of interest. A positive and significant association was found between the ‘pull’ factor and alcohol outlet change, with the results indicating that, for every one unit increase in the ‘young, single, foreign newcomer’ factor, we would expect an increase in the AOD difference of 0.43 (see Model 1). After controlling for the change in total households and population pre- and post-earthquake, as well as the level of land damage recorded, a positive, significant association remained between the change in AOD and the ‘young, single, foreign newcomer’ factor with only a small increase in the R² value (see Model 2). In fact, the effect size increased to 0.47. Examining the control variables, no significant associations were found (p ≤ 0.05 level). The R-squared values however for both models were fairly low (0.14–0.17).

Table 25.3 shows descriptive statistics of neighbourhood crime pre- and post-earthquake. Overall, crime decreased by over 10% post-earthquake. Mean neighbourhood crime decreased from 176.06 to 143.65 per neighbourhood across the pre- and post-earthquake periods. The high standard deviation values for both periods indicate great variability in the distribution of neighbourhood crime throughout the city. There was greater spatial clustering of crime in the pre-earthquake period as shown by the Moran’s I values.

Table 25.4 shows the results of the linear regression models, examining the association between the change in neighbourhood crime rates and various independent variables. A positive and significant
association was found between the change in alcohol outlet density and the change in crime rates (see Model 1), with the results indicating that, for every one unit increase in alcohol outlet density difference, we would expect an increase in the crime rate difference of 4.3 crimes per 1,000 population. After controlling for neighbourhood deprivation and the ‘pull’ factor (young, single, foreign newcomer), the positive, significant association increased between the change in AOD and the change in crime rate (see Model 2). The ‘pull’ factor was found to be negatively and significantly associated with crime rate difference, after adjusting for neighbourhood deprivation ($\beta = -5.29$, $p = 0.006$).

Finally, after controlling for the ‘pull’ factor, neighbourhood deprivation and the three ‘push’ control variables (i.e., change in total homes (structures), population change pre- and post-earthquake, and the proportion of red-zoned land), the positive, significant association remained between the change in alcohol outlet densities and the change in crime rate (see Model 3). The ‘pull’ factor also increased in strength and was negatively and significantly associated with crime rate difference ($\beta = -7.29$, $p < 0.001$). The proportion of red-zoned land was found to be negatively, significantly associated with crime rate difference (crime rate increase was associated with a lower percentage in the red zone). Population change was found to be positively, significantly associated with an increase in crime rate pre- and post-quake ($\beta = 0.24$, $p = 0.023$). The R-squared values increased markedly across models, ranging from 8% for Model 1 to 38% for Model 3.

**Discussion**

Natural disasters affect millions of people every year. It is estimated that at least one disaster occurs across the globe every day (McFarlane and Williams 2012), and there is evidence that the rate of natural disasters has increased dramatically since the turn of the century (see Leaning and Guha-Sapir 2013). The short to long term effects of these disasters on the built environment of communities are significant. In this study, we found that the spatial patterning of alcohol outlets changed dramatically in the aftermath of the Canterbury Earthquakes, with alcohol outlet densities decreasing in most affected areas (i.e., the central city) but increasing in neighbourhoods occupied by younger, single,
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foreign residents and those who were relatively new to the neighbourhood. This sub-section of the population are the most vulnerable to the psychosocial stressors of such a significant event and have been found to be more prone to hazardous drinking both in New Zealand (see Ministry of Health 2013) and internationally (see Macinko et al. 2015). Importantly, we found how crime has ‘followed’ alcohol outlet migration into neighbourhoods, with our results showing an increase in the change in crime rates in neighbourhoods which experienced changes in alcohol outlet densities. Of course, the positive association between alcohol availability and crime at the neighbourhood level is also well established both in New Zealand as a whole (Day et al. 2012) and in Christchurch in particular (Breetzke et al. 2013).

Interestingly, while both the number of alcohol outlets and the number of crime incidents have decreased substantially in the aftermath of the Canterbury Earthquakes, anecdotal evidence suggests that alcohol abuse as well as crime in post-quake Christchurch have increased (see Heather and Lynch 2012; Dally 2013; Robinson 2015). Explanations for these paradoxical findings could perhaps be found by examining how these distributions have changed post-quake. Our research has shown that whilst the total number of alcohol outlets decreased after the Canterbury Earthquakes the spatial distribution of outlets became more dispersed post-earthquake. Prior to the earthquake alcohol outlets were largely within the CBD and immediately surrounding neighbourhoods, limiting easy access to much of the population. The post-quake context has seen localized clusters of alcohol outlets appearing in neighbourhoods which previously had either a low number of outlets or none at all, thus affecting the perception of increases. Of course, the effects of alcohol outlet densities and access upon patterns of consumption are generally clear: greater densities and access lead to increased consumption (Scribner et al. 2000; Truong and Sturm 2007; Ayuka et al. 2014). It is also increasingly clear that populations in post-disaster cities generally increase their alcohol consumption (Schroeder and Polusny 2004; Cepeda et al. 2010).

Likewise, even though crime has decreased in post-quake Christchurch, there is also an increased perception among residents of the city that crime has increased post-quake (Heather and Lynch 2012; Dally 2013), whilst Breetzke et al. (2013) found that the fear of crime was heightened post-quake. Similar to the explanation provided above, the changing spatial distribution of crime post-quake could provide some insight here. Prior to the earthquakes, almost 12% of all crime in Christchurch occurred in Cathedral Square, which lies at the heart of the former CBD and was the location of numerous entertainment establishments (i.e., bars, restaurants and shopping centres). In the immediate aftermath of the earthquakes, a cordon was placed around the CBD and extensive structural assessments were undertaken within the cordoned-off area to ascertain the level of damage sustained. While the final section of the cordon was lifted in 2013, the rebuild, revitalization and occupancy of the CBD are still in their infancy at the time of writing. The result of these developments has been the spatial displacement of crime away from this former hot-spot and into other neighbourhoods of the city. Crime has decreased by almost 70% in Cathedral Square post-quake, with the total crime in this neighbourhood accounting now for less than 5% of Christchurch’s recorded crime. In this instance, crime has been spatially displaced to surrounding neighbourhoods and subsequently affected a greater proportion of the population whilst still decreasing overall. Finally, another possible consequence of the spatial dispersion of crime into more suburban areas is that it has become more visible, thus creating the public perception that crime has grown or is increasing when in fact the opposite is true.

So what are the implications of these results in terms of the health and wellbeing of Christchurch residents and possibly other disaster-affected cities? And what solutions can be offered to minimize the potentially harmful effects that an increase in alcohol access and crime in communities can have on health in a post-disaster setting? As previously noted, populations affected by natural disasters generally experience both short and long term negative health outcomes. Results of studies conducted...
in the immediate aftermath of the Canterbury Earthquakes have already shown the negative impacts the earthquakes have had on both physical health (Pearson, Pearce, and Kingham 2013) and mental health (Kemp et al. 2011). The increased dispersion and subsequent availability of alcohol outlets throughout Christchurch post-quake will most likely result in an increase in consumption in affected neighbourhoods and an associated increase in acute in-patient admissions for alcohol-related conditions. There is some evidence that such an increase is already occurring (see Canterbury District Health Board 2014). Moreover, residents in neighbourhoods which have experienced an increase in recorded crime (and the related fear) may also increase their alcohol consumption as a result of stress. Another possible reason for the increased consumption of alcohol in neighbourhoods could be related to the changing composition of Christchurch’s population. As previously indicated, the population of the city experienced significant upheaval in the aftermath of the Canterbury Earthquakes. Not only was there substantial intra-city movement of residents but also the in-migration of large numbers of construction workers from both around New Zealand and abroad. In fact, since July 2011, almost 5,500 work visas for the Canterbury rebuild have been issued, with the bulk of workers coming from Britain, Ireland and the Philippines (Stylianou 2015). These migrants are mainly young, male and single and with few social contacts in the city other than their workmates are likely to consume alcohol or increase their alcohol consumption. The fact that the rebuild is only in its initial stages and that the effects of both acute and delayed stress on the residents of Christchurch can significantly increase voluntary consumption (Steptoe et al. 1996; Magrys and Olmstead 2015) suggests that the long term effects of the spatial redistribution of alcohol outlets and crime in Christchurch on residents’ health and wellbeing are yet to be fully felt.

It is difficult to find ways for cities to adequately deal with the adversity typically encountered in the aftermath of a natural disaster. The devastation and disruption that occur generally affect the very social and informal fabric of communities. But perhaps an answer can be found in the way in which individuals respond to and deal with the stressors experienced. Whilst the problems Christchurch residents have experienced in terms of their physical and mental health have been previously noted, the resilience of Christchurch residents has also been well documented (Thornley et al. 2013). Importantly, community resilience is not simply the sum of individual resilience of community members but is driven by neighbourhood-level factors such as collective efficacy and social cohesion. Prior research in New Zealand has already identified a number of characteristics of the social, economic and built environments that have helped build resilience in both a health context (Pearson, Pearce, and Kingham 2013) and a crime context (Breetzke and Pearson 2015b). Future research should attempt to identify what drives neighbourhood-level resilience to the cumulative stressors (both real and perceived) experienced by neighbourhoods post-disaster. Building community resilience is key in disaster management (Tierney 2008), and identifying what factors help or hinder community resilience could assist in promoting positivity in community response and recovery. The fact that the rebuild of Christchurch has been described as ‘very slow and very non-inspirational’ (McDonald 2015) suggests that factors that inspire long term resilience are key.

Finally, understanding the interdependency between alcohol, crime and health in the aftermath of a natural disaster should be an important topic of research in the social and health sciences. The dramatic increase in natural disasters worldwide (Leaning and Guha-Sapir 2013), many related to climate-driven changes, means that countries and cities will increasingly have to deal with the short to long term effects of these events from a variety of human–environment perspectives. To understand how these three factors are affected in terms of their spatial distribution, magnitude and nature following a natural disaster can allow the respective agencies to better plan strategically, tactically and operationally for such an event and lessen the detrimental effects of a natural disaster on neighbourhood and city health.
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